Determinants of rural multidimensional poverty of households in Southern Ethiopia

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Abstract: Some studies have quantified the extent and examined the determinants of the global multidimensional poverty index (G-MPI) which contains only three dimensions of welfare. But studies on the extent and determinants of rural multidimensional poverty index (R-MPI) which contains rural livelihood as one dimension of welfare are scarce. Hence, this study quantified the extent and examined the determinants of rural multidimensional poverty index using the Alkire–Foster method and the ordered logistic regression model, respectively. Data were gathered from 415 random sample households in southern Ethiopia. The incidence, intensity, and adjusted headcount ratio of rural multidimensional poverty are 72.3%, 57.3%, and 41.4% respectively. Besides, 7.47%, 20.24%, 30.60%, and 41.69% of households are non-poor, vulnerable, poor, and extremely poor, respectively. The living standard and rural livelihood dimensions jointly contributed 60% to rural multidimensional poverty. Fuel for cooking, electricity, and housing are the primary contributors to rural poverty from the living standard dimension, while land ownership, off-farm activity, and tropical livestock units are the leading contributors from the rural livelihood dimension to rural deprivation. Regression results showed that education, land size, tropical livestock unit, off-farm participation, and saving are negatively
and significantly related to rural poverty, while dependency ratio, distance from market, distance from the road, and sickness of family members are positively and significantly related to rural poverty. Female-headed households were more deprived than male-headed households. Hence, promoting access to land, non-farm employment, markets, electricity, drinking water, and a road network would reduce rural multidimensional poverty in southern Ethiopia.

**Subjects:** Development Studies; Rural Development; Economics and Development; Economics

**Keywords:** Rural Poverty; Ordered Logit; Alkire–Foster Method; Rural Livelihoods; Ethiopia

**1. Introduction**

Poverty is one of the factors that threatens growth and development (Beatriz, 2016), and its reduction is important to speed up economic growth (Nallari & Griffith, 2011). Hence, a poverty reduction policy is expected to bring sustainable economic growth and a higher living standard to society (Lustig, 2002). However, poverty has remained the most challenging and deterrent to economic growth and development in developing countries in general and sub-Saharan African countries in particular (World Bank, 2020). As a result of this fact, the United Nations has adopted the 2030 Agenda for Sustainable Development to end poverty in all its forms everywhere (Nations, 2015). But defining and quantifying poverty is the initial step in designing poverty reduction programs, strategies, and policies (Khan et al., 2020).

Nevertheless, there exists little agreement among researchers, practitioners, and policymakers on the meaning, and measurement of poverty (Feleke et al., 2020). Until recently, poverty was defined and measured by a single indicator like income or consumption of households using the welfarist approach. According to the welfarist approach, poverty is the relative deficit of goods and services due to extreme income constraints, or poverty is regarded as the incapability to meet the minimum needs that are considered reasonable by the standard of the community (Wang et al., 2021). But the unidimensional measure of deprivation has some limitations because human life is not only affected by a single dimension but other dimensions such as education, health, and living standard are also equally important. Therefore, a poverty analysis should include these other dimensions of welfare (Abeje et al., 2020).

However, due to the progress of research on poverty measurement, the concept of poverty extended to include some non-material dimensions (Alkire et al., 2015; Mei et al., 2019). Consequently, a new concept of poverty was developed by Oxford Poverty and Human Development Initiative which depends on the capability or the non-welfarist approach to poverty (Alkire et al., 2015). The capability approach defines poverty as a lack of capability to function in society (Sen, 1985). Specifically, the non-monetary approach to poverty quantifies poverty using multiple indicators and a person is considered multidimensionally poor if he or she is deprived in at least one-third of the weighted multidimensional poverty indicators or if his or her weighted deprivation score is equal to or higher than the poverty cutoff of 33.33% (Alkire & Foster, 2007). While 1.3 billion people (22%) live in multidimensional poverty, 83% and 85% of multidimensionally poor people live in sub-Saharan Africa and rural areas, respectively (Alkire et al., 2020).

With 115 million people, Ethiopia is the second most populous country in Africa and has one of the fastest-growing economies in sub-Saharan Africa (World Bank, 2020). Despite this impressive economic growth, Ethiopia remains one of the poorest countries in the world with the highest incidence of both unidimensional and multidimensional poverty. Following the demise of the socialist government in 1991, the Federal Democratic Republic of Ethiopia (FDRE) started designing and implementing different development programs to reduce poverty and boost the welfare of society. For instance, the Sustainable Development Poverty Reduction Program (2002–2004), the Plan of Accelerated and Sustainable Development to End Poverty (2005–2010), the first Growth
and Transformation Plan (2011–2015), and the second Growth and Transformation Plan (2016–2020) are some of the programs implemented by FDRE (Ministry of Finance and Economic Cooperation [MoFEC, 2018]). While the GDP per capita of Ethiopia increased from 482.88 US dollars in 2000 to 2422.96 US dollars in 2020, the incidence of unidimensional or income poverty reduced from 44% in 2000 to 25% in 2020 [World Bank, 2020]. But Ethiopia has remained the first country with the largest number of multidimensionally poor people. For instance, the incidence of multidimensional poverty in Ethiopia slightly reduced from 88.6% in 2011 to 83.5% in 2016 (OPHI, 2020).

While many studies have quantified the extent and examined the determinants of unidimensional poverty [Biyena, 2019; Eyasu & Yildiz, 2020; Garza-rodriquez et al., 2021; Habtamu et al., 2021; Mekore & Yoekob, 2018], some studies [Bersisa & Heshmati, 2021; Mohammed et al., 2021; Su-Jung, 2020; Toriku et al., 2021] have examined the extent and determinants of the global multidimensional poverty index (G-MPI) which contains only three dimensions, namely health, education, and the living standards. The G-MPI was developed by the UNDP in 2010 and contains only 3 dimensions and 10 indicators. However, this index does not account for the livelihood characteristics of rural households (OPHI, 2020). To fill this gap, FAO and OPHI (2021) developed a rural multidimensional poverty index (R-MPI) which includes rural livelihood as one dimension of rural poverty in addition to health, education, and living standard. Hence, this study quantified the extent and examined the determinants of rural multidimensional poverty index (R-MPI) using the Alkire–Foster method and the ordered logistic regression model, respectively, in southern Ethiopia. The remaining sections of this article are organized as follows. The second section presents the theoretical and empirical literature review. The third section deals with the materials and methods. The fourth section presents results and discussion, while the last section deals with the conclusion.

2. Literature review

2.1. Theoretical literature

Regarding the definition and the measurement of poverty, there are two views in the literature: the monetary view and the non-monetary view [Saith, 2001]. On the one hand, the monetary or welfarist approach defines poverty using one indicator like income or consumption. According to this approach, poverty is defined as the inability to get the minimum level of income or resources to at least satisfy the basic needs of life [Laderchi et al., 2003]. On the other hand, the capability or the non-welfarist approach defines poverty using multiple dimensions and indicators. This approach defines poverty as the failure of a person to achieve basic capabilities to adequately fulfill certain crucial functions at a minimal level [Sen, 1985]. The capability approach views monetary resources as means to enhance the well-being of households and considers monetary resources as necessary but not sufficient conditions to prevent poverty [Sen, 1985].

Similarly, the welfarist approach and the non-welfarist approach measure poverty in different ways [Semasinghe, 2011]. The welfarist or the unidimensional approach quantifies poverty by using a single indicator, and it uses income or consumption to classify households as poor and non-poor depending on whether the income or consumption household lies below the poverty line [Foster et al., 1984]. There are different techniques for measuring unidimensional poverty, and all methods have their strengths and weaknesses [World Bank (WB, 2002)]. There are three approaches, namely, the direct calorie intake, food energy intake, and cost of basic needs, to measure unidimensional or consumption poverty in empirical analysis [World Bank, 2002]. First, the direct calorie intake method sets a poverty line as the minimum 2200 calorie requirement for survival [Foster et al., 1984]. Second, the food energy intake method takes the poverty line as the level of consumption per capita at which people are expected to meet their predetermined calorie intake. Third, the cost of the basic needs method determines the poverty line based on the bundles of food items consumed by the poor. Under this approach, while the food poverty line is obtained by determining the cost of food items which provide a minimum of 2200 kilo calories per person.
per day, the non-food poverty line is determined by adding the cost of other essentials such as clothing, shelter, health, education, and transport.

Although the welfarist approach is easy to apply, understand, and interpret, it failed to include different dimensions of welfare (Semasinghe, 2011). The non-monetarist approach to measuring poverty focuses on multiple dimensions of household welfare (Sen, 1985). According to this approach, welfare depends on opportunities, functioning, and capabilities. The movement from a unidimensional to a multidimensional analysis of welfare has led to the development of different measures of multidimensional welfare. First, the human development indicator (HDI) was coined by the United Nations Development Program (UNDP) as a multidimensional measure of welfare in 1990. This index contains three dimensions and four indicators. The three dimensions include health, education, and income, while the four indicators are life expectancy at birth, mean years of schooling, expected years of schooling, and GDP per person (Mahbub, 1995). However, the HDI does not consider qualitative factors and the GDP per person takes no account of the income distribution. But the global multidimensional poverty index (G-MPI) was introduced by UNDP and Oxford Poverty and Human Development Initiative (OPHI) in 2010. The G-MPI includes health, education, and living standards as dimensions of deprivation. The living standard dimension contains six indicators namely electricity, sanitation, water, house flooring, fuel for cooking, and assets, while the education dimension contains two indicators: years of schooling and child school attendance. Lastly, the health dimension contains two indicators: nutrition and child mortality. Still, the G-MPI does not account for the livelihood characteristics of rural households while measuring welfare (OPHI, 2020). To fill this gap, FAO and OPHI (2021) developed the rural multidimensional poverty index (R-MPI) which includes rural livelihood as one dimension of rural poverty in addition to education, health, and living standard.

Regarding the determinants of rural poverty, there are some theories of poverty and they include the individual, cultural, geographic, and structural theories of poverty. The individualistic theory of poverty insists that individual ability and characteristics are the drivers of poverty (Rainwater, 1970). The cultural theory of poverty assumes that poverty is caused by sets of skills, values, and beliefs which are socially created and individually held (Lewis, 1959). That means the low-income people tend to build up a culture of poverty and they consider themselves dependent, helpless, marginal, and powerless. Still, the geographical theory of poverty relates the drivers of poverty with the difference in the distribution of institutions, public services, and natural resources by location (Morrill & Wohlenberg, 1971). Lastly, the structural theory of poverty blames the social, political, and economic systems as the causes of the poverty of individuals (Bradshaw, 2007). The social, political, and economic systems determine the access of people to resources, and thereby limit their income and wellbeing.

2.2. Empirical review

Some previous studies have examined the extent and the determinants of multidimensional poverty. A study conducted by Roy et al. (2018) on determinants of multidimensional poverty in West Bengal using 3 dimensions and 10 indicators found that distances from the all-season road, marketplace, and health center are positively and significantly correlated with multidimensional poverty. Similarly, Mishra et al. (2020) conducted a study on multidimensional poverty using the Alkire and Foster (2007) method of estimating poverty in selected Indian districts and the study found that about half of the sample respondents are vulnerable to multidimensional poverty, while a quarter of the sample respondents are poor in the selected districts. The same study indicated that education and standard of living dimensions are the major contributors to multidimensional poverty. From the living standard indicators, fuel for cooking, sanitation, and assets are the key contributors to multidimensional poverty.

In Nigeria, a study conducted by Adepoju (2018) on multidimensional poverty using the Alkire and Foster (2007) method indicated that about 46.5% of households were multidimensionally poor. The same study showed that education, family size, number of assets owned, land size, and
marital status are significantly related to multidimensional poverty. Likewise, Dele (2020) examined determinants of multidimensional poverty in Nigeria and the study highlighted that family size is positively and significantly related to multidimensional poverty. A similar study was conducted by Eze and Alugbbo (2021) on multidimensional poverty in Nigeria and found that the incidence of multidimensional poverty was 64%. Still, a study conducted by Michael et al. (2019) on multidimensional poverty in rural Nigeria found that 62% of households were multidimensionally poor. The same study showed that the age, family size, and marital status of households were positively and significantly related to multidimensional poverty, while the gender, years of schooling, livestock ownership, farm size, and credit use were negatively and significantly related to deprivation of rural households.

Further, studies conducted by Chen et al. (2019) and Mei et al. (2019) on multidimensional poverty in Taiwan found that age of household, income, family size, and marital status are significantly related to multidimensional poverty. In Nepal, a study conducted by Goli et al. (2019) on regional differentials in multidimensional poverty indicated that standard of living is the primary contributor to multidimensional poverty. Furthermore, a study conducted by Mishra et al. (2020) on multidimensional poverty in north Indian districts found that more than half of the sample households were vulnerable to poverty. In Pakistan, Khan et al. (2020) conducted a study on multidimensional poverty using panel data and found that education and health are the major contributors to multidimensional poverty in Pakistan.

Concerning the effect of distances from the road, and local markets, studies conducted by Joshua et al. (2017), Motuma et al. (2020), and Roy et al. (2018) indicated that distances from the road and local markets are positively and significantly correlated with the deprivation of rural households. Besides, proximity to urban areas affects the livelihood strategies of rural households, and rural livelihood diversification through participation in rural–urban migration and non-farm activities impacts the welfare of rural households (Marcysiak & Prus, 2017). Yet, studies conducted by Mei et al. (2019) and Wang et al. (2021) on multidimensional poverty showed that years of schooling, dependency ratio, marital status, and the number of children are the drivers of household deprivation.

In Ethiopia, a study conducted by Tariku et al. (2021) on determinants of multidimensional poverty using the Alkire–Foster method found that 80.1% of the sample households were multidimensionally poor in Jimma Geneti Woreda. The same study showed that education, farm size, and cooperative membership are significantly related to rural household deprivation. Still, a study conducted by Bersisa and Heshmati (2021) on multidimensional poverty in Ethiopia found that family size and age of household heads are positively and significantly related, while the education of household heads is negatively and significantly related to deprivation of rural households. Moreover, Gebrekidan et al. (2021) examined the determinants of multidimensional poverty in northern Ethiopia and found that 60% of the sample households were multidimensionally poor. However, previous studies have quantified the extent and examined determinants of the global multidimensional poverty index (G-MPI) which was developed by the UNDP in 2010. The G-MPI contains 3 dimensions and 10 indicators. The limitation of the G-MPI is that the characteristics of the livelihoods of rural households are rarely taken into account in quantifying the extent of rural poverty (OPHI, 2020). To address this gap, FAO and OPHI (2021) developed a rural multidimensional poverty index (R-MPI) which includes rural livelihood as one dimension of rural poverty in addition to health, education, and living standards. Hence, this study quantified the extent of the rural multidimensional poverty index following the work of FAO and OPHI (2021) and examined the determinants of the rural multidimensional poverty index using an ordered logistic model.

3. MATERIALS AND METHODS

3.1. Description of Study Area
Southern Nations, Nationalities, and People’s (SNNP) regional state is one of the nine regional states in Ethiopia. The SNNP regional state is located in the southern part of Ethiopia, and it is
situated between 4°43’ and 8°58’ north latitudes and 34°88’ and 39°14’ east longitudes. The SNNP regional state accounts for 20% and 10% of the total population and land area of Ethiopia, respectively (Central Statistical Agency (CSA, 2021)). Administratively, the SNNP regional state is classified into 15 zones. This study was conducted in Hadiya and Kembata Tembaro zones in the SNNP regional state (Figure 1). These two zones are the most densely populated and the primary sources of both internal and international migrants in the SNNP regional state (Degelo, 2015). Hosanna and Durame are the capital towns of the Hadiya and Kembata-Tembaro zones and are located at 267 km and 260 km southwest of Addis Ababa, respectively. The population of the Hadiya and Kembata-Tembaro zones was 1,747,356 and 996,969 people, while the total land size was 3,593.31 and 1,555.90 square kilometers, respectively (CSA, 2021). There are 11 and 7 districts in Hadiya and Kembata-Tembaro zones, respectively. While Soro and Lemo districts were selected from the Hadiya zone, the Angacha district was selected from the Kembata-Tembaro zone for this study.

Soro is one of the eleven districts in the Hadiya zone, and it is situated between 7°23’ and 7°46’ north latitudes and 37°18’ and 37°23’ east longitudes. The altitude of the district ranges from 840 to 2850 m.a.s.l. The average annual temperature ranges from 18 to 25°C whereas the mean annual rainfall is 1260 mm in the district (Soro District Agricultural and Rural Development Office (SDARDO, 2021)). Lemo district is also found in the Hadiya zone, and it is situated between 7°22’ and 7°45’ north latitudes, and 37°40’ and 38°00’ east longitudes. The district is found 230 km south of Addis Ababa, and the altitude of the district ranges from 1900 to 2720 m.a.s.l. The average rainfall ranges from 900 to 1400 mm, while the minimum and maximum temperatures are 13 and 23°C, respectively (Lemo District Agricultural and Rural Development Office (LDARDO, 2021)). Angacha district is one of the seven districts in the Kembata-Tembaro zone in the SNNP regional state, and it is found 260 km southwest of Addis Ababa. The district is located between 7°30’ and 7°34’ north latitudes and 37°83’ and 37°88’ east longitudes. The altitude of the district ranges from 1501 to 3000 m.a.s.l. The mean annual rainfall ranges between 1001 and 1400 mm,
whereas the average annual temperature of the district ranges from 12.6°C to 20°C. Regarding livelihoods, the majority of the rural households in the three districts are engaged in crop and livestock production (Angacha District Agricultural and Rural Development Office (ADARDO, 2021)).

3.2. Data Sources, Types, and Collection Tools

Primary data were gathered from a sample of 415 rural households in three sample districts, Lemo, Soro, and Angacha in southern Ethiopia, using a survey questionnaire. Focus group discussions and interviews with key informants were held to support the data collected using the questionnaire. The training was given to data collectors, and they gathered primary data using a survey questionnaire. Also, secondary data were collected from the Ethiopian Central Statistical Authority, the World Bank, the Food and Agriculture Organization, the United Nations Development Program, the United Nations Department of Economic and Social Affairs, and other published and unpublished documents to get some background information about the study.

3.3. Measurement of Rural Multidimensional Poverty

The movement from a unidimensional analysis to a multidimensional analysis of welfare has led to the development of various measures of multidimensional welfare (Alkire & Fang, 2019). First, the human development indicator (HDI) was coined by UNDP (1990), and it contains three dimensions and four indicators. Second, the global multidimensional poverty index (G-MPI) was developed by OPHI and UNDP (2010), and this index contains 3 dimensions and 10 indicators. Third, the rural multidimensional poverty index (R-MPI) was developed by FOA and OPHI (2021) by including rural livelihood as one dimension of deprivation of rural households. Therefore, this study quantified the extent of the rural multidimensional poverty index (R-MPI) following the work of FAO and OPHI (2021) in the Hadiya and Kembata-Tembaro zones of southern Ethiopia.

Accordingly, this study used 4 dimensions and 16 indicators to quantify the extent of rural multidimensional poverty. First, the food insecurity and nutrition dimension includes three indicators: malnutrition, access to health, and child mortality. A household is considered to be malnourished if the kilocalories per adult equivalent per day is lower by 400 than the minimum daily requirement of 2200 kilocalories (FAO, 2010). There is the availability of health insurance in the study area, and interested households can use the service by paying a fixed annual premium. Thus, a household is considered deprived in this first dimension if the kilocalorie per adult equivalent per day is less than 2800; if no family members use health insurance services; and if a household faced the death of a child in the last 5 years. Second, the education dimension includes school attendance and school enrollment. If 13 years or older family members did not complete grade six, the household is considered deprived in this indicator. Similarly, if any school-aged child is not attending school, the household is said to be deprived of education. Third, the living standard dimension includes six indicators: housing, electricity, water, sanitation, cooking fuel, and asset. Fourth, the rural livelihood dimension contains five indicators: land ownership, tropical livestock unit, child labor, participation in safety net programs, and non-farm participation (OPHI, 2021).

As indicated in Table 1, each dimension is given equal weight, and under each dimension, each indicator is also given equal weight (Alkire & Foster, 2007). To quantify rural poverty, 1 is assigned for deprivation in each indicator, and 0 otherwise, and, hence, the maximum weighted sum of deprivation score (d) will be 100. A rural household is considered to be multidimensionally poor if the sum of the weighted deprivation score is equal to or more than 33.33% (Alkire & Foster, 2007).

Once the sum of the weighted deprivation of all indicators is determined, the headcount ratio of poverty (H) is determined by taking the ratio of the total number of multidimensionally poor households (q) to the total households under consideration (n) as follows:

$$ H = HCR = \frac{q}{n} $$

(1)
### Table 1. Dimensions, Indicators, and Cutoff of Rural Multidimensional Poverty

| Dimensions                  | Indicators                                                                 | Weight |
|-----------------------------|-----------------------------------------------------------------------------|--------|
| Food Insecurity & Health    | (1) Kilocalorie per capita per day of a household is less than 2800          | \( \frac{1}{12} \) |
|                             | (2) No family members use health insurance services in the area              | \( \frac{1}{12} \) |
|                             | (3) One or more child has died during the last 5 years in a family          | \( \frac{1}{12} \) |
| Education                   | (1) Thirteen years or older family members not complete grade 8              | \( \frac{1}{8} \) |
|                             | (2) At least one school-aged family member not enrolled in school           | \( \frac{1}{8} \) |
| Living Standard             | (1) A household uses dung, firewood, and charcoal as cooking fuel            | \( \frac{1}{24} \) |
|                             | (2) A household does not have access to improved sanitation service         | \( \frac{1}{24} \) |
|                             | (3) A household does not have access to electricity power                   | \( \frac{1}{24} \) |
|                             | (4) A household lives in a house with a dirty wall, floor, and roof         | \( \frac{1}{24} \) |
|                             | (5) A household uses unsafe sources of water: rivers, ponds, and wells      | \( \frac{1}{24} \) |
|                             | (6) The value of an asset is less than the mean value of the asset in the area | \( \frac{1}{24} \) |
| Rural Livelihoods           | (1) The mean land ownership in hectares is lower than the mean value in the area | \( \frac{1}{30} \) |
|                             | (2) The mean value of TLU is lower than the mean value in the area           | \( \frac{1}{30} \) |
|                             | (3) The average frequency of visits by development agents per month is lower than the mean visit in the area | \( \frac{1}{30} \) |
|                             | (4) At least one family member aged less than 14 years old participates in agricultural activity | \( \frac{1}{30} \) |
|                             | (5) No family members participate in any non-farm activities                | \( \frac{1}{30} \) |

Source: FAO and OPHI (2021)
The headcount ratio (HCR) shows the incidence of rural multidimensional poverty. However, the headcount ratio does not show the intensity of poverty, and, hence, the intensity of multidimensional poverty is determined by taking the ratio of the sum of the weighted deprivation of all poor to the number of total poor. Mathematically, the intensity of rural multidimensional poverty is given by:

$$ A = \frac{\sum_{i=1}^{q} C_i}{q} $$  \hspace{1cm} (2)

where $A$ is the average percentage of dimensions in which the poor households are deprived, $C_i$ is the weighted sum of the deprivation of the $i^{th}$ household, $\sum_{i=1}^{q} C_i$ is the sum of the weighted deprivation of all poor households, and $q$ is the number of multidimensionally poor households. Finally, the product of the incidence ($H$), and the intensity ($A$) of multidimensional poverty are used to determine the multidimensional poverty index ($MPI$).

$$ MPI = A \times H $$  \hspace{1cm} (3)

There are three merits of the Alkire and Foster (2007) method of quantifying poverty and these include simplicity, monotonicity, and decomposability by dimensions and sub-population groups (Alkire & Foster, 2007). Hence, the contribution of each dimension ($j = 1, 2, 3, 4$) to multidimensional poverty is computed as follows:

$$ \text{Contribution of dimension } j = \frac{\sum_{i=1}^{n_j} C_i}{\sum_{i=1}^{n} C_i} $$  \hspace{1cm} (4)

where $n$, $q$, $C_j$, and $MPI$ are the total number of households, the number of poor households, the deprivation in $j^{th}$ dimension, and the multidimensional poverty index, respectively. Besides, rural multidimensional poverty can also be decomposed by population subgroups using the following expression:

$$ \text{Contribution of population subgroup } n_s = \frac{\sum_{i=1}^{n_s} C_i}{\sum_{i=1}^{n} C_i} $$  \hspace{1cm} (5)

where $n_s$, $C_i$, and $q_s$ are the total number of households in a given group, the deprivation of the $i^{th}$ household, and the total number of poor households in that group, respectively.

Finally, the score of multidimensional deprivation is used to classify households into non-poor, vulnerable, poor, and extremely poor. Therefore, if the score of deprivation is less than 0.2, the household is non-poor; if the score of deprivation is greater than or equal to 0.2, but less than 0.33, the household is vulnerable to multidimensional poverty; if the score of deprivation is equal to or greater than 0.33, but less than 0.5, the household is poor; and finally if the score of deprivation is greater than or equal to 0.5, but less than or equal to 1, the household is extremely multidimensionally poor (Alkire & Foster, 2007).

### 3.4. Sampling techniques and sample size

This study was conducted in Hadiya and Kembata-Tembaro zones in SNNP regional state, southern Ethiopia. There are 11 and 7 districts in Hadiya and Kembata Tembaro zones, respectively. Proportionately, Lemo and Soro districts from the Hadiya zone and Angacha district from the Kembata-Tembaro zone were selected for this study. Besides, there are 33, 33, and 17 rural kebeles in Lemo, Soro, and Angacha districts, respectively. By employing a proportionate random sampling, four kebeles (Sundusa, Sonda, Shara, and Bona), three kebeles (Kerekicho, Garba Fandide, and Bobichro), and four kebeles (Haise, Shurmo, Jawe, and Sena) were selected from Soro, Angacha, and Lemo districts, respectively. Furthermore, sample gots were selected from each sample kebele to prepare the sampling frame. Lastly, sample households were selected from each sample got using a systematic random sampling technique. The following Cochran (1963) formula is employed to determine an adequate sample size for this study.
\[ n = \frac{Z^2pqN}{e^2(N-1) + Z^2pq} \]

where \(e\), \(p\), \(q\), \(n\), \(N\), and \(Z\) are the measure of precision, the assumed level of variability in the population, one minus the level of variability in the population, the sample size of the study, the total population, and the value of standard normal distribution, respectively. The total households \((N)\) in the three districts, degree of variability, and level of precision in this study are 94721, 0.5, and 0.05, respectively. Based on the above formula, a sample size of 383 was determined for the present study. But by adding 10% of this figure to account for incomplete responses, a total of 421 questionnaires were distributed and this study finally used data from 415 completed questionnaires.

### 3.5. Methods of data analysis

Data management activities and analyses were made using Stata Version 16. The Alkire–Foster method was used to quantify the extent of the rural multidimensional poverty index (R-MPI) of households. The value of the rural multidimensional poverty index lies between 1 and 100. This variable is used as an ordered dependent variable to examine the determinants of rural multidimensional poverty in the study area. To this end, households were classified as non-poor, vulnerable, poor, and extremely poor if the level of rural multidimensional poverty index is less than 20%; greater than 20, but less than 33.33%; greater than or equal to 33.33, but less than 50%; and greater than or equal to 50%, respectively (Alkire & Fang, 2019). Thus, the outcome variable in examining the determinants of rural multidimensional poverty is a categorical variable that assumes four values \((j = 1, 2, 3, 4)\).

Since the dependent variable is an ordered variable, this study employed an ordered logistic regression model. But the estimation results of the ordered logit model depend on the parallel lines assumption. If the parallel lines assumption is violated, a generalized ordered logit model will be used. However, the Brant test was employed to check the violation of this assumption in this study, and the result showed that the assumption of parallel lines is not violated. As a result, the ordered logit model was specified and estimated to examine the determinants of rural multidimensional poverty in the study area. Technically, the ordered logit model is given by:

\[
Pr(Y_j = j|X_i) = \left\{ \begin{array}{ll}
F(\alpha_j - X_i\beta) &= 1 \\
F(\alpha_j - X_i\beta) - F(\alpha_{j-1} - X_i\beta) &= 1 < j < J - 1 \\
1 - F(\alpha_{J-1} - X_i\beta) &= J
\end{array} \right.
\]

where \(P(.)\) is the probability of being in a particular category, \(F(.)\) is the logistic cumulative density function, \(\alpha_j\) is the cut point, \(X_i\) is a vector of an independent variable, \(\beta\) is a vector of parameters, and \(j\) is the number of categories, \(j = 1, 2, \ldots J\). From equation (6), the mathematical form of the ordered logit model is given by:

\[
\ln\left(\frac{Pr(Y = j|X_i)}{Pr(Y = j+1|X_i)}\right) = \alpha_j - X_i\beta \quad (1 \leq j < J)
\]

where \(Y_i\) is the categorical outcome variable which is the rural multidimensional poverty index, \(\ln\) is the natural logarithm, \(X_i\) is a vector of covariates, \(j\) is the number of categories, and \(\alpha_j\) is the cut points or intercepts. Lastly, by adding some covariates based on the theoretical and empirical literature, an empirical ordered logit model is given by:

\[
L_i = \beta_0 + \beta_AGE + \beta_2AGESQR + \beta_3EDUC + \beta_4CPE + \beta_5DR + \beta_6LS + \beta_7TLU + \beta_8NFP + \beta_9SAVING + \beta_{10}DSM + \beta_{11}DSR + \beta_{12}ASSET + \beta_{13}KT + \beta_{14}SICKNESS + U_i
\]

where \(L_i\) is the log of the odds ratio, \(AGE\) is the age of household head, \(AGESQR\) is the squared age of household head, \(EDUC\) is the education of household head, \(CPE\) is consumption per adult equivalent, \(DR\) is the dependency ratio, \(LS\) is the land size in hectares, \(TLU\) is the tropical livestock unit, \(NFP\) is a dummy variable for non-farm participation which assumes 1 for participants, and 0
otherwise, SAVING is a dummy variable for saving that assumes 1 for savers and 0 otherwise, DSM and DSR are distances from market and road, respectively, in minutes, ASSET is the monetary value of an asset, KT is a dummy variable that assumes 1 for Kembata-Tembaro zone, and 0 for otherwise, SICKNESS is a dummy variable which assumes 1 for families who experienced sickness in the last one year, and 0 otherwise, and $\epsilon_i$ is a disturbance term.

The age of the household head is measured in years, and it is assumed to have a non-linear relationship with the level of deprivation. This is because the asset or resource accumulation of households varies with the age of households. Thus, the age of the household is hypothesized to influence the level of deprivation positively, while the squared age of the household is hypothesized to affect the deprivation of the household negatively. A study conducted by Michael et al. (2019) found a positive relationship between the age of the household and the level of deprivation. Also, the dependency ratio is hypothesized to positively affect household deprivation. Studies conducted by Bersisa and Heshmati (2021) and Mei et al. (2019) found a positive and significant association between household deprivation and dependency ratio. Likewise, land size and livestock ownership are also hypothesized to negatively affect the deprivation of rural households. Studies conducted by Michael et al. (2019), and Tariku et al. (2021) also found negative and significant effects of land size and livestock ownership on rural deprivation. Also, non-farm participation is expected to negatively affect household deprivation. As well, a study conducted by Chen et al. (2019) found a similar result. Studies conducted by Motuma et al. (2020) and Roy et al. (2018) obtained a positive and significant association between deprivation of households and distances from the road and local market. This study also hypothesized a positive relationship between distances from infrastructure and deprivation. Chen et al. (2019) and Mishra et al. (2020) found a negative and significant effect of assets and saving on household deprivation. Finally, the coefficient of sickness in the above-ordered logit model is expected to be positive since an illness of family members is a kind of shock to household earnings.

4. Results and discussion
In this section, the extent of the rural multidimensional poverty index (R-MPI) is quantified using the Alkire–Foster method of measuring multidimensional deprivation. Unlike the global multidimensional poverty index (G-MPI) which contains only three dimensions of deprivation, the rural multidimensional poverty index (R-MPI) uses rural livelihood as one dimension of deprivation in addition to education, health, and living standards. Besides, results of some descriptive statistics of continuous and discrete variables, independent samples t-tests, and one-way analysis of variance are presented in this section. Lastly, the determinant of rural multidimensional poverty in the study area is examined in this section using the ordered logistic model.

4.1. Descriptive statistics for some continuous variables
In the beginning, the summary statistics of the socio-economic attributes of sample households were computed and presented in Table 2. The average age of the household head is 51.36 years, while the average family size and years of schooling of the household head are 7.5 and 4.5, respectively. The mean dependency ratio is 0.53, and the average land size of a household is 0.95 hectares, with a minimum of 0.13 hectares and a maximum of 4 hectares. The average land size per household is lower compared to the national average land size of 1.15 hectares per household in Ethiopia. Similarly, the mean tropical livestock unit is 3.84 with a minimum of zero and a maximum of 20 as is indicated in Table 2. Land is a key economic resource for rural people since their lives and livelihoods highly depend on crop and livestock production. The mean frequency of visits by development agents in the study area was 5.06 with a minimum of zero and a maximum of twelve times.

The mean kilocalories per adult equivalent per day is 2111.01 in the study area, and it is lower than 2200 kilocalories per adult equivalent per day which is the minimum kilocalorie required for a household to be food secured. Therefore, the mean kilocalorie per adult equivalent is higher compared to the national average of 1557. A study conducted by Sani and Kemaw (2019) on
determinants of food insecurity in northern Ethiopia found that the average kilocalorie per adult equivalent per day of households is 1999.4. As indicated in Table 2, the average annual consumption expenditure per adult equivalent is Birr 14,172.1 in the study area. The kilocalorie per adult equivalent per day and the mean annual consumption expenditure per adult equivalent are unidimensional measures of deprivation.

The average distances from a local market and all-season road were 41.13 and 22.20 minutes, respectively, and they are expected to positively correlate with the deprivation of rural households. In this study, about 90% of sample households are male-headed households, whereas 125, 164, and 126 rural sample households were included from Anigacha, Lemo, and Soro districts, respectively.

### 4.2. Rural multidimensional poverty status of households

The Alkire–Foster method was employed to quantify the incidence, depth, and adjusted headcount ratio of rural multidimensional poverty in the Hadiya and Kembata-Tembaro zones. To this end, the incidence, intensity, and adjusted headcount ratio of rural multidimensional poverty were computed using Stata 16 software and presented in Table 3. From the food insecurity and health dimension, households are primarily deprived of access to health, while from the education dimension, households are more deprived of school attendance. Similarly,

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**Table 2. Descriptive Statistics for Some Continuous and Discrete Variables**

| Variables                              | Mean   | Std. Error | Minimum | Maximum |
|----------------------------------------|--------|------------|---------|---------|
| Kilocalorie per Adult Equivalent       | 2111.01| 1191.57    | 491.61  | 7519.76 |
| Age of Household Head                  | 51.36  | 9.20       | 27.00   | 76.00   |
| Education level of Household Head      | 4.46   | 3.78       | 0.00    | 16.00   |
| Household Size                         | 7.47   | 1.40       | 3.00    | 12.00   |
| Dependency Ratio                       | 0.53   | 0.59       | 0.00    | 3.60    |
| Adult Equivalent                       | 6.77   | 1.40       | 1.62    | 9.88    |
| Land Size (in hectares)                | 0.95   | 0.60       | 0.13    | 4.00    |
| Tropical Livestock Unit                | 3.84   | 2.30       | 0.00    | 20.06   |
| Distance from Market (in minutes)      | 41.13  | 20.92      | 2.00    | 120.00  |
| Distance from Road (in minutes)        | 22.20  | 11.80      | 2.00    | 90.00   |
| Extension Visits per Year              | 5.06   | 2.84       | 0.00    | 12.00   |
| Consumption per Adult Equivalent       | 14,172.10 | 6955.72   | 4100.00 | 53,632.7 |
| Asset per Adult Equivalent             | 2931.44 | 3697.58   | 64.10   | 39,894.7 |
| Gender of Households Head              | Frequency | Percent   |         |         |
| Male                                   | 374    | 90.12      |         |         |
| Sample Districts                       |         |            |         |         |
| Anigacha                               | 125    | 30.12      |         |         |
| Lemo                                   | 164    | 39.52      |         |         |
| Soro                                   | 126    | 30.36      |         |         |

Source: Author Computation, 2022.
households are mainly deprived of access to cooking fuel and electricity from the living standard dimension. Besides, households are relatively more deprived of livestock ownership, non-farm activities, and land size from the rural livelihood dimension. Moreover, the contribution of each indicator to the overall rural multidimensional poverty (R-MPI) is computed, and presented in Table 3.

The results showed that food insecurity and access to health from the food insecurity and health dimension; school attendance from the education dimension; cooking fuel, electricity, and housing from the living standard dimension; and tropical livestock unit and non-farm participation from the rural livelihood dimension are the major contributors to rural multidimensional poverty in Hadiya and Kembata-Tembaro zones as indicated in Table 3. This suggests productive agricultural assets and rural non-farm activities have paramount importance in building the resilience of households to rural poverty.

As presented in Table 4, 31 (7.47%) sample households were multidimensionally non-poor. This means that these households are having deprivations in less than 20% of the indicators of well-being utilized. However, 84 (20.24%) of sample households were vulnerable to multidimensional poverty. Put differently, these households are not currently multidimensionally poor, but they are more likely to fall into multidimensional poverty soon. It shows that these households are deprived in at least 20% but less than 33.33% of the indicators of wellbeing used. In the same vein, 127 (30.60%) and 173 (41.69%) sample households were multidimensionally poor and extremely poor, respectively. One of the merits of the Alkire and Foster method of quantifying poverty is its decomposability by indicators.

As it is indicated in Table 4, the living standard and the livelihood dimensions are the first and the second major contributors to rural multidimensional poverty in Hadiya and Kembata-Tembaro zones. Accordingly, the living standard and the rural livelihood dimensions contribute 33.60% and 26.10% to the overall rural multidimensional poverty index. In short, 59.7% of multidimensional poverty is contributed by the living standard and the rural livelihood dimensions.
### Table 4: Contribution of Dimensions to Rural Multidimensional Poverty Index (R-MPI)

| Poverty Status | Frequency | Percent |
|----------------|-----------|---------|
| Non-Poor       | 31        | 7.47%   |
| Vulnerable     | 84        | 20.24%  |
| Poor           | 127       | 30.60%  |
| Extremely Poor | 173       | 41.69%  |

| Dimensions | R-MPI | Source: Author Computation, 2022 |
|------------|-------|---------------------------------|
| Rural Livelihood | 26.10 |                                  |
| Food Insecurity & Health | 22.30 |                                  |
| Education | 17.40 |                                  |
| Living Standard | 33.60 |                                  |

**Note:**
- Contribution to Rural Multidimensional Poverty Index (R-MPI)
- Source: Author Computation, 2022

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Eshetu et al., Cogent Social Sciences (2022), 8: 2123084
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On average, 72.3% of the households are multidimensionally poor in Hadiya and Kembata-Tembaro zones. This headcount ratio of multidimensional poverty is lower than the national average which was 83.5% in 2016. Gedefaw (2021) conducted a study on the determinants of multidimensional poverty in northern Ethiopia and found that 90% of households are multidimensionally poor, while a study conducted by Tariku et al. (2021) in western Ethiopia by using education, health, and living standard as dimensions of welfare indicated that 80.1% of households are multidimensionally poor.

As it is presented in Table 5, the poverty headcount ratio and the adjusted poverty headcount ratio ($M_0$) are the highest in Soro district and the lowest in Lemo district in the Hadiya zone. However, the intensity of poverty ($A$) is the highest in the Lemo district and the lowest in the Soro district in the same zone. Besides, the poverty headcount ratio is higher in the Kembata-Tembaro zone, and lower in the Hadiya zone. But the intensity of poverty is higher in the Hadiya zone compared to the Kembata-Tembaro zone. The intensity of multidimensional poverty ($A$) which measures the average deprivation of poor households is 57.3% and the Lemo district is the major contributor to this measure as indicated in Table 5.

Also, the adjusted headcount ratio which is the product of the incidence and the intensity of multidimensional poverty is 41.4%, and the Soro district is the primary contributor to this index. But the national incidence, intensity, and adjusted headcount ratio of rural multidimensional poverty in Ethiopia were 80.2%, 53.2%, and 42.6%, respectively, in 2016 (FAO and OPHI, 2021). This suggests that while the incidence and the severity of rural multidimensional poverty are lower in the study area compared to the national incidence and severity of rural multidimensional poverty, the intensity of rural multidimensional poverty is higher compared to the national intensity of rural multidimensional poverty. While the incidence of multidimensional poverty and the adjusted headcount ratio is higher in the Soro district, the intensity of multidimensional poverty is higher in the Lemo district. From Table 5, the poverty headcount ratio of female-headed households is 75.6% while it is 71.9% for male-headed households. Also, the adjusted headcount ratio of female-headed households is higher than that of male-headed households. But the intensity of rural multidimensional deprivation in female-headed households is lower than in their male counterpart.

As presented in Table 6, 52% and 55% of sample households are non-poor and vulnerable to rural multidimensional poverty, respectively, in the Lemo district. That means it is more likely for rural multidimensional poverty to rise in the Lemo district soon. Of the currently poor households, 34% and 39% of households are found in Anigacha and Soro districts, respectively. Despite the current higher incidence of rural multidimensional poverty, the extent of vulnerability to multidimensional poverty is lower in the Soro district compared to the other two districts. On the other hand, though the current incidence of multidimensional poverty is lower, the extent of vulnerability to multidimensional poverty is higher in the Lemo district as it is evidenced by Table 6.

| Table 5. Distribution of Rural Multidimensional Poverty Indices by Districts, Sex, and Zones |
|---------------------------------|-----------|-----------|-----------|
| Districts | Incidence of Poverty ($H$) | Intensity of Poverty ($A$) | Adjusted Poverty ($M_0$) |
|-----------|----------------------|----------------------|----------------------|
| Lemo      | 62.2                 | 60.9                 | 37.9                 |
| Soro      | 83.3                 | 55.2                 | 46.0                 |
| Anigacha  | 74.4                 | 55.8                 | 41.5                 |
| Total     | 72.3                 | 57.3                 | 41.4                 |
| Sex       |                       |                      |                      |
| Male      | 71.9                 | 57.7                 | 41.5                 |
| Female    | 75.6                 | 53.6                 | 57.7                 |
| Zone      |                       |                      |                      |
| Kembata   | 74.4                 | 55.8                 | 41.5                 |
| Hadiya    | 71.4                 | 58.0                 | 41.4                 |

Source: Author Computation, 2022
Unfortunately, both the number of non-poor and extremely poor households is higher in the Lemo district compared to the other two districts.

To compare the mean kilocalorie per adult equivalent per day among the four categories of multidimensional poverty: non-poor, vulnerable, poor, and extremely poor, a one-way analysis of variance (ANOVA) was employed, and the result is presented in Table 7. Accordingly, the difference between the mean kilocalorie per adult equivalent per day of non-poor households and vulnerable households is 756.70, and the mean difference is statistically significant at a 1% level of significance. Similarly, the difference between the mean kilocalorie per adult equivalent per day of vulnerable households and poor households is 905.87, and the mean difference is statistically significant at a 1% level of significance. Still, the difference between the mean kilocalorie per adult equivalent per day of poor households and extremely poor households is 862.08, and the mean difference is statistically significant at a 1% level of significance. This suggests a complementarity between unidimensional and multidimensional measures of welfare. By using 2200 kilocalories per adult equivalent per day as the minimum threshold of food security, 66.51% of sample households are food insecure in the study area.

| Table 6. Distribution of the Extents of Rural Multidimensional Poverty by Sample districts |
|-----------------------------------------------|---------------|---------------|---------------|---------------|
|                   | Anigacha      | Soro          | Lemo          | Total         |
| Number (A)        | Percent       | Number (B)    | Percent       | Number (C)    |
| Non-poor          | 12            | 0.39          | 3             | 0.10          | 16            | 0.52          | 31            |
| Vulnerable        | 20            | 0.24          | 18            | 0.21          | 46            | 0.55          | 84            |
| Poor              | 43            | 0.34          | 50            | 0.39          | 34            | 0.27          | 127           |
| Extremely poor    | 50            | 0.29          | 55            | 0.32          | 68            | 0.39          | 173           |
| Total             | 125           | 126           | 164           | 415           |

Source: Author Computation, 2022

| Table 7. One-way ANOVA test for Kilocalories per Adult Equivalent per day |
|-----------------------------------------------|---------------|---------------|---------------|
| Poverty (A)                                | Poverty (B)   | Mean Difference (A-B) | Std. Error | t-statistics |
| Non-poor                                   | Vulnerable    | 756.70         | 181.25       | 4.17         |
|                                            | Poor          | 1662.57        | 172.78       | 9.62         |
|                                            | Extremely poor| 2524.45        | 168.21       | 15.01        |
| Vulnerable                                 | Non-poor      | −756.70        | 181.25       | −4.17        |
|                                            | Poor          | 905.87         | 121.30       | 7.47         |
|                                            | Extremely poor| 1767.95        | 114.70       | 15.41        |
| Poor                                       | Non-poor      | −1662.57       | 172.78       | −9.62        |
|                                            | Vulnerable    | −905.87        | 121.30       | −7.47        |
|                                            | Extremely poor| 862.08         | 100.78       | 8.55         |
| Extremely poor                             | Non-poor      | −2524.45       | 168.21       | −15.01       |
|                                            | Vulnerable    | −1767.95       | 114.70       | −15.41       |
|                                            | Poor          | −862.08        | 100.78       | −8.55        |

Source: Author Computation, 2022
Note: * refers to the statistical significance of the mean difference at a 1% level of significance.
Table 8. Independent Samples T-test for Multidimensionally Poor and Non-poor Households

| Variables                      | Mean Value           | Mean Difference | Std. Error | t value |
|--------------------------------|----------------------|-----------------|------------|---------|
|                                | Poor (300)     | Non-Poor       |            |         |
| Kilocalories per AE            | 1665.70        | 3272.68        | -1606.98  | 104.30  | -15.41 |
| Age of Household Head          | 51.24          | 51.68          | -0.44     | 1.01    | -0.44  |
| Years of Schooling             | 4.29           | 4.89           | -0.59     | 0.41    | -1.43  |
| Dependency Ratio               | 0.56           | 0.46           | 0.09      | 0.06    | 1.47   |
| Adult Equivalent (AE)          | 6.69           | 6.96           | -0.27     | 0.15    | -1.79  |
| Land Size (in hectares)        | 0.89           | 1.11           | -0.22     | 0.07    | -3.40  |
| Tropical Livestock Unit        | 3.46           | 4.83           | -1.37     | 0.24    | -5.65  |
| Extension Visits per Month     | 4.63           | 6.17           | -1.54     | 0.30    | -5.09  |
| Food Expenditure per AE        | 11762.29       | 14,020.91      | -2258.62  | 715.67  | -3.16  |
| Non-Food Expenditure per AE    | 1654.20        | 2122.25        | -468.05   | 120.44  | -3.89  |
| Total Expenditure per AE       | 13416.49       | 16,143.16      | -2726.67  | 751.93  | -3.63  |
| Asset per AE                   | 2186.81        | 4873.96        | -2687.16  | 383.90  | -7.00  |

Source: Author Computation, 2022

Note: a, b, and c refer to statistical significance at 1%, 5%, and 10%, respectively.

The independent samples t-test was employed to test the statistical significance of the mean difference of some continuous variables for multidimensionally poor and non-poor households, and the results are presented in Table 8. The result showed that the mean kilocalorie per adult equivalent per day of poor households is statistically significantly lower than that of non-poor households. Besides, the average land size, tropical livestock unit, annual expenditure per adult equivalent, and asset per adult equivalent of poor households are lower than that of non-poor households, and the mean differences are statistically significant at a 1% level of significance as indicated in Table 8. Moreover, the mean difference in the frequency of visits by the development of poor and non-poor households is also statistically significant at a 1% level of significance.

4.3. Results of ordered logistic regression

To identify the drivers of rural multidimensional poverty among rural households, this study employed ordered logistic regression as outlined in the materials and methods section. The outcome variable is ordinal with four categories: non-poor, vulnerable to poverty, poor, and extremely poor. One of the assumptions of the ordered logit model is the assumption of parallel lines regression. If this assumption is violated, a generalized ordered logistic regression that allows the slope coefficients to vary across the categories will be employed. The Brant test is used to check the violation of this assumption in an empirical study. As presented in Table 9, the result of the Brant test showed that the assumption of parallel slopes is not violated.
The age of the household head is positively and significantly related to the probability of being at a higher level of multidimensional poverty, whereas the squared age of the household head is negatively and significantly related to the likelihood of being at a higher level of deprivation. This implies that at a higher age level, a household accumulates more and more resources, and build resilience to rural poverty. Similarly, Bersisa and Heshmati (2021), Kiani and Kazmi (2020), Mei et al. (2019), and Michael et al. (2019) conducted a study on the sources of multidimensional deprivation, and they found that the age of the household head is positively and significantly associated with multidimensional poverty. As presented in Table 9, education is negatively and significantly associated with rural multidimensional deprivation of households. In other words, as the level of education of household heads rises, the likelihood of being at a higher level of multidimensional poverty falls. Studies conducted by Goli et al. (2019), and Mishra et al. (2020) also indicated a negative and significant association between the education level of household heads and multidimensional poverty. Still, studies conducted by Gebrekidan et al. (2015) and Mei et al. (2019) showed that education, land size, and extension visits are negatively and significantly associated with multidimensional poverty.

Table 9. Regression Results of Ordered Logistic Model

| Covariates                  | Coefficients | Odds Ratio | Z value |
|-----------------------------|--------------|------------|---------|
| Age of Household Head       | 0.163(0.091) | 1.177(0.107) | 1.80 |
| Square Age of Household Head| -0.002(0.001) | 0.998(0.001) | -1.82 |
| Kembata Zone                | -0.603(0.275) | 0.547(0.151) | -2.19 |
| Years of Schooling          | -0.066(0.029) | 0.936(0.027) | -2.30 |
| Per capita Consumption      | -0.003(0.002) | 0.999(0.001) | -1.94 |
| Dependency Ratio            | 0.336(0.195) | 1.399(0.272) | 1.72 |
| Land Size, Hectare          | -0.442(0.196) | 0.643(0.126) | -2.26 |
| Tropical Livestock unit     | -0.155(0.047) | 0.856(0.039) | -3.34 |
| Non-Farm Participation      | -0.632(0.196) | 0.531(0.104) | -3.23 |
| Saving                      | -0.696(0.211) | 0.498(0.105) | -3.29 |
| Distance from Local Market  | 0.012(0.005) | 1.012(0.005) | 2.45 |
| Distance from All-season Road| 0.017(0.009) | 1.017(0.009) | 1.87 |
| Asset per capita            | -0.001(0.0003) | 0.999(0.0003) | -3.47 |
| Sickness                    | 0.609(0.310) | 1.838(0.569) | 1.96 |
| Cut1                        | -0.384       | 2.441      |        |
| Cut2                        | 1.536        | 2.438      |        |
| Cut3                        | 3.159        | 2.442      |        |

Diagnostic test results:
Parallel line test (Brant test): Chi-square (28) = 31.29, Prob > Chi2 = 0.304
Multicollinearity test (Variance inflation factor): VIF = 1.29
Model misspecification test (link test): Coefficient Std.Error Z value prob>Z
The predicted value of the outcome variable (y) 0.719 0.192 3.73 0.000
The squared predicted value of the outcome variable (y^2) 0.067 0.042 1.59 0.112

Source: Author Computation, 2022.

Note: Values in the parentheses refer to standard errors, and a, b, and c denote statistical significance at 1%, 5%, and 10%, respectively.
However, the coefficient of dependency ratio is positive and significant as it is indicated in Table 9, and this implies that as the dependency ratio increases, the probability of being at a higher level of multidimensional poverty rises. In the same vein, studies conducted by Chen et al. (2019), Joshua et al. (2017), Mei et al. (2019), and Wang et al. (2021) on determinants of multidimensional deprivation found a positive and significant association between dependency ratio and multidimensional deprivation of households. The coefficient of consumption per capita is negative and statistically significant at a 5% level of significance. This result is in agreement with the study conducted by Eze and Alugbu (2021). Moreover, land size is negatively and significantly related to rural multidimensional poverty at a 5% level of significance. This means that as land size increases, the likelihood of being at a higher level of multidimensional deprivation decreases in the study area.

Since the life and livelihood of rural people are very related to agricultural activities, access to land is considered the primary driver of rural multidimensional deprivation. Also, studies conducted by Adepoju (2018), Mare et al. (2022), Michael et al. (2019), and Tarku et al. (2021) on determinants of multidimensional poverty found that land size is negatively and significantly associated with multidimensional poverty. Yet, the coefficient of tropical livestock unit is negative and statistically significant at a 1% level of significance as is presented. That means as the number of livestock increases, the chance of being at a higher level of multidimensional deprivation decreases. This is because, in most rural areas, livestock are important sources of food and income for households.

Besides, Joshua et al. (2017), Mare et al. (2022), and Mei et al. (2019) also conducted studies on sources of multidimensional deprivation, and they found that the number of livestock is negatively and significantly related to multidimensional poverty. The distance between the road and the local market is significantly rural multidimensional poverty increasing covariates in the study area. Put differently, as the distance from the all-season road and local market increases in minutes, the probability of being at a higher level of multidimensional poverty in a rural household increases, citrus paribus. Studies conducted by Motuma et al. (2020) and Roy et al. (2018) also found similar results. Besides, the coefficients of asset and household saving are negatively and significantly related to rural multidimensional poverty at 1%, and studies conducted by Chen et al. (2019), Mishra et al. (2020), and Sameti (2019) found a similar result. In addition, non-farm participation and rural multidimensional deprivation of households are negatively and significantly related. As well, studies conducted by Gedefaw (2021), and Joshua et al. (2017) on determinants of multidimensional poverty found that non-farm participation is negatively and significantly associated with household deprivation. Finally, the coefficient of sickness is positive and significant in influencing the deprivation of rural households, and a study conducted by Gedefaw (2021) on determinants of multidimensional deprivation found a similar result.

Furthermore, the marginal effect after ordered logistic regression was estimated, and the results are presented in Table 10. For instance, as land size increases by 1 ha, the probability of being extremely poor decreases by 10.4% and is significant at 5%, citrus paribus. Similarly, as the number of tropical livestock units increases by one unit, the probability of being extremely poor decreases in the study area by 3.7% and is statistically significant at 1%. This suggests that productive agricultural assets significantly increase the welfare of rural households. But both land size and tropical livestock unit significantly increase the probability of being non-poor as indicated in Table 10.

Likewise, participation in non-farm activities significantly decreases the probability of being extremely poor by 14.9% and is statistically significant by 1%. That means the probability of being extremely poor in households who participated in non-farm activities is lower by 14.9% compared to households who did not participate in non-farm activities. Added to these, as the dependency ratio increases by one unit, the probability of being extremely poor increases by 7.9% and is statistically significant. The implication is that the dependency ratio decreases both resource and consumption per person of households, and this by itself will increase the vulnerability of
households to deprivation. As years of schooling of household head increases by 1 year, the likelihood of being extremely poor decreases by 1.6% and significantly by 5%. As presented in Table 10, the probability of being extremely poor for households from the Kembato-Tembaro zone is significantly lower by 13.7% compared to households from the Hadiya zone, and significant at 1%. Finally, the diagnostic test results in Table 9 reveal that the basic assumptions of the ordered logit model were not violated. The value of the variance inflation factor is less than 10, and this indicates that independent variables are not highly correlated. The model misspecification test of the link test also showed that the coefficient of the predicted value of the outcome variable and its squared value are statistically significant and insignificant, respectively, in influencing the outcome variable, and this implies that there is no model misspecification.

5. Conclusion
Both unidimensional poverty and multidimensional poverty are widespread and serious challenges in Ethiopia. But the extent of poverty varies across periods and geographical areas. Some previous studies have quantified the extent and examined the determinants of the global multidimensional poverty index (G-MPI) which contains only three dimensions, namely, health, education, and living standard. But this study quantified the extent and examined the determinants of the rural multidimensional poverty index (R-MPI) which contains the rural livelihood as one dimension of deprivation in addition to health, education, and living standard using the Alkire–Foster method and the ordered logistic model, respectively. Primary data were gathered from 415 random sample households in southern Ethiopia in the year 2021.

The depth of rural multidimensional poverty in the study area (57.3) is higher compared to the depth of national rural multidimensional poverty (53.2). But the incidence of rural multidimensional poverty in the study area (72.3) is lower compared to the incidence of national rural multidimensional poverty (80.2) in Ethiopia. Besides, the incidence and the severity of rural multidimensional poverty in female-headed households are higher compared to male-headed
households, while the depth of rural multidimensional poverty is higher for male head-households in the study area. Moreover, 42% of rural households are extremely multidimensionally poor with a rural multidimensional poverty index greater than or equal to 50%. The living standard and the rural livelihood dimensions are the first and the second contributors to the rural multidimensional poverty in the study area, respectively. They jointly contributed about 60% to the total deprivation of households. Besides, fuel for cooking, electricity, and housing are the primary contributors to rural poverty from the living standard dimension, while land ownership, off-farm activity, and tropical livestock units are the leading contributors to rural multidimensional deprivation from the livelihood dimension of welfare. This result disclosed the importance of the rural livelihood dimension which contains the livelihood characteristics of rural households in quantifying the extent of rural deprivation. This suggests that limited access to agricultural assets and non-farm employment opportunities in rural areas increase the deprivation of rural households by lowering their income.

Regression results revealed that years of schooling, land size, tropical livestock unit, off-farm participation, saving, and assets per adult equivalent are negatively and significantly related to rural multidimensional poverty, whereas dependency ratio, distance from the local market, distance from all-season road and sickness of family members are positively and significantly related to rural multidimensional poverty in the study areas. The regression results also showed that female-headed households are more deprived in rural multidimensional poverty than male-headed households. This result supports the structural theory of poverty which predicts that political, economic, and socioeconomic factors determine the welfare of households by affecting access to productive assets, viable employments, and public services. As well, this study suggests that rural development programs that aim at a mere increase in income of households alone cannot eradicate the deprivation of rural households. Rather, promoting access to agricultural land, electricity, safe drinking water, output and input markets, viable off-farm employment, education, and a road network would reduce rural multidimensional poverty in southern Ethiopia. However, the use of cross-sectional data and the limited number of dimensions to measure the welfare of rural households are the limitations of this study. Future research should use more dimensions of welfare such as shocks, coping mechanisms, political, and social dimensions. They also need to focus on dynamic poverty analysis or vulnerability to future deprivation than static or ex-post poverty analysis.

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Note
1. Gots are the lowest level of administration in the study area which mostly contain more than 50 households. From a total of 147 gots in all sample Kebeles, 36 sample gots were included in the study.

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