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**Article**

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# Determinants of poverty in rural cocoa farming communities in Ghana: unidimensional and multidimensional analysis

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**ABSTRACT**

Poverty is a rural phenomenon due to the dominance of subsistence farming in rural communities. This study compares the estimates of unidimensional and multidimensional methodologies to analyse the factors that influence the poverty levels of cocoa farming households predominantly in rural Ghana. A census was conducted in the Chorichori community in Ghana using a structured questionnaire to gather information from 386 cocoa farming households. The multidimensional poverty index and expenditure-based poverty measures were used to estimate a bivariate probit regression to find the determinants of cocoa farming households' poverty. The study's outcome indicates that poverty among the cocoa farmers is jointly determined, unidimensionally and multidimensionally, by the access to healthcare, household child deaths, household's school-age child not in school, access to farm inputs, and the age of the household head. Whereas the education level of the household head, frequency of ill-health, use of external labour, migration status, and relationship to the household head were significant in determining multidimensional poverty, the number of household members, cooperative union membership, access to farm water, occupational diversity, household access to financial credit, and the marital status of the household head significantly determined unidimensional poverty among the cocoa farmers. Even though both poverty measures produced fairly different results, the study's findings showed the mutual and exclusive importance of the unidimensional and multidimensional poverty approaches in determining poverty and formulating good developmental policies for cocoa farmers. Therefore, selecting an approach should be based on prevailing circumstances, such as differences across locations and within households or entities.

**IMPACT STATEMENT**

This research provides critical insights into the complex nature of poverty among cocoa farming households in rural Ghana. By comparing unidimensional and multidimensional poverty measures, the study reveals significant disparities in how poverty is assessed, offering a more comprehensive understanding of the socio-economic challenges faced by rural communities. This dual approach not only uncovers the socioeconomic factors that contribute to poverty but also reveals discrepancies and complementarities between different poverty measurement methods, offering a nuanced perspective that can enhance the accuracy of poverty assessments. The findings highlight the need for policymakers, development agencies, and social planners to target interventions that address the specific factors contributing to poverty in rural areas, thereby improving the effectiveness of poverty alleviation programs. By informing more holistic and inclusive policies, this study supports efforts to reduce poverty among rural cocoa farmers, ultimately contributing to broader economic development and social equity in Ghana and similar contexts across developing countries.

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## Introduction

Poverty is a major concern for all governments globally. In the 1990s, development literature focused on how economic growth can be used as a strategy to reduce poverty and noted progress in many countries' poverty reduction with rapid and high rates of growth (Dollar & Kraay, 2000; World Bank, 2000). Subsequent literature argued that poverty reduction was not achieved primarily through the structure of growth and income inequality but specifically through growth rates (Asogwa et al., 2012; Mellor, 1999; Ravallion & Datt, 1996). Recent literature advocates for using innovation systems to reduce poverty (eg Onumah et al., 2023). Dzanku (2015) noted that 'growth in agriculture is reported to be more pro-poor than growth in other sectors'. Poverty is a rural phenomenon (De Janvry & Sadoulet, 2000; GSS, 2014, 2018). According to Ghana Living Standard Survey (GLSS) 5–7 reports[1], rural areas contributed 85.3%, 78% and 83.2% of total poverty in Ghana, despite the different degrees of poverty among rural dwellers. In Sub-Saharan Africa, rural dwellers are predominantly farmers and distinctions are classified by the ecological zones of rural areas (forest, savannah and coastal). Forest areas are suitable for cocoa cultivation, and hence cocoa farmers dominate the forest zones in Ghana. The trend of poverty incidence for all the rural zones and national poverty in Ghana increased from GLSS 1–2 and then decreased in GLSS 3 reports. However, except for the GLSS 3 report in which rural forest areas had a higher poverty incidence (26.5%) than coastal areas (22.6%), the earlier rounds of GLSS reports on poverty incidence by locality in Ghana (GLSS 1–3) show that rural forest areas had a lower incidence of poverty than other zones and the national poverty incidence (Coulombe & McKay, 1995). Likewise, Hernández-Núñez et al. (2022) found among Colombian rural households that Cocoa farmers have the highest capital endowment and level of welfare compared to diversified farmers and new cocoa farmers. The current estimates of poverty incidence in Ghana by locality are measured by dividing total household consumption by the number of adult equivalents in the household, which is different from calculating the total household expenditure, per capita, in constant prices, adjusted for the effects of differential recall error between GLSS 1, 2, and GLSS 3. Despite the differences in the methodologies, the current trends of GLSS results are not different from earlier ones (Coulombe & McKay, 1995; GSS, 2014, 2018). GLSS 5–7 report that rural forest areas have the lowest poverty incidence among the different rural zones, rural areas, and the national poverty level. Even with extreme poverty, only the rural coastal zone recorded a lower incidence of 9.6% compared to 12.6% in the rural forest. Nonetheless, the rural forest zone has recently followed the general trend of reduction in Ghana's poverty incidence. Although the contribution of rural forest zones to the total poverty of Ghana has been lower than that of rural savannah zones, it has been far above that of rural coastal zones. Rural forest areas, on the other hand, increased their contribution to total poverty from 29.1% to 30.3% from GLSS 5 to 6, before falling to 25.3% in GLSS 7 (GSS, 2018). Furthermore, evidence suggests that most of the world's impoverished live and work in rural areas (IFAD, 2001; World Bank, 1999); hence, reducing overall poverty depends largely on reducing rural poverty. In Africa, programmes and policies implemented to serve poverty reduction strategies included the Structural Adjustment Programme and Poverty Reduction Strategy Papers (PRSPs). In Ghana, additional strategies such as LEAP (Livelihood Empowerment Against Poverty), the Capitation Grant, the School Feeding Programme, the free distribution of school uniforms, exercise books, and textbooks, the elimination of schools under trees, and the free senior high school education are just a few of the programmes that have been implemented to alleviate poverty among the vulnerable population. Consequently, it is critical to adopt a poverty alleviation strategy by primarily assessing the socioeconomic characteristics to determine the factors that influence the poverty levels of rural dwellers who are predominantly engaged in the agricultural sector.

Based on the capabilities approach by Sen (1979, 1985), many scholars have argued that poverty is multidimensional and includes dimensions of basic needs: education, health, and other indicators of standard of living (eg De Janvry & Sadoulet, 2000; Fergusson et al., 2001). Current studies also take into account intangible factors such as the satisfaction of being employed, empowerment, community ties, legal and human rights, and political freedoms (World Bank, 2000). As such, the World Bank and other international bodies in recent years have revised their earlier reliance on measuring poverty using a unidimensional approach, which views welfare according to income or expenditure (Ningaye et al., 2011). Consequently, recent studies favour the multidimensional poverty measure over the traditional

expenditure-based measure for analysis and policy formulation due to its inclusion of many indicators of life. Moreover, cocoa farmers, predominantly in rural forest areas, face many challenges, including crop diseases (cocoa swollen shoot virus disease (CSSVD), black pods), lack of social amenities, and inadequate extension officers. For instance, the cocoa swollen shoot virus disease has caused a massive decline in the living standards of many cocoa farmers in Ghana in recent years (Agyeman-Boaten & Fumey, 2021). Although recent records have shown a decline in poverty in Ghana, the poverty phenomenon persists in rural areas dominated by farmers. Despite all these challenges, it is difficult to find current studies that comprehensively investigate the factors determining cocoa farmers' poverty and the differences in the estimates of the two poverty measuring techniques (money-metric and non-money metric). Determining the socioeconomic well-being of Ghana's cocoa farmers is difficult without empirical evidence. Given the critical role of cocoa farming in the rural economy and the persistent poverty in these regions, more accurate assessments to inform effective policy interventions are needed. This study aims to assess the factors that influence the poverty levels of cocoa farming households in rural Ghana by comparing the findings of both unidimensional and multidimensional approaches. The specific objectives include (1) identifying and examining the socioeconomic characteristics of rural cocoa farmers that influence their poverty levels, and (2) comparing the findings of the multidimensional poverty measure to the unidimensional (income- or expenditure-based) measure. To achieve this, quantitative data for the study were collected through a survey from Chorichori (a cocoa farming community in Ghana). The bivariate probit regression analysis was employed for the study estimates, with multidimensional poverty index (MPI) and expenditure-based approaches as the measures for the dependent variables (multidimensional poverty and unidimensional poverty), respectively.

This study contributes significantly to literature and policy-making, focusing on poverty measurement and alleviation among rural cocoa farmers in developing countries. Firstly, it contributes to understanding the dynamics between the unidimensional and multidimensional poverty methods using data from rural cocoa farmers. Through empirical research, this study uniquely juxtaposes monetary and non-monetary welfare indicators from a rural population in a developing country in Africa. This approach highlights the discrepancies and complementarities between the two poverty methods. Secondly, it examines the factors determining the poverty levels of rural cocoa farmers, which are under-explored in existing literature. The findings are intended to inform governments, poverty analysts, and social planners to target the most important factors for alleviating poverty in the rural sector.

The remainder of the paper is organised as follows. The next section provides an overview of poverty in Ghana, followed by a brief review of the literature. The methodology and data collection procedure are presented in section three. The study's findings, analysis, and discussions are presented in the fourth section. The final section summarises the findings and makes policy recommendations for poverty alleviation.

## *Poverty in Ghana*

Poverty in Ghana experienced a significant decline between 1988/1989 and 1991/1992 after increasing between 1987/88 and 1988/89 (GLSS 1–3). It rose from 36.8% in 1987/88 to 41.8% in 1988/89 before falling to 27.9% in 1991/92 (Coulombe & McKay, 1995). According to the Ghana Statistical Service's GLSS report, new poverty lines and price deflators have demonstrated a drop in national poverty rates across all poverty indicators from 1992 to 2017 (GLSS 3–7) (GSS, 2018). Between 1987 and 1992, poverty decreased dramatically between 1988/89 and 1991/92, more than offsetting the increases in all rural areas between 1987/88 and 1988/89. Ghana achieved the first Millennium Development Goal (MDG) of halving poverty from 51.7% of the population in 1992 to 24.2% of the population in 2013. It is poised to achieve Sustainable Development Goal (SDG) 1, which calls for an end to poverty in all its forms everywhere. From 1992 to 2013, the headcount ratio declined from 56.5% to 24.2%. In recent GLSS reports, poverty incidence has been reduced slightly to 23.4%. Additionally, extreme poverty decreased from 33.2% in 1992 to 8.2% in 2017. As a result, nearly a quarter of Ghana's population is poor, with less than a tenth of the population living in extreme poverty. Generally, the dynamics of Ghana's current poverty condition, from GLSS 5 to GLSS 7 (2005/06–2016/17), show that poverty is still predominantly a rural phenomenon, with rural savannah having the highest incidence as the poorest locality. Since 1991/92,

poverty has been more widespread in other urban areas than in Accra, but poverty levels in urban areas are generally lower than in any of the three rural localities (Coulombe & McKay, 1995; GSS, 2014, 2018). The GLSS 7 report indicated that self-employed household heads engaged in the agricultural sector contribute the highest to poverty in Ghana, with their highest poverty incidence. Meanwhile, private employees and self-employed household heads working in industries other than agriculture are less likely to be poor than those who work in agriculture (GSS, 2018).

## Literature review

There are many theories of poverty discussed and classified differently in the literature. A common classification in recent literature is based on the root causes of poverty. Well-known classifications include theories based on the cause of poverty in individual deficiencies (conservative) and those that attribute poverty to broader social phenomena (liberal or progressive). The classification can be extended into five causes of poverty, which are the theories that originate from individual deficiencies, cultural belief systems, political or economic distortions, geographical disparities, and cumulative and circumstantial origins (Bradshaw, 2007). This study deliberates on two phenomena of poverty**:** cultural/behavioural and structural/economic. The cultural thesis linked to the individual theory of poverty, argues that poverty is rooted in the behaviour of the poor and deficient character that undermines success and economic well-being (Aikaeli, 2010). As a result of the poor's dysfunctional values concerning mainstream social norms on family, education, and work, poverty is passed down from generation to generation, resulting in rising rates of violence, crime, substance abuse, and family breakdown (Aikaeli, 2010). This argument is criticised for blaming and stigmatising the poor, as it merely outlines the symptoms of poverty without addressing systematic causes. The 'structural or economic' school of thought also argues that most poverty results from favours for a certain group over others, which ensues from structural factors in economies and institutional environments. Holzer (1991) noted that an individual's poverty can be ascribed not just to personal attributes, but also to the conditions in which they live. Economic opportunities, such as productive employment and infrastructure, and social amenities, may be among these variables. Marxists endorse this viewpoint that poverty in the developing world highlights the developed world's past exploitation (Aikaeli, 2010). However, because some present prosperous countries were once colonies, this theory has been criticized as lacking adequate proof. Notwithstanding these two main arguments, people, cultures and institutions in certain geographical regions face disparities in essential resources necessary to generate welfare and income. Furthermore, they are limited in their ability to advocate for equitable redistribution of resources. The structural approach and the theory of poverty due to geographical disparities are emphasised in this study. It ties rural income to driving production factors such as ecological conditions, land development, and the size and education of the labour force (Aikaeli, 2010; Samuelson & Nordhaus, 1992).

Empirically, some studies have employed different methods to analyse poverty. Mekonnen (2024) used a new vulnerability to income and multidimensional poverty estimation index to measure the likelihood of individuals falling into and remaining in poverty. The study found that in Ghana vulnerability to income and multidimensional poverty were 37.9% and 56%, respectively with 23.4% of the 37.9% at risk of falling into poverty and 14.57% at risk of remaining in poverty. Costa (2003) also employed rank correlation analysis to determine how the unidimensional and multidimensional techniques reveal the presence of two distinct groups of poor households. He concluded that income-based evaluation only delivers a partial picture of poverty. Comparing multidimensional and unidimensional poverty estimates for the Mandi Bahuddin District in Pakistan for 2010 and 2014, Khan et al. (2020) identified mixed results in comparing unidimensional estimates with multidimensional poverty in Asia and Africa. They recommended a holistic strategy to identify multidimensional poverty in the social sector because the relative proportion of educational and health poverty towards MPI remained larger. Bersisa and Heshmati (2021) used the logit model to investigate the determinants of household poverty status in Ethiopia, employing both unidimensional and multidimensional measurements. They found that intensity, severity, and depth of poverty differ significantly between the two measurements. Meanwhile, Belhadj and Limam (2012) revisited two issues raised by the use of fuzzy measures rather than traditional poor/non-poor

dichotomous measures, proposing the use of fuzzy monetary and non-monetary measures with poor and non-poor membership functions.

Besides, many studies have tried to investigate the determinants of welfare or poverty among different groups of population with the expenditure-based approach to welfare (eg Asogwa et al., 2012; Babatunde et al., 2008; Eyasu, 2020; Owuor et al., 2007; Salami et al., 2017; Woldie et al., 2020). In the context of multidimensional poverty, Huluka (2024) utilized an ordered probit model and found the location, household's head demographics (sex, literacy and age), family size, land area and region of residence as the key influencing factors of multidimensional poverty in Ethiopia, which is predominantly rural. However, limited literature has empirically highlighted the differences between the unidimensional and the multidimensional methods, especially with a dataset from rural areas and developing countries such as Ghana. Costa (2003) believes that comparing unidimensional and multidimensional methodologies is an appropriate step in poverty analyses and that if the differences are minor, unidimensional analysis should continue to play a significant role in poverty research. When the two groups of poor, on the other hand, show significant differences, an appropriate framework must be chosen.

## Methodology

### *Research design*

Surveys serve as a primary methods for gathering data from respondents for quantitative studies, enabling the analysis of large samples before generalising the findings to the broader population (Hesse-Biber, 2010)). Consequently, the study utilises quantitative methods and data to draw conclusions on the numerical values. The study is part of a broader study to investigate the impact of cocoa swollen shoot virus disease (CSSVD) on the livelihood of cocoa farmers in Ghana (Agyeman-Boaten & Fumey, 2021). The study relied mainly on primary data; however, secondary information was also sourced from the Ghana Statistical Service, Ghana Cocoa Board and the Sefwi Akontombra District Assembly.

### *3.2. Study area*

The research area, Chorichori, is in the Sefwi Akontombra District of the Western North Region, near the Sui Forest Reserve. Figure 1 illustrates the district map of Sefwi Akontombra District, delineating the specific position of Chorichori, while Figure 2 shows the spatial layout of the Chorichori community. The community is located 281 km from Accra, Ghana's capital city. From 1964 to 2001, the community received an average of 1461 mm of annual rainfall, and the climate is tropical, with an average temperature of 22 °C–27 °C (Boni et al., 2004). During the cocoa season, workers and traders from francophone

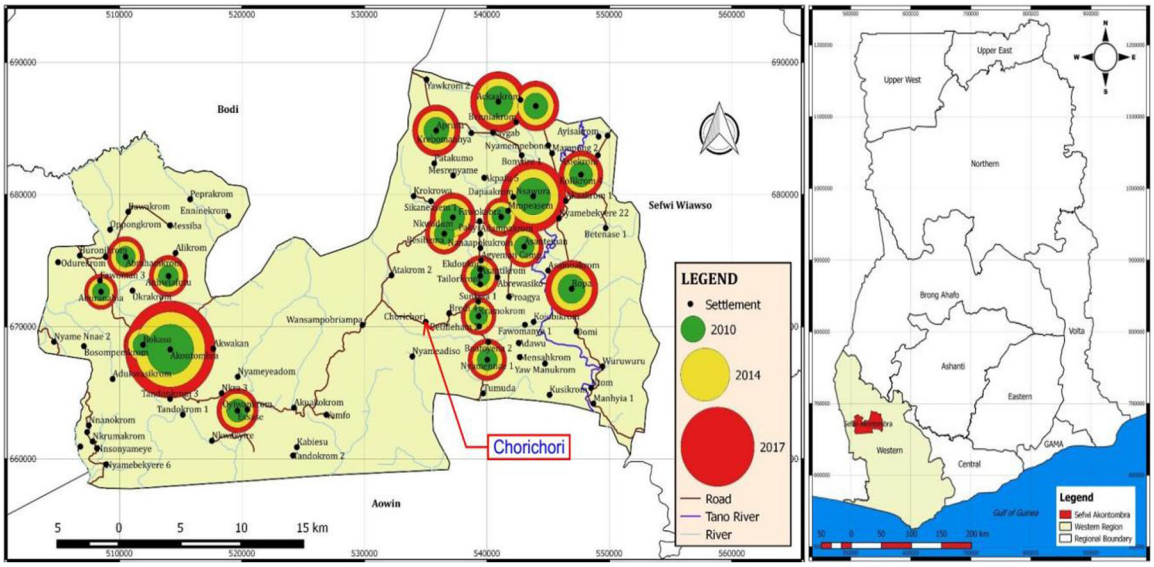


**Figure 1.** Akontombra district population projection map. Source: Akontobra District Assembly.

**Figure 2.** Chorichori: study site. Source: Google map.

countries and other parts of Ghana, primarily from the north, used to do business in the study area. Unfortunately, the emergence of the cocoa swollen shoot virus disease in recent years has caused a massive decline in the economic activities of these migrants in and around the study area. Over 75% of the people in the area work in agriculture, farming cocoa and food crops including plantain, cassava, vegetables, and rice, among others (Schulte-Herbruggen, 2012). The climate, soil type, topography, and other characteristics of the study location make it ideal for cocoa cultivation. The community is connected to the national electricity grid. Other social amenities of the community include a basic school up to junior high level, a community centre, two boreholes, a river, two public pit-latrine toilets, a community health planning and services (CHPS) compound, nine churches and a mosque. The main cooking fuel used by the community dwellers is wood and the primary building materials are metal roofing sheets, cement floors, and mud or clay for the outer walls. About 84 percent of the people in the community grow cocoa, making it a fair representative for the rural cocoa farming communities. However, the survey does not claim to be completely representative of Ghana but anticipates that the findings based on this sample will serve as a useful estimate for rural cocoa farmers when broadly interpreted.

## *Sampling procedure and technique*

### *Data collection*

The study data were collected primarily from a primary source in four weeks from January to February 2018. A structured questionnaire was administered to gather the primary data. The questionnaire aimed to capture various aspects of the respondents' socioeconomic conditions, particularly focusing on their engagement in cocoa farming.

### *Sampling technique*

Martínez-Mesa et al. (2016) noted that sampling results, especially in studies aiming to estimate the prevalence of disease, can be affected by random or sampling error. To mitigate these errors and ensure the reliability of the data, an exhaustive approach within the cocoa farming community was adopted. Given the practical limitations such as time restrictions, ethical concerns, budgetary constraints, and logistical challenges, a non-probabilistic sampling method, specifically purposive sampling technique, was adopted.

### *Target population*

The target population of the study comprised households within a rural cocoa farming community that was significantly affected by the cocoa swollen shoot virus disease. The goal was to obtain comprehensive data from this specific population segment. To achieve a thorough and representative data set, a census of the cocoa farming community was conducted. It involved interviewing all households in the community, but the survey was terminated if a household was found not to engage in cocoa farming. This approach ensured that only relevant respondents (cocoa farmers) were included in the survey.

### Sample size and data collection process

Data were collected from 386 rural cocoa farmers who were identified through a community survey conducted in Chorichori and its surrounding hamlets. The survey was conducted as a one-time exercise through face-to-face interviews. The method facilitated comprehensive data collection and allowed for clarifications and additional information to be gathered during the interviews. The objective of obtaining a total enumeration of households in the community was successfully achieved through this method.

### Ethical compliance

To achieve full participation from respondents as well as meet research ethical requirements, the questionnaire was meticulously designed to assure respondents of confidentiality and anonymity. Moreover, respondents' participation in the interview was entirely voluntary, with each respondent providing verbal consent following a thorough explanation of the questionnaire's purpose and procedures. This study was part of a broader study to investigate the impact of cocoa swollen shoot virus disease (CSSVD) on the livelihood of cocoa farmers in Ghana, and hence, ethical clearance was secured through the University of Ghana, Legon, Department of Economics Ethics Committee in adherence to the guidelines set forth by the Ethics Committee for Humanities. Consequently, the department issued an introductory letter to the stakeholder institutions and respondents, outlining the ethical considerations and objectives of the study.

### Instruments

Quantitative data was collected with a paper-based structured questionnaire administered to households in the cocoa farming community. Access to the questionnaire and study data is facilitated through the data availability statement. The survey collected indicators on the cocoa farmers' household demographic or personal characteristics, capability (education and health), CSSVD and farm characteristics, economic resources (Food and Non-food expenditure), housing/dwelling-related information, and household asset ownership (living standard indicators). The questionnaire was designed following Ghana living standard surveys of the Ghana statistical service prior to 2018 and the new (acute) multidimensional poverty index for developing countries proposed by Alkire and Santos (2011).

### Analytical technique: estimation approach

To ensure accuracy, consistency, and reliability, the primary data collected were screened. Codes were assigned to the responses extracted from the questionnaire before data entry. Descriptive analyses of the variables were conducted to analyse the socioeconomic characteristics of the cocoa farmers. The Multidimensional Poverty Index (MPI) and the unidimensional (expenditure-based) approaches were used as dependent variables to measure the poverty variable. Finally, the research objective to determine the predictors of the poverty of rural cocoa farmers was achieved with the estimation of a bivariate probit regression model. Afterwards, an analysis was made to compare the multidimensional and the unidimensional determinants of poverty among rural cocoa farmers.

## Study variables

### The dependent variable 1: the multidimensional poverty index (MPI)

Typically, the conventional way of measuring poverty, welfare, or living standards of a household is likely to be unidimensional, preferably total household expenditure. Meanwhile, current studies have opposed using unidimensional approaches to measure poverty for multidimensional methods to capture certain quality-of-life attributes (Ningaye et al., 2011). Bourguignon and Chakravarty (2002) noted that the idea that all non-monetary aspects of welfare have no markets, and when they do, they are imperfect, is a key underlying feature of the multidimensional approach. Thus, there is no guarantee that they will be supplied with goods. Because some authors believe the money-metric approach is unsuitable because it focuses solely on monetary indicators, the Multidimensional Poverty Index (MPI) was used in this study to estimate the welfare or poverty levels of cocoa farmers in the study area and compared to expenditure-based unidimensional estimates. Initially, the global Multidimensional Poverty Index (MPI) was aligned with indicators used to track the Millennium Development Goals

(MDGs). The Oxford Poverty and Human Development Initiative (OPHI), Human Development Report Office (HDRO) and United Nations Development Programme (UNDP) collaborated, designed, launched, and released the global MPI in 2010 as part of the Human Development Report's twentieth anniversary (Alkire & Jahan, 2018). The MPI approach relies on the Adjusted Headcount Ratio ($M_0$) or Alkire and Foster (2011) model. It directly measures the nature and magnitude of interrelated deprivations in health, education, and living standards for each household. The headcount (percentage of poor in society) multiplied by the average number of deprivations among the poor yields the Alkire and Foster (2011) model. The product of the poverty headcount (***H***) and the average deprivation share among multidimensionally poor people (***A***).

$$MPI = M_0 = Incidence(H) * Intensity(A) \tag{1}$$

The poverty headcount (***H***) is mathematically defined as $= \frac{q}{n}$, where $q$ represents the number of multidimensionally poor households and $n$ the total population. Likewise, poverty intensity (***A***) is defined as $A = \frac{\sum_{i=1}^{n} c_i(k)}{qd}$, where $i$ is each individual observation (household); $k$, the selected cutoff point; $C_i$ represents the number of deprivations suffered by a household $i$ while $c$ denotes the column vector of these deprivation counts $C_i$ and $d$ is the total number of dimensions used. Hence,

$$\begin{aligned} MPI = M_0 = HA = \left(\frac{q}{n}\right)\left(\frac{\sum_{i=1}^{n} c_i(k)}{qd}\right) = \frac{\sum_{i=1}^{n} c_i(k)}{nd} \\ MPI = M_0 = HA = \alpha\left(g^0(k)\right) \end{aligned} \tag{2}$$

where $g^0 = [g_{ij}^0]$ is a matrix whose $ij^{th}$ entry is 1 when observation $i$ is deprived in the $j^{th}$ indicator and 0 when otherwise.

Rogan (2016) simplified the adjusted headcount as 'the total number of (weighted) deprivations experienced by the poor divided by the total possible number of (weighted) deprivations that could be experienced by the population.' The OPHI uses the MPI approach to measure acute multidimensional poverty to compare different countries' living standards through the yearly OPHI country briefings. This was made feasible by the flexibility of the Alkire-Foster technique, as well as many other multidimensional poverty measures, which can be used with a variety of dimensions, indicators, weights, and cut-offs to create an index for different societies and contexts (Alkire & Robles, 2017; Nawar, 2014). The Alkire-Foster's Method considers dimensions to be weighted differently or equally depending on the relative importance of the different deprivations. Consequently, the MPI approach is suitable for this study because the data collected for the research are compatible with the data required to compute MPI. Questions concerning a household's education, health, and standard of living indicators such as housing conditions, household assets, lighting, cooking fuel, water supply, and toilet facilities were among the indicators used for the development of a scale for this study. Based on the availability of data and the rural nature of the study area, this study uses the same three dimensions and ten indicators as the MPI approach, with some modifications to the indicators in health and housing condition: roof type, floor material, wall material, occupancy status; and water supply (or minutes for fetching water) to conform to the measures adopted by the Ghana Statistical Service (Alkire & Santos, 2011; Agyeman-Boaten & Fumey, 2021; Agyeman-Boaten et al., 2022; GSS, 2020). According to OPHI (2017), if a person is deprived in at least one-third of the weighted indicators, they are classified as multidimensionally poor or 'MPI poor'. Therefore, the poverty (k) cutoff value used for the study is 33.33 percent of the weighted indicators. Table 1 shows the dimensions, indicators, weights attributed to the indicators, and their deprivation cutoffs. Years of schooling and enrollment are the two complementary indicators for *education*. A literate individual's abilities in their household benefit all household members (Alkire & Santos, 2011).

While years of education are a reasonable proxy for functioning that requires education, such as understanding information, numeracy, and literacy, enrolment is a good indicator of school-age children being exposed to a learning environment. Furthermore, child mortality and household illness frequency are health-functional failures because the majority of the occurrences that cause them can be avoided and were used for the *health dimension*. The welfare of the household is affected by an unhygienic environment, and malnutrition, among other factors. According to Alkire and Santos (2011), indicators of *living standards* are a means to an end, not an end in themselves. It was categorised into housing

**Table 1.** Dimensions, indicators, deprivation, and weights of the MPI.

| Dimension | Deprived if | Indicator | Weight |
|---|---|---|---|
| Education | school-age child (1 to 8 years) is not attending school in the household | Enrolment | 1/6 |
| | no person in the household has entered Middle School or JHS | Years of schooling | 1/6 |
| Health | any child (up to 14 years) died in the household | Child Mortality | 1/6 |
| | household members, on average, suffer from illness or ill-health quite frequently (once a month or more) | Frequency of illness | 1/6 |
| Standard of living | the main material used for the roof is branches or grass/thatch **or** the main construction material used for the floor is mud/clay **or** the main construction material used for the outer walls is branches or grass/thatch, mud/clay or wood **or** the holding/tenancy arrangement of the dwelling is squatting or perching | Housing Condition | 1/18 |
| | source of lighting for the household is not electricity | Lighting | 1/18 |
| | the primary source of cooking fuel of the household is collected wood or charcoal | Cooking Fuel | 1/18 |
| | the main source of water supply of the household is river and it takes the household more than 30 minutes to access water | Water Supply or Minutes for Fetching Water | 1/18 |
| | toilet facility used by the household is not owned and/or shared | Toilet Facility | 1/18 |
| | the household does not have two or more durable assets and/or livestock; and land | Household Asset | 1/18 |

Source: Author's field survey, 2018 based on Alkire and Santos (2011).

conditions, such as floor type, roof type, and outer-wall type; living conditions, such as cooking fuel, lighting, water source, and toilet facilities; living comfort, such as occupancy status and minutes spent fetching water; and assets, such as durable and cattle (Agyeman-Boaten & Fumey, 2021). While the housing indicators provide a comfortable setting for rest and relaxation, the living conditions promote good health. A decent lighting source helps a home to participate in a variety of social and economic activities. Stress and other life issues are reduced by living a comfortable life. Many households in rural areas and developing countries rely on their assets and animals to survive.

### *Dependent variable 2: expenditure-based welfare (unidimensional poverty measure)*

The money-metric measure of utility and welfare through expenditure is used in the study based on the unidimensional approach. Some scholars suggest that expenditure is preferable to income because expenditure is more accurately reported in household surveys and better reflects permanent income (Coulombe & McKay, 1995; Olaniyan & Abiodun, 2005; Okunmadewa et al., 2005; Oni & Yusuf, 2007; Omonona, 2009; World Bank, 1996). According to Datt and Jolliffe (1999), income as a measure of welfare has numerous faults, particularly in Sub-Saharan African nations, because it varies from year to year and season to season depending on farm productivity and pricing. Most people, once again, are hesitant to reveal their true income. Meanwhile, the amount spent on consumption is important and not the amount of income per se (Omonona, 2009). The study measured household welfare using the ratio of per capita household expenditure to the poverty line. Omonona (2009, p. 11) posits that 'one practical advantage of modelling welfare rather than poverty *per se* is that the dependent variable is continuous and can be estimated by OLS'. Omonona (2009, p. 7) further explained that 'OLS is different from those approaches used to measure welfare (as per capita expenditure or its log) in that it incorporates both the per capita expenditure of the household and the poverty line into a single variable known as welfare ratio and defined as per capita expenditure divided by the poverty line' (ie $\frac{y_i}{x_i}$, where $\frac{y_i}{x_i}$ is the welfare ratio, $y_i$ is the per capita expenditure of household *i,* and $z_i$ is the poverty line).

### *Determining the poverty line (threshold)*

The study's unidimensional model uses household expenditure per capita or the poverty line ratio as a dependent variable in a bivariate probit regression with exogenous household demographic and socioeconomic characteristics and cocoa farm characteristics as explanatory variables, as suggested by Ravallion (1996). The absolute and relative poverty approaches are the two major approaches used by economists to determine a poverty line. A household is considered poor if its consumption level is insufficient to acquire a given level of goods and services recognized as an essential minimum living standard, according to the absolute approach with a fixed value of the poverty line. The relative poverty

approach with a flexible poverty line, on the other hand, deems a household poor in comparison to others in the same society or economy. Even though some authors consider the relative poverty level to be arbitrary and subjective (Olaniyan, 2000) and argue that it should be standardised against specific costs of essential necessities (basic needs) in the economy, this study uses it due to a lack of data to compute the absolute poverty line.

The following two poverty lines are used to classify households as poor or non-poor based on total household expenditure on food and non-food items. Two-thirds of the average per capita household expenditure is used to estimate the moderate poverty line. The core or very poor poverty level, on the other hand, is based on one-third of average per capita household expenditure. Thus, all people with per capita expenditures less than the threshold amount are termed poor, whereas those with expenditures equal to or greater than the threshold amount are considered non-poor. This study follows Coulombe and McKay (1995), Omonona (2009), and Salami et al. (2017) and limits its analysis to the moderate poverty line. Therefore, the unidimensional dependent variable is two-thirds of the average per capita household expenditure serving as a proxy for an income-based measure of poverty or welfare in the bivariate probit regression model.

### *The independent variables*

The study's variables were chosen to match the literature. The explanatory variables taken into account for determining the poverty level of cocoa farmers include household demographic and socioeconomic characteristics (education level of the household head, Marital Status of the Household head, Age of Household Head, relationship to the household head, number of household members, cooperative union, access to healthcare, ill-health frequency, household child death, household's school-age child not in school, occupational diversity, household access to financial credit and the household migration status), and cocoa farm characteristics (access to farm water, access to farm inputs, use of external labour force and cocoa land size). The descriptions of the variables are presented in Table 2.

### *Bivariate probit*

The bivariate probit approach was used to jointly estimate the probability of being either unidimensionally or multidimensionally poor. The bivariate probit model estimates two equations for both binary dependent variables, where the independent and identically distributed errors of each equation are correlated (Greene, 2003).

$$y_{1i}^{*} = \alpha Z_i + \varepsilon_{1i} \tag{3}$$

$$y_{2i}^{*} = \beta x_i + \delta y_{1i} + \varepsilon_{2i} \tag{4}$$

where $y_{1i}^{*}$ and $y_{2i}^{*}$ are latent variables and $y_{1i}$ (unidimensional poverty) and $y_{2i}$ (multidimensional poverty) are dichotomous variables. The dichotomous variables are observed as follows:

$$y_{li} = \{1, if\ \ y_{li}^{*} > 0\ \ 0, if\ \ y_{li}^{*} \leq 0; where\ \ l = 1, 2. \tag{5}$$

$\alpha$, $\beta$, and $\delta$ are the vectors of coefficients, and $x_i$ and $z_i$ are vectors of exogenous variables. Using full information maximum likelihood, the study follows Greene (1998, 2003) to estimate the bivariate probit model, where $\varepsilon_i$ follows the bivariate normal distribution with zero mean, variance 1, and covariance ($\rho$).

Grootaert and Braithwaite (1998) posit that considering a variable to be exogenous depends on the time horizon deemed relevant. If the time is long enough, most policy and targeting variables at the household level become exogenous. Meanwhile, in regression analysis, one must ensure that the regressors are truly exogenous due to the inherent problem of biased estimates caused by treating an endogenously generated variable as exogenous. As a result, this study took a pragmatic approach and employed a large number of explanatory variables that are useful policy and targeting variables in the short term. Also, the relevant time frame for the actual data collection for this study was four weeks. Omonona (2009, p. 12) noted that 'for a one-period model estimation, based on cross-sectional household data, the case for exogeneity is stronger, but not absolute'. As a result, the model incorporated right-hand side variables that a typical household cannot change significantly in a month or can only change in the great difficulty of cost. The sets of explanatory variables are assumed to be exogenous in this study for the four-week time frame.

**Table 2.** Description of the study variables.

| Variable Name | Descriptions |
|---|---|
| *Dependent Variables* | |
| *Multidimensional Poverty/Welfare (*MPI) | MPI is the multidimensional poverty measures. Dummy: 0 = not poor; 1 = Poor |
| *Unidimensional (Expenditure) Poverty/Welfare (*eWelf) | Household expenditure Welfare or Welfare ratio is the unidimensionally poverty measure. Dummy: 0 = not poor; 1 = Poor |
| *Independent Variables* | |
| *Access to financial credit (*FinCr_Acc) | Household's *access to financial credit*: dummy: 0 = No; 1 = Yes) |
| *Sex of the Household head (*HHSex) | Sex of the Household head: dummy: 1 = Male; 2 = Female |
| *Household head's Education Level* (HHEdu) | Education level of household head: categorical: 0 = None; 1 = Preschool/Primary; 2 = Middle School/JHS; 3 = SHS/Voc/Tech; 4 = Tertiary |
| *Occupation Diversity (*OccDiv) | The household occupationally diversify: dummy: 0 = No; 1 = Yes |
| *Marital Status of the Household head (*HHMarSta) | Marital Status of the Household head: categorical: 1 = Single; 2 = Married; 3 = Cohabit; 4 = Divorced; 5 = Widow/Widower |
| *Number of household members (*No_HHMem) | Number of household members: continuous variable |
| *Age of Household head (*HHAge) | Age of Household head: continuous variable. |
| *Migration Status (*MigSta) | Migration status of the Household: dummy: 1 = Indigene; 2= Settler |
| *Access to farm water (*FmWat_Acc) | Household have access to water for farm activities: dummy: 0 = No; 1 = Yes |
| *Cooperative Union (*Coop_Union) | Household member belong to any farmer cooperative union or group: dummy: 0 = No; 1 =Yes |
| *Access to farm inputs* | Households have access to farm inputs (such as insecticides, weedicides etc.): dummy: 0 = No; 1= Yes |
| *Use of external labour force (*ExLF_Use) | Household uses external labour force: dummy: 0 = No; 1 = Yes |
| *Cocoa Land Size* | Size of cocoa farmland (in acres) own by the household: categorical: 1= Below 5; 2 = 5–10; 3 = 11–25; 4 = Above 25) |
| *Access to healthcare (*Healthcare_Acc) | Households have access to health care services: dummy: 0 = No; 1 = Yes |
| *Ill-health frequency (*illhealth_Freq) | The frequency of household members on average suffer from illness or ill-health: categorical: 1 = Quite frequently (once a month or more); 2 = Not so frequently (about once in 3 months); 3 = Not at all/very rare (once a year or less) |
| *Child Death (*Child_Death) | any child (up to 14 years) death in the household in the last 12 months: dummy: 0 = No; 1 = Yes |
| *Household's child not in school (*NoSchChild) | School-age child (1–8 years) who is not attending school: dummy: 0 = No; 1 = Yes |
| *Relationship to the Household head (*RelaHHH) | Relationship to the Household head: categorical: 1 = Head 2 = Spouse; 3 = Son or Daughter; 4 = Grandchild 5 = Other Relative; 6 = Non-relative |

Source: Author's field survey (2018) and literature.

## Results and discussion

### *Socioeconomic, demographic and cocoa farm characteristics of the cocoa farming households*

Table 3 summarises the socioeconomic, demographic and cocoa farm characteristics of the cocoa farming households in the study area. The mean age of the cocoa farming household heads was 51.7 years. The minimum is 25, while the maximum age is 80 years. This high average may be attributed to agriculture not being attractive to the youth, which has pushed them to engage in other economic activities such as mining. Access to financial credit was difficult as 3.63% of the farmers had access to credit. More than half (64.8%) of the farmers diversify occupationally.

Only 7.26% of the farming household heads had completed secondary (5.96%) and tertiary (1.30%) education. This confirms the assertion that many individuals who have acquired higher levels of education in Ghana prefer other sectors of the economy than agriculture. Only 15% of the household heads were female. Due to the subsistence nature of farming in Ghana, just over a third of cocoa farmers (38.6%) own cocoa land exceeding 10 acres. The mean household size was approximately six (6), and the maximum was thirteen (13). As high as 75.39% (291) of the household heads had married, with just 1.81% (7) being single. Also, about 82% of the farmers use an external labour force. These high percentages may be due to the need for additional help (spouse) or human resources to farm effectively in Ghana. Since the study area is a forest zone with rivers and streams, more than two-thirds of farmers

**Table 3.** Descriptive statistics of cocoa farms, socioeconomic and demographic characteristics of the cocoa farming households ($n = 386$).

| Background Characteristics | Freq | (%) | Background Characteristics | Freq | (%) |
|---|---|---|---|---|---|
| Relationship to household head | | | Marital status of household head | | |
| *Head* | 75 | 19.43 | *Single* | 7 | 1.81 |
| *Spouse* | 69 | 17.88 | *Married* | 291 | 75.39 |
| *Son or Daughter* | 174 | 45.08 | *Cohabit* | 32 | 8.29 |
| *Grandchild* | 29 | 7.51 | *Divorced* | 18 | 4.66 |
| *Other Relative* | 32 | 8.29 | *Widow/Widower* | 38 | 9.84 |
| *Non-Relative* | 7 | 1.81 | Access to farm water | | |
| Access to Financial Credit | | | *No* | 116 | 30.1 |
| *No* | 372 | 96.37 | *Yes* | 270 | 69.9 |
| *Yes* | 14 | 3.63 | Migration Status | | |
| Household's child not in school | | | *Indigene* | 64 | 16.6 |
| *No* | 336 | 87.05 | *Settler* | 322 | 83.4 |
| *Yes* | 50 | 12.95 | | | |
| Occupation diversification | | | Use of external labour force | | |
| *No* | 136 | 35.2 | *No* | 71 | 18.4 |
| *Yes* | 250 | 64.8 | *Yes* | 315 | 81.6 |
| Households' Education level | | | Households' child not in school | | |
| *None* | 92 | 23.83 | *No* | 336 | 87.05 |
| *Preschool/Primary* | 91 | 23.58 | *Yes* | 50 | 12.95 |
| *Middle Sch./JHS* | 175 | 45.34 | Member of Cooperative Union | | |
| *SHS/Voc/Tech* | 23 | 5.96 | *No* | 305 | 79.22 |
| *Tertiary* | 5 | 1.30 | *Yes* | 80 | 20.78 |
| Sex of household head | | | Access to inputs | | |
| *Male* | 328 | 84.97 | *No* | 208 | 54.03 |
| *Female* | 58 | 15.03 | *Yes* | 177 | 45.97 |
| Cocoa land size (in acres) | | | Access to healthcare | | |
| *Below 5* | 89 | 23.2 | *No* | 5 | 1.30 |
| *5–10* | 146 | 38.1 | *Yes* | 381 | 98.70 |
| *11–25* | 105 | 27.4 | Household ill-health frequency | | |
| *Above 25* | 43 | 11.2 | *Quite frequently (once a month or more)* | 171 | 44.30 |
| Number of household members | 386 | 100 | *Not so frequently (once in 3 months)* | 110 | 28.50 |
| Age of household head | | | *Not at all/very rare (once a year or less)* | 105 | 27.20 |
| *18–40* | 108 | 28.0 | **Child Death** | | |
| *41–65* | 218 | 56.5 | *No* | 378 | 97.93 |
| *Above 65* | 60 | 15.5 | *Yes* | 8 | 2.07 |
| Multidimensional Poverty | 386 | 100 | **Household expenditure** | 386 | 100 |

*Source*: Author's field survey, 2018.

had access to water for farm activities. Even though 84% of the dwellers engaged in cocoa farming, 97.15% (375) of the cocoa farming households had cocoa farming as their main occupations. However, only about 17% were indigenes. Other households had salaried work (2.59%) and artisan work (0.26%) as their main occupations. About 12.95% of the households had a school-age child out of school. About 80% of the farmers had no cooperative unions to join. This may be due to their lack of awareness of the benefits they could accrue from joining these associations. Although only 1.3% did not have access to healthcare, only 2.07% of the households had recorded child deaths, but 44.3% had quite frequent ill-health. Finally, over half (54.03%) lacked the access to farm inputs.

## *The multidimensional poverty index analysis of cocoa farmers*

The multidimensional poverty index varied from 0.056 to 0.667, with a mean of 0.262 and a standard deviation of 0.125, based on the 386 farmers interviewed. Thus, poor cocoa farming households in the study area face 26.2% of the deprivations that would be faced if everyone in the area were poor and deprived across all the indicators.

## *Decomposition of the incidence of deprivation among cocoa farmers based on cutoffs*

The results of households that were classified as poor based on at least $k$ indices are discussed in this section. In this study, $k$ is the cutoff point at which a household is classified as being deprived at various levels. The study employs ten indicators and three dimensions, with seven distinct weighted indicator cutoffs. This approach is similar to Deutsch and Silber (2008) comparison of four approaches using the Israeli Census from 1995. Table 4 shows that 93.01 percent of the homes, or 359 households, were

**Table 4.** Deprivation rates and cutoffs of indicators of cocoa farmers.

| Poverty level | MPI_1 | MPI_2 | MPI_3 | MPI_4 | MPI_5 | MPI_6 | MPI_7 |
|---|---|---|---|---|---|---|---|
| *Cut- off (k)* | 1 | 2 | *3* | 4 | *5* | 6 | 7 |
| *Frequency* | 359 | 273 | *99* | 58 | *15* | 6 | 0 |
| *Percent (%)* | 93.01 | 70.73 | *25.65* | 15.03 | *3.89* | 1.55 | 0 |

*Source*: Author's Field Survey and Analysis (2018)[2].

**Table 5.** Survey MPI results at various cutoffs.

| Poverty Levels Multidimensional | Cut off (*k*%) | Frequency | | | Cocoa Farmers (%) |
|---|---|---|---|---|---|
| | | Male | Female | Pooled | |
| *MPI Poor* | 33.33 | 53 | 46 | 99 | 25.65 |
| *Vulnerable to poverty* | 20–33.33 | 91 | 83 | 174 | 45.08 |
| *Severe poverty* | 50 | 9 | 6 | 15 | 3.89 |
| *Unidimensional* | | | | | |
| *Moderate poverty* | $^2/_3$ of eWelf | 29 | 17 | 46 | 11.91 |
| *Core poverty* | $^1/_3$ of eWelf | 6 | 1 | 7 | 1.81 |

Source: Author's Field Survey and Analysis (2018).

deprived in at least one ($k = 1$) indicator, with only 12 households not deprived in any indicators. As the cutoff is raised, the number of households deprived decreases. Only one household (1.55%) is poor in at least six ($k = 6$) indicators, according to the MPI 6 poverty level. Because no household is deprived beyond '$k = 6$', cutoff points after $k = 6$ are not deemed meaningful.

Based on OPHI (2017), the poverty (k) cutoff value is 33.33%. Again, 'if a person is deprived in 20%–33.3% of the weighted indicators, they are considered '*Vulnerable to Poverty*', and if they are deprived in 50% or more (ie $k \geq$ 50%), they are identified as being in '*Severe Poverty*'. Using these definitions, a household will be MPI poor at the $k = 3$ cutoff and severely poor at the $k = 5$ cutoff (Table 5). At a threshold of $k = 33.33\%$, 25.65% of households (99 households) were deprived in at least a third of the weighted indicators, according to the findings. The findings also revealed that 45.08% of households (174 households) were classified as vulnerable to poverty at the $k = 20\%–33.33\%$ cutoff. Finally, only 3.89% of households (15 households) were severely deprived at the $k = 50\%$ cutoff.

The MPI findings are discussed in view of the results from the OPHI country briefing conducted on Ghana in 2017, which employed a similar methodology. According to the OPHI country estimates for Ghana, 49.4% were MPI poor and 21.0% were severely poor, which is significantly higher than the study's estimates of 25.65% MPI poor and 3.89% severely poor cocoa farmers. This suggests that many cocoa farmers have a higher multidimensional standard of living than other Ghanaians in rural communities and Ghana in general. Meanwhile, cocoa farmers had a higher level of vulnerability (45.08%) than the OPHI estimates of 20.7% for rural Ghanaians and 23.0% for Ghanaians in general. The decomposition of the unidimensional poverty indicates that 46 cocoa farmers representing approximately 12% were moderately poor, while close to 2% were the core poor.

## Discussion of regression results

Table 6 presents the findings from bivariate probit regression. Two models were run with multidimensional and unidimensional (expenditure-based) poverty as the dependent variables to find the factors determining poverty among cocoa farmers in rural communities. The first model is the main model used for the study analysis. The second model was run to further investigate categorical variables, such as education levels and the relationship of a household member to the household head given the probability of being poor. It was also used to check the robustness of the main model. All of the explanatory variables are assumed to be exogenous, and a multicollinearity test reveals that none of the variables is multicollinear. Both models were statistically significant with Wald chi2 ($p < .01$). It demonstrates that all the predictors are significantly related to multidimensional poverty and expenditure-based poverty. The regression model estimations were both robust to correct heteroscedasticity. The marginally statistically significant correlation coefficient shows a positive correlation between the error terms of the two equations.

**Table 6.** Regression estimates of the rural cocoa farmer's poverty status.

| | Model_1a eWelf | Model_1b MPI | Model_2a eWelf | Model_2b MPI |
|---|---|---|---|---|
| Household Head Marital status | 0.393*** | −0.008 | 0.451*** | 0.073 |
| | (0.09) | (0.097) | (0.101) | (0.092) |
| Age of Household Head | −0.02* | 0.014* | −0.025** | 0.018** |
| | (0.011) | (0.008) | (0.011) | (0.009) |
| Access to Financial Credit | −4.12*** | 0.126 | −3.894*** | 0.667 |
| | (0.523) | (0.563) | (0.571) | (0.608) |
| Migration Status of the Household | −0.216 | 0.838** | −0.144 | 0.757** |
| | (0.282) | (0.355) | (0.327) | (0.365) |
| Member of Cooperative Union | −0.917** | 0.078 | −1.214*** | −0.009 |
| | (0.446) | (0.236) | (0.431) | (0.245) |
| Access to Farm Inputs | −0.922*** | 0.331* | −1.113*** | 0.377** |
| | (0.239) | (0.188) | (0.29) | (0.185) |
| Cocoa Land Size | −0.029 | 0.022 | −0.01 | −0.024 |
| | (0.125) | (0.11) | (0.123) | (0.109) |
| Access to Farm Water | 2.003*** | 0.274 | 2.003*** | 0.244 |
| | (0.549) | (0.192) | (0.56) | (0.202) |
| Number of Household Members | −0.309*** | −0.019 | −0.349*** | −0.008 |
| | (0.061) | (0.041) | (0.062) | (0.047) |
| Occupation Diversification | 0.619*** | −0.267 | 0.509** | −0.361* |
| | (0.218) | (0.203) | (0.239) | (0.203) |
| Use of External Labour Force | 0.36 | 0.532* | 0.245 | 0.512 |
| | (0.315) | (0.31) | (0.35) | (0.321) |
| Access to Healthcare | 3.553*** | −6.241*** | 3.084*** | −7.143*** |
| | (0.484) | (0.361) | (0.406) | (0.612) |
| Ill-Health Frequency | −0.09 | −0.684*** | −0.04 | −0.761*** |
| | (0.154) | (0.16) | (0.167) | (0.164) |
| Child Death | 0.711** | 7.722*** | 1.576*** | 7.523*** |
| | (0.359) | (0.448) | (0.511) | (0.473) |
| Household's child not in school | 0.936*** | 2.966*** | 0.781** | 2.956*** |
| | (0.293) | (0.311) | (0.314) | (0.321) |
| Household Head Education level | −0.114 | 0.304*** | | |
| | (0.14) | (0.112) | | |
| Relationship to the household head | −0.048 | −0.252*** | | |
| | (0.092) | (0.091) | | |
| 1bn. Household Head Education level | | | | |
| 2.Preschool/Primary | | | −0.702* | −0.046 |
| | | | (0.361) | (0.341) |
| 3.Middle/JSS/JHS | | | −0.503 | 0.563** |
| | | | (0.312) | (0.278) |
| 4.SSS/SHS/Voc/Tech/Com | | | 0.516 | 1.281*** |
| | | | (0.584) | (0.456) |
| 5.Tertiary | | | 0.9 | 0.232 |
| | | | (0.691) | (0.923) |
| 1bn. Relationship to the household head | | | | |
| 2.Spouse | | | 0.06 | −0.331 |
| | | | (0.377) | (0.296) |
| 3.Son or Daughter | | | 0.224 | −0.366 |
| | | | (0.317) | (0.236) |
| 4.Grandchild | | | 0.123 | −1.944*** |
| | | | (0.41) | (0.608) |
| 5.Other Relative | | | −1.117 | −0.463 |
| | | | (0.816) | (0.483) |
| 6.Non Relative | | | 0.125 | −4.895*** |
| | | | (0.759) | (0.285) |
| _cons | −4.508*** | 3.243*** | −3.874*** | 4.233*** |
| | (1.364) | (1.24) | (1.253) | (1.132) |
| **athrho:_cons** | **0.333*** | | **0.292** | |
| | **(0.201)** | | **(0.202)** | |
| **Observations** | **381** | | **381** | |
| **Pseudo $R^2$** | **.z** | | **.z** | |

Robust standard errors are in parentheses. *** $p < .01$, ** $p < .05$, *$p < .1$.

At the 1% level, the coefficient for the number of household members was also significant and indicated a negative relationship with unidimensional poverty, which is confirmed by Babatunde et al. (2008) and Salami et al. (2017). It indicates an increase in the number of members in a cocoa farming household by one person is associated with higher income and a decreased likelihood of being unidimensionally poor by about 0.309 units. Some studies argue that with a larger number of children and fewer active adult members of a household (unemployed and elderly), the burden of meeting the

minimum cost of a household's nourishment becomes heavier, resulting in higher levels of poverty (Asogwa et al., 2012; Omonona, 2001; World Bank, 1996). This study conversely suggests that households with more members were less likely to be unidimensionally poor on average if these members are more active. Contrary to the study of Huluka (2024), the negative relationship of the multidimensional model was not significant.

Contrary to earlier studies by Adenuga et al. (2013) and Babatunde et al. (2008), the age of the household head was found to be significant in both models but at a marginal influence of 10% in the main model and 5% in the second model for both poverty measures. Nonetheless, Adeoti (2014) and Huluka (2024) found a significant relationship between age and multidimensional poverty.

At the 1% level, the coefficient of education level of household heads showed a positive and statistically significant relationship with multidimensional poverty but was not significant with unidimensional poverty. The positive relationship indicates an increase in the level of education of cocoa farmers' household heads is associated with a 0.304 unit probability of being multidimensionally poor. However, Adenuga et al. (2013) found education level to be positive but not significant in influencing multidimensional poverty. Adeoti (2014) and Huluka (2024), on the other hand, found that education level significantly decreases the probability of being multidimensionally poor. Although the relationship between the education level of the household head and unidimensional poverty was not significant, World Bank (1996), Babatunde et al. (2008), Asogwa et al. (2012), Salami et al. (2017) and Eyasu (2020) found an increase in expenditure welfare to associate with a rise in education level; thus, a negative effect between education levels and unidimensional poverty suggests a rise in education level leads to a reduction in poverty level. The ambiguous results regarding the relationship between education levels and both MPI and unidimensional poverty prompted further investigation, which required the second model. A further examination indicated that some education up to the primary level (about 6–8 years, including preschool) was marginally significant (at the 10% level) in lowering the cocoa farmers' unidimensional poverty. Higher levels were not significant. On the other hand, middle school or junior high (secondary) school and senior high (secondary) school, vocational or technical school leavers who are rural cocoa farmers are likely to be poor multidimensionally at a 5% and 1% significance level. Other levels were not significant. Farmers' understanding of new technologies is believed to improve with education, enhancing their knowledge of cocoa production and management practices. Some education level of the cocoa farmer household heads builds their capabilities to appropriately follow the best practices in cocoa farming, such as the right application of fertilizer, weedicide, and pesticides, which reflects high crop yield and their ability to spend more. However, higher education does not influence the unidimensional poverty of rural cocoa farmers. On the multidimensional front, attaining a secondary level education increases the probability of a rural cocoa farmer being poor. The results indicate that it would benefit an individual with higher education to engage in large-scale cocoa production with improved technologies and management practices rather than engaging in subsistence farming which is predominant in rural cocoa farming communities.

Household members' relationship with the household head was also significant and negatively influenced only multidimensional poverty at the 1% level. The coefficient suggests that the relationship of the household members to the household head is associated with a lower household's multidimensional deprivation by approximately 0.252 units. For further understanding of the relationship, the results based on the second model showed that being a grandchild or non-relative to the cocoa farming household head were the only significant indicators to determine multidimensional deprivation. The negative coefficients (−1.944 and −4.895) signify the low probability of the grandchild or non-relatives being multidimensionally poor relative to the household head. No other relationships to the household head were found to be associated with multidimensional poverty or expenditure-based poverty.

Even though the coefficient of the marital status of household heads (0.393) was highly significant in the expenditure model at the 1% level, it was not significant in the multidimensional model. It implies that a household head's marital status is associated with unidimensional poverty through expenditure but does not influence multidimensional poverty. This finding is consistent with the studies of Adenuga et al. (2013) and Bersisa and Heshmati (2021). Likewise, Adeoti (2014) also confirmed the insignificance of the household head's marital status in a multidimensional model.

The coefficient for households that migrated to the study area was significant at a 5% level and negatively related to the multidimensional poverty but not the expenditure-based poverty. The coefficient (0.838) indicates that settlers are more likely to be multidimensionally poor than indigenous households. This finding could be partly attributed to the fact that while indigenous households accumulate and maintain assets such as comfortable homes and improved living standards in the study area, settlers may prioritise these aspects elsewhere, hence deprived of those indicators. This finding is supported by Amfo et al. (2022, 2023).

The results showed that households' access to financial credit negatively and significantly influenced expenditure poverty at the 1% level. However, it did not significantly influence the depth of multidimensional poverty, as confirmed by Adenuga et al. (2013). The results signify that households that households with access to loans experience lower unidimensional poverty by approximately 4.12 units. The ease with which such funds can be utilized in numerous household activities may explain the large influence that the households' access to credit has on their expenditure welfare (Apata et al., 2010). Some authors argue that access to credit enables households to acquire more productive resources for their household enterprises and meet consumption expenditures such as medical costs, school fees, food, and social emergencies, thereby enhancing their income-generating capacity and overall welfare (Apata et al., 2010; Asogwa et al., 2012; FOS, 1999; Owuor et al., 2007; Omonona, 2001).

The coefficient for the cocoa farmer households' membership in a cooperative union was negative and significantly influenced unidimensional poverty at a 5% level but was not significant multidimensionally. It deviates from Adenuga et al. (2013) findings that membership in an association was negative and significant in influencing the depth of multidimensional poverty. The results suggest that a cocoa farming household that joins a cooperative union is associated with higher expenditure wellbeing of approximately 0.917 units. This indicates that households that join a cooperative union are more likely to improve their money-metric welfare than those that do not join. Various benefits through credit facilities, access to improved production inputs, and access to information, among others, extended to members could be the reason for their improved well-being. As a form of social capital, Hernández-Núñez et al. (2022) advocated for the participation of rural household members in local organisations.

In the expenditure-based poverty model, the coefficient for the households' access to farm water was positive and significant at a 1% level, but not significant in the multidimensional poverty model. The coefficient indicates that a cocoa farmer's household with access to farm water is associated with expenditure-based poverty by approximately 2.003 units. Thus, households with access to water for cocoa farming or near river bodies are more likely to experience unidimensionally poverty than those without. A simple explanation could be that some farmers believe that cocoa farms near water bodies suffer specific challenges such as reduced sunlight in the farm, causing darkness on cocoa farms, which leads to rotten cocoa pods, thereby reducing cocoa yield and depriving the households of income or revenue.

The findings showed that occupational diversity has a significant (1% level) and positive influence on unidimensional poverty. The coefficient shows that a cocoa farmer household that diversifies occupationally is associated with a higher unidimensional poverty of about 0.619 units. It suggests that a household's unidimensional poverty increases with occupational diversification and confirms the findings of Hernández-Núñez et al. (2022) in the cocoa sector. Conversely, some studies have found that occupationally diverse households enhance living standards unidimensionally and have been confirmed by Asmah (2011), Schulte-Herbruggen (2012), Guatem and Andersen (2016), Ampaw et al. (2017), and Eyasu (2020). This study could not confirm the claim that diversification ensures income stability as the farmer engages in other economic activities (Asogwa et al., 2012). Even though there was a negative and marginal association at a 10% level in the second model, occupational diversity was not significant in influencing multidimensional poverty in the main model. However, Dagunga et al. (2020) found that the extent and dimension of diversification reduce multidimensional poverty among farming households.

The coefficient of cocoa farming households with access to healthcare was significant for both dimensions in the two models at a 1% level. Access to healthcare negatively influences and is associated with a lower probability of multidimensional poor cocoa farming households by approximately 6.241 units. Also, it positively influences and is associated with higher expenditure-based poverty by approximately 3.553 units. While access to healthcare is likely to reduce the multidimensional poverty of cocoa farmers,

it is likely to increase expenditure-based poverty. Furthermore, a household that recorded a child's death significantly influenced both the multidimensional and unidimensional models at 1% and 5% levels, respectively. The positive coefficient of both dimensions indicates that a household with a record of child death in the last 12 months is associated with a higher probability of being deprived multidimensional by 7.722 units and is likely to be unidimensionally poor by 0.711 units. A child's death may be attributed to malnutrition, bad hygiene, and financial difficulty, resulting from the household's deprivation rendering it incapable of saving the lives of children living in the household. Meanwhile, the frequency of ill-health in the cocoa farming household was negative for both dimensions in the two models but significant at the 1% level for multidimensional poverty and not significant in expenditure-based poverty. The coefficient (0.684) indicates that a decrease in the frequency of illness among cocoa farming households is associated with a low probability of being multidimensional poor. This suggests that good health remains a vital indicator of the multidimensional well-being of the cocoa farmer. The position of this finding has been confirmed by Adenuga et al. (2013) and Lawal et al. (2018).

A Household with a school-age child not attending school was positive and significantly influenced both unidimensional and multidimensional poverty at the 1% level. The coefficients indicate that on average a cocoa farming household with a school-age child not attending school is associated with multidimensional poverty by approximately 2.966 units and unidimensional poverty by 0.936 units. Children who are not able to attend school may be due to the deprived status of the household and low household income, hence, unable to cater for the child through school.

The study's findings also showed that the multidimensional poverty of cocoa farmers is positively influenced by the use of an external labour force at a 10% significance level. However, it showed no significance for unidimensional poverty. The marginal significance indicates that the engagement of the external labour force by the cocoa farming households is associated with the households' multidimensional poverty by approximately 0.532 units.

The household's access to inputs was positive and significant in influencing multidimensional poverty at the 10% level. It was also found to be negative and significant in the unidimensional model. It indicates that households with access to farm inputs are associated with a higher depth of multidimensional poverty by approximately 0.019 units. Additionally, the results confirm the study by Woldie et al. (2020), who found the negative and significant influences of input utilization on expenditure-based poverty. Finally, the cocoa land size of the household had no significant influence on both unidimensional and multidimensional poverty, contradicting the findings of Huluka (2024).

Ravallion (1996) argues that a model's usefulness depends on its ability to capture and determine what it ought to, not on the degree of its sophistication. According to Khan et al. (2020), multiple methods for identifying and designing poverty alleviation programs should be promoted because the severity and depth of poverty differ throughout villages and within households. Similar to the findings of earlier scholars (eg Costa, 2003; Khan et al., 2020), different results were realised for both monetary and non-monetary poverty or welfare measures. Costa (2003) contends that because the two approaches describe two distinct groups of poor households, any socioeconomic policy to decrease poverty based on income data is unlikely to meet its stated objectives because it is directed at socioeconomic units that are, in reality, non-poor. As a result, it is only within the context of a multidimensional approach that it is feasible to appropriately identify the poor and create poverty-reduction strategies.

## Conclusion and policy implications

In Ghana, traditional poverty measurement and analysis have primarily been based on a single-dimension monetary or expenditure-based approach, with little attention devoted to multidimensional poverty assessment. However, many authors assert that the multidimensional poverty approach is more suitable to measure poverty than a unidimensional approach and have highlighted the critical limitations of the monetary approaches to measuring poverty. Comparing the unidimensional and multidimensional approaches using the bivariate probit model, this study examines the factors that influence the poverty of rural cocoa farmers in Ghana. The result demonstrates some differences drawn from the multidimensional and unidimensional estimates. It is evident from the result that the influence of the variables on either the expenditure-based approach or the multidimensional poverty approach depends on several

factors, which include the differences in cocoa farming household characteristics, the household head characteristics, and the setting of the study. For instance, unidimensional poverty was significantly influenced by household characteristics rather than multidimensional poverty. However, many of the variables simultaneously influenced both multidimensional poverty and unidimensional poverty. Another potential factor could be attributed to recent prevalence of the cocoa swollen shoot virus disease in the study area, ravaging cocoa production and their income-earning ability. Since multidimensional welfare is attained over time, these households were considered multidimensionally sufficient before the incidence of the disease, hence the less multidimensional impact. Although the directions and significance levels may differ, the two approaches estimated five variables that simultaneously influenced poverty significantly with coefficient from 0.014 to 7.722 units. They include access to healthcare, household child death, household's school-age child not in school, access to farm inputs and the age of the household head. In addition, the two approaches produced differing significant associations for the remaining variables. While the education level of the household head, ill-health frequency, use of external labour force, migration status, and the relationship to the household head were significant to determining multidimensional poverty, the number of household members, cooperative union, access to farm water, occupational diversity, household access to financial credit, and marital status of the household head significantly determined unidimensional poverty of the cocoa farmers. The two approaches diverged on many variables in terms of direction and significance because poverty indicators cannot be directly acquired through the income of cocoa farmer households.

The study's findings suggest that to improve the living standards of cocoa farmers who mostly depend on the cocoa output for their livelihood, a measure to move from subsistence to large-scale farming is crucial, especially for higher-educated farmers. The availability of improved and subsidised farm inputs and access to financial credit are among the measures to move many cocoa farmers from income poverty and hence, subsistence to a larger scale. The formation of effective farmers' unions and farmers' organisations to promote knowledge transfer, savings mobilisation, inputs, and output marketing and distributions, and farm credit sourcing and supply should be encouraged among cocoa farming households to improve economic well-being. The health status of the cocoa farming household largely determines their multidimensional welfare. Therefore, governments, policymakers, and stakeholders of the cocoa industry and the agricultural sector should ensure that access to healthcare services, and measures to reduce the households' frequency of ill health, and child death, among others, are maintained. Larger households were found to reduce unidimensionally poverty among the cocoa farming households. It indicates that a large labour force in the household is required to significantly make a fortune out of cocoa farming. Since the result showed that cocoa farmers require some level of education of about eight years to reduce unidimensional poverty, prioritising comprehensive social policy, which guarantees access to quality education at the basic level is essential. This study concludes that even though multidimensional methods of poverty measurement provide wide coverage of deprivations determining poverty, analysis based on both the unidimensional and the multidimensional methods provides a better understanding of the poverty situation of a population for the formulation of good developmental policies. Hence, an approach should be adopted based on circumstances at stake, such as the differences across locations and within households or entities.

## Notes

1. The Ghana Living Standard Surveys are round of surveys initiated in the 1980s and conducted by the Ghana Statistical Service to provide benchmark data on living standard of the population, monitor, and evaluate progress made by planners and policymakers in improving and sustaining those standards. The rounds include GLSS 1 (1987/88), GLSS 2 (1988/1989), GLSS 3 (1991/1992), GLSS 4 (1998/1999), GLSS 5 (2005/06), GLSS 6 (2012/2013) GLSS 7 (2016/17).
2. MPI deprivation rates and cutoffs of indicators analysis based on OPHI Country Briefing 2017, on Ghana (OPHI, 2017); Average MPI = 0.26.

## Authors contributions

The corresponding author solely contributed to the conception and design, analysis and interpretation of the data, and drafting and revision of the manuscript for intellectual content to be published. He agrees to be accountable for all aspects of the work.

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## Data availability statement

The data supporting the findings of the study are openly available in Mendeley Data at 10.17632/hpk3ddmjr3.1 and the questionnaire is included as a supplementary document.

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