SHEA PICKING AS AN ENGINE OF POVERTY REDUCTION IN NORTHERN GHANA (CASE STUDY: FOUR COMMUNITIES IN THE BOLGATANGA MUNICIPALITY)

A.Hatskevich

Czech University of Life Sciences Prague, Institute of Tropics and Subtropics, Department of Economic Development, Czech Republic

J. E. Essilfie

Electricity Company of Ghana, Takoradi, Ghana

Abstract

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 lowing 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 picking on rural household income in four (4) communities in the Sumbrungu area of the Bolgatanga Municipality of the Upper East Region of Ghana. Regression analysis performed indicated that shea picking activity in the selected communities is a signification source of income as compared to the official minimum dairy wage in Ghana. The main factors that influence income of shea-picker household are the age of the picker and the quantity of shea fruits picked per day and an interaction between shea quantity and location of community with respect to Bokom community. Income distribution among interested households under this work appeared to be well distributed which indication that a common taughtfully designed poverty reduction strategy could be rolled out in all the communities in the area and among all shea-picker households.

Keywords: Shea, households, communities, household income, Ghana, distribution, poverty

Introduction

One common characteristic of rural households in Sub-Saharan Africa (SSA) is that they derive their living mostly on farming. Rural households of SSA are mainly engaged in smallholder farm and contribute about 26 % of GDP as well as providing employment to almost 65 % of the labour force (World Bank Report, 2007). In World Bank report of 2008, agriculture is mentioned to be a strong option for poverty alleviation, ensuring food security and economic growth. It is interesting to know that in most areas the farms are mostly rain feed and hence climatic condition among other factors determines the success of agriculture growth. Recent studies have established that only a small percentage of those farms have seen expansion and intensification leaving the rest stagnated with lowing productivity, decrease in size and low output (Jirstrom *et al.*, 2011; Djurfeldt *et al.*, 2008).

Population growth in the rural areas is also presenting stress on the farm lands resulting in continues cultivation of a piece of land with the necessary input to maintain the fertility of the land. In addition, widening of the rural-urban inequality with respect to infrastructure, market, economic opportunities and micro-finance is further rendering a greater percentage of rural population poorer. Peasant farming has therefore failed to be the force of poverty reduction in most of the rural communities of SSA.

This has necessitated the need to look at other possible sources of rural income. Activities in the non-agricultural sector had been recognized as an alternative source of livelihood for the rural poor and needs to be enhanced since they are directly or indirectly linked to agriculture (World Bank Report, 2007; Ellis and Biggs, 2001; Ellis, 1999). Researchers in recent times have established that non-farm income is on the ascendency and becoming important accounting for between 35 - 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)

This work therefore, looks at one of the opportunities in the study area which has the potential of being an engine of poverty reduction. The growing increase in the demand of shea butter on the international market has made the product an immerging economic commodity. This is mainly so because it has found many uses in a wide range of food products, medicinal preparations and the cosmetic industry. The European Union consider shea as one of the six vegetable oils to be used as a Cocoa Butter Equivalent (CBE). Interestingly, the shea tree which grows in the wild is mainly found in areas of immense poverty.

The involvement of all stakeholders in the industry is discussed in other to arrive at those recommendations and suggestions to strengthen and modify the existing practices to achieve the needed result for effective poverty alleviation.

As mentioned in literature (Grigsby and Force, 1993) and also confirmed through the April, 2012 discussion, shea fruit picking, processing of fruits into nuts as well as processing the nuts into shea butter had been the reserve for women. This means that the shea industry can be a meaningful vehicle for poverty alleviation in the northern part of Ghana. Most importantly both the "have and have not's" have almost equal access to the shea tree.

It is also stated in TechnoServe Ghana (2004) that, 90 % of the world's shea nuts as raw material in the world for shea butter processors and marketers can be produced by Ghana. The main obstacle to the development of this indigenous traditional industry that could highly support sustainable development of Northern Ghana is attributed to the lack of finance opportunities. Although the shea industry can effectively alleviate women of their poverty, financial constraint and inadequate technical support has made them to remain in their poverty.

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. This means that the shea industry is an alternative livelihood for majority of the deprived (in terms of education and finance capabilities) women in the three northern regions of Ghana (SNV, 2006).

This paper examines the factors of income generation and income distribution among shea-picker households in four communities in the Bolgatanga Municipality namely: Kulbia Bokom, Kulbia Atolesum, Kulbia Amolgoduni and Anateem Kulbia. The nature of poverty alleviation strategy that could be rolled out to effectively reduce poverty is recommended.

Sustaining The Shea Industry

Stakeholders in the Ghanaian shea industry can be grouped into seven thus, local community, collectors or pickers, processors, local and central government, local and international extension services, NGOs and micro-finance institutions and local and international buyers. Though they all together contribute to the development of the industry in diverse ways, sustainability of the raw material of the industry lies mostly in the hands of the people living in the local communities. Therefore for the purpose of this paper, the activities of the local community and pickers are discussed here below.

Local Community

Human activities do determine the sustainability of vegetation through deforestification or aforestification of a particular area. Yidana (1994) had reported that from field observation it has been observed that on lands protected from bush fires, with minimal use of heavy equipment (e.g. ploughing with tractors), numerous young shea trees sprout from existing old stumps. These young trees when not disturbed by farming activities, animals such as cattle and goats grow rapidly into mature trees, producing fruits after only seven years instead of the normal 12 to 15 years (Yidana, 1994). It is therefore obvious that the community is an important stakeholder in the sustainability of the shea industry since her activity can either maintain the shea cover or destroy it. Controlling and directing the activities of the local community through policy enactment and enforcement can to a greater extent ensure the sustainability of the shea tree.

Pickers

Although the shea tree grows in the wild the land on which it is, belong to someone or it is a free ranged follow. The rights to collect shea fruits vary according to land tenure arrangements of the area. In Ghana, wives of the owner of a piece of land collect the shea on that land, and they can also join those without land to gather shea fruits from fallow lands. As it was put by Mclain (1990), rules of access to tree products vary according to ethnic groups, the degree of land pressure, and the economic value of tree products (reviewed in Boffa, 1991; McLain, 1990). It is also reported by Grigsby and Force (1993) that in Ghana women pick shea fruits from their husbands' plots, and the oldest wife regulates the activity and is responsible for the allocation of farmlands of husband among wives in polygamous marriages (Grigsby and Force, 1993). Schrechenberg (1996) put it that fallowed lands or abandoned plots are destined for the wives of the previous owners, whilst uncultivated plots are open to all women.

The right to land therefore put a lot of pressure on some portions of the land as many women try to earn a living from the same piece of land. In desperate attempt to collect more fruits, some women and children do shake the trees or throw items into the tree branches to force both ripe and unripe fruits to fall. This practice affects the quality and total volume of shea nut resulting in less butter yield as unripe fruits contain less and immature fat. Most importantly their activities if not controlled through policy implementation could be detrimental to the shea coverage leading to low income.

The Study Area

The study area comprises of four communities in the Sumbrungu area of the Bolgatanga Municipal of the Upper East Region. Upper East Region is one of the three northern regions of Ghana and shear borders with Northern

and Upper West Regions of Ghana, Burkina Faso and Togo. Upper East Region like others northern regions is located in the Guinea savannah agro-ecological zone. 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. The underdevelopment of the area can be attributed to political neglect during the colonial and post-colonial periods, unreliable rainfall and long periods of drought and low-soil fertility. Upper East Region is blessed with multipurpose wild trees like shea and locust bean that have economic values. When the needed attention is given to these wild trees, they can provide sustainable opportunities for income generation which can lead to poverty reduction. Chalfin (2004) in his publication 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 had not been effectively tapped due to the socio-economic conditions and lack of proper policy and governmental barking as in the case of cocoa. It is therefore important that research is carried out to unfold the potential of shea and brought to the known of the international community. 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.

Sumbrungu is about 9 km from Bolgatanga, and located on the Bolgatanga-Paga highway. The four communities are, Kulbia Bokom, Kulbia Atolesum, Kulbia Amolgoduni and Anateem Kulbia. The study communities are all located along the Bolgatanga-Navrongo highway in the range of 4 and 12 km from Sumbrungu Township.

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. Most inhabitants in the area are predominantly farmers and are involved in small scale/peasant farming. 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. This is basically so because the farming season is the major hunger period and also coincide with the shea season so the women go into shea picking and other income generating activities in other to provide food for the family. With increase in population, young couples put up their buildings thus reducing the farming land of the parents. This coupled with the degradation of the land with time and the lack of inputs for modern farming practices had resulted in the farm products not being sufficient to cater for the annual food requirement of the households. Diversification of income generating activities now remains the option for survival.

The major crops cultivated during the raining season are: millet, sorghum, frafra potatoes, maize, rice, groundnuts, cowpea, bambara beans and sweet potatoes.

Research Methodology

The methodology used 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.

Case study techniques may include observations, interviews, newspaper articles, previous research results, and audiovisual materials. In many instances, the researcher may spend long period of time on site so as to interact regularly with the people who are the subject of the case study.

In this research, the case study was focused on purposefully selected sites and individuals were conducted. Although findings are 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 is focused on shea pickers of the Upper East Region, precisely the Sumbrungu area. The study 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).

Study Objectives

The main objective of this research is to identify determinates of household income in four communities in the research area of Sumbrungu in the Bolgatanga District of the Upper East Region of Ghana. The study's specific objectives are therefore:

1. Verify hypothesised determinants of household income, such as location, household size, gender of household head, number of children, education of household head and shea picker, other income activities other than shea, age of picker and number of days of shea picking among others.
2. Project household income assuming all other income generating determinants are constant apart from shea activity.
3. Analysis the strength of location in determining household income.
4. Estimate the household income distribution among shea-picker households in the selected communities and in general.

Research Hypothesis

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 following hypotheses were made for the shea-picker household:

1. Gender of household head has no effect on household income.
2. Age of shea picker has no effect on income.
3. Location with the Sumbrungu area do not determine household income.
4. Household size do not affect income.
5. Income from shea picking is not significant in total household income.

Data Collection and Processing

The methodology had been divided into three sections under the titles:

1. Sampling and Interview process;
2. Data collection instrument;
3. Data analysis procedures.

Sampling And Interviews' Process

Interviews were conducted at three levels: individuals, organized (focus) groups and NGOs/Governmental institutions. Participants were those identified to be directly involved in the shea industry.

Figure 1 showing the researcher conducting interview with the local representative acting as an interpreter.

Figure 1: Researcher administering questionnaire

Households: Individuals interviewed are the youth and adults of households involved in shea picking and producing.

Focus groups: Women groups involved in shea butter production were focused on. The key criteria used in selecting focus groups was the ability of more than two persons in the group to answer to the questionnaire to be administered and also communicated directly with the researcher and assistants. Literacy is very low in the focused area.

NGOs and Government institutions: Government institutions like National Board for Small Scale Industries, Ministry of Food and Agricultural

and Ghana Regional Appropriate Technology Industrial Service, Catholic Mothers Association, Women and Orphans Movement and Rural/Community Banks were focused on. Due to high level of bureaucracy, it was not possible to access information from the Cocoa Marketing Board, Ministry of Food and Agricultural and The Cocoa Research Institute of Ghana directly. A meeting with the Regional Director of the Ministry of Food and Agricultural in Bolgatanga lead us to the NGOs and other organizations.

Instruments For The Research

To conform to the guidelines of using human subjects in the research, the consent of the rural women through the local council representative of the area was sort. Questionnaires were administered by the local representative and the researcher followed up with a second batch of questionnaires and personally conducted interviews. Questions were followed by probing remarks which allowed the researcher to get more in-depth information on the perceptions of women on NGOs and Governmental interventions in the shea industry.

To cross-check information, the researcher made some observations during the interview period, visited processing site to have a firsthand knowledge on the production process and also visited the market.

Procedure For Data Analysis

Collected data was reviewed and discussed with practitioners and academicians in the field of agriculture and economic development in Ghana.

Statistical and analytical methods were used to evaluate acquired data. Conclusions and recommendations were made from the results of the analyses.

Multiple Regression Analysis

Regression models are statistical models used to determine the variation in one or more variables when there is a change in one or other variables. In this research there are more than one perceived variables that determine the income of the rural women, therefore a multiple regression analysis was used. Multiple factors determine the income of rural poor hence depending on the motive of a research work some factors will be of most concern than others. In literature, factors are grouped based on the level of control a household have on them. Under this work factors that are household dependant are considered for the analysis. Therefore a household based model is looked at.

Conceptual Framework

A 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.

The regression model can be expressed in econometric terms as:

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

where y is the observed per head household income, t - the time of study, β - estimated coefficient associated with a given independent quantitative variable $X_{(k,t)}$, $\emptyset$ - 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:

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

In this work the dependent variable is the total household income over the four months period of farming, collection of weaving material and shea picking activity.

Possible Independent Variables

X_1 - Household size is defined as the numbers of persons both adults and children dependent on the common source(s) of household income.

X_2 - Age of shea picker or butter producer who is part of the family and administered a questionnaire or was interviewed.

X_3 - No. of children of school going age in the household

X_4 - No. of employed members of the household

X_5 - No. of unemployed members of the household

X_6 - Average quantity of shea nuts obtained from the shea fruit picking activity per week

X_7 - No. of children of school going age in the household but are not going to school

X_8 - No. of children of school going age in the household and are going to school

X_9 - No. of children under school going age in the household

D_1 - Gender of household head

D_2 - Education of household head. Basically all the educated ones are of primary education therefore the question stood as educated or not.

D_3 - Marital status of shea picker. The marital situation of all the four communities is the same. Ladies in the communities marry as early as eighteen years of age even in some cases below that age. Marriage in the communities a so inter family dependent that rate of divorce is very insignificant. Therefore the marital situation is mainly of two possibilities: married or widowed.

D_4 - Education of shea picker or butter producer. The situation is similar to that of the household heads.

D_{5-7} - Location is defined as the community from which one is domicile.

D_{8-10} - Other sources of income. Basket weaving which is termed as craft in this work, farming activity, etc.

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 determinates are recognised to be infrastructure, climate, prices, Governmental policies geographical location, etc.

Adebayo's submission of 1985 suggested that income levels of the rural poor may be attributed to some crucial determinates, hence understanding these determinates could result in developing effective polices aimed at alleviating rural poverty. This was reemphasised by Adeyemi and Kupoluyi (2003) with a statement that a closer look at the determinants of rural income provides an explanation to the factors that are responsible for low income and poverty of rural communities where the greater percentage of the poor are located.

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^2 or adjustable R_a^2, F-test and Mallow's C_m criteria are given as:

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

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

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

where *RSS* is defined as:

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

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

Mallow's C_m statistic - $C_m = \dfrac{RSS_m}{RSS_k / (n - k - 1)} + 2(m + 1) - n$ (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 below:

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.

Data Collection

Household income data was collected from four communities in the Sumbrungu area of the Bolgatanga District Assembly. In all data from 97 shea-picker households were taken with the brake down as: Kulbia Atolesum

56, Kulbia Amolgoduni 16, Kulbia Anateem 10, Kulbia Bokom 15. Eleven (11) organizations involved in the shea industry were also interviewed.

Due to the educational level of the respondents, the observed total income was computed base on the questionnaire administered and the interviews conducted. The value for the other forms of income apart from salaries which could be officially know through pay slips, all the others were estimated base on the quantities of goods and the current market prices. For example one household will estimate weaving 20 bolga baskets in the season, so the total income from basket weaving was calculated as the multiplication of the number of basket and the current weaver price.

Similarly income from shea nuts and farming activity were arrived at based on the quantities obtained.

Considering that the communities have similar conditions in respect to geographical location, infrastructure and climatic condition among others and also the numbers of observations obtained from the communities, all data were pooled together for the regression analysis.

Preparation of Data

To prepare the field data for the multiple regression analysis, the explanatory variables were first grouped into quantitative and qualitative variables. The qualitative variables were then coded as follows:

Education of shea picker or butter producer:

Male   - 1,   Female - 0

Farming activity:

Yes   - 1,   No - 0

Craft activity:

Yes   - 1,   No - 0

Gender of household head:

Male   - 1,   Female - 0

Education of household head:

Educated   - 1,   Non educated - 0

In other to capture the effect of location on income, a location variable was introduced. Preliminary analysis on location revealed that, Bokom was the best location to be used as the reference. Bokom community was therefore not assigned a quantitative variable whiles Anateen, Amolgoduni and Atolesum were represented by - 1.

Simulation Results And Discussion

After the initial set of possible factors had been taking through pre regression examination and seemingly significant variables put into regression and results tested on Assumptions in Linear regression, thus linearity, independency, normality and homoscedasticity, a final regression model was obtained.

Out of nineteen explanatory variables, five (5) explanatory variables (see Table 1) comprising of two (2) quantitative and three (3) qualitative variables and one (1) interactive term constituted the final regression model.

Table 1: Identification of variables

Variable Identification	Name of Variable
X_2	Age of shea picker
X_6	Shea qty picked/day
D_6	Anateem community
D_7	Atolesum community
D_8	Amolgoduni community

Table 2: Presents the results of the regression analysis of the final model

Regression Statistics					
Multiple R	0.9533				
R Square	0.9088				
Adjusted R Square	0.9027				
Standard Error	188.9340				
Observations	97				
ANOVA					
	df	SS	MS	F	Significance F
Regression	6	32003591.91	5333931.985	149.4263	1.44E-44
Residual	90	3212646.562	35696.07291		
Total	96	35216238.47			
	Coefficients	Standard Error	t Stat	P-value	
Intercept	1341.9404	119.6740	11.2133	8.95E-19	
X_2	-10.6172	1.4244	-7.4539	5.36E-11	*
X_6	28.7524	1.7207	16.7093	2.49E-29	*
D_6	500.2691	79.4887	6.2936	1.10E-08	*
D_7	234.7352	55.6186	4.2204	5.81E-05	*
D_8	733.4247	163.4719	4.4865	2.13E-05	*
X_6D_8	-7.2929	3.0692	-2.3762	1.96E-02	**
* Significant at 1% level					
** Significant at 5% level					

Regression analysis (see Table 2) of the final model resulted in the significance of all the variables at a level of 1 % and its interaction between shea/day and Amolgoduni significant at 5 % level.

Interpretaion of the Final Regression Model Analysis

The result indicate that the explanatory quantitative variables; age of the shea picker and quantity of shea picked per day as well as the explanatory qualitative-location variables are very significant independent variables with P-values virtually zero, thus at a significant level far less than 1 %. The interactive term between location of Amolgoduni community and

shea collected per day is also significant at a P-value of 0.019, falling within 5 % level of significance.

From the result it could be said that the two (2) explanatory variables, location factor and interactive term between Amolgoduni and shea collected per day which are in cooperated into the final reduced model do explain the dependant variable of household income at 95.33 % leaving only 4.67 % of the factors of the household income unexplained. The overall regression equation's accuracy which is expressed in terms of R^2 and adjusted R^2 is estimated to be above 90 % 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 90 % which by literature is satisfactory.

The overall probability that the output of the regression analysis is not by chance is indicated by the Significance of F. From the results it is shown that the probability that the regression output is by chance is very close to zero or approximated to be zero. This is a confirmation of the validity of the regression output.

Having a very significant p-value for the explanatory variables, it could be said that the coefficients of the explanatory variables well indicates the change in the dependent variable with a unit change in the respective explanatory quantitative variable. Thus an increase in age of one (1) will result in reduction of household income by 10.62 Ghana cedis and an increase of 1 kg of shea picked per day will increase the household income by 28.75 Ghana cedis. On the other hand, the qualitative variables indicate the effect of location of the household income of the shea picking households in the research area. The result indicate that pickers in Anateem community stands to earn 500.27 Ghana cedis more than their counterparts in the Bokom Community under a condition of the same age and quantity of shea picked per day. In the same way pickers from Amolgoduni and Atolesum will receive 733.43 and 234.74 Ghana cedis higher respectively. It can be explained as a result of proximity of the Bolgatanga-Navrongo highway as well as the proximity to the Sumbrungu Township where the local market is located.

Assumption Test On Final Model

To confirm the validity of the final model after the issue of heteroscedasticity of the initial reduced model is resolved, the model was retested on normality and independence assumptions.

From the graphs of Figure 2, it could be seen that the residuals do not have relationship with neither the observed income nor any of the explanatory variables. This is a clear indication that the residuals are

independent, hence the assumption of dependency is met and therefore the hypothesis of independence could be accepted.

The normality test result is as presented in Table 3 alongside that of the reduced model. The result clearly rejects the non-normality hypothesis. From Table 3, kurtosis of -0.527 as against -0.803 for the reduced model indicates that the final model residual distribution is of a sharper form than that of the reduced model.

The skewness of the distribution also indicates that the distribution of the residuals is skewed to the negative side with the skewness of -0.265 as against the -0.109 value for the reduced model. Although the skewness is about doubled it still falls within the accepted range of between -2 to 2.

The Chi-square statistics conducted on the residual also resulted in a value of 0.179 as against the value of -1.420 for the reduced model. This is an improvement since it indicated that the overall difference between the histogram of the residuals and the hypothesis normal distribution is smaller than in the case of the reduced model.
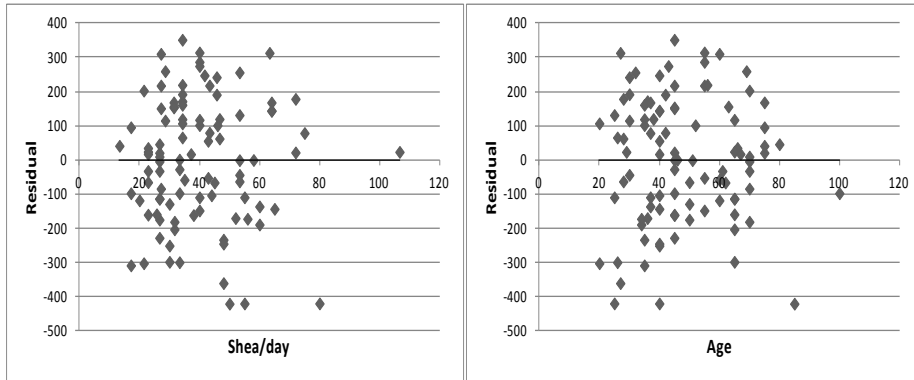
Table 3: Comparison of normality test results

Identity	Final Model (After collection of hetroscedasticy)	Reduced Model
Average	6.43E-11	5.34E-11
kurtosis	-0.5273	-0.8028
Skewness	-0.2652	-0.1086
chi-sq sta	0.1786	-1.4199
chi-sq Critical Value	12.5916	12.5916

**Figure 2:** Residual vs. explanatory variables scatter plots
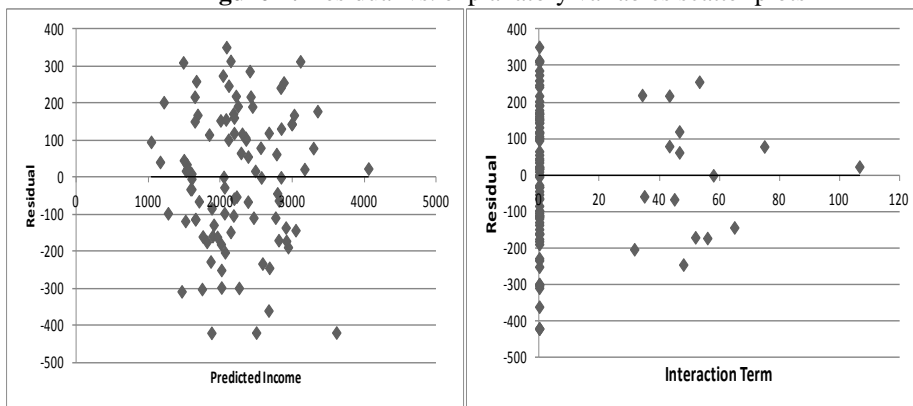
The histogram and the residual vs. observations plot of Figures 3 and 4 also give a visual representation of the residual distribution. In conclusion it could be said that although the normality of the distribution of the residuals is not perfectly normal, the deviation from normality is within an acceptable range and therefore the residuals of the final regression model of this work could be comfortably termed to be normal and therefore reject the non-normality hypothesis.

Figure 3: Residuals vs. observations plot
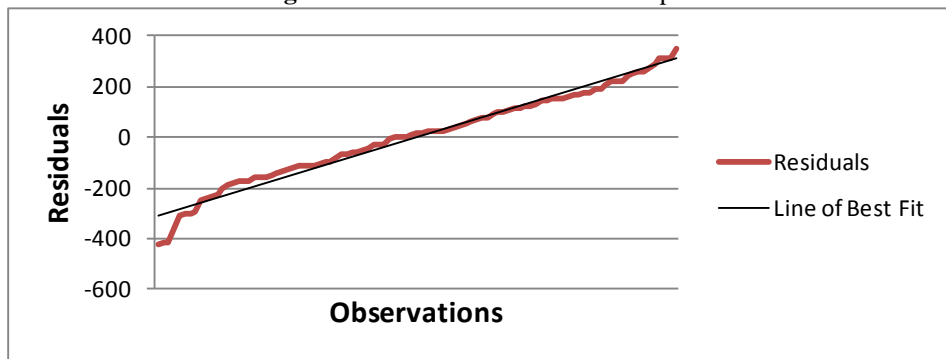
Figure 4: Histogram of the residuals
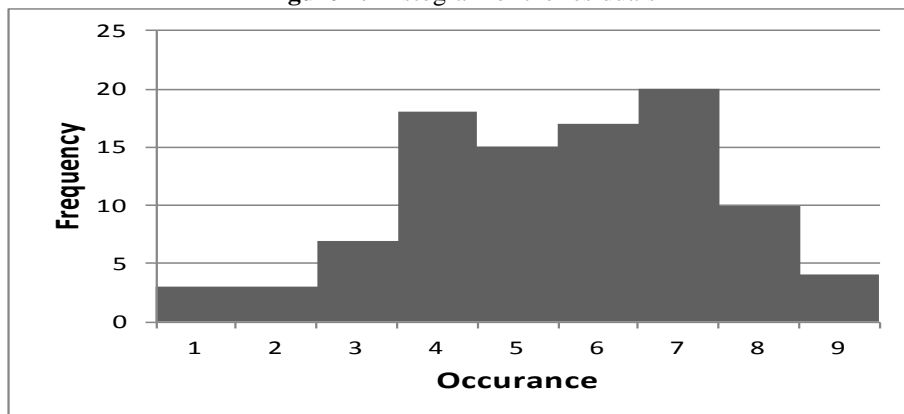
Prediction Of Income From The Final Regression Model

From the final reduced model, household income of shea picking families in the research area can be estimated by the generalized expression:

$Y = 1341.94 \ -10.62X_2 \ +28.75X_6 \ + \ 500.27D_6 \ +234.74D_7 \ +733.43D_8 \ - \ 7.29(X_6D_8) + \varepsilon$

To predict the household income of shea-picking families in the research area the following assumptions are made:

- That the interaction between shea collected per day and Amolgoduni community remains the same under increasing shea collection.
- All other variables in the equation remains constant except shea collected per day.

Based on these assumptions, twelve (12) different shea collection scenarios were considered for four (4) ages of 20, 30, 40 and 50 years. The simulation results are as presented in Figure 5.

From the graphs of Figure 5, it is clear that pickers at Amolgoduni have a comparative advantage over their counterparts in the other three locations, thus their income from the same quantity of shea collected for the same age group is more than others but above 100 kg of shea collected per day they loss completely their comparative advantage and rather become the less advantage getting an income less than that of their counterparts at Bokom the less advantage location of all the other three locations. This might be as a result of the fact that Households in Amolgoduni has advantage over the rest of the locations in income generation as it is located close to the Sumbrungu Township. Economic activities at Amolgoduni is far advance and with better infrastructures like market and employment. As a result household income is not solely dependent on shea and peasant farming as it is the case in the far distance community of Bokom. From the analysis it was clear that shea is the main income source in the area. Therefore with increase in income from shea, Amolgoduni losses its interaction advantage as the coefficient of interaction is negative. Also the increase in income from shea renders the income from other sources of income in Amolgoduni insignificant and erodes it completely with shea collection per day exceeds 100 kg.

Based on the regression model used in this work, locations of Anateem and Atolesum maintain their location advantage over Bokom since they are only relatively closer to Sumbrungu Township and have no interaction term with the quantity of shea collected per day.

The effect of age also remains constant over the range of variation in shea picked per day. The effect of the negative coefficient is clearly seen as the older one generates a lower income as compared to a younger picker taking all other conditions to be the same.

Figure 5: Predicted household income as a function of shea collected per day for different location and age of pickers
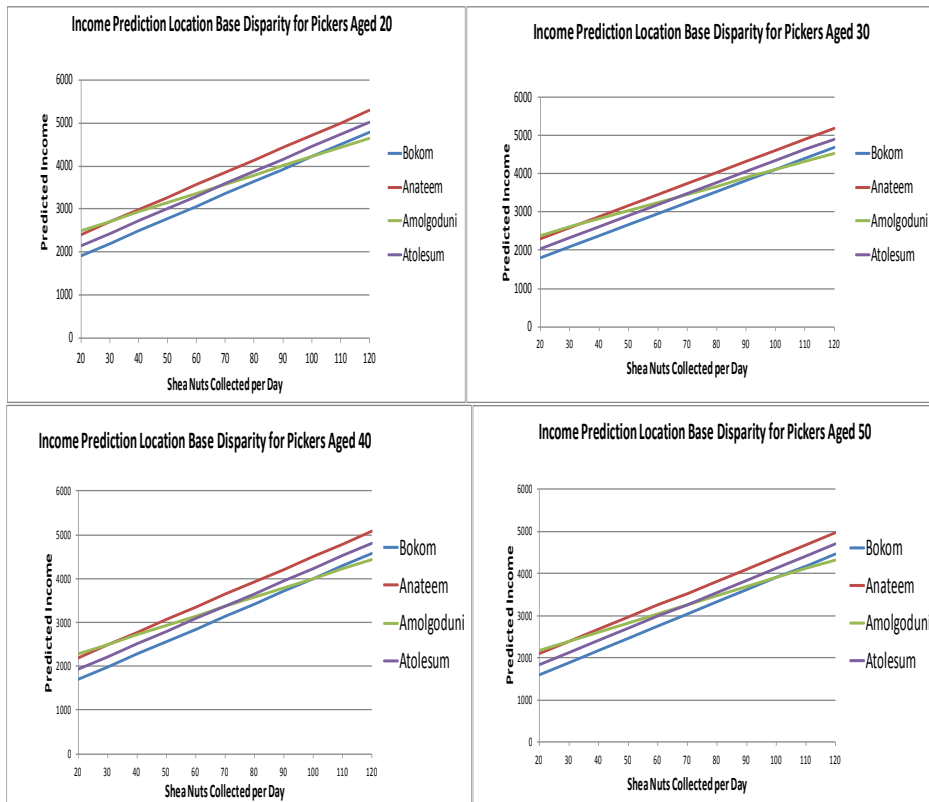
**Table 4:** Percentage increase in household income per 1 % increase in shea collection

Age(years)	Community	% Increase in income
20	Bokom	0.30
	Anateem	0.24
	Amolgoduni	0.17
	Atolesum	0.27
30	Bokom	0.32
	Anateem	0.25
	Amolgoduni	0.18
	Atolesum	0.28
40	Bokom	0.34
	Anateem	0.26
	Amolgoduni	0.19
	Atolesum	0.30
50	Bokom	0.36
	Anateem	0.27
	Amolgoduni	0.20
	Atolesum	0.31

It can also be seen from table 4 that percentage increase in income with 100 % increase in quantity of shea picked per day is higher in the range

of 30 - 36 % for Bokom followed by Atolesum, Anateem and Amolgoduni with the ranges of 27 - 31, 24 - 27 and 17 - 20 % respectively. It is interesting to note that though age increase reduces the household income, percentage increase with increase in quantity of shea collected per day is higher with age increase. This phenomenon could be explained by the fact that the reduction in income as a result of age increase is less compared with the increase in income as a result of increase in quantity of shea collected per day.

Income Distribution Of Shea Picker Households

Figure 6: Income distribution of shea picker households
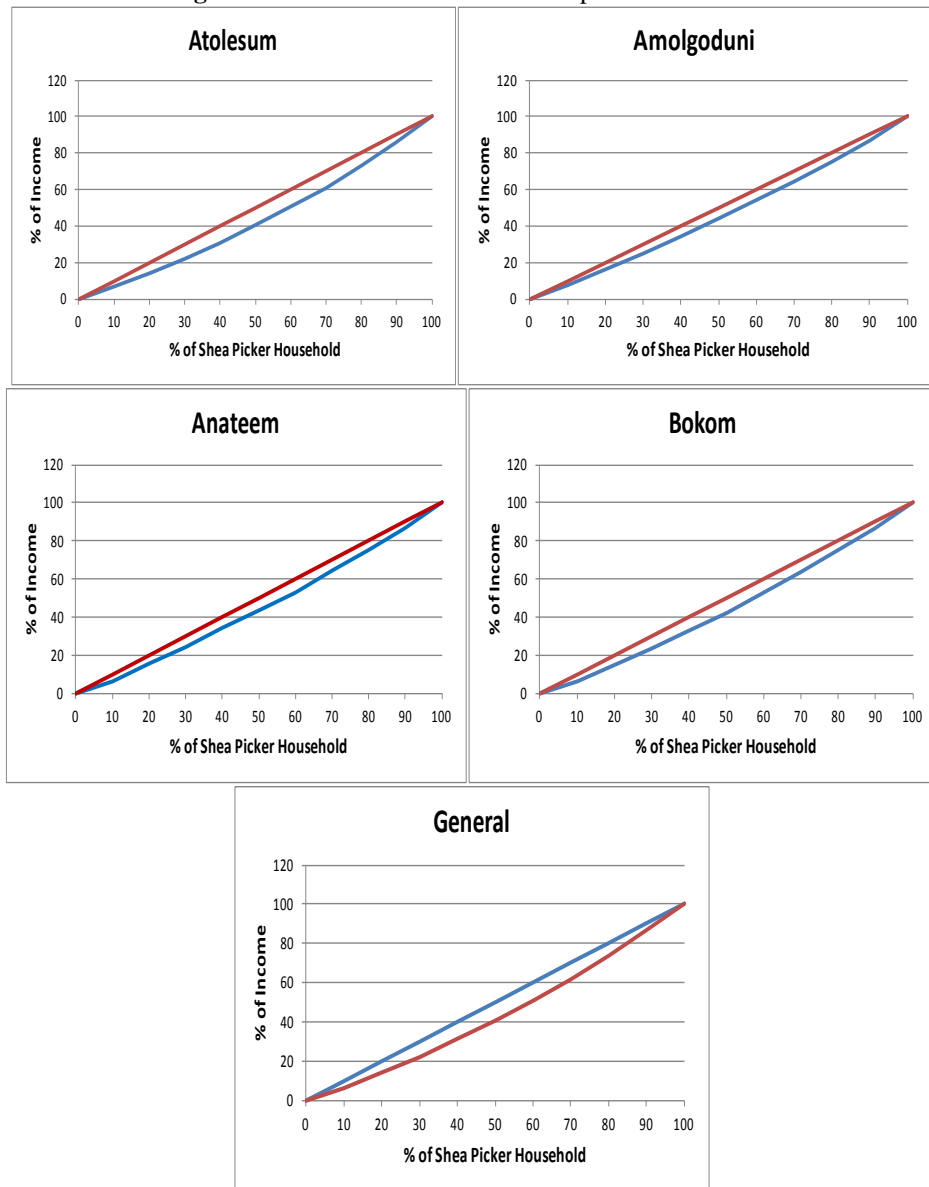
Another statistic analysis relating to poverty reduction is that of income distribution among the shea picker households. This is to direct policy makers and implementers as to how to rollout poverty alleviation strategies to ensure effective and significant reduction in poverty as well as bridging the gap between income level groups. This analysis was conducted on community bases as well as the four communities coming together as a unit. Figure 6 presents the Lorenz curves arrived at. The general observation is that income is fairly distributed among the households. The Gini coefficients as presented in Table 5 indicates that the community with the best income distribution is Amolgoduni following the order, Anateem, Bokom and Atolesum with Gini coefficients of 0.08, 0.09, 0.11 and 0.13 respectively.

Taking the four communities as a whole, income distribution is of Gini coefficient of 0.13 coinciding with that of Atolesum. This is an indication that the shea picker households in the communities share similar conditions and as such any strategy aimed at income boosting could be made across board, there is no need to design separate strategies for the individual communities.

Table 5: Gini coefficients of income distribution of shea picker households

Community	Gini Coefficient
Atolesun	0.13
Amolgodini	0.08
Anateem	0.09
Bokom	0.11
General	0.13

Conclussion And Recommendations

The regression analysis conducted in this paper had been assessed to capture over 90 % of the variables that do determine the income of shea-picker households in the research area of Sumbrungu. The variables in the model are of a significance level of less that 1 % with an overall model significance level of almost zero. Considering the results obtained, the model could be accepted as a true representation of the situation on the ground and used for future income prediction and poverty aleviation strategy planning. Age of shea fruit picker and quantity of fruits picked per day are the main factors determining their income. It has also been extablished that location of the various communities with respect to Bokom community is also significant and directly affects the quantity of shea friuts picked per day. It could therefore be concluded that the hypothesis saying that age of shea fruit picker and location do not affect income could be regected. On the other

hand, hypothesis stating that gender of household head size of household do not determine income could not be regected. The fifth hypothesis which says that income from shea picking is not significant in total household income cannot be accepted but could be rejected since the average income of a shea picker per day is more than the minimum wage of 4.48 Ghana cedis. Taking the four communities as the bases for analysis, it could be said that income distribution among shea-picker households in each of the communities as well as globally are very close to a normal distribution. In view of this the same policies and strategies could be rolled out in all the communities thus making planning and implementation of policies as well as strategies simpler.

Considering the homogeneous nature of the rural communities in the North and the conclusions made here above, it could therefore be said that with well planed policy enactment and implementation the shea industry could be in no doubt an effective engine of poverty reduction in the Northern Regions of Ghana.

To fully tap the benefits of the wild shea tree the following recommendations are made:

1. Shea tree protection policy should be enacted and enforced.
2. The unemployed youth should be assisted with protective clothing and gadgets to enable the engage in the picking of shea fruits.
3. Due to the distance factor and the limit of fruits that could be carried over those distances it would be helpful if tricycles could be given to the pickers in the form of credit to enhance their work.

Acknowledgements

References:
Adebayo, A. F. (1985): The Implication of Community Leadership for Rural Development Planning in Nigeria, Comm. Dev J., vol. 20, pp. 24-31.
Boffa, J. M. (1991): Land and tree management and tenure policies in Burkina Faso's agroforestry system. MSc. thesis, Purdue University, West Lafayette, Indiana. p. 167.

De Janvry, A.; Sadoulet, E.; Murgai, R. (2002): Rural Development and Rural Policy. Handbook of Agricultural Economics, Chapter 31, Volume 2, Edited by B. Gardner and G. Rausser. Elsevier Science B.V.

Ellis, F. (1999): Rural livelihood diversity in developing countries: evidence and policy implications. Overseas Development Institute (ODI), Natural Resource Perspectives, Number 40.

Ellis, F.; Biggs, S. (2001): Evolving themes in rural development 1950s-2000s. Development Policy Review, vol. 19, no. 4, pp. 37-448.

Ellis, F. (2005): Small-Farms, Livelihood Diversification and Rural-Urban Transitions: Strategic Issues in Sub-Saharan Africa. A Paper prepared for the Research Workshop on: "The Future of Small Farms." Withersdane Conference Centre, Wye, Kent, UK, 26-29 June 2005.

Greene, W. H. (1993): Econometric analysis. New York, Macmillan.

Grigsby, W. J.; Force, J. E. (1993): Where Credit is Due, Forests, Women and Rural Development. Journal of Forestry, no. 91, pp. 29-34.

Haggblade, S.; Hazell, P.; Reardon, T. (2010): The Rural Non-farm Economy: Prospects for Growth and Poverty Reduction. World Development, vol. 38, no. 10, pp. 1429-1441.

Hassan, R. M.; Badu, S. C. (1991): Measurement and determinants of rural poverty, Household consumption pattern and food poverty in rural Sudan. Food Policy, vol. 16, no. 6, pp. 451-460.

Hastie, T.; Tibshirani, R.; Friedman, J. (2001): The Elements of Statistical Learning. Data Mining, Inference, and Prediction. Springer, New York.

Jirström, M.; Andersson, A.; Djurfeldt, G. (2011): Smallholders caught in poverty - flickering signs of agricultural dynamism. In African Smallholders: food crops, markets and policy. (in Djurfeldt *et al.*) London: CABI. Chapter 4, pp. 74-106.

Lanjouw, P.; Ravallion, M. (1995): Poverty and household size. Economic Journal, vol. 105, pp. 1415-1434.

Losch, B.; Freguingresh, S.; White, E. (2011): Rural Transformation and Late Developing Countries in a Globalizing World: A Comparative Analysis of Rural Change. Final Report of the RuralStruc Program, Revised Version. Washington, DC: World Bank.

Mclain, R. (1990): Le régime foncier et l'agroforesterie au Mali Central: etude du terroir villageois aux unités familiales. Land Tenure Center, Madison, Wisconsin. 74 pp.

Otsuka, K.; Yamano, T. (2006): Introduction of the special issue on the role of nonfarm income in poverty reduction: Evidence from Asia and East Africa., Agric. Economics, vol. 35(s3), pp. 393-397.

Reardon, T. (1997): Using Evidence of Household Income Diversification to Inform Study of the Rural Nonfarm Labor Market in Africa. World Development, vol. 25, no. 5, pp. 735-747.

Simler, K. R.; Dava, G. L.; Daat, G. (2004): Rebuilding after war: Micro-level determinants of poverty reduction in Mozambique, Research Report 132, International Food Policy Research Institute, Washington DC.

Schreckenberg, K. (1996): Forests, fields and markets: a study of indigenous tree products in the woody savannahs of the Bassila region, Benin, Ph.D. Thesis, University of London, 326 pp.

Schultz, T. (1961): Investment in human capital, American Economic Review, vol. 51, pp. 1-17.

Stichting, N. V. (SNV) (2006): Improving Market Access for Smallholder Farmers: Concept note on developing shea market chains. SNV Shea Sub-sector Study.

Technoserve Ghana (2004): "West Africa Shea Trade", PowerPoint presentation by Samuel Akyianu, TechnoServe, Dakar.

Welch, F. (1970): Education in Production, Journal of Political Economy, vol. 78, issue 1, pp. 35-59.

Winters, P.; Essam, T.; Zezza, A.; B. Davis, B.; Carletto, C. (2010): Patterns of Rural development: A Cross-Country Comparison Using Microeconomic Data. Journal of Agricultural Economics, vol. 61, no. 3, pp. 628-651.

Yidana, J. (1994): Studies in the shea tree. Reports, Cocoa Research Institute of Ghana. p. 10.

Reports

Chalfin, B. (2004): Shea Butter Republic: State Power, Global Markets, and the Making of an Indigenous Commodity. New York: Routledge.

World Bank (2007): Agriculture for Development. World Development Report 2008, Washington DC: World Bank.