Contribution of Nontimber Forest Products to Rural Household Income in the Kassena-Nankana West District of Ghana

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Abstract

The contribution of income from nontimber forest products (NTFPs) to rural livelihoods and household income has received global recognition. However, there are growing concerns of overexploitation of NTFPs driven by poverty and policy neglect that threaten the sustainability of the NTFP resource base in Kassena-Nankana West District (KNWD) of Ghana. The study investigated the contribution of income from NTFPs to household income and socioeconomic factors that influence the collection and marketing of NTFPs in KNWD. Using a multistage sampling technique, quantitative data were collected from 375 households through structured survey questionnaires. Qualitative data were gathered through focus group discussions, key informant interviews, and field observations. Results showed that income from NTFPs forms a significant part of household income with a contribution of 32.69 percent to household income. Regression analysis revealed sex of respondent ($P = 0.057$), household size ($P = 0.046$), agricultural land size ($P = 0.000$), NTFP retailers ($P = 0.000$), NTFP wholesalers ($P = 0.000$), and value-added NTFPs ($P = 0.000$) as significantly and positively correlated with income from NTFPs. Results further indicated that poor households depend primarily on NTFPs in order to achieve their subsistence and income needs compared to high-income households. This research recommends that stakeholders and policymakers consider the needs of forest-dependent communities in policy analysis on NTFP conservation measures. Also, the role of households, especially the low income (poor), in the management of forest resources should be spelled out since they depend primarily on NTFPs to meet their subsistence and income needs.

Nontimber forest products (NTFPs) are plant and animal resources in their biological origin that are collected or gathered from forests areas as well as farmlands, man-made plantations, trees outside forests, and other common lands (Anokye and Adu 2014). The contribution of NTFPs to rural livelihoods has received global recognition among researchers, policymakers, and development experts (Mamo et al. 2007, Angelsen et al. 2014, Melaku et al. 2014, Moe and Liu 2016). Forest resources are sources of food, shelter, building materials, fuel, cash income, and medicine for millions of people.

The World Health Organization (WHO 2004) estimated that about 60 percent of the world's population use herbal medicine for treating their sicknesses and that up to 80 percent of the population living in the African region depend on traditional medicine for some aspects of their primary health care. Also, more than 1.6 billion people all over the world depend on forest resources for livelihoods in various capacities, whereas about 350 million of these people are dependent largely on forest resources for their subsistence and income needs (Chao 2012).

Despite the vital contributions of NTFPs to rural livelihoods, the sustainability of these NTFP resources is threatened by deforestation, land degradation, and overexploitation (Osei-Tutu et al. 2010, Derkyi et al. 2014). Also, forest policies in Ghana still categorize NTFPs as ''minor'' forest products, thereby shifting the focus of forest policy directions toward timber production to the neglect of NTFP resources (Osei-Tutu et al. 2012, Anokye and Adu 2014).

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Also, NTFP collection activities are not carefully documented to provide NTFP-specific policy guidelines to sustainably manage forest resources (Kaboré and Yaméogo 2008, Ankomah 2012, Osei-Tutu et al. 2012, Anokye and Adu 2014).

In Ghana, households collect and market various kinds of NTFPs on a daily basis in local, regional, and international markets for their domestic and/or commercial uses (Anokye and Adu 2014). Recent research recognized the significance of NTFPs in alleviating poverty and improving food security as well as livelihood diversification for rural communities (Ahenkan and Boon 2011a, Heubach et al. 2011). About 25 percent of economically active Ghanaians are estimated to derive income from NTFPs, and 38 percent of households in Ghana also trade in NTFPs (Ahenkan and Boon 2010, Anokye and Adu 2014).

Also, Ahenkan and Boon (2010) and Anokye and Adu (2014) further emphasized the contribution of income from NTFPs to the socioeconomic development, food security, nutrition, and health improvement of rural and forest-fringe communities in Ghana. Income from NTFPs is anticipated to command a significant share of forest gross domestic product, and NTFPs are recognized to play a crucial role in the Ghanaian economy (Ahenkan and Boon 2011b, Issaka 2017).

Furthermore, TREE-AID Ghana launched a program in September 2011 dubbed Non-Timber Forest Product Trade Programme, Ghana, where they worked with about 8,000 NTFP producers in 22 communities across the northern savanna zones of Ghana. The NTFP trade program was designed to improve small cooperative businesses that trade in shea (*Vitellaria paradoxa*), forest honey, and baobab (*Adansonia digitata* L.) fruit with the aim of providing options for diversification of income sources and improving livelihoods to create pathways out of poverty for households (Anokye and Adu 2014). Some of the common NTFPs found in the northern savanna zones of Ghana are dawadawa (*Parkia biglobosa*), shea, baobab, honey, and tamarind.

In other tropical regions, the dependence on NTFPs and the contributions of income from NTFPs to rural households cannot be underestimated. For example, Moe and Liu (2016) studied the economic contribution of NTFPs to rural livelihoods in the Tharawady District, West Bago, Myanmar. Their study found that NTFPs recorded a share of 44.37 percent of income in household total income, followed by an agricultural income share of 32.55 percent, whereas income from nonfarm activities recorded the least share of 23.07 percent of household income. Similarly, income from NTFPs was reported as the most important source of household income in Natma Taung National Park, Myanmar, contributing to about 55 and 50 percent of the total household annual income in two villages of the study area (Aung et al. 2014).

According to Sumukwo (2017), households that live close to forest areas used a portfolio of forest activities for income diversification, with income from NTFPs exerting a strong equalizing effect by contributing 26 percent of the household income. Therefore, restricting access of the rural poor to NTFPs would lead to increased income inequalities with a substantial loss to household welfare. Sharma (2015) recorded a contribution of 24.99 percent to household income from NTFPs, resulting in the reduction of income inequalities among households.

Studies by Melaku et al. (2014) in the Bonga forest area of southwestern Ethiopia reported income from NTFPs as the second most important source for households, contributing about 47 percent to household income from NTFPs. The contribution of NTFPs in their studies was slightly less than income from agriculture (crops and livestock), which accounted for 50 percent of total household income with the remaining 3 percent coming from off-farm activities.

Studies conducted by Heubach et al. (2011) on NTFP income and dependency on NTFPs by rural households in northern Benin investigated disparities between three income levels. Their results showed that income from NTFPs accounted for a share of 39 percent of household annual income, which was slightly less than income from crop production with a contribution of 44 percent to household total income. Even though the lowest-income households were relatively more dependent on NTFPs than better-off households, the latter received more income from NTFPs than the poorer households (Heubach et al. 2011). Moreover, their research also revealed that income from NTFPs reflected the traditional sources of livelihood opportunities of ethnic groups in the study areas.

According to a study by Mukul et al. (2015) in Satchari National Park, Bangladesh, about 27 percent of households received some form of income from the collection, processing, and selling of NTFPs. Collection of NTFPs was considered the primary occupation for about 18 percent of the households with an estimated contribution of 19 percent to household total annual income. Chinese caterpillar fungus was considered one of the important NTFPs that augment the livelihood strategies of people who lived in the mountain communities of Nepal, with a contribution of 21.10 and 53.3 percent to farm income and household total income, respectively (Shrestha and Bawa 2014).

Studies by Tewari (2012) showed that about 85 percent of households in rural South Africa depend on a variety of NTFPs in the form of building materials, food, and medicinal products to sustain their subsistence needs. Similarly, Ahenkan and Boon (2011a), Osei-Tutu et al. (2010), and Anokye and Adu (2014) also demonstrated how rural and forest-fringe dwellers in Ghana exploit various kinds of NTFPs to sustain their subsistence and commercial needs.

Kamanga et al. (2008) revealed income from the NTFPs sector as the third most important source of rural household income, with a share of 15 percent in household annual income. In their study, income from nonfarm activities was regarded as the most important source of income for households with a contribution of 47 percent to household income, followed by agriculture with a share of 28 percent of household annual income.

According to Ghosal (2014) and Worku et al. (2014), quantitative data on the contribution of forest resources to rural livelihoods are crucial in developing options that will guide the specific policymaking process in the sustainable use of forest resources. Also, the ability of rural and forest-fringe communities to use NTFPs to enhance their economic growth and cultural endurance as well as environmental health cannot be underestimated. These resources are available especially for the poor at low cost and could be extensively used by people with limited alternative sources of food and income (Sharma 2015).

Despite the growing recognition of the contribution of NTFPs to rural subsistence and economic needs, the

contributions of NTFPs are not formally recorded (Osei-Tutu et al. 2012). Also, the NTFPs sector, especially in the northern savanna zones of Ghana, remains inadequately represented in policy analysis. Furthermore, large numbers of rural dwellers in the northern savanna zones of Ghana, of which the Kassena-Nankana West District (KNWD) forms a part, depend on NTFPs (Issaka 2017). In the literature, we found no previous study that focused on the contribution of income from NTFPs to households in the KNWD. To minimize overexploitation of NTFPs and consolidate the income from NTFPs in juxtaposition with development and policy initiations, it is essential to examine the contribution of income from NTFPs to rural households compared to other sources of income in the KNWD.

Materials and Methods

Study area

The study was conducted in the KNWD of Ghana. Large numbers of rural households in the KNWD depend on NTFPs for their subsistence and economic needs without adequate policy analysis (Issaka 2017). The district is bordered by Burkina Faso to the north, Bongo District and Bolgatanga Municipality to the east, Kassena-Nankana Municipality to the south, and Builsa North and South Districts and Sissala East District to the west (Kassena-Nankana West District Assembly [KNWDA] 2010). Figure 1 shows the location of study communities in the KNWD.

The district has a total population of 70,667, representing 6.8 percent of the population of the Upper East region, with a relatively high proportion of its population in the young age range (Ghana Statistical Service [GSS] 2013). Within the district, an estimated population of 60,792 live in rural areas, about six times more than those who live in urban areas (9,875). The district has a total land area of approximately 1,004 km^2 (GSS 2013). Proportionally, the population of the district comprises 49.2 and 50.8 percent of males and females, respectively, with a growth rate of 1 percent and a population density of 81 persons/km^2 (GSS 2013). Also, the district is estimated to have a total of 12,813 households with 86.03 percent living in rural areas and 13.97 percent in urban areas (KNWDA 2010). The average household size in the rural areas is 5.5 persons per household.

The district is generally characterized by the Sahel and Sudan savanna vegetation, which consists of open grasslands with deciduous trees and shrubs (United Nations Development Program Ghana 2010). Some of the most densely vegetated parts of the district can be found along river basins and forest reserves. Some of the river basins and forest reserves in the district are the Sissili, Atankwide, Anayere, and Asibelika basins and the Nakong and Kayoro forest reserves. However, anthropogenic activities have considerably affected the original state of the forest and vegetation cover in recent years. The low vegetation cover has negatively affected the rainfall pattern, thereby reducing the underground water supply (GSS 2013). The most common economically important trees found in the district are shea, dawadawa, baobab, mango, tamarind, neem, moringa, and acacia.

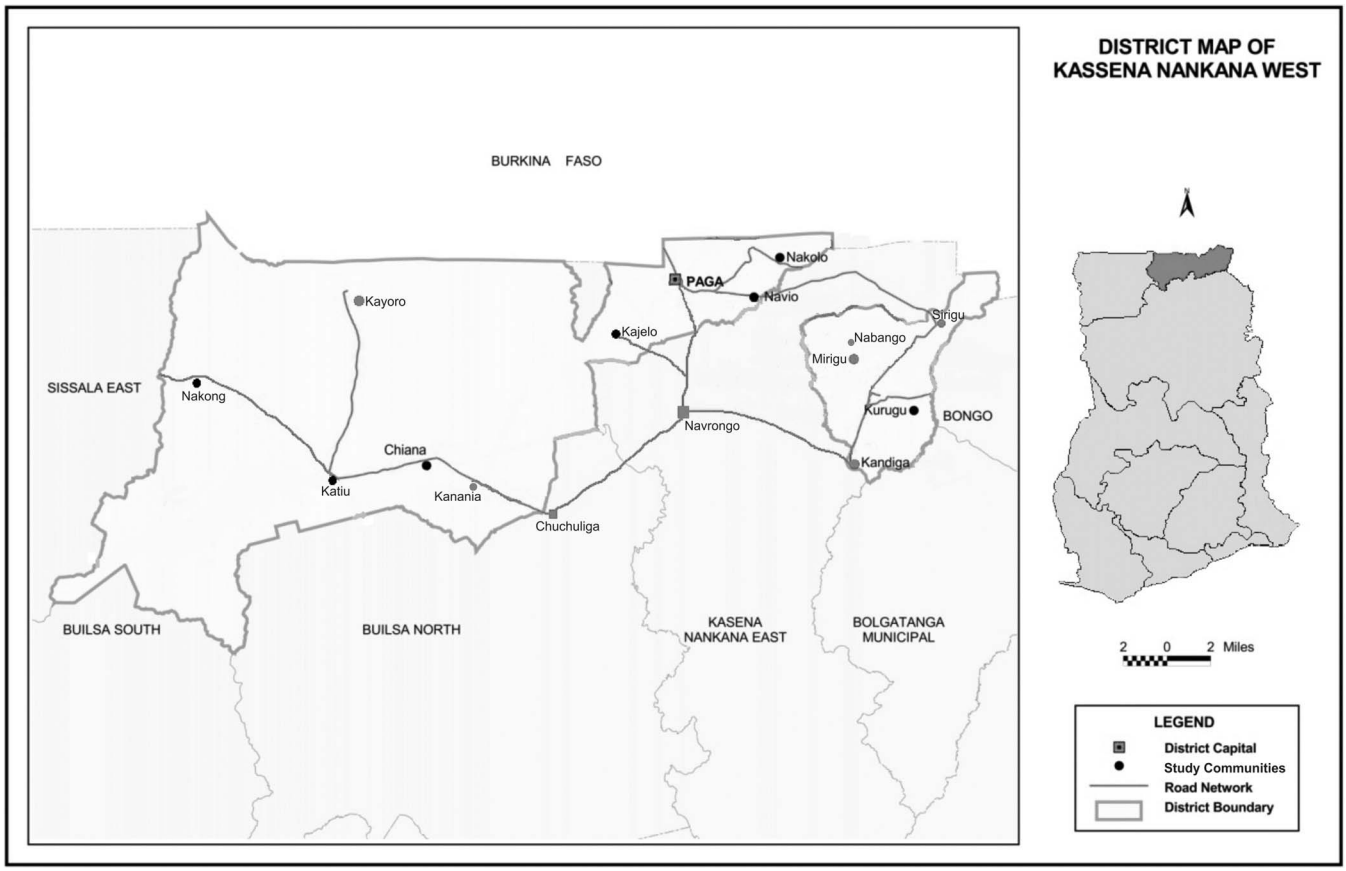

Figure 1.—Map of Kassena-Nankana West District showing study villages.

Agriculture is the dominant economic activity in the district, employing more than 68.70 percent of the people (Derbile 2010, KNWDA 2010). Major agricultural activities engaged in by households in the district are crop farming and livestock rearing (GSS 2013). A share of 90.70 percent of the total households in the district is engaged in agriculture, which suggests that the economy of the district is mainly agrarian. Commercial activities in the district mainly revolve around livestock, artisanship, and unprocessed and semiprocessed foodstuffs (GSS 2013). These commodities are sold in the local markets and outside the district. The local industrial activities in the district include shea butter extraction, dawadawa processing, soap making, baobab pulp, pito brewing, milling, weaving, dressmaking, pottery, and rice milling (Derbile 2010, KNWDA 2010). Most of these local industries are usually owned by individuals and employ few people.

Study design

A combination of quantitative and qualitative data were gathered in this research. The multistage sampling procedure (purposive and random sampling techniques) was used in selecting study villages and responding households for the survey in the KNWD. First, seven communities in the KNWD were selected due to their closeness to forest resources. Second, responding households were selected across seven villages using random sampling. A simple proportional random sampling approach was used to obtain a sample size of 375 households from the seven villages for the household survey. For example,

$$\text{Proportional sampling} = \frac{\text{Number of household in community}}{\text{Total number of households in all communities}} \times \text{Sample size}$$

The total household population across the seven selected communities from which the final sample size was collected was 6,030 (GSS 2013). Using the Yamane (1967) mathematical formula, the sample size was determined at a 95 percent confidence level and a ±5 percent margin of error:

$$n = \frac{N}{\left(1 + N(\alpha^2)\right)}$$

where n is the sample size, N is the sample frame (total number of households in selected villages), and α is the margin of error/confidence interval. Table 1 summarizes the determination of the sample size for each of the study communities in the KNWD.

Data collection

The research used a mixed-methods framework using different tools and approaches in collecting quantitative and qualitative data from responding households in the KNWD. Quantitative data were collected from households through structured survey questionnaires that contained closed- and open-ended questions. Household heads were targeted to answer the structured survey questionnaires. However, any household members who had knowledge of household characteristics and could answer the questions were selected for the interview in the absence of household heads. Qualitative data were collected through focus group discussions, key informant interviews, and field observations. Focus group discussions and key informant interviews were carried out with NTFP value-chain actors, such as collectors/extractors, producers/processors, NTFP aggregators, and opinion leaders in the study area. The number of participants during the focus group discussions ranged from 10 to 20 persons. Qualitative information gathered in this research was integrated with quantitative results to justify the quantitative analysis.

Table 1.—Sample size determination for each study community (Ghana Statistical Service 2010).

Community	Household population	Percentage (%)	Sample size
Nakong	360	6.00	23
Katiu	860	14.30	54
Chiana	2,677	44.40	167
Kajelo	516	8.60	32
Nakolo	817	13.50	50
Navio	406	6.70	25
Kandiga-Kurugu	394	6.50	24
Total	6,030		375

Methods of Analysis

The research focused on income derived from NTFP resources for the subsistence and cash needs of rural households. Cash income included all income generated from the sale of goods and services, while subsistence income covered the value of products that were consumed directly by the household or given away to friends or relatives as gifts. The livelihood outcomes of families were measured based on the levels of income that they obtained at the family level (Kamanga et al. 2008, Moe and Liu 2016). In the income estimation processes, both subsistence and cash income from crop, livestock, nonfarm activities, and income from collection and sale of NTFPs were added to obtain household total income. Therefore, the total income obtained by households was estimated as follows:

$$\text{Household total income}_i = \sum_{i-1}^{n} \begin{pmatrix} \text{Crop income}_i + \text{Livestock income}_i \\ + \text{Nonfarm income}_i + \text{NTFP income}_i \end{pmatrix}$$

Farm income (income from crop and livestock)

The farm income estimated in this study included all incomes earned from agricultural crops (consumed and sold) as well as income earned from livestock production (including livestock that was consumed and/or sold within recall period). For example, crop income $= TR - TC$, where TR is total revenue from crop production and TC is total/transaction cost for crop production. Annual livestock income for each household was derived by summing the values of livestock products, such as milk, meat, and eggs, as well as livestock sales and livestock services such as draft power.

Livestock income was calculated by using an annual income stream method that was proposed by Cavendish (2002) as follows;

$$Y_0 = P_0 \left(\frac{r}{r - \left(\frac{1}{1+r}\right)^T + 1} \right)$$

where Y_0 is the current-year livestock income stream, T is the life span of the livestock measured from the current year, r is the discount rate, and P_0 is the current unit price of the livestock based on own and market report price. Similarly, previous researchers (e.g., Heubach et al. 2011, Aung et al. 2014, Moe and Liu 2016) adopted this method to estimate the income steam of livestock in their studies.

Nonfarm income

The nonfarm income was calculated by estimating all household annual incomes that were obtained through all kinds of nonfarm activities, including wages of labor services, remittances, private provisional shops, income earned from rentals and other property rights, salaries, and pension. The nonfarm incomes were estimated per working hours/days/weeks/months.

Income from NTFPs

The NTFPs income estimated in this study included all income obtained through NTFP activities, such as the picking and/or extraction of shea butter, dawadawa, baobab fruit pulp and leaves, beekeeping and honey production, and marketing of fuelwood. The dependency of families on NTFPs was measured as the proportional share of NTFP subsistence and cash income in a household's annual income (Vedeld et al. 2004).

Levels of household annual income earned from NTFPs have been described as the consumption and/or sale of NTFPs at the first point in the marketing chain (Vedeld et al. 2004). In our study, levels of household annual income earned from NTFPs were estimated by adding all incomes from NTFP products collected and/or marketed by households for subsistence needs as well as commercial purposes. The prices of various NTFP products were obtained through the households' face-to-face interviews and market surveys.

Socioeconomic factors that influence dependence on income from NTFPs

The multiple linear regression model was adopted to estimate the parameters of variables that influence household income from NTFPs. In cases where the dependent variable is continuous, the multiple linear regression is considered the best linear unbiased estimator. However, the residual of income from NTFPs as a dependent variable, including independent variables (e.g., age of respondents, household size, and agricultural land size), did not show normality and was therefore normalized through the natural log (Gelman 2007).

Specification of the empirical model

The multiple linear regression model was specified as follows;

$$\begin{aligned} Y_i = {} & \beta_0 + \beta_1 \text{Sex} + \beta_2 \text{Log age} + \beta_3 \text{Years of schooling} \\ & + \beta_4 \text{Log household size} \\ & + \beta_5 \text{Log agriculture land size} + \beta_6 \text{NTFPs retailers} \\ & + \beta_7 \text{NTFP wholesalers} + \beta_8 \text{Value addition of NTFPs} \\ & + \beta_9 \text{Membership of association} + \varepsilon_i \end{aligned} \quad (1)$$

where Y_i is the income from NTFPs, β_0 is the intercept, $\beta_1 + \beta_2 + \ldots \beta_k$ are the estimated coefficients of independent variables, and ε_i is the error term.

Description of variables used in the model

Sex of respondent.—Sex is a dummy variable that indexes the gender of respondents; it takes a value of 1 for female and 0 for male. Men and women engage in the exploitation of different NTFPs based on sociocultural conditions (Suleiman et al. 2017). On the one hand, men are more likely to gather more NTFPs because of their physical abilities to engage in strenuous NTFPs collection. On the other hand, the gathering of NTFP resources is generally perceived as ''a woman's responsibility'' (Poole et al. 2016). In this research, sex is expected to show either a positive or a negative effect on income from NTFPs

Age of respondent.—According to Heubach et al. (2011) and Suleiman et al. (2017), the age of household heads has a positive and significant effect on income obtained from NTFP resources. Other empirical studies identified the age of household head to be inversely related to NTFP income (e.g., Mulenga et al. 2011, Melaku et al. 2014, Moe and Liu 2016). In this research, the age of respondents is measured in a number of years obtained since birth and is expected to have either a positive or a negative effect on income from NTFPs.

Years of schooling.—The years of formal education of household members is expected to influence the nature and choices of their economic activities. Years in higher education are more likely to increase the alternative employment opportunities of people (Sumukwo 2017), and this could divert people from subsistence livelihoods activities, such as the gathering of NTFPs from the forest (Suleiman et al. 2017). According to Angelsen et al. (2014), a high level of education was shown, as expected, to be inversely related to income from forest resources. Therefore, years of education is expected to have a negative relationship with dependence on NTFPs.

Household size.—According to Suleiman et al. (2017), households with a larger number of people are more likely to depend on NTFP resources for food because of their numerical ability to gather more NTFP products. Similarly, other empirical studies confirmed household size to have a positive and significant relationship with income received from NTFPs (Aung et al. 2014, Moe and Liu 2016, Mugido and Shackleton 2017). Therefore, household size is expected to have a positive effect on income earned from NTFP activities. In this research, household size was measured as the number of people living together in one house or compound and sharing food from a cooking pot or utensils.

Agricultural land size.—According to Aung et al. (2014) and Melaku et al. (2014), households with larger agricultural landholdings are more likely to gather and trade NTFP resources because accessibility to larger agricultural lands could offer people greater opportunities to collect or gather more NTFPs from private trees instead of competing with other NTFP extractors. On the other hand, agricultural landholding is more likely to reduce the participation of people in NTFP exploitation because of the likelihood of farmers to invest more resources in their agricultural activities (Mulenga et al. 2011). Agricultural landholding is expected to have a mixed effect on income earned from NTFP exploitation. The size of agricultural land was measured in acres.

Value-added NTFPs.—Value-added NTFPs is a dummy variable that reveals whether individual households are able to process or transform their raw NTFP resources into high-quality products before selling in order to improve their income levels. It indicated a value of 1 for household members who processed their raw NTFP products into other high-quality products and 0 otherwise. According to Angelsen et al. (2014), people are more willing to invest their financial resources in high-value quality forest products. Furthermore, promoting value-added high-value forest products is more likely to increase the productivity and sustainability of forest resources (Worku et al. 2014). Value-added NTFP resources are therefore expected to postulate a positive correlation with income obtained from NTFPs.

Membership of association.—Membership of association is a dummy variable that reveals whether household members belong to any NTFP-related association in the study area. It takes a value of 1 for respondents who belong to a social group and 0 otherwise. The membership of people in NTFP-related groups or any social network is crucial in the circulation of information among their members as well as in striving for a common goal (Suleiman et al. 2017). Also, household members who belong to social networks are less likely to engage in the illegal extraction of NTFP resources in order to sustain the forest resources. This study assumes that membership of NTFP-related associations may positively correlate with income from NTFPs.

Comparison of income from NTFPs among income groups

In order to compare income from NTFPs among income groups, the sample was split into three different income groups (low-income, medium-income, and high-income levels). These income groups were split equally based on household possession (livestock), agricultural landholding, and household total income during a focused group discussion. A nonparametric Kruskal-Wallis *H* test (Kruskal and Wallis 1952) was adopted to determine the level of significance in the distribution of income from NTFPs among the three income levels (Aung et al. 2014, Moe and Liu 2016). Also, percentiles (25th, 50th, and above 50th) were used to assess and compare the level of significance of income from NTFPs among the low-income, medium-income, and high-income groups in the study area. The measure of both relative and absolute (quantitative) income from NTFPs was considered in estimating the level of importance.

Results and Discussion

Socioeconomic characteristics of respondents

Distributions of the demographic and socioeconomic characteristics are presented in Table 2. The average age of the responding household members was 40.87 years with a minimum of 17 years and a maximum of 80 years. This implies that the study communities have a youthful population since most respondents are in middle age. Also, 66.24 percent of the respondents were female, while 33.76 percent were male. The average years of schooling of respondents was about 4.47 years with a minimum of 0 years and a maximum of 15 years. This implies a high rate of illiteracy in the study communities because most of the respondents are believed to have achieved only formal education but could not proceed to higher-education institutions.

The mean size of a typical household is 4.67 with a minimum 1 and a maximum of 12. The household size (4.67) realized in this study is less than the average household size (5.5) obtained during the population and housing census conducted in 2010. This could be attributed to the possible emigration of people to urban centers in search of white-collar jobs and better living conditions. The average farm size is 4.71 acres, with a minimum of 1 acre and a maximum of 10 acres per household.

The results also revealed that about 34 percent of respondents processed or transformed (added value) their NTFPs into finished and semi-finished products (high quality) before selling in the market, which improved their income levels. The reason that most people could not process these NTFP resources into finished or semi-finished products before selling could be attributed partly to a lack of knowledge and technical know-how. Therefore, 66 percent of the respondents who sell their NTFPs at the raw stage after collection might earn very low income compared to those who add value to their NTFP resources.

Furthermore, about 57 percent of the respondents belong to NTFP-related associations. This implies that more members of households would have access to relevant market information and strong bargaining power since they belong to groups. It could also help members learn and share new ideas that promote NTFP production. The results further showed that about 78 percent of the respondents were engaged in farming as their main occupation.

Finally, among the NTFP value-chain actors in this study, about 69 percent of responding households were gatherers or collectors of NTFPs who do not add any value to their NTFP resources, while only 25 and 6 percent of the respondents were NTFP retailers and wholesalers, respectively. This implies that the NTFP collectors do not earn the expected income since they do not have the knowledge and capacity to process their NTFP resources into high-quality products, which could fetch higher returns. Table 2 is summary of the household characteristics.

Major NTFPs in study area

The study revealed that shea, baobab, dawadawa, fuelwood, and honey are the NTFPs that make significant contributions to household income. This study empirically showed that shea, baobab, and fuelwood are the three most important NTFPs that contribute to the socioeconomic development of rural households.

Results from Table 3 show that more households were engaged in shea activities (92.78%) than in baobab (73.71%), fuelwood (38.66%), dawadawa (30.41%), and honey (11.08%) for their subsistence and income needs. Similarly, the share of the major types of NTFP income was more in shea (48.52%) than in baobab (15.93%), fuelwood (15.77%), dawadawa (10.86%), and honey (8.92%). The reasons for the observed pattern were that almost every household owned a shea tree and there are relatively more shea trees found in the study area compared with other economic trees. Moreover, there is an existing local and international market for shea products (nuts and butter), and they are used mainly during cultural and traditional activities, such as funerals.

Also, during the focus group discussion, respondents indicated that there is an emerging external interest for

Table 2.—Socioeconomic characteristics of households.

Variables	Mean	SD	Minimum	Maximum
Age of respondent (yr)	40.87	11.78	17	80
Years of formal education	4.47	4.89	0	15
Household size (no. of people)	4.67	1.44	1	12
Farmland size (acres)	4.71	1.54	1	10
Farm income (GH¢)	3,312.26	2,297.65	260	17,800
Nontimber forest product (NTFP) income (GH¢)	2,140.88	1,232.34	384	7,098
Nonfarm income (excluding NTFPs) (GH¢)	1,096.12	1,270.70	140	11,200
Sex of respondent (dummy; 1 = female, 0 = male)	0.66	0.47	0	1
Value-added NTFPs (dummy; 1 = yes, 0 = otherwise)	0.34	0.47	0	1
Membership of association (dummy; 1 = yes, 0 = otherwise)	0.57	0.50	0	1
Main occupation (dummy; 1 = farming, 0 = otherwise)	0.78	0.42	0	1
NTFP collectors	0.69	0.46	0	1
NTFP retailers	0.25	0.44	0	1
NTFP wholesalers	0.06	0.23	0	1

baobab in neighboring countries, such as Burkina Faso and others, thereby requiring people, especially youth, to travel long distances in search of more baobab to sustain their income needs. Furthermore, fuelwood is collected or gathered by every household for domestic purposes (e.g., cooking food) and for sale to meet their income needs. Table 3 shows a summary of the major NTFPs collected in the study area.

The share of income from NTFPs in total household income

Results from Table 4 show that income from NTFPs are the second most important revenue component for rural households after farm income (agriculture), contributing about 32.69 percent to household total income (exchange rate is GH¢5.17 = US$1.00). Farm income is the most important source of household income, contributing a share of 50.57 percent. Nonfarm income represented the least revenue component for the local people with a share contribution of 16.74 percent in household total income. The reasons accounting for this pattern were that most of the households were engaged in agrarian activities in the study villages. About 78 percent of respondents were mainly farmers.

The contribution of income from NTFPs to household total income is crucial in the achievement of livelihood outcomes. This makes the income from NTFPs an integral part of a livelihood strategy for households. Table 4 contains a summary of household average income per annum and the share of income from the various sources of income. Comparatively, the proportion of income from NTFPs in household annual income in this study is relatively higher than in other studies. The ethnic communities in Chittagong Hill Tracts, the southeastern region of Bangladesh, realized a contribution of 11.59 percent from NTFPs in household total income (Misbahuzzaman and Smith-Hall 2015).

According to a study by Sarma (2016), in Assam, India, the total contribution of NTFPs to household income varied between 9 and 20 percent. Furthermore, the findings of Kamanga et al. (2008) revealed a proportional contribution of 15 percent of NTFP income in the total income of rural households, which in both rural Uganda and Nandi County, Kenya, derived 26 percent of their income from NTFPs (Jagger 2012, Sumukwo 2017). Angelsen et al. (2014) reported 28 percent of environmental income in household annual income.

However, there are some cases where the share of NTFP income is relatively higher than 32.69 percent. For example, in Zambia, the contribution of NTFPs to rural household income was estimated at 34 percent (Mulenga et al. 2011). According to Endamana et al. (2016), NTFP income accounted for a share of 54.5, 50, and 50.5 percent of household annual income in Cameroon, Congo, and the Central Africa Republic, respectively. Respondents emphasized during focus group discussion that exploitation of NTFP resources remains an obvious alternative source of income for rural households to augment shortages of foodstuffs and other income needs in the lean season.

Socioeconomic factors that influence dependence on income from NTFPs

Multiple linear regression was used to analyze income from NTFPs against socioeconomic variables. Several socioeconomic factors influence the extent and pattern of the income from NTFPs of households. The regression analysis showed that sex of respondent ($P = 0.057$), household size ($P = 0.046$), agricultural land size ($P = 0.000$), NTFP retailers ($P = 0.000$), NTFP wholesalers ($P = 0.000$), and value-added NTFPs ($P = 0.000$) are significantly

Table 3.—Nontimber forest products (NTFPs) and their proportion of income.

NTFPs	No. of households	Proportion of households	Mean income from NTFPs per year	Share (%) of NTFP income per year
Shea	360	92.78	1,547.01	48.52
Baobab	286	73.71	507.80	15.93
Dawadawa	118	30.41	346.21	10.86
Honey	43	11.08	284.42	8.92
Fuelwood	150	38.66	502.83	15.77

Table 4.—Household annual mean income.

Income types	Average household annual income (GH¢)	Minimum (GH¢)	Maximum (GH¢)	SD	Share (%) of income per year
Farm income	3,312.26	260	17,800	2,297.65	50.57
Nontimber forest product income	2,140.88	384	7,098	1,232.34	32.69
Nonfarm income	1,096.12	140	11,200	1,270.70	16.74

and positively correlated with income from NTFPs (Table 5).

The sex of the respondent ($P = 0.057$) is significantly and positively correlated with income from NTFPs. This implies that women are more directly engaged in the collection and marketing of NTFPs than men. This assertion supports findings of Timko et al. (2010), Heubach et al. (2011), and Poole et al. (2016), where collection of NTFPs was the primary responsibility of women (though men and boys also participated). This was further echoed in focus group discussions where a woman (name withheld) explained that ownership of agricultural lands is culturally entrusted to men and that trees with economic value found on such lands are exclusively owned by the landowners, who are usually men. However, most men do not engage in harvesting NTFPs because it is conceived that the collection of NTFPs is ''women's work.''

However, Suleiman et al. (2017) disagreed with these findings with the claim that cultural barriers limit women's participation in NTFP collection from the forest. Their studies therefore hypothesized that men are more likely to gather NTFPs from the forest compared to women.

Furthermore, the positive correlation of household size ($P = 0.046$) with income from NTFPs implies that a household with a lot of members could have more hands to collect various kinds of NTFPs and more ''mouths'' to feed. This research supports the findings of Kar and Jacobson (2012), Moe and Liu (2016), and Suleiman et al. (2017), where household size has a positive and significant correlation with the collection and marketing of NTFPs.

The positive correlation of the agricultural land size of households ($P = 0.000$) with income from NTFPs implies that households that own larger agricultural lands generate more income from NTFPs compared to households with little or no access to agricultural lands. Results of this research confirmed the assertion of Heubach et al. (2011), that accessibility to farmlands offers an increasing possibility to harvest more NTFPs from private or domesticated trees instead of competing with other NTFP extractors.

Furthermore, a woman (name withheld) during focus group discussion explained that trees with economic value that are found on farm fields exclusively belong to landowners, offering them greater opportunity to gather more NTFPs than the households that have little or no agricultural land. According to a respondent (name withheld), low-income households are said to have limited agricultural landholdings and a lack of access to NTFP resources. This result contradicts the findings of Moe and Liu (2016) and Mamo et al. (2007), where households with large agricultural lands showed a significant and inverse relationship with income from NTFPs. Sumukwo (2017) revealed that when income from agriculture increases, people are more likely to reduce the extraction of NTFPs.

Using NTFP collectors as a base variable, NTFP retailers ($P = 0.000$) and NTFP wholesalers ($P = 0.000$) showed a significant and positive correlation with income from NTFPs, implying that they earn more income from NTFPs than the NTFP collectors. This assertion was echoed in focus group discussion, where the NTFP collectors bemoaned the lack of market information and their technical inability to transform their raw NTFPs into finished or semi-finished (high-quality) products to enable them to earn expected income from NTFPs. On the other hand, NTFP retailers and wholesalers earn more appreciable income than NTFP collectors because of their ability to access relevant market information and their strong bargaining power.

Additions of value to NTFPs ($P = 0.000$) had a positive and significant relationship with income from NTFPs. This analysis implies that respondents who processed their raw NTFPs into finished and/or semi-finished products earn higher income compared to those who sold their NTFPs products at the raw stage. This finding is in line with the results of Angelsen et al. (2014), where about 59 percent of

Table 5.—Linear regression of income from nontimber forest products (NTFPs) against socioeconomic factors.[a]

Variables	Coefficient	Standard error	t	$P > t$	95% confidence	Interval
Sex	0.1016918	0.0531837	1.91	0.057*	−0.0028893	0.206273
Log age	−0.0037397	0.0975189	−0.04	0.969	−0.1955022	0.1880229
Years of schooling	−0.0018715	0.0060203	−0.31	0.756	−0.0137098	0.0099669
Log household size	0.1781724	0.0889256	2.00	0.046**	0.0033078	0.353037
Log agricultural land size	0.3554167	0.0805426	4.41	0.000***	0.1970366	0.5137968
NTFP retailers	0.243058	0.0574453	4.23	0.000***	0.1300967	0.3560192
NTFP wholesalers	0.6354056	0.1122951	5.66	0.000***	0.414587	0.8562243
Value-added NTFPs	0.2205108	0.056122	3.93	0.000***	0.1101517	0.33087
Membership of association	0.0339823	0.0538121	0.63	0.528	−0.0718345	0.1397991
_cons	6.4821	0.4067561	15.94	0.000***	5.682249	7.28195

[a] Observation = 379, $R^2 = 0.2811$, adjusted $R^2 = 0.2636$, $F(9, 369) = 16.04$, Prob > $F = 0.0000$, root mean square error = 0.47307, ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$.

Table 6.—Comparison of income sources among different income levels.[a]

Income sources	Percentiles: 25th (low income) Average income per year (GH¢)	%	50th (medium income) Average income per year (GH¢)	%	Above 50th (high income) Average income per year (GH¢)	%	Kruskal-Wallis test: Degrees of freedom	*P*	χ^2
Farm income	1,642.50	50	2,795.00	52	4,282.50	51	2	0.000	237.281
Nontimber forest product income	1,276.25	39	1,927.50	36	2,698.00	32	2	0.000	83.304
Nonfarm income	370.00	11	650.00	12	1,440.00	17	2	0.0024	12.097

[a] $***P < 0.01$.

income from forest products was attributed to the collection and marketing of high-value NTFPs.

Comparison of income from NTFPs among income groups

By comparing income from NTFPs among income groups in this study, the high-income households received higher income from NTFPs in quantitative terms than the low-income groups. However, the low-income households are more dependent on NTFPs in order to realize their basic needs than are the high income households (Table 6). This assertion was reflected in the focus group discussion, where respondents indicated that the prevalence of poverty in the study area compels low-income households to sell NTFPs immediately after collection in order to fulfill basic needs. Respondents added that the low-income households are not able to halt their NTFPs or to process them into high-quality NTFPs to fetch high prices.

Results from Table 6 show that low-income households derived 39 percent of their income from NTFPs, while the contribution of income from NTFPs dropped to 32 percent for high-income families. However, high-income households derive much higher income from NTFPs (average income = GH¢2,698.00) than low-income households (average income = GH¢1,276.25). This implies that low-income households rely much more on income from NTFPs for subsistence needs but do not earn high absolute income from NTFPs compared with high-income households. Also, a lack of skills and financial capacity to process NTFPs into high-quality products could also be blamed on low-income households.

Results of this study are in line with the findings of Angelsen et al. (2014), which also confirmed that wealthier families in rural and forest-fringed communities are more likely to invest their financial resources in producing high-quality forest products that earn highly significant returns compared with poor households. Also, a study by Aung et al. (2014) in Natma Taung National Park, Myanmar, showed that high-income households benefited more from NTFPs than low-income households. Results of this study are also similar to findings by Jagger (2012), where wealthier households derived a huge proportion of their income from value-added NTFPs.

One factor that could explain why better-off households derive the highest absolute income from NTFPs is their ownership of large farmlands, which is supported by a significant and positive relationship with NTFP income. This is because families that own large farmlands are offered greater opportunities to harvest more NTFP resources from their own domesticated trees of economic value (Heubach et al. 2011). Hence, households with large farmlands stand the chance to easily fulfill their basic needs through their domesticated NTFP resources without any confrontations, compared with those who own small or no farmlands in the study area.

On the other hand, the results of this study contradict those of Moe and Liu (2016) in the Tharawady district of Myanmar, where the lowest- and middle-income households proportionally earn higher income from NTFPs in quantitative terms compared to the better-off households. Their results added that better-off households are owners of large livestock and agricultural lands, with better nonfarm job opportunities. In Bangladesh, the lowest income earners in rural and forest-fringed areas are relatively more dependent on NTFPs for their subsistence and cash income needs compared to the better-off households (Kar and Jacobson 2012). In their study on NTFP dependency in the Central Himalayan foothills of Nepal, Rijal et al. (2010) also revealed that high-income households do not depend on NTFPs but rather concentrate on income from their crop production and livestock.

Conclusion and Recommendation

This study found that the contribution of income from NTFPs to household income plays a significant role in household livelihoods. The KNWD is mainly agrarian, with agriculture contributing a share of 50.57 percent to household income, while income from NTFPs contributed a share of 32.69 percent to household income. Income from nonfarm activities represented the least share, with a contribution of 16.74 percent to household income. About 92.78 percent of households collect and/or market shea, while 73.71, 38.66, 30.41, and 11.08 percent of households collect and/or market baobab, fuelwood, dawadawa, and honey, respectively, for their subsistence and income needs.

Empirical results showed that sex of respondent, household size, agricultural land size, NTFP retailers, NTFP wholesalers, and value-added NTFPs are significantly and positively correlated with income from NTFPs. The positive relationship of gender with income from NTFPs implies that women are more directly engaged in the collection and marketing of NTFPs than men.

Findings further showed that low-income (poor) households derived the highest share of their household income from NTFPs compared to high-income families. This implies that poor households depend mainly on NTFPs in order to achieve their subsistence and income needs compared to high-income households.

Results from this study revealed a substantial contribution of income from NTFPs to household income. This sends

signals to stakeholders and policymakers to consider the NTFP sector in forest conservation measures that could meet the needs of forest-dependent communities. Also, the role of households, especially the low-income ones, in the management of forest resources should be spelled out since they depend mainly on NTFPs in order to meet their subsistence and income needs. Further, capacity and skills training on adding value should be provided for NTFP collectors/gatherers (especially women, as the collection and marketing of NTFPs is their primary responsibility) to enable them to add value to their NTFPs before selling in order to improve their income levels.

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