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## Food Security in Northern Ghana: Does Income from Shea Based Livelihoods Matter?

Romeo Oduro Akra<sup>a</sup>, Irene Susanna Egyir <sup>a</sup>, Alhassan Wayo Seini<sup>a</sup>, Martha Awo<sup>b</sup>, Emmanuel Okyere<sup>a</sup>, and Kodjo Barnor<sup>a</sup>

<sup>a</sup>Department of Agricultural Economics and Agribusiness, University of Ghana, PMB Accra, Ghana; <sup>b</sup>Institute of Statistical, Social and Economic Research, University of Ghana, PMB Accra, Ghana

### ABSTRACT

Shea is an important resource that support livelihoods and food security in northern Ghana. This study assesses the contribution of shea's contribution to collectors' income and food security. Shea income contributes about 21% to total income. Using The Food Consumption Score (FCS) to determine household food security status of shea collector households, majority of households (75.3%) were found to lack high food security. The Ordered Logit Regression (OLR) model was used to estimate the effect of shea income on household food security. The effect of shea income on food security was minimal. Income obtained from combining shea collection, farming and butter production has the highest effect on household food security. Other factors found to positively affect food security were attainment of basic education, farm size, picking nuts from family field, number of household's food contributors while household size had an inverse effect on food security. The study recommends the encouragement of positive gender relations that allow women to have access to shea resources and advocates training to build capacity of collectors in other livelihood activities.

### KEYWORDS

Shea Collector Households; Food Security; Shea Income; Ordered Logit Model; Food Consumption Score; Northern Ghana

## Introduction

Food is a necessity of life and a basic means of sustenance, the adequacy of which (in quantity and quality) is a key requirement for a healthy and productive life (Tiwaseng et al. 2018).

Globally, around 800 million people are undernourished and 836 million suffer from extreme poverty (FAO et al. 2017). In Ghana, over 1.2 million citizens, representing about 5% of the population, are considered food insecure and another 2 million vulnerable to food insecurity (MoFA 2015). Despite Ghana's efforts to achieve strong economic growth and reduce national poverty and food insecurity, IFAD et al. (2011) report that some level of poverty and food insecurity in various occupational groups, social groups and geographical areas still exist in the country. As established by various rounds of the Ghana Living Standards Survey (GLSS), northern Ghana, which is the region where this study is set, is the highest single contributor to the level of poverty in Ghana with its inhabitants representing 58% of the total number of poor people in the country. The region has a rural

**CONTACT** Romeo Oduro Akra  [rodewise@yahoo.co.uk](mailto:rodewise@yahoo.co.uk)

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population of about 70% and farming is the main occupation (GSS 2014). Farming is the main strategy employed to tackle food insecurity but, in the view of Zereyesus et al. (2017), farming alone cannot solve the problem of food insecurity in the region due to poor soils, low agricultural productivity, and changing and increasingly unpredictable rainy seasons.

Aside from farming, shea (*Vitellaria paradoxa*) fruit picking and processing support livelihoods and food security by providing cash income to female household members with limited income sources (Pouliot 2012). The shea sector employs about 85% of women and contributes about 70% of the income of rural households in the lean season (Adams et al. 2016). The shea season starts at a time when household money and food are scarce (Pouliot 2012). Most women in the region traditionally contribute to household food needs, essentially through providing the daily protein and vitamin needs (Awo and Anaman 2015). They thus supply meat/fish, vegetables, oils and other condiments during food preparation. These ingredients are usually procured with the money raised from shea activities. For this reason, shea income fills an annual income and consumption gap in the lives of collectors and processors. In addition to the money obtained from sales of shea products, the fresh pulp has been reported to contribute to daily food needs owing to its high nutritional value (Maranz et al. 2004). The butter obtained from shea is also a well-known staple-edible oil that supports the health and livelihoods of collectors and their families (Naughton et al. 2015).

Despite the enormous potentials of shea to support livelihoods and improve food security, studies on food security in northern Ghana have mostly focused on farm and non-farm activities, but seldom took the shea contribution into account (Quaye 2008; Owusu et al. 2011; Tsiboe et al. 2016).

In addition to providing additional evidence on the importance of shea contribution for the livelihoods of rural people in the northern region of Ghana, the present study seeks to fill a gap in the literature by disaggregating the income contribution of the major income generating strategies among shea collectors (shea nuts, butter, and farming). More specifically, our objectives were to:

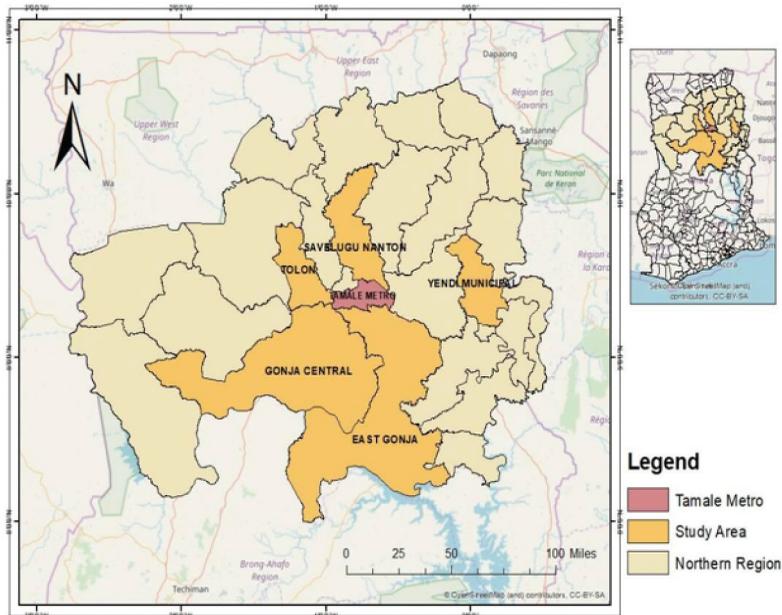
- Estimate the contribution of shea income to total collectors' income
- Assess the food security status and dietary pattern of shea collector households
- Estimate the effect of shea income on food security of shea collector households

## Materials and methods

### *Sampling and data collection*

Multistage sampling technique was used to obtain the sample for the study. The Northern region was the focal study area since it was the largest region across Ghana's shea belt during the course of the study in 2017 covering about 70% of the shea belt (Lovett 2010). That region had since then (2019) been divided into three – Northern, Savannah and North East. The study area is occupied predominately by the Mole Dagbon ethnic group (GSS 2012), and its main land cover is savannah grassland, thinly interspersed with some drought-resistant trees, such as the shea, dawadawa (*Parkia biglobosa*), baobab or various acacia species.

We first selected five (5) districts with collectors registered under the Shea Network Ghana (SNG). For ease of access, districts with direct linkage to the Tamale Metropolis and



**Figure 1.** Map of the study area districts. Source: University of Ghana RS/GIS Lab

**Table 1.** Selected districts and communities for the study.

District	Selected communities	Number of respondents
East Gonja	Dashei, Worlanyili, Janton	60
Central Gonja	Aliyili, Zanzugu, Galinzengu	60
Yendi	Adiboo, Kanimo, Puriya	60
Tolon	Gbarimani, Kasuliyili, Waribogu	60
Savelugu/Nanton	Nakpazuu, Tibali, Zorgu	60
<b>Total</b>		<b>300</b>

Yendi Municipal areas were selected for the study (Figure 1). Communities within each district were numbered in separate groups and three (3) lots randomly picked resulting in 15 communities for the study (Table 1). In each of the 15 communities, 20 respondents were randomly selected using the lottery approach. Overall, 300 respondents were sampled and interviewed between 16 May and 6 June 2017 with the aid of a questionnaire (Appendix C, supplemental file). Since shea collection is the preserve of women in the study area, only women were included in the survey.

## Data analysis

### *Estimating the contribution of shea income in total collectors' income*

Annual incomes obtained from shea collectors were used in the analysis. While some collectors may depend on only one activity for their income, others might earn their incomes from a combination of sources. For this study, shea nut collection and shea butter production were distinguished from the other non-farm activities. Due to the small number

of respondents having non-farm activities other than shea, these activities were grouped under the umbrella of other non-farm activities.

Four income generating strategies were identified, combining the number of income activities a shea collector engages in. These were:

- (1) Obtained income from farming and shea nut collection only (FS);
- (2) Obtained income from farming, shea collection, and butter production (FSB);
- (3) Obtained income from farming, shea collection, and other non-farm activities (FSN); and
- (4) Obtained income from farming, shea collection, butter production and other non-farm activities (FSBN).

Annual Income for the past year from each strategy was obtained by adding the annual incomes from the individual activities constituting the strategy as follows:

$$I = \sum x_i \quad (1)$$

Where I = Income obtained from an income generating strategy

$x_i$  = Individual income generating activities constituting the strategy

### ***Assessing the food security status of shea collector households***

We used the Food Consumption Score (FCS), because it combines frequency of food consumption, dietary diversity and relative importance of each food group and has a standard decision criteria (Weismann et al. 2009), thereby capturing both quantitative and qualitative aspects of food consumption (Lovon and Mathiassen 2014). The score is calculated using the frequency and weight of food consumed by a household during the 7 days before the survey. These data are grouped into eight food consumption groups and, using standardized weights, are combined into a composite score (Table 2). Food groups with relatively good quality protein, high energy, and a varied range of micronutrients that can be easily absorbed are assigned higher weights. The tool considers a food item to be consumed once (on one occasion) even if it was consumed on more than one occasion in a day. Therefore, a food item eaten on three of the last seven days have a count of three, irrespective of how many times it was consumed in one particular day. The food items are then assembled into the appropriate food groups, for which the maximum number of consumption days is seven.

**Table 2.** Food groups used for the computation of the household dietary diversity scores.

Food Group	Description	Weight
Starchy staples	Cereals, tubers	2
Pulse/legumes	Dried beans, dried peas, groundnuts, nuts	3
Vegetables	Vegetables	1
Fruits	All fruits including 100% fruit juice	1
Meat/fish	Meat, fish and other animal protein	4
Dairy	Milk and milk products	4
Oils and fats	Oils and fat	0.5
Sweets	Sugar, honey, sweetened juice drinks, sugary foods	0.5

Source: WFP (World Food Programme) (2008)

The score for a shea collector was used to represent the food security status of the household since collectors do not prepare their meals separately but eat from the same pot with their household. This study adopts the definition of household submitted by the National Population Commission of Nigeria (National Population Commission, ICF International 2014) as a person or group of persons, related or unrelated who usually live together in the same dwelling unit, have common cooking and eating arrangement.

Following the determination of consumptions frequencies and assignment of weights to the respective food groups, the consumption score for each household was calculated as:

$$FCS = \sum x_i a_i \quad (2)$$

Where:

$FCS$  = food consumption score,

$x_i$  = number of days in which a food group,  $i$ , has been consumed by the household within the reference period,

$a_i$  = weight coefficient for each food group

Weighted sum of frequency of household consumption is a continuous variable with a possible range of 0 to 112. The cut-off points for determination of food security status depend on whether oil is considered consumed in the study area. A food group is considered consumed if it is eaten more than 50% of the study recall period.

The World Food Program (WFP) established the following thresholds to categorise food security levels:

- 0–21: Poor/low food consumption
- 21.5–35: Borderline/moderate food consumption
- >35: Acceptable/high food consumption

These thresholds are widely applicable and have been used to measure household food consumption (e.g. Zereyesus et al. (2012)). They can, however, be attuned if marked differences are observed in the consumption pattern of a population, for example, in situations or areas where sugar and/or oil is consumed frequently across the surveyed households. In such situations, frequent consumption (i.e. 7 days) of oil and/or sugar (with weights of 0.5 each) already gives a score of 7 for the week. When this score is combined only with frequent consumption (7 days' worth) of a starchy staple, the score already arrives at 21. This is because frequent consumption of starchy staples (with a weight of 2) gives a score of fourteen (14) for the week. Adding this score to the seven obtained from sugar and/or oil leads to a score of 21. As a result, an individual who consumes these food groups with a rare consumption of any other food group could be considered as moderately food secure which may not be the situation on the ground. Therefore, WFP (2008) recommends that the thresholds be raised from 21 and 35 to 28 and 42, respectively (by adding 7 to each threshold to account for the daily consumption of oil and sugar). Following this justification, Oumarou et al. (2020) used the adjusted thresholds to study household food security in Niger Republic and we thus adopted the same adjusted thresholds in our study, as follows:

- 0–28: Poor food consumption
- 28.5–42: Borderline food consumption

- >42: Acceptable food consumption

### *Estimating the effect of shea income on food security status of households.*

## **Theoretical background**

The random utility theory is the theoretical basis for this study. The theory assumes that individual choices are the outcome of a process in which the random variable is associated with each alternative, and the alternative with the greatest realisation is the one selected (Babulo et al. 2008). When the perceived stimuli are interpreted as levels of satisfaction, or utility, this can be interpreted as a model for economic choice in which the individual chooses the option yielding the greatest realisation of utility. Assuming a random individual,  $n$ , is faced to make a choice among  $K$  different strategies to obtain an outcome, then the utility the individual obtains from alternative strategy,  $k$ , can be represented by  $U_{nk}$ ,  $k = 1, \dots, K$ . Under this condition, the individual will only choose alternative  $k$  if the derived utility is relatively higher than the utility that will be obtained from choosing other alternatives.

This relationship can be mathematically represented as:

$$U_{nk} > U_{ni} \quad (3)$$

The attained utility ( $U_{nk}$ ) from alternative  $k$  is comprised of  $V_{nk}$  (aspect of  $U_{nk}$  resulting from the observed characteristics of the alternative, and some individual and household-specific attributes,  $H_n$ ) and  $\varepsilon_{nk}$  (random error term).

The utility function can be expressed as follows as:

$$U_{nk} = V_{nk} + \varepsilon_{nk} \quad (4)$$

$$= V(\tau_{nk}, H_n) + \varepsilon_{nk} \quad (5)$$

With specific reference to this study, four (4) alternatives of income generating strategies are identified. If the probability associated with adopting a given strategy is represented by  $P_{nk}$  ( $k=1-4$ ), then  $k=1$  if 'SF' strategy is adopted,  $k=2$  if 'SFB' strategy is adopted,  $k=3$  if SFN strategy is adopted and  $k=4$  if SFBN is adopted.

The livelihood outcome of concern for this study is food security of shea collector households which is to be achieved through the implementation of any one of the identified strategies. Applying this to the study, the relationship between food security and income generating strategy can be represented as:

$$\text{Food Security} = f(\text{income generating strategy}) \quad (6)$$

Three levels of food security were determined for the study. These were low, moderate and high food security. The Ordered Logit Regression Model was used to estimate the effect of resource access, income generating strategies and other factors on food security. Also known as the proportional-odds model, the model has been used to analyse categorical data by Fullerton (2009) and Meng et al. (2014).

One of the assumptions underlying ordered logistic regression is that the relationship between each pair of outcome groups is the same. In other words, ordered logistic regression assumes that the coefficients that describe the relationship between, say, the lowest

**Table 3.** Description of independent variables in the ordered logit model and their a priori expectations.

Variable	Variable name description	Measurement	Expected sign
X <sub>1</sub>	Basic formal education	1 = Yes 0 = Otherwise	+
X <sub>2</sub>	Age of shea nut collector	Years	±
X <sub>3</sub>	Food expenditure	Cedis (GHS)	+
X <sub>4</sub>	Farm size	Hectares	+
X <sub>5</sub>	Distance to main source of nuts	Kilometres	-
X <sub>6</sub>	Distance to market	Kilometres	-
X <sub>7</sub>	Availability of storage facility	1 = Yes 0 = Otherwise	+
X <sub>8</sub>	Family land as main source of nuts	1 = Yes 0 = Otherwise	+
X <sub>9</sub>	Household size	Number of persons	±
X <sub>10</sub>	Number of food contributors	Number of persons	+
X <sub>11</sub>	Land tenure security	1 = Yes 0 = Otherwise	+
X <sub>12</sub>	Quantity of nuts collected Effects of strategies	Kilograms	+
X <sub>13</sub>	Income from farming and shea collection strategy only (FS)	1 = FS 0 = Otherwise	+
X <sub>14</sub>	Income from farming plus shea collection plus butter production strategy (FSB)	1 = FSB 0 = Otherwise	+
X <sub>15</sub>	Income from farming plus shea collection plus non-farm strategy (FSN)	1 = FSN 0 = Otherwise	+
X <sub>16</sub>	Income from farming plus shea collection plus butter production plus non-farm (FSBN)	1 = FSBN 0 = Otherwise	+

Note: Average exchange rate of the US\$ to the Cedi (GHS) was 4.25406 at time of study (May, 2017)

versus all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories, etc. This is called the proportional odds assumption or the parallel regression assumption. Because the relationship between all pairs of groups is the same, there is only one set of coefficients (only one model). If this was not the case, a different model would be needed to describe the relationship between each pair of outcome groups. A violation of this assumption in the ordinal logit model influences the results of the model assessment and explanation.

Following Liu (2009) and Citko et al. (2012), the Brant test was used to test the null hypothesis that there exist no difference in the coefficients between models. A significant test statistic provides evidence that the parallel regression assumption has been violated as found by Otieno et al. (2020). The parallel regression assumption was insignificant (Appendix A, supplemental file) meaning the coefficients of the outcome are not statistically different from each other and as a result a single model can be fitted.

## Model specification

The model was specified as:

$$Y_i^* = B'X_{i+}e_i \quad (10)$$

Where  $Y_i^*$  denotes the underlying unobserved variable that indexes food security status,  $B'$  is a  $k \times 1$  vector of unknown regression parameters to be estimated,  $X_i$  is a vector of explanatory variables to be estimated and  $e_i$  is the stochastic error term. With three categories, two cut-off points were estimated.

**Table 4.** Socio-economic characteristics of respondents.

Variable	Frequency	Percent	Mean	SD
Age of respondent			44.3	11.3
Household size			7.9	3.7
Educational level				
None	188	62.7		
Basic	93	31.0		
Secondary	19	6.3		
Main source of nuts				
Family land	151	50.3		
Communal land	131	43.7		
Neighbour's land	18	6.0		
Quantity of nuts collected			375.3	105.6
Respondent income (GHS)			2207.9	1159.3
Expenditure on food (GHS)			1556.3	774.6
Farm size			3.6	1.2

Note: Average exchange rate of the US\$ to the Cedi (GHS) was 4.25406 at time of study (May, 2017)

Assuming  $Y_i^*$  values of 1, 2 and 3 for three ordinal responses representing low food security, moderate food security and high food security, respectively, the probability of obtaining an outcome are given as  $P_1 = \Pr(y=1)$ ,  $P_2 = \Pr(y=2)$  and  $P_3 = \Pr(y=3)$  for an outcome of 1, 2 and 3, respectively (Table 3).

## Results

### *Socio-economic characteristics of respondents*

Respondents' socio-economic characteristics are presented in Table 4.

The average age of shea collectors in the study area was 44 years with a standard deviation of 11 years. An average household in the study area had eight members. Most of the 300 shea collectors in our sample had no formal education (63%). The average nut weight collected was 375 kg per shea season. About 50% of shea collectors sourced nuts mainly from family lands, while 44% and 6%, respectively, sourced from communal land and neighbour's land. The annual mean income and expenditure on food in the study for a shea collector was GHS 2,207.92 and 1,556.33<sup>1</sup> (US\$ 519 and US\$ 368), respectively. The modal strategy was "shea collection plus farming plus butter production (FSB)" with 59% of respondents and a mean income of GHS 2,206.3 (US\$ 519). The strategy with the highest mean income was the strategy that combined farming, butter production and non-farm activities (FSBN) in addition to shea collection with GHS 3,236.7 (US\$ 761).

**Table 5.** Distribution of respondents' income generating activities and mean incomes.

Activity	Frequency	Percentage	Mean Income (GHS)	Percentage
Farming	300	100.0	1442.5	64.7
Shea nut collection	300	100.0	166.9	7.5
Shea butter production	211	70.3	293.5	13.2
Other non-farm	116	38.7	325.0	14.6
Overall			2227.9	100

Note: Average exchange rate of the US\$ to the Cedi (GHS) was 4.25406 at time of study (May, 2017)

### ***Contribution of shea to total income***

The main activities identified for this study were farming, shea butter production, and non-agricultural activities. The non-agricultural activities identified in the study area included dressmaking, hairdressing, petty trading, agro processing, wage employment (especially butter production for a fee), sale of firewood, and food vending. For the purpose of this study, they were considered together as one income generating activity because each of the individual activities were undertaken by a too small proportion of the respondents to stand alone in the analysis. A collector can engage in one or more of these activities in order to achieve their livelihood goals. The study revealed that 70% of our respondents further processed their nuts into butter, while about 39% engaged in other non-farm activities (Table 5). The proportion of shea collectors who further process into butter in the study area was low compared to the 87% reported by Adams et al. (2016) among rural women in the Wa Municipality of the Upper West region of Ghana. This implies that a higher proportion of collectors sell their nuts to aggregators or other butter producers in our study area.

Farming was the highest contributor to shea collectors' total income with about 65% followed by the other non-agricultural activities with a little above 15%. Income contribution from sale of shea nuts and shea butter production were about 8% and 13%, respectively. The mean income for shea nuts sale was consistent with the findings of Adams et al. (2016) who recorded mean income of GHS 190.31 representing about 7% of total income. On average, shea income (nut and butter) accounts for about 21% of total income.

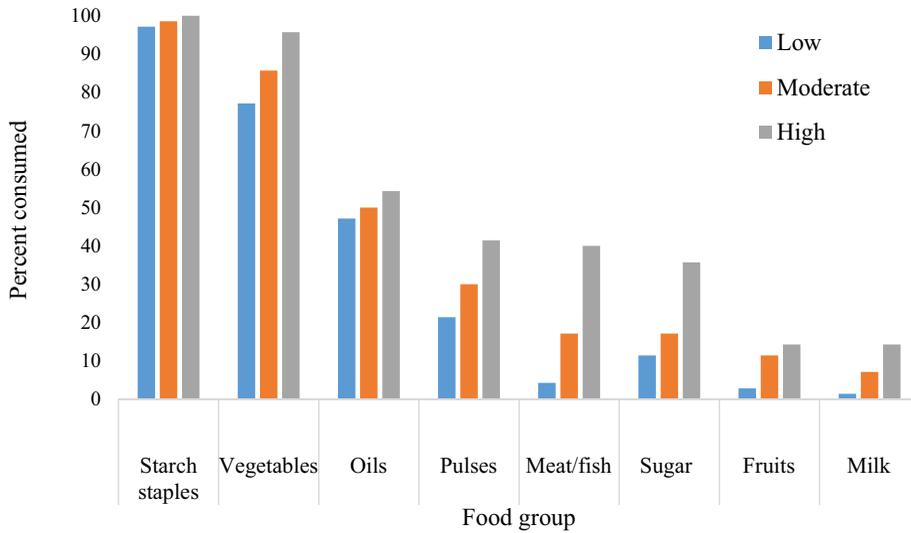
### ***Distribution of Income generating strategies***

The modal income generating strategy in the area was 'farming, shea collection and butter production' (FSB) with 59% of the 300 respondents. Twenty-five percent adopted the 'farming and shea collection only' (FS) strategy, while 11% adopted the 'farming, shea collection, butter production and non-farm' (FSBN) strategy and only 5% practiced 'farming, shea collection and non-farm' (FSN).

The fact that all the shea collectors were found to be farmers was not surprising since shea is a seasonal crop and collectors are more likely to engage in other income generating activities during the off-season. Considering the rural nature of the study area, it is expected that farming will be a major component of their livelihoods. As a result, these two activities are the main sources of livelihood for rural women in the Northern Region. Our results are also consistent with those of Adams et al. (2016), who found that most shea collectors were farmers and further process shea nut into butter – the FSB strategy.

### ***Food security status of shea collector households***

Following determination of food consumption pattern, oil was considered to be consumed by the study group since it had a score of 50.48. Therefore, the higher limits of the threshold were used. The consumption score obtained for the study area was 35.77 indicating moderate food security. About 15% and 60% of households were found to be low and moderate food secured, respectively. About 25% of households were highly food secured.



**Figure 2.** Household dietary pattern.

### ***Household dietary pattern***

Analysis of household dietary pattern examined the range of food groups consumed by household (Figure 2). A food group is deemed to be consumed by a household if it is consumed at least 50% of the recall period. Per this criterion, starchy staples, vegetables and oil were considered very important in the study area. Starchy staples were consumed 98% of the time; vegetables were consumed 86% of the time; oils were consumed 50% of the time. In other words, starchy staples, vegetables and oils were consumed in approximately seven, six, and three and a half days, respectively, out of the seven-day recall period. Other food groups consumed less often included: Legumes, 31% of the time (2 days) and meat/fish, 17% of the time (1.2 days) of the time. Food groups consumed occasionally included sweets/sugar (5.2%), milk (2.8%) and fruits (1.9%); they were consumed less than 10% of the 7-day recall period. In the study, food groups consumed at less than 50% of the recall period were not considered consumed as prescribed by WFP (World Food Programme) (2008). The quality of the diet of the households in the study area is low since protein (legumes, meat and fish) and micronutrients (fruits) are less frequently consumed.

The high consumption frequency of starchy staples was to be expected since *tuo zaafi* which is the main diet in the area is prepared from maize. Rice is also a staple in the area. *Tuo zaafi* is mainly eaten with okro and green soup and dawadawa or processed spices explaining the consumption frequency of vegetables. Green leafy vegetables and (sometimes) groundnuts were used in the preparation of accompaniment for *tuo zaafi*. Since most of our respondents engage in shea butter production, oil is usually available in the house to be used for stews and for frying. This explains the high consumption of oil in the study area.

### ***Effect of shea income and other factors on food security of shea collector households***

The parallel regression assumption that the distance between coefficients are similar was tested using the Brant test (appendix A, supplemental file). The chi-square estimate (0.241)

**Table 6.** Ordered logistic results for determinants of food security status.

Variable	Coefficient	Marginal effects		
		Low food security	Moderate food security	High food security
Obtained income from Shea Collection and Farming Strategy (SF only)	0.8182*** (0.5062)	-0.0781*** (0.0232)	-0.2028 (0.0930)	0.2810*** (0.1092)
Obtained income from Shea Collection and Farming and Butter Prod Strategy (SFB)	0.1779* (0.4407)	-0.0531 (0.0347)	-0.0401* (0.0232)	0.0933* (0.5286)
Shea Collection and Farming and Non-farm Strategy (SFN)	0.7037 (0.7371)	-0.0396* (0.2336)	-0.1065 (0.1278)	0.1463 (0.1495)
Basic formal education	0.4678* (0.2616)	-0.0341* (0.0189)	-0.0277 (0.0192)	0.0619* (0.0360)
Perception of food security	0.1894 (0.2065)	-0.0136 (0.0154)	-0.0117 (0.0129)	0.0254 (0.0277)
Farm size	2.8507*** (0.6082)	-0.2055*** (0.0513)	-0.1763*** (0.0630)	0.3818*** (0.0811)
Distance to main source of nut	0.0560 (0.0817)	-0.0078 (0.0060)	-0.0067 (0.0053)	0.0146 (0.0109)
Distance to market	-0.0560 (0.0448)	0.0040 (0.0031)	0.0035 (0.0030)	-0.0075 (0.0060)
Availability of storage space	0.3235 (0.3505)	-0.0255 (0.0306)	-0.0149 (0.0120)	0.0404 (0.0409)
Family field as main source	0.9178*** (0.2609)	-0.0711*** (0.0274)	-0.0474** (0.0195)	0.1185*** (0.0330)
Household size	-0.6083*** (0.0930)	0.0438*** (0.0079)	0.0376*** (0.0138)	-0.0814*** (0.0146)
Number of food contributors	1.0143*** (0.1694)	-0.0731*** (0.0141)	-0.0627*** (0.0231)	0.1358*** (0.0257)
Quantity of nuts collected (kg)	0.0018 (0.0012)	-0.0001 (0.0001)	-0.0001 (0.0001)	0.0002 (0.0002)
/cut1	3.6142			
/cut2	8.0968			
Number of observation = 300	Wald chi2(16) = 116.90		Prob > chi2 = 0.0000	
Log pseudolikelihood = -200.7979			Pseudo R2 = 0.2874	

\*, \*\* and \*\*\* denote statistically significant variables at 10%, 5% and 1% significant levels, respectively

indicates that the parallel regression assumption has not been violated and thus the ordered logit regression model is an appropriate tool to use. Multicollinearity among the independent variables was tested using the variance inflation factor (VIF). The VIF test shows no multicollinearity amongst the independent variables as all the estimated VIFs were less than 10 (Appendix B, supplemental file).

### *Income from shea based strategies*

Presented in Table 6 is the regression results of this study. Income obtained from the FSNB strategy was used as the base variable for the regression and is thus not discussed in this section. Income obtained from combining shea collection with farming only (SF) significantly improved (by 28%) the chances of a household being high food secure while reducing the chances of being low and moderately food secure by 8% and 20%, respectively.

Worthy of note is the role of shea in improving household food security. The regression results showed that the quantity of shea nuts collected have no effect on household food security status. This suggests that the significant positive effect of the FS strategy on household food security is driven mainly by the contribution of farming, which allows money from shea to be spent on other household needs. This finding is not surprising considering the fact that farming contributes about 64% of shea collectors' income

compared to about 8% for the sale of shea nuts in the study area. Supporting this observation, Laube (2015) asserts that shea collection provides low returns on labour and that shea collection and marketing at the local level alone cannot assist in reducing poverty and food insecurity significantly.

Income obtained from the FSB strategy was found to increase the likelihood of belonging to a high food secure household by 9% while reducing the chances of being moderate food secure by 4%. Our results show that the production of butter aside nut collection and farming in the Northern Region is an important means of generating income for women. Shea constitutes a key source of income for women in northern Ghana and its butter is the main source of cooking oil in the study area. Naughton (2016) found butter production to reduce food insecurity vulnerability and thus sustain an improved food security position.

The FSN strategy was significant at reducing the likelihood of a household being low food secure by 4% but had no effect on moderate and high food security. The general direction of the relationship supports the argument of Owusu et al. (2011) and Aidoo et al. (2013) who found a positive relationship between non-farm income and household food security. The relatively lower effect of this strategy on household food security could, however, be attributed to the fact that not all the incomes earned from this strategy was used on food. In another scenario, additional incomes could be used to procure more of a particular food group and not necessarily to consume diversified food groups. This reason holds true especially in the study area where households were observed to increase the number of times food is prepared in the house rather than increase the number of food groups consumed per day.

### **Other factors**

**Basic education.** Our results show that acquiring formal education at the basic level reduces the probability of a shea collector household being low food secured by approximately 3% and increases the probability of being high food secured by about 6%. The positive effect of education on food security can be attributed to the fact that attainment of basic education and literacy has a key role in food access and utilisation. Additionally, acquiring knowledge about feeding and dietary diversity improves the understanding of the need to have balanced meals. This finding is consistent with Mutisya et al. (2016) who found a positive and significant effect of education on food security. Formal education could improve the awareness of the possible advantages of adopting new technologies and diversifying income thereby improving food security. This assertion is supported by Nkegbe et al. (2017) who found a similar relationship between education and food security in the SADA regions of Ghana.

**Farm size.** Farm size was measured as the total land area cultivated by respondents. This study found a positive and significant relationship between the farm size of respondents and the food security status of their households. An additional hectare of land cultivated by a respondent increased the likelihood of their household being high food secure by about 36% and reduced the chances of them being low and moderate food secure by about 18% each. This finding is consistent with Aidoo et al. (2013) who found a positive relationship in Ghana between the size of farms of smallholders and food security status. This is possible because larger farm sizes are better able to support crop and farm diversification. This

finding is in line with Abu and Soom (2016) who found that the larger the farm size of an individual, the more interest they take in their farming business which would eventually improve yield and food supply and hence the better their food security situation. This study's finding however contradicts Helfand and Taylor (2021) who found agricultural productivity to decline with farm size. Demeke et al. (2016) demonstrated that to have dietary diversity, households producing their own food must diversify farm production.

***Family land as main source of shea nuts.*** Collectors generally need that their source of shea nuts be secure. Collecting nuts mainly from family fields, as expected, improved the food security status of shea collector households. Ability to access enough nuts from family land may denote time saving which can be invested in other income generating activities since extra time might be devoted to searching for nuts in the bush in communal fields. In the view of Laube (2015) collectors with full control over trees on the land or farms of their male family members alongside community fields have a better chance of improving nut access. In situations where exclusive rights to shea trees are not granted or shea trees on family fields do not yield enough nuts, women resort to picking from community fields or the fields of neighbours. As a result, holding all other factors constant, collectors who were able to pick enough nuts from family fields as well as picking from other sources were found to have enough nuts which could be sold or processed into butter. It is based on this that respondents who collected nuts mainly from family fields increased their likelihood of being high food secure by about 12% and reduced their chances of being low and moderate food secure by 7% and 5%, respectively, compared to picking mainly from communal and neighbour's fields.

***Household size.*** An extra household member increased the likelihood of a household being low and moderately food secure by about 4% each while reducing the likelihood of being high food secure by about 7%. This is because all things held constant, an increase in the household size will lead to an increase in food requirements and puts more pressure on household food resources thereby limiting the household's ability to properly feed all its members. This finding is consistent with the finding of Abafita and Kim (2015) who argue that adding more members to a household especially the elderly, health constrained and children increase the probability of that household being food insecure. This could be due to the fact that these groups of people are not able to contribute to the daily food needs of the household. Additionally, they may require special nutrition due to their conditions.

***Number of household food contributors.*** An additional household member's contribution to food led to an increase in the likelihood of a household being high food secure by about 12%. For households in the low and moderate food security bracket, an additional member's ability to contribute to food and nutrition needs led to a reduction of their undesirable food security situation by about 6% each. In the view of Ojogho (2010) an increase in the number of food contributors reduces household dependency ratio and reduces the burden imposed on fewer food contributors. Members can contribute to household food needs through provision of food or release of cash to procure food. This finding corroborates Tsiboe et al. (2016) who reported that an increase in the number of food contributors could help in situations where some household members experience crop failure. Additionally, the

tendency for these individuals to contribute different food group, thereby improving dietary diversity, is very high.

**Land tenure security.** Security of land tenure for shea collectors positively affects food security in the study area. Secured land access may provide incentives to spend resources to increase land productivity which may lead to increased food availability. Secured and consistent access to land also ensures that food and cash crops can be cultivated, thus contributing to food security. Studying the linkage between food security and land security, Kyaw (2009) made a similar observation where the incidence of food insecurity and poverty was prevalent among the landless poor in rural areas. These observations were further confirmed by Kenney-Lazar et al. (2016) who found tenure security to have a positive effect on all the food security pillars. Providing a gendered twist to this link, Landesa (2012) pointed out that the positive relationship between secure land access and food security becomes increasingly important when women have secured land rights at the household level.

## Conclusions and recommendations

This study has been insightful in bringing to bear the livelihoods and food security of shea collector households in Northern Ghana covering five districts. Respondents were made to recollect their yearly activities and the income earned from them. In a typical informal setting where records are hard to come by, estimates were made to achieve this objective. The household Food Consumption Score was used to assess food security status. Since this method relies on a 7-day recall period, respondents sometimes had to rely on other household members to correctly recall their meals within the week. Since only women were sampled for this study, their consumption pattern could be different from other household members in the consumption of some food groups. For example, children could wander and consume more fruits, which should improve their consumption score, but this kind of detail was not captured by this study.

Outside of these limitations, we may conclude that shea income (nut and butter) contributes only about a fifth of collector's income, far behind farm income, which is the major income contributor. Additionally, we found that combining shea collection, farming and butter production is the prevalent income generating strategy among collector households. Shea collector households are only moderately food secure. This is because diets consumed by respondents were found to be high in starchy staples and low in protein-rich food groups like meat/fish and milk. Income generating strategies combining shea and farming only, as well as shea, farming and butter production had positive effects on household food security. Other factors that positively affect the food security of shea collector households in the Northern Region of Ghana include attainment of basic education by shea collector, farm size, having family field as main source of nut, and number of food contributors in the household. Household size has a negative effect on food security status.

The study thus advances the following recommendations:

- Extension education and nutritional awareness programmes should be intensified and targeted at shea collector households to encourage increased intake of high-protein

food groups other than concentrating on the consumption of cereal and other starch-based staples.

- Since basic education is an important factor, development policies must focus on the attainment of basic education of children in shea collector households. Adult literacy campaigns should also be promoted and sustained for the elderly to increase their food security and nutritional awareness.
- Since majority of shea collectors resort to picking from “private” as against “public” sources, there arises the need to encourage positive gender relations that will allow women to have easy access to shea resources.
- By way of suggestions, future research could consider employing other food security measurements that will look at other aspects of food security. Since five districts were used due to time and logistic constraints, the scope of future studies could also be expanded to other shea growing areas in the country. The entire shea value chain could be studied to ascertain its relationship and effects on food security.

## Note

1. Note: Average exchange rate of the US\$ to the Cedi (GHS) was 4.25406 at time of study (May, 2017)

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## ORCID

Irene Susanna Egyir  <http://orcid.org/0000-0003-2067-8946>

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