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Research Article

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Posted Date: March 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9098478/v1

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Additional Declarations: No competing interests reported.

Contributions of Non-Timber Forest Products to Multidimensional Poverty Alleviation in Kalakpa Communities in Ghana

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Abstract

Despite progress, multidimensional poverty continues to constrain sustainable development. Non-timber forest products (NTFPs) play important roles in rural livelihoods and in alleviating multidimensional poverty. As part of this study, we assessed the contributions of NTFPs to multidimensional poverty alleviation in Kalakpa communities in Ghana. In addition, the disparity between the multidimensional poverty index for Kalakpa communities and the national index was measured. A multistage sampling technique was employed to select 362 household heads to elicit information on 13 multidimensional poverty indicators and NTFPs incomes. This was complemented by an in-depth interview with twelve local chiefs. Using the Alkire-Foster method to compute the multidimensional poverty index for Kalakpa communities, this study found the following: incidence of poverty (68.2%), intensity of poverty (44.6%), households' vulnerability to multidimensional poverty (48.0%), and households in severe multidimensional poverty (53.4%). The multidimensional poverty index of 0.405 indicates that 40.5% of households in the Kalakpa communities were multidimensionally poor, compared with 24% at the national average (0.236). Moreover, on average, households earned approximately GHS584.50 (USD 37.70) per month as income from NTFPs. This amount supports healthcare, education, employment, and household living standards, alleviating their multidimensional poverty. This study therefore recommends investing monthly NTFP income in crop and animal production and trading. Further income can be earned through the collection, processing, transportation, and marketing of NTFPs. These interventions, backed by government policies and programs, will alleviate multidimensional poverty and ensure sustainable development.

Keywords: Non-Timber Forest Products, Multidimensional Poverty, Fringe Communities, NTFPs income, Alkire-Foster method

1 Introduction

Non-Timber Forest Products (NTFPs) are biological products obtained from forests other than timber. They are a major source of income for forest communities in Ghana and other developing countries [1]. NTFPs such as honey, medicinal plants, mushrooms, roots, gum, chewing sticks, game, and fodder have played crucial roles in many countries [2]. In recent times, NTFPs have been recognized by many scholars, policymakers, and development practitioners as a tool for alleviating multidimensional poverty in forest communities [3, 4, 5, 6]. Trading in NTFPs requires less capital than other income-generating activities; hence, it is suitable for marginalised groups constrained by limited financial resources and opportunities [3]. Through NTFPs, economic empowerment is stimulated among households, thus reducing their vulnerability to multidimensional poverty [7]. NTFPs continue to provide alternative sources of employment for households in forest communities, who harvest, gather, process, and transport NTFPs to markets for sale. A targeted approach to alleviating multidimensional poverty in forest communities hinges on effective harvesting, processing, packaging, transportation, and sale of NTFPs [1]. Globally, NTFP income provides households with financial capacity. Fargeot et al. [8] estimated that annual consumption of "bushmeat" in Bangui, the capital of the Central African Republic, amounts to USD 16 million and accounts for more than 1% of the country's GDP. Global bamboo trade has also increased, surpassing USD $3.417 billion in 2019 [1]. Bamboos, considered a raw material, contributed USD $400 million to India's GDP through the Indian incense industry. Rattan products from Indonesia account for USD $238 million [3]. Similarly, South Africa estimates that 300,000 traditional healers rely on NTFPs for medicinal herbs to treat their compatriots who cannot afford orthodox hospital treatment [9]. Ghana's shea nut exports to Burkina Faso, Togo, Côte d'Ivoire, Mali, and Benin exceed 140 million kilograms and are valued at USD $24 million [7]. NTFPs' income has major benefits for alleviating multidimensional poverty. For instance, financing education, health, employment, and living standards.

Sustainable Development Goal 1 targets reducing poverty in all its dimensions by 2030 and halving the proportion of men, women, and children living in extreme poverty [10, 11]. According to the Ghana Statistical Service [2020], multidimensional poverty is a condition in which households experience deprivation across multiple indicators in education, health, employment, and living standards [1, 12]. The World Bank had previously described people in extreme poverty as those living on less than $1.90 per day [10]. Poverty is one of the world's

greatest challenges to sustainable development. Sub-Saharan African countries are not an exception to this [13]. Although the global proportion of the extremely poor has decreased, regional distributions of this deprivation are uneven and are widening by the day in sub-Saharan Africa [13, 14]. Studies conducted by OPHI [15] revealed that the global multidimensional poverty index in 2019 was 57.5% in sub-Saharan Africa, compared with 23.1% for developing countries. These setbacks confronting sub-Saharan Africans are echoed in Sen's Feasible Capacity Theory [16], which describes poverty as the deprivation of capabilities and lack of multiple freedoms that people value and must value.

The Marginal Poverty Index (MPI) measures the extent and severity of deprivation experienced by vulnerable households in basic survival needs, such as public health, education, employment, and living standards. MPI provides disaggregated data that reveal the realities of vulnerable households [17]. Measuring MPI of households is based on four dimensions: cooking fuel, water, assets, housing, overcrowding, electricity, and sanitation, grouped under the living standards dimension. The other indicators include school attendance, school attainment, and school lag captured under the education dimension. The remaining indicators are nutrition and health insurance captured under the health dimension. The last indicator is wage under the employment dimension [17, 18, 19]. This study defines dimensions as the four broad categories of quality of life used to measure poverty, while indicators are specific, measurable variables that reflect each dimension [17]. MPI shows levels of household deprivation. Thus, a household is deprived if it has limited access to less than half of the indicators [15, 20]. The multiple indicators used to measure multidimensional poverty confirm that deprived households face hardship [20].

Despite improvements in NTFPs income generation for forest communities, the living conditions of Kalakpa communities remain low compared to the national population [21]. Afriyie et al. [21] further stated that the poor living conditions in Kalakpa communities put people at a continuous risk of deprivation. There have been many studies on NTFPs harvesting, value addition, commercialisation, utilisation, and conservation in Kalakpa communities. However, the extent to which NTFP income helps alleviate multidimensional poverty in Kalakpa communities has not been adequately studied.

Therefore, this study aimed at assessing the contributions of NTFPs to multidimensional poverty alleviation in Kalakpa communities. In addition, measure the disparity between the multidimensional poverty index for Kalakpa communities and the national index.

2 Materials and Methods

2.1 Study area

The map (Fig. 1**)** shows the Kalakpa resource reserve and its communities located in the traditional homelands of Abutia and Adaklu. The reserve covers a total area of 325 km² [21], with GPS coordinates of 06º 19′ N, 06º 28′ N, and 00º 18′ E, 00º 30′ E. The vegetation is typically characterized by Guinea savanna with a mix of dry forest and short savannah grassland [21]. The reserve showcases a spectacular combination of patch forests on hills, centrally located within the reserve, and grasslands on the plains. Plants commonly found here are the Cabbage tree (*Cussonia arborea*), African walnut (*Daniellia oliveri*), Spanish Gold (*Entada abyssinica*), and Small-leaved fig (*Ficus platyphylla*). The reserve area is characterised by a hot, humid tropical climate with year-round temperature and rainfall variability. Temperature ranges between 24ºC and 32ºC. The lowest temperature occurs in June, while March records the highest temperature. Rainfall is heavy, between 1200mm and 1300mm, and is interspersed with droughts, commonly called the harmattan in West Africa. The windy, dry, and hazy harmattan is at its worst in December [21, 22]. The Kalakpa resource reserve lies on major geological formations, including forest lithosols, Ochrosols, and heavy clay soils.

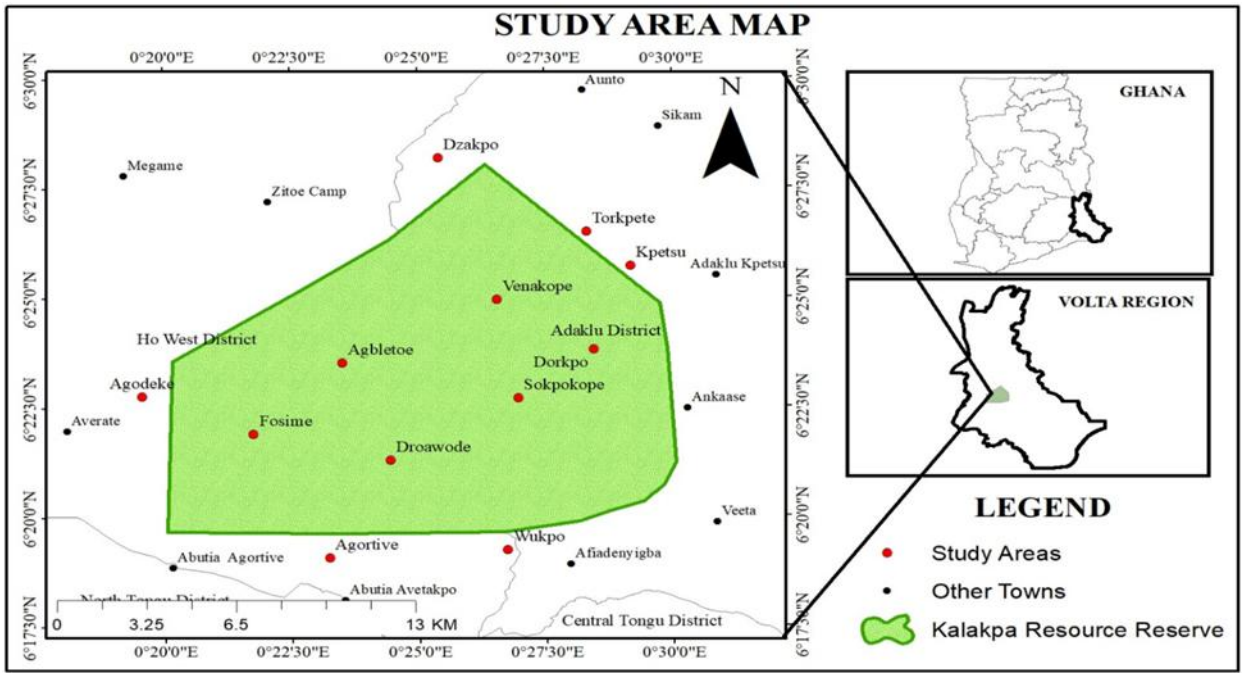


Fig. 1 Location of study communities

The reserve typically supports savanna vegetation and its associated indigenous animals [21]. The reserve is a habitat for a diverse range of wildlife, including the Waterbuck (*Kobus ellipsiprymnus*), Red-river hog (*Potamochoerus porcus*), and Buffalo (*Syncerus caffer*). Small mammals, including rodents such as Crested porcupines (Hystrix cristata), Giant rats (Cricetomys gambianus), Pangolins (Manis tricuspis), and Grasscutters (Thryonomys swinderianus), are present [21, 22]. Butterflies and birds abound in this reserve. The most popular bird is the Congo serpent eagle (*Dryotriorchis spectabilis*). Other attractions include the scenic beauty of the Zitoe, Koffitoe, Abutia, and Kadanga hills along the Togo-Akuapim range, which attracts tourists [21]. Main economic activities undertaken by the communities include harvesting NTFPs, cultivating oil palm, beans, plantain, cassava, maize, okra, and groundnut, and rearing domestic livestock such as sheep, goats, fowl, cattle, and pigs, as well as apiculture [21, 22]. Historically, the government of Ghana officially established the reserve in 1975 to protect the ecological significance of the biodiversity [22]. Consequently, communities within the reserve were to be relocated [21]. However, to date, this has not been done. Within the reserve, residents live in temporary mud-and-thatch houses in anticipation of evacuation. Permanent houses are prohibited in the reserve. In addition, the Wildlife Conservation Act, 1975 (Act 155), which established the reserve, prohibits

the government from providing basic amenities, such as schools, health facilities, electricity, piped water, and boreholes, to such communities. Consequently, infectious diseases and illiteracy are high within communities in the absence of medical facilities and schools, respectively. Multidimensional poverty conditions worsened due to these setbacks. However, most medicinal herbs, honey, fuelwood, and fruits harvested in these communities are sold in Ho, Sogakofe, Bator, and Dzemeni markets, which serve as the main source of income for these communities [21, 22]. Households experience food insecurity due to climate change, including unreliable rainfall patterns, soil infertility, and poor farming methods. Therefore, harvesting and trading in NTFPs have become the panacea for sustaining livelihoods in most households.

2.2 Data sources

This study relied on primary and secondary data sources. An interview schedule was administered to respondents to collect socio-demographic characteristics, in addition to 13 indicators: cooking fuel, water, assets, housing, overcrowding, electricity, and sanitation, grouped under living standards. The other indicators are school attendance, school attainment, and school lag captured under education. The remaining indicators are nutrition and health insurance, captured under health. Using the Alkire-Foster [23] and OPHI [24] approaches to multidimensional poverty analysis, a summary table of variables for the dimensions, indicators, and deprivation cut-offs is shown in Table 1. Secondary data were from the Ghana Living Standard Survey [20] and the Oxford Poverty and Human Development Initiative [15]. A multistage sampling technique was deployed. Using the Ghana Statistical Service method for clustering Electoral Areas in the Population and Housing Census [25], all communities in the study area were grouped into two clusters based on the two districts that house the Kalakpa resource reserve. The Ho West district cluster is located west of the reserve, while the Adaklu district cluster is east of it. Sampling was stratified because Kalakpa communities are both within and on the fringes of the reserve. The reserve fringe communities surround the reserve, while communities are located in the reserve. Therefore, the location of the communities became the criterion for stratifying them into within and fringe communities to ensure equal representation of all communities and the validity of the results, similar to the successful Ghana Population and Housing Census [25]. The western side of the reserve has four fringes and five within communities, while the eastern side has four fringes and three within communities. Therefore, three (3) fringes and three (3) within communities on

both the west and east sides of the reserve were randomly selected for the study. The selected within reserve communities included: Fosime, Droawode, Agbletoe, Venakope, Dorkpo, and Sokpokofe. Selected fringe communities were: Agodeke, Dzakpo, Kpetsu, Agortive, Wukpo, and Torkpete. Yamane's [26] formula, as seen in (1), was used to determine the appropriate sample size for a projected population of 3,766 household heads. This was done to ensure proportional representation of both males and females and to minimise sampling errors and biases within the study communities. In the absence of household heads, proxies (i.e., spouses or adult children aged 18 years or older) were appointed to be interviewed to complete the interview schedule.

$$n = \frac{N}{1 + Ne^2} \quad \textbf{(1)}$$

where: (n) represents the estimated sample size, (N) the population size, and (e) stands for the desired error rate of 0.05 (5%) in sampling. By using the Yamane formula as seen in (1), a sample size of n = 362 respondents was obtained from the projected population of 3,766 household heads. This sample was approximately 10% of the projected population, which is representative of the population [27]. Respondents in sampled communities were selected at random using a random number table to participate in interviews for completing the interview schedule. In addition, in-depth interviews were conducted with 12 chiefs to gather their perspectives on the subject. This study aligns with Ghana's 4 dimensions and 13 indicators for the multidimensional poverty index used in the Ghana Living Standard Survey [20], as shown in Table 1. Ghana's choice of dimensions and indicators is guided by Sustainable Development Goals (SDGs) and the priorities of the National Development Planning Commission of Ghana.

2.3 Method of analysis

The socio-demographic characteristics of respondents included: age, gender, marital status, level of education, household size, occupation, and net monthly income. Respondents stated their respective ages, while gender was binary (males or females). Marital status was grouped into six categories. Educational levels were classified into no formal education, primary, JHS, SHS/Tech/Voc., and Tertiary. The wealth index measured asset ownership of radio, TV, mobile phone, bicycle, motorbike, refrigerator, and computer, acknowledged globally as a

multidimensional poverty indicator [28]. Descriptive and multiple regression analyses were used. Multiple regression measured the strength of the relationship between the dependent variable (MPI) and the independent variables (indicators).

2.4 Modelling specification

2.4.1 Alkire-Foster method for computing multidimensional poverty index (MPI)

The Alkire-Foster method is widely used to measure multidimensional poverty. The method captures poverty across multiple dimensions rather than relying on income- or consumption-based measures. First, the method identifies the deprivation experienced by each poor person and aggregates them into a weighted deprivation score. The weighted deprivation scores are then aggregated for the given population.

2.4.2 Three steps in calculating the multidimensional poverty index (MPI)

The first calculation is the incidence or headcount ratio (H), which represents the proportion of the entire population that is multidimensionally poor, and is expressed as [12]:

$$H = \frac{q}{n} \quad \textbf{(2)}$$

Where q represents the number of people who are identified as multidimensionally poor, n represents the total population. The value of H is reported as a percentage.

The second is the calculation of intensity (A), which refers to the severity of multidimensional poverty (weighted deprivation) experienced by households, and is expressed as:

$$A = \frac{1}{q}\sum_{i=1}^{q} C_i(k) \quad \textbf{(3)}$$

Where C$i(k)$ represents the censored deprivation score of the i person, while q represents the number of multidimensionally poor.

The third is the calculation of the multidimensional poverty index or adjusted headcount ratio, which is the product of incidence and intensity (MPI = H × A), shown as:

$$MPI = H * A \quad \textbf{(4)}$$

MPI responds to changes in both incidence and intensity. Therefore, MPI increases when more people become poor or when there is an increase in the number of poor people who are further

deprived. Similarly, MPI can be calculated as the weighted sum of censored headcount ratios to represent the percentage of people identified as poor and deprived in the indicators. Always, MPI is broken down to show the composition of multidimensional poverty per the indicators, which adds to its policy relevance in analysis. The Alkire-Foster method allows the adaptation of MPI structure: dimensions, indicators, weights, and cut-offs for specific purposes in contexts. Thus, MPI in the Alkire-Foster method reflects incidence (H) and intensity (A) of poverty and is expressed as a product of the two measurements [12] stated as:

$$M_o = H * A = \frac{q}{n} * \frac{\sum_{i=1}^{n} C_i(k)}{qd} \quad \textbf{(5)}$$

2.4.3 Dimensions, indicators, indicator cut-offs, and weights

Unlike the Alkire-Foster methodology, which is based on three dimensions of MPI as health, education, and living conditions and measured across ten indicators, Ghana modified its MPI to 4 dimensions and 13 indicators to reflect its development priorities, as shown in Table 1. Ghana's selection of dimensions, indicators, and cut-offs for the computation of the multidimensional poverty index was conducted through a consultative process anchored on the Sustainable Development Goals (SDGs) and National Development Planning.

2.4.4 Selected dimensions of poverty measurement

Living standards: This dimension relies on seven indicators, including improved toilet facilities, clean drinking water, clean cooking fuel, access to electricity, owning at least two assets, house ownership, and the absence of overcrowding. Households are deprived if they do not own two or more of these assets (television, radio, bicycle, telephone, car, motorbike, truck, and refrigerator). Similarly, UN-Habitat considers 3 or more household members sleeping in a room to constitute overcrowding and deprivation.

Table 1 Indicators, deprivation cut-offs and weights for national MPI

Dimension	Indicator	Deprivation cut-off definition	Indicator weights
Living Standards	Cooking fuel	Deprived if the main source of cooking fuel is firewood or charcoal, and the kitchen is indoors.	1/28
	Water	Deprived if the main source of water is an unprotected dug well, unprotected spring, tanker-truck, with a small cart/drum, river/stream, or the source of water is more than 30 minutes walking distance.	1/28
	Assets	Deprived if it does not own at least 2 small assets, such as a radio, TV, bike, motorbike, refrigerator, computer or 1 big asset such as a car.	1/28
	Housing	Deprived if the main construction materials of outside walls are built with burnt bricks, mud and wattle, tarpaulin and corrugated iron sheets or if the main floor material is earth/mud or other.	1/28
	Overcrowding	Deprived if 3 or more members share a bedroom.	1/28
	Electricity	Deprived if it has no electric power.	1/28
	Toilet	Deprived if household uses a bucket/pan, a pit latrine, a public toilet, no facility or another, or it is shared.	1/28

[Source: 17]

Table 1 Indicators, deprivation cut-offs and weights for national MPI (Continued)

Dimension	Indicator	Deprivation cut-off definition	Indicator weights
Education	School attendance	Deprived if any school-age child (4-15years) is not attending school.	1/12
	School attainment	Deprived if no member 15 years and older has at least 9 years of education.	1/12
	School lag	A child is deprived if they are attending school, but he/she is two or more years behind compared to the expected age/grade relationship.	1/12
Health	Mortality	Deprived if either a child (<5years) or a pregnant woman Mother died in the household.	1/8
	Health insurance	Deprived if there is any member who has not registered for health insurance (private or national health insurance) or is not currently covered under a health insurance.	1/8
Wage Employment	Employment	Deprived if no member 15 years and older in the household is employed	1/4

[Source: 17]

For deprivation cut-offs in this dimension, MPI requires all school-age children to attend school or have completed primary, with at least one person having completed at least 9 years of schooling, while the rest are progressing steadily. A household in which one member has completed 9 years of schooling is non-deprived. But a household with a child not schooling, or lags two years behind, is deprived.

Health: Health reflects quality of life, productivity, and longevity. Nutrition and child mortality come under the health dimension globally, but Ghana chose health insurance over nutrition [20]. Data on child (< 5 years) and maternal mortality in the MPI computation shows that

households are deprived if there is at least one child (< 5 years) death in the past 12 months. Similarly, a household is deprived if at least one female aged 12-54 years died while pregnant or 6 weeks after delivery. Again, a household is deprived if at least one person is not covered by the national health insurance scheme. Wage employment: SDG 8.5 aims at full and productive employment for all by 2030. Therefore, a household is deprived if no member aged 15 years or older is employed. Employment indicator in MPI reflects economic well-being and quality of life. A person or household is multidimensionally poor if he/she is deprived in one-third (33.3%) of the weighted indicators. Alkire - Foster construct for multidimensional poverty measurement allows the construction of deprivation profiles for individuals and households in order to identify the multidimensionally poor people [23, 29].

3 Results

3.1 Descriptive statistics

This section provides descriptive statistics (Table 2) for all socio-demographic variables of the study area, presented as percentages. The age distribution of respondents includes the highest age group of 43.1% for 40-49 years. Again, the second-highest age group is 32.0% for ages 50-59 years. The youngest age group, 20-29 years, accounts for 0.8% of respondents. The highest age group category of 40-49 years suggests the majority of respondents are economically active.

Table 2 Socio-demographic characteristics of respondents

Variable	Percentages	Variable	Percentages	Variable	Percentages
Age of Respondents (years)		Gender		Marital Status	
20-29	0.8	Male	75.7	Single	3.6
30-39	12.8	Female	24.3	Married	45.7
40-49	43.1			Co-habiting	14.1
50-59	32.0			Divorced	7.5
60-69	11.3			Separated	0.6
				Widowed	28.5
Total	100.0		100.0		100.0
Level of Education	Percentages	Household Size	Percentages		
None	22.7	2	0.3		
Primary	7.2	3	7.2		
JHS	22.9	4	18.8		
SHS/Tech/Voc.	30.6	5	34.3		
Tertiary	16.6	6	22.6		
		7	10.7		
		8	6.1		
Total	100.0		100.0		

Source: Field data

Gender is skewed in favour of males at 75.7% compared to 24.3% females. Besides, 61.6% of respondents are married, compared to 38.4% who are unmarried. Regarding educational attainment, 30.6% reached the Senior High, Technical and Vocational School (SHS/Tech/Voc.) level, followed by 22.9% in the Junior High School (JHS) category. Appreciable 16.6% of the respondents attained tertiary education compared to 22.7% who had no formal academic education. Household size, which represents a person or a group of people living together and sharing housekeeping arrangements with one person recognised as their head, shows 34.3% for 5 members, followed by 22.6% for 6 members. Respondents within the highest household size of 8 members were 6.1%, whilst the least household size of 2 members was 0.3%.

3.2 Contribution of each indicator to multidimensional poverty

Results of multidimensional poverty indicators in the Kalakpa communities are shown in Table 3. All 13 indicators are grouped under 4 dimensions. The first dimension is the living standard, which covers cooking fuel, water, assets, housing, overcrowding, electricity, and unimproved toilet facilities as indicators adopted from the Ghana Living Standard Survey. The second is the education dimension, which focuses on school attendance, school attainment, and school lag, while the third dimension focuses on mortality and health insurance. The last dimension covers wage employment, which is measured by the employment indicator.

Each indicator under the various dimensions contributes to multidimensional poverty in the Kalakpa communities. Under the living standard, the indicator for cooking fuel reveals that 64.1% (232) of households rely on firewood or charcoal as their main source of cooking fuel compared to 35.9% (130) who rely on electricity and liquified petroleum gas. Chi-square analysis in Table 3) reveals that cooking fuel usage is significantly different among Kalakpa communities (χ^2 =46.50, p<0.001). The main source of water for households within 30 minutes of walking distance shows that 54.7% (198) of households depend on unprotected wells, springs, and rivers/streams, compared to 45.3% (164) who rely on pipe-borne water. There is a significant inequality in water sources in Kalakpa communities (χ^2 =5.62, p<0.001). With respect to assets, 62.7% (227) of households own at least two small assets such as a radio, a television, a mobile telephone, a bicycle, a motorbike, a refrigerator, a computer, or a car, compared to 37.3% (135) who own only one asset. Chi-square analysis for assets shows significantly different results among Kalakpa communities (χ^2 =2.46, p<0.001). The main construction materials for housing are burnt bricks and corrugated iron sheets, with 47.0% (170) of households using these materials, compared with 53.0% (192) who use cement blocks and tile roofing sheets. Households were overcrowded by 65.7% (238) because three or more people shared a bedroom, compared to 34.3% (124) who slept at most two people per room. Differences in the main construction materials exist but are not significant (χ^2 =6.74, P=0.20). For lighting their apartments, 47.2% (171) of households rely on electricity as the main source, compared to 52.8% (191) who use kerosene lamps and candles. Chi-square analysis for electricity shows significant differences in results among Kalakpa communities (χ^2 =2.46, p<0.001). For toilet facilities, 66.3% (240) of households use bucket/pan, pit latrine, public toilet, or a shared or no facility, compared to 33.7% (122) who flush their toilets into septic tanks. Chi-square analysis for the unimproved toilet confirms that results are significantly different among Kalakpa communities (χ^2 =2.46, p<0.001).

Table 3 Percentage contribution of each indicator to multidimensional poverty

Living Standards Indicators	Yes Responses Frequency	Percentage (%)	No Responses Frequency	Percentage (%)	χ^2	*p*-value
Cooking fuel	232	64.1	130	35.9	46.50	0.001***
Water	198	54.7	164	45.3	5.62	0.001***
Assets	227	62.7	135	37.3	8.22	0.001***
Housing	170	47.0	192	53.0	6.74	0.200^{NS}
Over Crowding	238	65.7	124	34.3	13.89	0.001***
Electricity	171	47.2	191	52.8	0.64	0.001***
Unimproved Toilet	240	66.3	122	33.7	2.46	0.001***
Education Indicators						
School attendance	141	39.0	221	61.0	0.31	0.0002***
School Attainment	124	34.3	238	65.7	9.94	0.0002***
School Lag	93	25.7	269	74.3	36.76	0.007***
Health indicators						
Mortality	72	19.9	290	80.1	77.01	0.001***
Health Insurance	163	45.0	199	55.0	0.26	0.071*
Wage Employment Indicator						
Employed	90	24.9	272	75.1	16.19	0.001***

Significance level: NS: Not Significant; *$P < 0.10$ (10%); **$P < 0.05$ (5%); ***$P < 0.01$ (1%).

Regarding school attendance, 39.0% (141) of households have children aged 4-15 years attending school, contrary to the indicator that a household is deprived if no member aged 15 years or older has at least 9 years of education. It was found that 61.0% (221) of children aged 4-15 years were not attending school. It is evident in Chi-square analysis that a significant inequality in educational attainment for Kalakpa communities (χ^2 =0.31, *P*=0.0002). School attainment shows that 34.3% (124) of households have children aged 15 or older who have attained at least 9 years of education, in accordance with the multidimensional poverty indicator. On the contrary, 65.7% (238) of children in households did not achieve 9 years of school attainment. This study found a significant difference in educational attainment for Kalakpa communities (χ^2 =9.94, *P*=0.0002). Again, 25.7% (93) of respondents have children who do not lag two or more years behind their class based on age and expected class. On the contrary, 74.3% (269) of households have children who are lagging in school. Chi-square shows a significant inequality in educational lag for Kalakpa communities (χ^2 =36.76, *P*=007).

Turning attention to the health dimension, only 19.9% (72) of respondents affirmed that a child (< 5 years) or a pregnant woman died in their households in the last 12 months, compared to 80.1% (290) who did not lose a child or pregnant mother. Chi-square analysis for mortality reveals a significant difference in results for Kalakpa communities (χ^2 =77.01, p<0.001). Households covered by the national health insurance scheme constituted 45.0 % (163), while 55.0% (199) were not covered by the national health insurance scheme. The differences in health insurance exist but are not significant in Kalakpa communities (χ^2 =0.26, *P*=0.071). The employment dimension is measured by the employment indicator, which shows that 24.9% (90) of households have members aged 15 and older who are employed, compared to 55.0% (272) whose members are unemployed. This study amplifies a significant inequality in employment for Kalakpa communities (χ^2 =16.19, p<0.001).

Table 4 shows the multidimensional poverty index for Kalakpa communities. The incidence of poverty (proportion of multidimensionally poor– H), followed by the intensity of poverty (average weighted indicators from which the poor are deprived– **A**). Incidence (**H**) of multidimensional poverty was 68.2%. This means at least three out of every five household heads in the Kalakpa communities are multidimensionally poor. The intensity of poverty, which shows the deprivation each poor household head experiences, was 44.6%. This means that each poor

household head, on average, is deprived of 45% of the weighted indicators, which implies that a multidimensionally poor household head is deprived of 6 of the 13 weighted indicators.

Table 4 Multidimensional poverty index: incidence, intensity, vulnerability

Poverty cutoff (k)	Index	Value
	MPI	0.405
K-value = 45%	Incidence (H %)	68.2
	Intensity (A %)	44.6
K-value = 47%	Percentage of households vulnerable to poverty	48.0
K-value = /> 50%	Percentage of households in severe poverty	53.4

Where:

- **H** (Incidence) = 0 to 1 (or 0% to 100%): Higher values mean more households are poor.
- **A** (Intensity) = 0 to 1 (or 0% to 100%): Higher values mean poorer households experience more deprivation.
- **K** (Cut-off or deprivation threshold): Deprivation score ≥ K means the household is multidimensionally poor.
- **MPI** (Multidimensional Poverty Index) = 0 to 1 (or 0% to 100%): Overall measure of multidimensional poverty severity in households where 0 means no multidimensional poverty, and 1 means higher severity and prevalence of multidimensional poverty.

3.3. Level of multidimensional poverty

Meanwhile, the marginal poverty index (MPI), which is the product of the incidence and intensity of poverty, was 0.405. This means the multidimensionally poor household heads in Kalakpa communities experience 40.5% of the weighted deprivation compared to the total 100% possible deprivation they could experience. The multidimensional poverty index is a composite index. Therefore, the specific indicators contributing most to deprivation are determined through the index disaggregation (Table 3). The highest incidence or censored headcount ratio was in the sanitation indicator (66.3%), with 45.0% of household heads multidimensionally poor and not covered by national health insurance. In addition, 47.0% of the household heads were both

multidimensionally poor and deprived in housing. Finally, 62.7% of the household heads were multidimensionally poor and deprived in assets. These household heads do not own more than one asset, such as a radio, a television, a telephone, a bicycle, a motorbike, a refrigerator, a computer, or a car.

3.4. NTFPs income in Kalakpa communities

Figure 2 shows the value of NTFPs income earned by households in Kalakpa communities, taking into consideration NTFPs consumed, gifted, and sold. Households' NTFPs income ranged from GHS199 (USD 13.26) to GHS1099.50 (USD 73.3). On the whole, 30.9% of households earned GHS 699.50 (USD 46.63), which represents their share of NTFPs income for the month. Again, 23.8% of the households earned GHS899.50 (USD 59.96), while 21.5% earned GHS299.5 (USD 19.96) from NTFPs. Cumulatively, the total number of respondents who earned less than GHS500 (USD 33.33) as a proportion of their total household income for the month was 26.8% (97). The mean monthly income from NTFPs for all households in the Kalakpa communities was GHS 584.50 (USD 37.70). Based on the strength of the 3,766 households in Kalakpa communities, it was found that the total monthly income from NTFPs earned by all households amounted to GHS2,201,227.00 (USD 141,995.24), which consolidated to GHS26,414,724.00 (USD 1,703,901.46) per year. Respondents claimed that NTFPs income gives them the financial capability to provide decent accommodation, procure assets such as fridges, motorbikes, televisions, clean fuel, pipe-borne water, and decent toilet facilities for their households, thereby enhancing their standards of living. Based on NTFPs income support for education, healthcare, employment, and the overall living standards of households, the respondents were unequivocal that NTFPs are the panacea for multidimensional poverty in their communities.

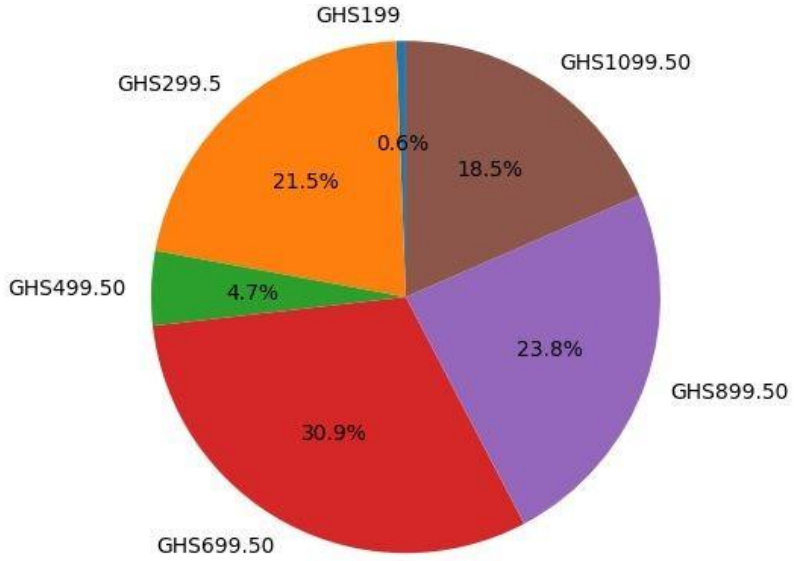


Figure 2 NTFPs income in Kalakpa communities

3.5. Household items of expenditure and actual expenditure

Table 5 shows households' monthly expenditure items and the amounts spent on them. The highest expenditure item is education, on which 42.8% (USD 16.67) was spent, followed closely by farming inputs, on which 34.2% (USD 13.33) was spent. Food and groceries also cost 25.8% (USD 10.0).

Table 5 Household items of expenditure and actual expenditure

Household items of expenditure	***Average household expenditure (GHS)**	**Expenditure as a percentage (%) of NTFPs' monthly income (GHS 584.50)**
Food and groceries	150 (USD 10.0)	25.8
Housing and rent	120 (USD 8.0)	20.5
Farming inputs	200 (USD 13.33)	34.2
Clothing and footwear	70 (USD 4.67)	12.0
Health care	100 (USD 6.67)	17.1
Education	250 (USD 16.67)	42.8
Transportation	60 (USD 4.0)	10.3
Water and sanitation	40 (USD 2.67)	6.8
Savings and loan repayment	150 (USD 10.10)	25.7
Social and cultural	100 (USD 6.67)	17.1

* Exchange rate: USD1 = GHS15.2141 (Bank of Ghana Exchange Rates Indicator, 2024)

On the other hand, the least-expensive items in Table 5 are water and sanitation, for which households spend 6.8% (USD 2.67) of their monthly NTFPs income. Water is available at the lowest cost because of the paradox of value, which states that essential goods, such as water, are less expensive than non-essential goods, such as diamonds. Transportation also accounts for 10.3% (USD 4.0) of the expenditure. Other items of expenditure include housing and rent, clothing and footwear, health care, savings and loan repayments, and social and cultural activities.

3.6. NTFPs monthly income and multidimensional poverty alleviation

The bivariate correlations between multidimensional poverty and households' monthly NTFPs income were proxied in two poverty categories: vulnerable to multidimensional poverty and severely multidimensionally poor. These two categories have been tested further using multivariate regression techniques to assess the strength of the relationship between multidimensional poverty and households' monthly NTFP income.

Table 6 Correlation between NTFPs monthly income and multidimensional poverty

	Fruits	**Game**	**Fire wood**	**Medicinal plants**	**Honey**
Vulnerable to multidimensional poverty	0.11***	7.06***	0.12***	1.52	1.55
Severely multidimensionally poor	0.13***	7.63***	0.14***	2.52	2.51

Level of Significance: *P<0.05; **P<0.01; ***P<0.001;

Table 6 shows the correlation between NTFPs' monthly income and multidimensional poverty. The positively significant correlation coefficients (β_i>0) in Table 6 imply that as multidimensional poverty increases, NTFPs' income earned also increases in direct confirmation of the poverty trap cycle theory by Hilson et al. [30]. Poverty trap cycle theory describes just how poverty drives communities into continuous and unsustainable exploitation of the environment because of severe poverty, and yet, never get out of poverty because of the relatively low environmental income earned. The correlation coefficient of 0.11 between fruits and households

vulnerable to multidimensional poverty is a small positive association, but it is higher in severely multidimensionally poor households, at 0.13. The 13% value for severely multidimensionally poor households is relatively higher than the 11% for households vulnerable to multidimensional poverty. Regarding the game, a strong and positive correlation of 7.06 exists between the game and households vulnerable to multidimensional poverty, but a higher, stronger, and positive correlation of 7.63 exists between the game and households that are severely multidimensionally poor. Again, between severely multidimensionally poor households and medicinal plants, a correlation of 2.52 is found, which is higher than 1.52 for households vulnerable to multidimensional poverty. Firewood and honey showed a correlation of 0.12 and 0.14 for households vulnerable to poverty and households severely multidimensionally poor, respectively. Again, Table 6 shows a lower but positive correlation for firewood (0.12) and honey (1.55) for households vulnerable to multidimensional poverty compared to households severely poor. In conclusion, Table 6 shows that all sources of NTFPs' monthly income positively correlated with vulnerability and severely multidimensionally poor households. These positive correlation coefficients support the view that households increase the harvest of NTFPs when poverty vulnerability and severity increase because they want to earn a higher NTFP monthly income to subdue multidimensional poverty.

4 Discussion

4.1 Role of NTFPs income in multidimensional poverty alleviation in Kalakpa communities

Multidimensional poverty alleviation is core to the Sustainable Development Goals. By using NTFPs as a multidimensional poverty alleviation measure, Ghana and the Kalakpa communities align with the United Nations' development objectives to foster the welfare of all citizens [31]. The mean monthly income from NTFPs for households in Kalakpa communities is GHS584.50 (USD 37.70), and there is potential to generate additional income, which will improve the livelihoods of households. The wide benefits of NTFPs have gained global attention [6, 32]. In addition, the monthly income accrued from NTFPs offers the opportunity to Kalakpa communities to provide their basic needs, such as electricity, safe potable water, safe energy sources, safe sanitation facilities, educational needs, and national health insurance, which are recognised as multidimensional poverty indicators useful in the measurement of the

multidimensional poverty index in Ghana and Kalakpa communities [5]. This study found that Kalakpa communities rely heavily on the NTFPs for their livelihoods. Through the investment of NTFPs income in crop and animal production and trade, the economic empowerment of households is enhanced, liberating them from unpredictable agricultural income undermined by crop failure caused by climate change, thereby leading to multidimensional poverty alleviation [3].

Harvesting of NTFPs is rife during periods of crop failure. Further, NTFP-related activities require diverse skills for harvesting, processing, packaging, and transporting to market centres. These employment opportunities provide a stable, regular income to households [33]. Combating multidimensional poverty in Kalakpa communities is intrinsically linked to intentional development of human capital. Through skills development initiatives by stakeholders such as the management of the Kalakpa resource reserve and NTFPs buyers, households, especially the youth, broaden and nurture alternative skills to alleviate multidimensional poverty [34]. When lifted out of multidimensional poverty, individuals in households seek further education and skills to enhance their households' economic standing [35]. NTFPs' income fosters entrepreneurship among households, leading to the development of small enterprises that process NTFPs into marketable products such as herbal medicines, handicrafts, and food items [36]. The entrepreneurial spirit promotes collaboration among communities for the benefit of all enterprises within them [37]. Multidimensional poverty alleviation efforts lessen income inequality among households and create more equitable communities where each household can afford food, potable water, accommodation, and healthcare [38].

Ghana's 2024 Multidimensional Poverty Report [20] provides a comprehensive overview of 13 indicators, against which household data from Kalakpa communities were matched to compute the multidimensional poverty index and determine whether gaps exist between national and local data at the micro level. Differences were found in local and national MPI indicators. The high multidimensional poverty index for Kalakpa is ample evidence that the national multidimensional poverty index has gaps. Similarly, Rwanda has significantly reduced multidimensional poverty, whereas multidimensional poverty in Nigeria has increased recently, with disparities between states widening [10].

4.2.1 Standard of living indicators relative to national indicators

The potential of NTFPs income to address the 4 dimensions and 13 indicators of the multidimensional poverty index is a manifestation of its ability to alleviate multidimensional poverty in Kalakpa communities. Globally, the annual economic value of NTFPs harvested has been estimated at USD 90 billion. About a third of this value earned circulates within local economies [39]. Studies in Kano revealed that 45% of households earn between 20.5% and 40.5% of their household income from NTFPs. The same applies in West and Central Africa, where NTFPs income matches or surpasses the minimum wage for most school teachers and other professionals [1]. Again, global trade in mushrooms has been valued at over $2 billion annually [3]. The mushroom market is anchored on four species commonly consumed in the temperate regions: matsutakes (*Tricholoma spp*.), chanterelles (*Cantharellus* spp.), boletes (*Boletus* spp.), and truffles (*Tuber* spp.) [3]. In Ghana, a study that asked rural women to rank 16 NTFPs by their significance as major sources of income and food found that 76% ranked mushrooms as the "most important" resource [40]. Other studies identified numerous species of birds, reptiles, rodents, and amphibians in tropical regions, which are targeted for their delicacies [41]. Fargeot et al. [8] estimate that annual bushmeat consumption in Bangui, the capital of the Central African Republic, amounts to USD $16 million and represents more than 1% of the Central African Republic's GDP. NTFPs provide diverse local income sources that are important for alleviating multidimensional poverty [7].

This study found that a significant proportion of respondents use fuelwood in their homes, and their main sources of water are unprotected springs, rivers, and dug wells, compared to the national level, where households use piped water, boreholes, and other natural sources [17]. Multidimensional poverty is characterised by the inability to meet basic needs, such as access to safe drinking water. Hence, households' access to safe, clean water tapped from forest rivers and purified into pipe-borne water is a major step toward alleviating multidimensional poverty in communities [1]. According to this study, the mean monthly NTFP income of GHS584.50 (USD 37.70) earned by households in Kalakpa communities helped most households own at least two assets, which support their welfare, as is the case at the national level. These incomes provide evidence of NTFPs contributions to improving households' incomes. If households live on NTFPs income and save incomes earned from main employment for a period, invest the savings in commerce and agriculture, their overall household income will improve and lift them out of

multidimensional poverty. In Zimbabwe, asset ownership is a stronger predictor of household multidimensional poverty status than education and employment [42]. Households in Kalakpa communities use burnt bricks and corrugated iron sheets for roofing, contrary to the national outlook, where the majority of households use cement/concrete for their apartment floors.

Globally, NTFPs income provides financial capacity for households to provide residential accommodation to their members and enhance their well-being. Overcrowding is higher in the study area than at the national level [20]. Overcrowding is the situation where three or more members of a household share a bedroom. Deprivation manifests in the use of unimproved toilet facilities. A higher proportion of households in Kalakpa communities use bucket/pan, pit latrine, public toilet, shared facilities, or no facility than in the national average, where the majority use water-closet toilets that flush into a septic tank [17]. Households without toilet facilities at the national and local levels engage in open defecation, with consequences such as disease and cholera outbreaks. This insanitary condition in Kalakpa communities pertains in Pakistan. Here, the majority of households in Thatta District use unimproved toilet facilities, whereas very few households in the Hyderabad District use such facilities [43].

4.2.2 Education indicators relative to national indicators

Alleviating multidimensional poverty requires targeted investment in infrastructure and public services, such as schools staffed by professional teachers. School lag, as an indicator, is high in the study area. School lag means that children who attend school are two or more years behind their peers in the same age class. Nationally, school lag for children in Ghana is low, but it is relatively higher in the study area. Educational attainment is lower in the study area than the national average [20]. Building schools, roads, hospitals, and other facilities creates jobs and improves households' capacity to access vital services, thereby stimulating economic growth and development. Ghana's efforts to alleviate multidimensional poverty are showcased in its dedication to attracting investments, partnerships, and aid to forest communities to shore up their economic well-being [44]. Assessing educational attainment within multidimensional poverty in Zambia and South Africa showed that inequality in household socio-economic status is attributable to the educational attainment of households [45] and the associated 3.5% rise in household income in Fiji [46]. Again, Nigeria's adult literacy rate was moderate in 2016, compared to South Africa's high rate in the same year [47]. These statistics suggest that stakeholders and policymakers should

prioritize improving educational attainment as a strategy to reduce multidimensional poverty at the local level. When people meet their basic needs, they focus on self-improvement and education [48]. Multidimensional poverty alleviation is crucial to ensuring political and social stability. When forest communities experience improvement in their living standards and economic well-being, they contribute positively to the democratic process, leading to a stable and peaceful society. Multidimensional poverty alleviation is central to the United Nations Sustainable Development Goals, which Ghana aligns with [3, 31].

4.2.3 Health indicators relative to national indicators

Sustainable use of NTFPs improves households' nutritional diversity and the medicinal resources from which herbal medicines are obtained to treat infections and diseases. Consequently, mortality is low for children (< 5 years) and pregnant mothers who died in households in the study area. Most households in Kalakpa communities are not covered by national health insurance, despite the high national average [17]. Ghana's Multidimensional Poverty Report 2024 [20] provides further evidence of the low registration for the health insurance scheme [20]. This study found a strong preference for herbal treatment, which is responsible for the low interest in national health insurance. Similarly, South Africa estimates that 300,000 traditional healers rely on NTFPs for medicinal herbs to treat their compatriots who cannot afford orthodox hospital treatment. The global botanicals market, valued at approximately USD 85 billion, has been growing annually at 5%-15% [39]. Ghana's shea nut exports to Burkina Faso, Togo, Côte d'Ivoire, Mali, and Benin exceed 140 million kilograms and are valued at USD 24 million [7].

4.2.4 Employment indicator relative to national indicator

Formal-sector employment in agriculture and the informal sector is lower for households than the national average. This study further acknowledges the importance of NTFPs as an important safety net for diversifying income [49]. Throughout human civilisation, people have harvested NTFPs for thatching roofs, weaving baskets, and making mats. For instance, in the Kalakpa communities, many houses, particularly those within the reserve, rely heavily on thatch to roof their mud houses. Developing countries, such as Nigeria, Kenya, and Rwanda, reduced poverty significantly through World Bank-sponsored Economic Recovery Programmes, although local disparities in multidimensional poverty have persisted in many countries, anchored in

inadequate employment opportunities [12]. In Nepal, studies identified 100 entrepreneurs managing 42,000 tonnes of 100 NTFP species, generating USD 26 million. Nepal exports about 90% of its NTFPs to India.

4.3 Level of multidimensional poverty

This study found the marginal poverty index (MPI) for Kalakpa communities as 0.405. This means household in Kalakpa communities experience 40.5% of the weighted deprivation compared to the total 100% possible deprivation they could experience. In a similar study, the United Nations, the Food and Agriculture Organization and the Oxford Poverty and Human Development Initiative undertook empirical study of multidimensional poverty index in rural Ethiopia, Malawi, Nigeria and the Niger based on 2030 agenda for Sustainable Development which aims at ending poverty and hunger [53]. FAO et al. [53] calculated the rural multidimensional poverty index using data from household surveys conducted in Ethiopia, Malawi, Nigeria and the Niger. The results computed through Spearman's rank correlation coefficients in the four countries are ranked starting from the poorest to the best off through headcount ratio and multidimensional poverty index value. The coefficients range from -1 to 1 whereas a value of 1 shows perfectly positive association between the rankings across the four countries. For all the countries, the Spearman coefficient is 0.94 for the multidimensional poverty index value which shows that the differences in rankings are minimal and almost perfectly positively associated.

4.4 NTFPs monthly income and multidimensional poverty alleviation

Other related studies have used correlation analyses to determine the association between households' multidimensional poverty and income through series of correlations to explore the relationship between multidimensional poverty index and income in Ghana [19]. The main explanatory variables by Osei et al. [19] include four multidimensional poverty categories which are based on nationally prescribed poverty cut-offs: severely multidimensionally poor, multidimensionally poor, vulnerable to poverty, and not multidimensionally poor [19]. They found that households which are vulnerable to poverty and are multidimensionally poor have higher propensity to engage in other income generating activities including the harvest of NTFPs compared to households not multidimensionally poor. Similarly, households that are

multidimensionally poor have higher propensity to harvest NTFPs compared to households not multidimensionally poor. The analysis of Osei et al. [19] reveals marginal significance of 10% correlations coefficient between multidimensional poverty and income. Again, in relating multidimensional poverty to health in Ghana, Agyire-Tettey et al. [18] established positive correlation between multidimensional poverty and child health by noting that the higher the multidimensional poverty of a household, their greater their risk of avoiding medical care because of financial limitations. Recent studied by Díaz et al. [52] also established a positive correlation between multidimensional poverty and ill health in Columbian. They found that adolescents in Columbian households that are multidimensionally poor are highly likely to develop poor mental health due to deprivations in schooling, employment opportunities, and health insurance.

All these positive correlations in related studies align with the findings of this study which established positive correlations between monthly NTFPs income and multidimensional poverty. Therefore, when households become vulnerable to or severely multidimensional poor, their harvest of NTFPs increases because of the hope of earning higher income. As stated earlier, this hope is delusional based on the poverty trap cycle theory describes how poverty drives households into continuous and unsustainable exploitation of NTFPs because of severe poverty, and yet, never get out of poverty due to the relatively low income earned from NTFPs sold. These positive correlations show that the Kalakpa resource reserve risk being over exploited for NTFPs which threatens its very existence at a resource reserve.

5 Conclusion

5.1 Roles of NTFPs in multidimensional poverty alleviation in Kalakpa communities

The contributions of NTFPs to multidimensional poverty alleviation in Kalakpa communities were evident in this study. Multidimensional poverty alleviation is core to the Sustainable Development Goals. By using NTFPs income as a multidimensional poverty alleviation strategy, Ghana and Kalakpa communities align with the United Nations' development objectives for the welfare of all citizens. The mean monthly income from NTFPs in Kalakpa communities improves households' livelihoods. In addition, NTFPs income provides households with the opportunity to meet basic needs, such as electricity, safe potable water, safe energy sources, safe sanitation facilities, educational needs, and national health insurance, which are often

captured as multidimensional poverty indicators in the measurement of the multidimensional poverty index. Kalakpa communities rely heavily on NTFPs' monthly income for their livelihoods. Investing the income from NTFPs monthly in crop and animal production and trading enhances household economic empowerment, thereby alleviating multidimensional poverty.

Again, NTFPs collection, processing, transporting, and marketing are significant in generating additional employment. Diverse skills for harvesting, processing, packaging, and transporting NTFPs to market centres provide households with a stable, regular income. The study found that combating multidimensional poverty in Kalakpa communities is intrinsically linked to intentional development of their human capital. Through skills development initiatives by the management of Kalakpa resource reserve and by NTFPs buyers, households, especially the youth, broaden and nurture alternative skills for multidimensional poverty alleviation. When lifted out of multidimensional poverty, households seek further education and skills development to enhance their economic standing.

NTFPs income fosters entrepreneurship among households, leading to the development of small enterprises that process NTFPs into marketable products such as herbal medicines, handicrafts, and food items. The entrepreneurial spirit promotes community collaboration and a sense of unity among households, benefiting all enterprises. Multidimensional poverty alleviation provides additional benefits by reducing income inequality among households, creating more equitable communities where each household can afford food, potable water, accommodation, and healthcare.

5.2 Reality of dimensions and indicators in Kalakpa communities

Furthermore, this study highlighted the disparity between the multidimensional poverty levels in Kalakpa communities and the national multidimensional poverty index reported in Ghana's 2024 Multidimensional Poverty Report [20]. Households in the Kalakpa communities relied heavily on firewood and charcoal, and less on electricity and liquefied petroleum gas, which are common at the national level. Unprotected rivers, wells, and less pipe-borne water sources are available to them than is the case nationally. A greater percentage of households own two or more assets, such as a radio, a television, a computer, a fridge, or a motorbike. More households sleep in overcrowded rooms built with bricks and roofed with corrugated iron sheets. School attendance and attainment are low among households. Very few school-age children are lagging, meaning

their ages are commensurate with the classes they are in. Mortality among children less than 5 years and pregnant mothers was less than the national levels. Employment is lower than the national level. The incidence and intensity of poverty are high, leading to high multidimensional poverty in Kalakpa communities with policy implications.

5.2.1 Policies that target multidimensionally poor households

To eradicate multidimensional poverty in the Kalakpa communities, government and development partner policies and programmes must focus more on improving the 13 indicators examined in this study. As a first step, the government of Ghana and its development partners should provide the following resources to Kalakpa communities at subsidised prices to encourage patronage: clean fuel, electricity, potable water, hygienic toilet facilities, educational infrastructure to build their capacities to own assets. In addition, policies and programmes of government, the private sector, and international development agencies must be refocused and tailored to the indicators. These strategies are crucial to breaking the poverty trap, which holds households in Kalakpa communities in a vicious circle of poverty and income inequalities.

In addition, government budgets at the national and District Assembly levels must be pragmatic in providing access to female education, rural electrification, and rural water and sanitation programmes. Citizens should be educated on self-development through skills training and academic education. High NTFPs incomes earned in Kalakpa communities should be invested partly in farming, petty trading, and securities to diversify households' income sources and lift households out of poverty. Moreover, District Assemblies should provide policy guidelines on the sustainable harvesting, processing, and marketing of NFTPs. Improved income will enable households to unlock their full potential in eradicating multidimensional poverty. Specific policies and interventions must invest in value addition to increase the market value of NTFPs, benefiting households. Strengthening local households' capacity to harvest, process, market, and negotiate fair prices for NTFPs will benefit them.

Although this study sufficiently supports the capacity of NTFPs to alleviate multidimensional poverty in the study area, it falls short of determining the extent to which NTFPs can sufficiently alleviate multidimensional poverty across different parts of Ghana. Some related studies acknowledge NTFPs as significant, strategic and diversified sources of household income [50]. However, analysing the relationship between NTFPs and multidimensional poverty among poor

households, with NTFPs income being their highest component of total household income, mirrors a potential poverty trap [51]. Nonetheless, the influence of NTFPs on the positive development of households in forest communities depends on their contributions to livelihood strategies leading to multidimensional poverty alleviation [3]. Besides, overexploitation of NTFPs leads to their depletion. According to Shackleton et al. [51], over-reliance of households on NTFPs is likely to lead to a poverty trap anchored in "low returns" from NTFP sales.

5.3 Conserving the Kalakpa resource reserve

These findings have implications for policy on the protection of the Kalakpa resource reserve. Public education on the conservation of NTFPs in fulfilment of the objective for establishing the reserve will be a step in the right direction. In addition, the wanton harvest of NTFPs by households needs to be addressed through participatory management of the reserve instead of the centrally managed approach in which the Forest Services Division of the Forestry Commission of Ghana is in charge. Bringing all stakeholders such as chiefs, family heads, District Assemblies, Assembly members, NTFPs traders, farmers and the Police together in participatory management will be helpful in protecting the Kalakpa resource reserve from over exploitation.

Finally, future study will explore the possibility of participatory management of the Kalakpa resource reserve as a strategy for protecting it from over exploitation and conservation of NTFPs.

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Data availability

All data generated or analysed during this study are included in this published article and its supplementary information files.

Funding

No funding was received to conduct this study or assist with preparing this manuscript.

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Contributions

Dickson Kudzo Mortson conceptualised the study, designed methodology, collected and analysed the data. Jones Abrefa Danquah the principal supervisor, critiqued, guided and offered critical suggestions on conceptualisation, methodology, data collection and analysis leading to the drafting of this manuscript. John Abraham the co-supervisor guided the conceptualisation, through methodology to data analysis. Obed Asamoahreviewed and refined the manuscript to meet standard for submission.

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Ethics declarations

Ethics approval and consent to participate

All experimental protocols involving human participants were approved by the Institutional Review Board (IRB) of the University of Cape Coast. The approval number was: IRB UCC-498/2024 and approval date was: 19-05-2025. All procedure was carried out in compliance with relevant national, international, and institutional ethical rules and laws. Before any data was collected, each participant gave their informed consent.

Consent for publication

The manuscript does not include any personal identifiers, photographs, or information that could lead to the identification of individual participants.

Competing interests

The authors declare that they have no competing interests.

Informed consent

Informed consent was obtained from all participants prior to their inclusion in the study. The objectives of the research, methods, potential benefits, and voluntary nature of participation were clearly explained to each informant in their local language. Participants were made aware that they might leave the study at any time without facing any repercussions. The study did not include any individuals who were younger than 18 years.

Declaration of generative AI in scientific writing

During the preparation of this article, the authors used Grammarly to correct grammar and restructure sentences for coherence. After utilizing this tool, the authors reviewed and edited the content as needed and took full responsibility for the final version of the published article.