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Research Article

Multidimensional food security status of households and its determinants in Dera Woreda, North West Ethiopia

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Abstract: *The concept of food security and its measurement approach has evolved over time. Previously, food security was primarily viewed from the supply side (food availability). Today, however, food security is recognized as a multidimensional concept encompassing at least four components: food availability, access, utilization, and stability. Consequently, national and international food policymakers require information generated from multidimensional food security indicators. Despite this need, studies to date have often analyzed food security using a single dimension. This study employed a recently developed approach, called the Multidimensional Food Security Index (MFI), to analyze the multidimensional food security status of households and its determinants in Dera Woreda. The index was developed from 24 questions designed to address different dimensions of food security (quantity, quality/diversity, and acceptability). Data were collected from 205 randomly selected households, four focus group discussions, and eight key informant interviews. The findings show that 43.41%, 26.34%, 19.02%, and 11.22% of households fall into the categories of mildly food insecure, food secure, moderately food insecure, and severely food insecure, respectively, in terms of multidimensional food security. Using a multinomial logit model, household-level variables such as the age of respondents, family size, farm income, marital status, and total farm size were identified as determinants of multidimensional food security in the study area. The study concluded that, despite the production potential, food insecurity prevalence in the area is high. Therefore, to improve the multidimensional food security status of households, relevant stakeholders should undertake both short-and long-term actions, focusing on the variables identified as determinants of multidimensional food security.*

Keywords: Dera Woreda, Determinants, Food security, Multinomial logit analysis
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1. Introduction

The issue of food security and its implications remains a top priority on the agenda worldwide (Huluka and Beneberu, 2019). According to the FAO's report, an estimated 713 to 757 million people may have faced hunger in 2023, equating to one in every 11 people globally and one in every five people in Africa (FAO et al., 2024). Approximately 75% of the world's poorest population lives in rural areas, where agriculture is still the primary source of livelihood (Fróna et al., 2019). However, on average, over 20% of the rural population experiences food security issues. The demand for high-fibre foods, animal feed, and crops is continually rises, placing additional pressure on already stressed arable land and freshwater supplies (Fróna, 2020). Food security

in developing countries faces significant and complex challenges, impacting both rural and urban populations. These challenges are often rooted in economic constraints, environmental vulnerabilities, infrastructure limitations, climate change, and social factors, all of which collectively affect food availability, access, utilization, and stability (Fróna, 2020; Koyachew and Bamlak, 2021; Ike et al., 2017; Maxwell et al., 2013). Food security in Ethiopia is a critical issue. While the country has made strides in addressing the problem, many challenges persist due to factors such as climate change, population growth, agricultural limitations, and political instability. Dera Woreda, located in the South Gondar Zone of the Amhara region in Ethiopia, also faces unique food security challenges that reflect broader regional issues while being shaped by local conditions. Food security in Dera Woreda is affected by climate variability, agricultural practices, poverty, and regional conflict.

Given the emphasis on addressing food security, researchers have focused on refining its definition and measurement. As a result, the concept and measurement approach have evolved over time. In the past, food security was mainly seen from the supply side (the availability of enough food at the household or national level). Today, food security and insecurity describe whether households have access to food of sufficient quality and quantity (Mohamed, 2017). According to the FAO, food security at the household level exists when all members have access at all times to adequate and suitable food that meets their dietary needs and preferences for an active, healthy life, whether through production or purchase (Taylor, 2013). This definition implies that four essential elements such as availability, accessibility, utilization, and stability must be present for food security. Therefore, food security is a multidimensional issue, and national and international policymakers need information derived from multidimensional food security indicators.

Given the complexity of food security factors, the approach used to measure it is crucial for developing effective policies and strategies. Reliable and appropriate food security measurement is fundamental to designing robust food systems for the 21st century (Ike et al., 2017). Insufficient and non-comprehensive food security measurements can lead to shallow strategies that fail to address the various dimensions of food security. Coates (2009) demonstrated that a single food security measure cannot capture the comprehensive concept of food security and may underestimate the nature and severity of an individual's food situation.

One reason for food insecurity remains unresolved worldwide is the lack of a holistic strategy based on multidimensional food security measurement. Thus, a comprehensive understanding of food security requires the use of multiple indicators (Ike et al., 2017). Despite this, except for studies by Koyachew and Bamlak (2021), Ike et al. (2017), and Mohammed (2021), many studies on food security have used a uni-dimensional measurement approach that cannot fully address all aspects of food security (Frehiwot, 2007; Feleke and Bogale, 2009; Beyene and Muche, 2010; Muche et al., 2014; Huluka and Beneberu, 2019; Abdela, 2020). Studies assessing multidimensional food security determinants are rare in the existing literature (Gadiso et al., 2023; Ragif, 2019; Nthabeleng et al., 2024). Moreover, despite its potential for crop cultivation and livestock rearing, households in Dera Woreda have been living with varying levels of poverty and food security. To the best of our knowledge, no study has assessed the food security status of households in Dera Woreda, either through a single or multidimensional approach. A detailed investigation is needed to empirically determine food security status and its associated factors in the study area. This study was therefore initiated to fill this literature gap by undertaking a multidimensional food security analysis and identifying its associated factors in Dera Woreda.

Although a comprehensive food security measurement approach called the Multidimensional Food Security Index (MFI) was developed by Maxwell et al. (2013), few studies have applied this approach to generate data. The index was developed from seven dimensions of food security: the Coping Strategies Index (CSI), the Reduced Coping Strategies Index (rCSI), the Household Food Insecurity and Access Scale (HFIAS), the Household Hunger Scale (HHS), the Food Consumption Score (FCS), the Household Dietary Diversity Scale (HDDS), and a self-assessed measure of food security (SAFS) (Koyachew and Bamlak, 2021). The index consists of 24 questions designed to address

various dimensions of food security (quantity, quality/diversity, and acceptability). This study aims to add to the literature by providing clear procedures for applying the MFI. Using this method, the study generated multidimensional food security data intended for policymakers to help improve the food security status of households in the study area.

2. Research Methodology

2.1. Description of the study area

The study was conducted in Dera Woreda, located in South Gondar Zone of Amhara National Regional State, Ethiopia. The woreda comprises 39 kebeles, of which two are rural towns and one serves as the woreda's administrative town (urban). Geographically, Dera Woreda lies between 9° and 13°45′ North latitude and 36° and 13°45′ East longitude, covering an area of 152,524.13 hectares. The woreda falls within the Woina Dega (mid-altitude) agro-ecological zone and receives an average annual rainfall of 1,000 to 1,500 mm, with an annual temperature ranging from 13 °C to 30 °C. These conditions make the woreda suitable for both crop production and livestock rearing.

Land use in the woreda is distributed as follows: 46% is cultivable, 6% is pasture, 1% is forest or shrub-land, 25% is covered by water, and the remaining 25.9% is considered degraded or other land types. The major staple crops produced in the area include teff, millet, corn, and sorghum, while cotton and sesame serve as cash crops. Khat is also a significant cash crop in the study area.

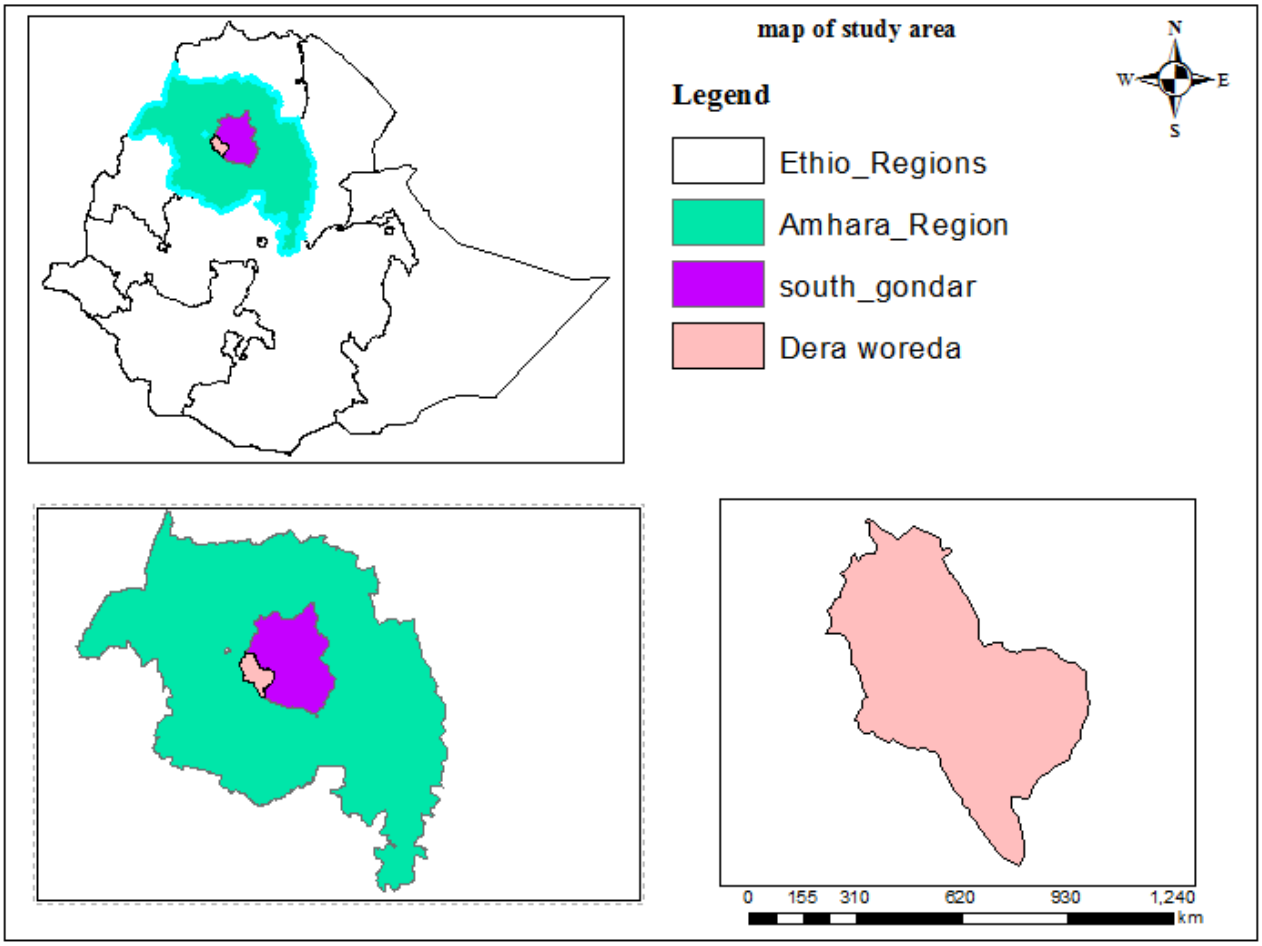

Figure 1: Geographical Location of the study area

2.2. Sampling procedure and sample Size determination

The study employed a three-stage sampling procedure to select samples representing rural households in the study area. In the first stage, Dera Woreda was purposively chosen due to its potential for crop and livestock production, as well as the researcher's familiarity with the area. Due to its productivity potential, the area is expected to be food secure. However, food availability alone does not guarantee food security and is insufficient to ensure food security, especially when studying the multidimensional nature of household food security. Thus, the researcher intentionally selected the woreda to see whether the productive potential of the area is translated into multidimensional food security or not. In the second stage, the 4 kebeles (Dewel, Goha, Hulet-Wegdama, and Emma-shnekoro) were randomly selected. In the third stage, using total household population data from the woreda, a total of 205 sample household heads were selected using simple random sampling technique based on probability proportional to the size of their household head. The sample size was determined by using Yamane's (1967) formula.

$$n = \frac{N}{1+N(e)^2} \quad [1]$$

Where N is the total number of households in the woreda, which is 149,462 and n is the sample size.

2.3. Data collection and analysis

This study mainly relied on primary data which were collected from sample respondents (205) through face-to-face interviews with the help of structured questionnaires and eight key informant interviews and four focus group discussions guided by checklists. Health extension workers and Development agents were participated in the key informant interview while the focus group discussion constituted women and men farmers. The FGD and KII techniques were mainly used to validate the econometric results and thus data about food security status awareness, livelihoods and other socioeconomic factors were collected.

Additionally, the necessary secondary data were also collected from reports and unpublished documents relevant to the study topic. The structured questionnaire encompasses the socio-economic and institutional characteristics of sample households and multidimensional food security which was adapted from Maxwell *et al.* (2013). Maxwell *et al.* (2013) developed a multidimensional household food security index (MFI) to capture many dimensions of food security and this study also followed a similar procedure to analyze multidimensional food security. Accordingly, households were categorized as "food secure," "mildly food insecure," "moderately food insecure," and "severely food insecure" depending on the response of the respondents to each MFI question (Table 1).

Table 1: Multidimensional household food security categories

Responses	MFI Categories	% of HHs in MFI categories
If Any of NOTEAT-SENDEAT = never, and PULSE and GRAIN = often, and EATSEED-NOTWNT = never, and LIMVAR- WORRY = never or rarely, and SAFS = food secure or mildly food secure, and DAIRY-VEGET = rarely or sometimes or often	Food secure	$\frac{n=1}{N}$x100
If PULSE or GRAIN = sometimes, or any of EATSEED-NOTWNT=rarely, or any LIMVAR-WORRY = sometimes, or SAFS=moderately food insecure, or any of DAIRY-VEGET= never	Mildly food insecure	$\frac{n=2}{N}$x100
If any of NOTEAT-SENDEAT = rarely, or PULSE or GRAIN = rarely, or any of EATSEED-NOTWNT = sometimes, or any of LIMVAR-WORRY=often, or SAFS = food insecure	Moderately food insecure	$\frac{n=3}{N}$x100
If any of NOTEAT-SENDEAT= sometimes or often, or any of PULSE or GRAIN=never, or any of EATSEED-WORRY=often, or SAFS=food insecure	Severely food insecure	$\frac{n=4}{N}$x100

Note: ***n*** is the number of households with MFI categories 1, 2, 3 and 4 representing food secure, mildly food insecure, moderately food insecure and severely food insecure, respectively. **N** is the total number of households in the MFI category and HHs stands households

2.3.1. Econometric model specification

To identify the determinants of the household's multidimensional food security, a multinomial logit model was employed. This model is appropriate when our dependent variable has more than two categories. In this study, the dependent variable has four categories (food secure, mildly food insecure, moderately food insecure, and severely food insecure). Ordered logit can also be used for such kinds of dependent variables but it only works for ordered/ranked dependent variables. But in this study case, we have no order-dependent variable and hence multinomial logit model was selected. Following Gujarat and porter (2009) the models can be mathematically represented as:

$$Pi = E(Yi = \frac{1}{Xi} = F(\beta 0 + \beta i Xi \quad [2]$$

$$= \frac{1}{1+e-(\beta 0+\beta i)} \quad [3]$$

$$= \frac{1}{1} + e - (\text{zi}), \text{where zi} = \beta 0 + \beta i \quad [4]$$

$= \frac{e^{-(z)}}{1+e^{-(z)}}$ is the cumulative logistic distribution functions [5]

Where P(Y=1) is the probability that the farmers fall into different MFI categories, Xi is the socio-economic factors that affect household MFI, β0 is the constant term and βi's are the coefficient of covariates. Furthermore, the qualitative data used to supplement the quantitative data which were collected from FGD and key informant interviews were interpreted and narrated the text form.

2.3.2. Description of variables and hypothesis

The dependent variable in this study was multidimensional household food security status computed following Maxwell et al. (2013) and the households were categorized as "food secure," "mildly food insecure," "moderately food insecure," and "severely food insecure".

Based on the review literature, theoretical reality, and prior knowledge of the researchers about the study area some of the common predictors that were expected to have an influence on the rural households' food security status are summarized in Table 2.

Table 2: Summary of variables and hypothesis

Dependent variables	Variable Types	Units of Measurement	Expected sign
Multidimensional food security	Categorical	1 = Food secure, 2 = mildly food insecure, 3 = moderately food insecure, 4 = severely food insecure	
Independent Variables			
Sex of HH's head	Dummy	1 male, 0 female	+
Age of a household head	Continuous	Year	-
Marital status	Categorical	1 = single, 2 = married 3 = Divorced, 4 = Widow	+
Family size	Continuous	Numbers	-
Dependent ratio	Continuous	Numbers	-
Education level of HH head	Dummy	1 = literate, 0 = illiterate	+
Credit Utilization	Dummy	1 = use credit, 0 otherwise	+
Distance from Market	Continuous	It is measured in minute	-
Use chemical fertilizer	Dummy	1 = use, 0 otherwise	+
Land size of cultivated	Continuous	Hectare	+
Livestock holding in TLU	Continuous	It is measured in TLU	+
Annual income	Continues	Birr	+
Off-farm Income	Continuous	Birr	+

HH = Household, TLU = Tropical livestock unit computed based on the conversion factor for each livestock type
Source; Adapted based on Maxwell et al. (2013), Koyachew and Bamlak, (2021)

3. Results and Discussion

3.1. Socio-economic characteristics of respondents

The results indicate that male-headed households (81.46%) make up the majority of the sample households (Figure 2). Only 18.8% of female-headed households fall into the food secure category of the MFI, compared to 28% of male-headed households. Male-headed households may produce more agricultural output than their female-headed counterparts due to greater control over resources and better access to agricultural inputs, which can contribute to food security. However, the crosstab analysis shows no significant difference in the percentage of male-headed versus female-headed households in terms of multidimensional food security status.

Most of the respondents were married (65.9%) while the remaining 25.9% and 8.2% were widowed and divorced, respectively. There is a significant percentage variation in the level of multidimensional food security across the different marital statuses of the respondents (Table 3). Regarding educational status, the majority of the sample households were illiterate. They make up 62.44% (Figure 2). In terms of MFI, a somewhat higher proportion of illiterate households fall under the food secure category than their counterparts. The distinction was also noted in the MFI category for moderately food insecurity. The percentage of illiterate families in this category is higher than that of literate ones. The chi-square result shows that there is no percentage difference in the multidimensional food security status between literate and illiterate households.

A significant number of sampled households (57.6%) did not receive credit in the 2021/2022 production year. In the severe food insecure category, the percentage of non-credit receivers is higher than their counterpart which is 13% and 9.2 % for non-credit receivers and receivers respectively (Table 3). This implies the positive contribution of credit to multidimensional food security improvement. Fertilizer is an important agricultural input that can boost productivity and enhance food security by ensuring the availability of food in the household. Despite this, a significant number of the sample households did not utilize fertilizer. Lack of access to fertilizer is the major factor claimed by respondents during the focus group discussion. One of the focus

group discussants said that "*since a few years getting fertilizer is hardly possible and its price skyrocketed when it is available*". It is a significant percentage difference between farmers who applied chemical fertilizer and did not apply it in terms of multidimensional food security at the 10% level of significance (Table 3). This implies that the soil needs additives to get ready for cultivation and households are aware of production maximization strategies.

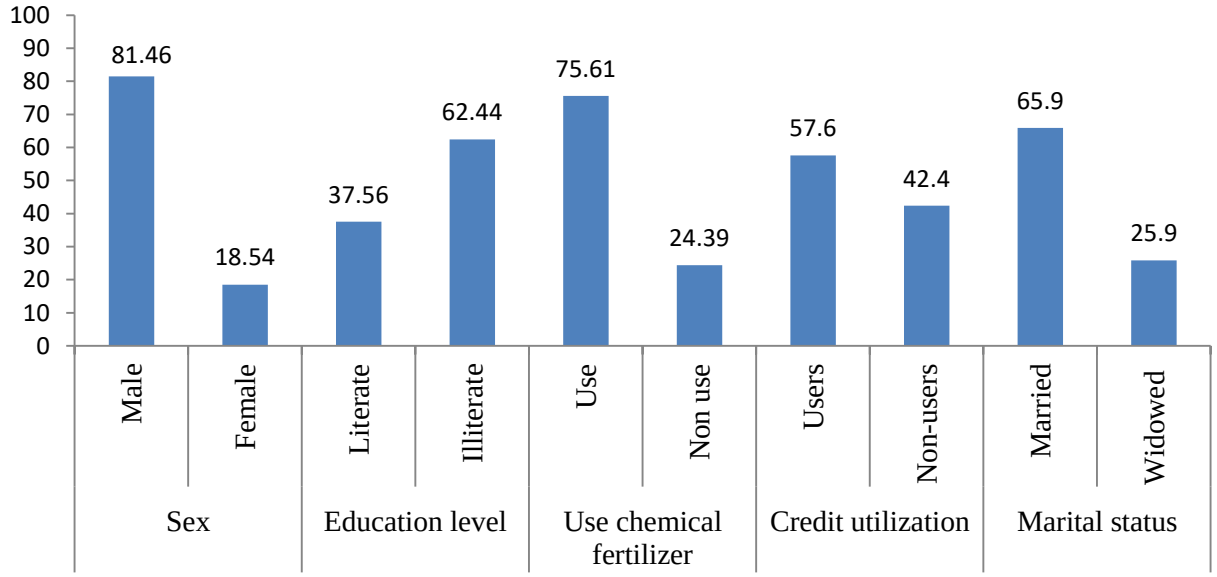

Figure 2: Percentage of the sampled households for categorical variables

Table 3: Crosstab result of dummy variables with respect to MFI

MFI		Food secure		Mildly food insecure		Moderately food insecure		Severe food insecure		Total	Chi-square
		Freq.	%	Freq.	%	Freq.	%	Freq.	%		.26
Sex of household head	Female	7	18.8	17	44.73	11	28.94	3	7.9	38	
	Male	47	28.14	72	43	28	16.7	20	11.98	167	
Education Status	Illiterate	32	25	55	42.9	28	21.9	13	10.5	128	.56
	Literate	22	17.2	34	44	11	14.28	10	12.98	77	
Credit	Non-user	32	27.11	51	43.2	20	14.3	15	12.7	118	.74
	User	22	25.3	38	43.6	19	21.8	8	9.19	87	
Chemical fertilizer	Non-users	10	20	19	38	11	22	10	20	50	.098*
	Users	44	28.4	70	45.16	28	18.6	23	8.36	155	
Marital status	Married	42	31.11	61	45.1	24	17.8	8	5.92	135	.000***
	Widowed	11	20.76	21	39.6	14	26.41	7	13.20	53	
	Divorced	1	5.88	7	41.2	1	5.88	8	47.5	17	

* and *** indicates the significant at 5% and 0.1%, respectively.

The average age of the sample households was 48 years, placing them in the middle-aged category. The mean household size was six members, with a minimum of two and a maximum of ten members (measured in adult equivalents). On average, sample households were located 100 minutes away from the main market center (Table 4). Although it is challenging to convert this into kilometers due to

varying walking speeds, a common estimate is that one kilometer takes about 12 minutes to walk. Using this estimation, the sample households are approximately 8.33 kilometers from the market center.

The primary occupation in the study area is farming, with farmers generating an average income of 37,005 Ethiopian birr (ETB) from the sale of crops and livestock. In addition to on-farm activities, farmers also earn income from off-farm activities, with respondents earning an average of 3,021 ETB from these sources. The mean farm size of the sample households is 1.17 hectares, which is slightly larger than the national average farm size of about 0.9 hectares (CSA, 2015).

The one-way ANOVA was used to see the significant mean difference between the MFI categories for the continuous variables. Accordingly, the dependency ratio and households' annual farm income were found to be significant (Table 5).

Table 4: Descriptive results of continuous variables

Variable	frequency	Mean	Std. Dev.	Min	Max
Age of Household Head	205	47.785	10.073	27	72
Farm size	205	6.015	1.474	2	10
Distance from market	205	100.073	71.473	10	360
Annual farm income	205	37005.971	17407.068	5300	85430
Off-farm income	205	3021.463	9450.217	0	60000
Total land holding size	205	1.17	.7	0	4
TLU	205	5.073	2.636	0	13

TLU = Tropical Livestock Unit

Table 5: The one-way ANOVA results of an association between a continuous variable with MFI

MFI by	Mean Square	F	Significance
Age of households	0.736	0.803	0.782
Family size	0.289	0.307	0.963
Dependency ratio	3.683	5.312	000***
Distance from market	0.815	0.916	0.557
Off-farm income	0.502	0.541	0.950
Annual farm income	1.101	3.338	000***

MFI = multidimensional food security index; ***, indicate the significance level at 0.1%

To determine the MFI category in which the significant mean difference was observed, post-hoc was employed. As a rule of thumb for this test, the last row of the post-hoc results is reviewed to identify the significant MFI difference. Accordingly, a significant mean difference in the dependency ratio was observed in the food-secure and mildly food-insecure households. The dependency ratio was computed by summing up the number of households below 15 ages and above 65 ages and dividing it by the total household members. These groups (below 15 ages and above 65 ages) are economically inactive and at the mercy of other household members. It is hypothesized that dependency ratio and food insecurity are positively related. The result aligns with the hypothesis (Table 6). However, at this stage, it is challenging to determine whether food-secure or mildly food-insecure households have higher or lower dependency ratios. We can only conclude that there is a significant mean difference between food-secure and mildly food-insecure households concerning the dependency ratio.

Similar to the dependency ratio, the ANOVA result of annual farm income is also significant, implying that there is a significant mean difference between households' food security status in terms of their annual farm income. Following the same procedure, the post hoc of annual farm income is tested to see where the significant value lies. Accordingly, there was a significant mean difference between food-

secure and mildly food-insecure households (Table 6).

Table 6: Post hoc test of dependency ratio against MFI

Multiple comparisons: Dependent Variable (Dependency ratio), Test (Tukey HSD)				
MFI	MFI	Mean Difference	Standard Error	Significance
Food secured	Mildly food insecure	-.46881*	.15264	.013
	Moderate food insecure	-1.19620*	.18596	.000
	Severe food insecure	-1.43596*	.22034	.000
Mildly food insecure	Food secured	.46881*	.15264	.013
	Moderate food insecure	-.72738*	.16993	.000
	Severe food insecure	-.96715*	.20699	.000
Moderate food insecure	Food secured	1.19620*	.18596	.000
	Mildly food insecure	.72738*	.16993	.000
	Severe food insecure	-.23977	.23265	.732
Severe food insecure	Food secured	1.43596*	.22034	.000
	Mildly food insecure	.96715*	.20699	.000
	Moderate food insecure	.23977	.23265	.732

* indicates the significant level at 5%; MFI = multidimensional food security index

Table 7: Post hoc test of annual farm income with MFI

Multiple comparisons: Dependent Variable (annual farm income), Test (Tukey HSD)				
MFI	MFI	Mean Difference	Std. Error	Sig.
Food secured	Mildly food insecure	12415.218*	2229.446	.000
	Moderate food insecure	29894.329*	2716.020	.000
	Severe food insecure	32268.829*	3218.143	.000
Mildly food insecure	Food secured	-12415.218*	2229.446	.000
	Moderate food insecure	17479.111*	2481.981	.000
	Severe food insecure	19853.611*	3023.228	.000
Moderate food insecure	Food secured	-29894.329*	2716.020	.000
	Mildly food insecure	-17479.111*	2481.981	.000
	Severe food insecure	2374.499	3397.977	.897
Severe food insecure	Food secured	-32268.829*	3218.143	.000
	Mildly food insecure	-19853.611*	3023.228	.000
	Moderate food insecure	-2374.499	3397.977	.897

* indicates the significant level at 5%; MFI = multidimensional food security index

3.2. Multidimensional food security status of households

This study intended to measure the food security status of households by using the multidimensional food security index. The MFI approach developed from a combined seven measurements of food security, namely the Coping Strategies Index (CSI), the reduced coping strategy index (rCSI), the Household Hunger Scale (HHS), the Household Food Insecurity Access Scale (HFIAS), The Food Consumption Score (FCS), the Household Dietary Diversity Score (HDDS) and Self-Assessment Food security (SAFS). These food security measurements could address the four pillars of food security (availability, access, utilization, and stability). The index consists of 24 questions ranging from any member who had not eaten any food in the past 30 days (NOTEAT) to any household that consumed any vegetables (VEGTAT).

Except for the SAFS, which is measured by a household's self-assessment of being either food secure or insecure, each question offers a similar set of four response options: frequently, occasionally

(sometimes), rarely, and never. The specific meaning of these responses varies depending on the context of the question (Koyachew and Bamlak, 2019). The multidimensional food security index (MFI) is calculated by summing the scores assigned to each frequency of response. A household can achieve a maximum score of 96 (if all 24 responses are "frequently") and a minimum score of 24 (if all responses are "never").

The households would be categorized into "food secure", “mildly food insecure", "moderately food insecure”, and "severely food insecure" based on households’ responses to every 24 questions of MFI (Maxwell et al., 2013). For instance, households were categorized as “severely food insecure” when their response to any of the first six questions was worst or second-worst (from NOEAT to SENDEAT) and any worst response to any of the next seven questions (from PULSE to NOTWNT). Whereas households were categorized under “food secure” when they provided the optimal response for questions 1–13, at least the optimal or second-best response for questions 14–19, and anything but the worst response for questions 20–24 (Koyachew and Bamlak, 2021). Similarly, households categorize as mildly food insecure when they provided the second-best response to questions 7 or 8 (PULSE OR GRAIN), 9-13 (EATSEED to NOTWNT), and 14-18 (LIMVAR to WORRY) but the second worst response to question 20-24 (DAIRY to VEGET) and moderate food insecure response for SAFS. Households lie in the moderate food insecurity when they respond to the second-best response to the first six and 9-13 MFI questions and the second worst response to 7 and 8 questions and the first worst response to 14-18 whereas the food insecure response to the SAFS question. Accordingly, the MFI result indicated that the majority (43.41% of the sampled households are under the category of “mildly food in secure”, followed by the food secure category of households (26.34%). The remaining 19% and 11.22% of the respondents are in the basket of moderately food insecure and severely food insecure categories, respectively (Figure 3). The recent study conducted by Koyachew and Bamlak (2021) found similar results where 73% of their study samples were categorized under mildly food insecure category.

Apart from the above four categories of MFI, Maxwell et al. (2013) further classify the MFI into two (food secure and food insecure). This is done by merging the food secure and mildly food insecure into food secure households and moderately food insecure and severely food insecure into food insecure households. Based on that, about 79.75% (143 households) of the sample households in the study area lies in the food secure category. The result is almost close to but less than what has been reported by Koyachew and Bamlak (2021) who found 86.5% of food-secure households.

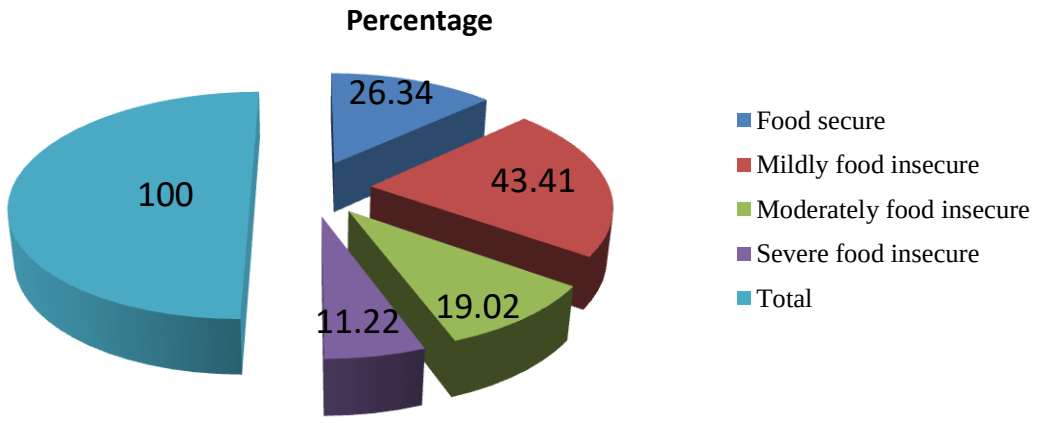

Figure 3: MFI status of the households in the study area

3.3. Determinants of household's multi-dimensional food security status

The results of the multinomial logit estimation indicate that the likelihood of households falling into different MFI categories was significantly affected by various factors. Specifically, seven out of the sixteen variables in the model influenced the probability of households being in the food-secure category. The probability of being in the second category (moderately food-insecure) was influenced by five variables, while the last category (severely food-insecure) was strongly impacted by six variables. The mildly food-insecure category was used as the base outcome or comparison group. Some variables affect all MFI categories but with varying magnitudes, significance levels, and directions. These variables are discussed in detail below.

The study hypothesized that the age of the household head would negatively affect the household's food security. However, the results contradicted this expectation and revealing a positive relationship between the household head's age and food security status at a 5% significance level (Table 8). The relative risk ratio (RRR) was 1.063 (Data to included), indicating that additional one year increase in the household head's age increased the likelihood of the household being food secure by approximately 6.3%.

This positive correlation of age with food security might be attributed to accumulated wealth of the household over time enhanced their food security status. In Ethiopia, this pattern aligns with cultural practices where people tend to save and invest in assets to ensure a secure future. This observation was supported with issues raised during the focus group discussions (FGDs). One participant, a 65-year-old male who chose to remain anonymous, shared: "*There are two golden periods for better consumption: before having children and later in old age." He elaborated, "No one will care for us unless we have accumulated wealth. Even my children may not support me. Therefore, I have saved enough to ensure my future."*

The findings of the present study contradict with the results of Salisu et al. (2016), who reported that aging negatively impacted household food security. The discrepancy could be explained by regional and cultural differences in the study areas.

The model result also indicates that age is favorable for all food security statuses. This implies that as the age of the head of a household increases, the household's food security status may change in several ways, often influenced by factors like experience, labor capacity, income stability, and access to social support. This is also supported by researchers. For example, older household heads tend to have more experience in farming practices, resource management, and food budgeting, which can positively impact food security. They might be more skilled in agricultural techniques, enabling them to achieve better yields or manage food supplies more effectively during lean periods (FAO, 2022 and Birhane et al., 2013). On the other hand, ageing often brings a decline in physical strength, limiting the ability to engage in intensive agricultural work, which could reduce productivity. This is particularly relevant in rural areas where labour is critical for food production. If there isn't enough younger labor in the household, food security could decline due to lower output (Mutabazi et al., 2018).

Family size of the households positively influenced the food secure household category but was negatively associated with the moderately food insecure and severely food insecure group of households at different levels of significance. The RRR coefficient indicates that as the family size increases by one person expressed by adult equivalent, the probability of a household falling in the food secure category increased by about 57% as compared to the base outcome (mildly food insecure households). Since the family size is interpreted by converting it to an adult ratio, the number of family sizes can serve as labour. In rural areas where the source of labour is family and the agriculture sector is labour-intensive, the positive contribution of family size to food security is not surprising. The finding contradicts with the study of Mebratu (2018), who found a negative association between household size and food security. As expressed earlier, the sign of the family size for the moderate food insecure category of MFI was negative at the 5 % level of significance (Table 8). The RRR value of this

category was 0.477 implying that the probability of households falling into the moderate food insecure group was reduced by about 0.523 or 52.3% (1-0.477) when the family size is increased by one person.

The dependency ratio was a variable that significantly affects the entire MFI category (food secure, moderate food insecure, and severe food insecure) at the same 1% level of significance (Table 8). It was negatively affecting the food secure group of the household but positively affected the moderate food insecure and severe food insecure households. The odd ratio of the model shows that the probability of the households being food secure is reduced by 72% (1-RRR value of the dependency ratio) when the dependency ratio increases by one person (Data to included). This suggests that households with a large number of economically inactive persons are less food secure than those households with a lesser number of economically inactive persons. This could be because the more significant presence of economically inactive persons tends to create pressure on the active labour force. They contribute less to production but their consumption might be high. On the other hand, the probability of households falling into the moderate and severe food insecure group increased by 9.6 and 17.77 times greater than the base outcome category. The finding is similar to that of Gemeda (2020) who reported a direct relationship between dependency ratios with food insecurity.

The distance between household residences and the market centre significantly affected the multidimensional food security of households. It negatively affected the food secure category of the households at a 5% level of significance (Table 8). The RRR value implied that as the distance from the market increased by one minute, the probability of households being in the food secure category reduced by 1%. This is also not surprising because farmers nearest to the market center are expected to have a good food security status due to, they could easily access market information and better access to agricultural inputs that have a critical role in ensuring pillars of food security. The result corroborates the finding of Usman and Daniel (2021) who reported households that are located far from market centers consumed less diverse food and spend less on food consumption than their counterparts. On the other hand, the probability of the households falling into the moderate food insecure group was high when households are at a far distance from the market center. When the distance to the market center is increased by one minute, the probability of the households to fall into moderate food insecure category is increased by 0.79%.

Another important variable that highly affects the multidimensional food security status of the household was the household's annual income. The variable positively contributes to the households being in the food secure category while negatively affecting the moderate and the severe food insecure households. The significant level for the three MFI categories of this variable was 1%. The result indicates that as the household's annual income increases by one birr, the probability of the household being in the food secure category increases by 0.0067%. It is obvious but not necessarily true that there is a positive relationship between the annual income of the household and food security, as those who earn a better annual income can purchase food and non-food items necessary for their family member. The result is in line with the finding of Misgina (2014), who revealed a positive association between annual income and food security.

Surprisingly, the study found that the total cultivated land size negatively affects households' multidimensional food security (Table 8). The results indicated that for every additional hectare of cultivated land, the probability of a household being in the food-secure category decreased by 66% compared to the base outcome. While land is a vital asset in rural areas and a key production factor, it is generally expected that households with larger farm sizes would be more food secure due to the potential for higher production. However, the findings of this study reveal a negative association between total cultivated land and food security.

Several factors could explain this unexpected result. Larger farm sizes may not translate to increased production without proper management. A large farm without sufficient labor or livestock, such as oxen for plowing, may not ensure better productivity. The

study measured total land size, which does not necessarily mean all land is suitable or actively used for production.

The results of direct observation and KIIs also confirmed the study's findings. KIIs highlighted that some farmers with large farm sizes lack the resources, such as oxen, to plow their fields. Additionally, many farmers do not use fertilizers or crop productivity-enhancing technologies, limiting their ability to optimize yields.

Moreover, focus group discussions (FGDs) and KIIs revealed that a significant portion of cultivated land is allocated to cash crops like khat and eucalyptus trees. While these crops generate income, the money earned is not consistently reinvested in purchasing edible crops to improve food security. Instead, farmers often spend their income on non-food items such as agricultural inputs, children's education, durable assets, and luxury goods. This behavior results in households having money but still facing food shortages or lacking nutritional diversity. These findings underscore that merely owning large cultivated land does not guarantee food security. Effective land use, access to resources, and the prioritization of food-related expenditures are crucial factors in achieving household food security.

The total Livestock unit (TLU) plays a significant contribution to crop production in developing countries, particularly in Ethiopia. This has great implications for ensuring food security. Similar to this fact, the finding of this study indicates that as the number of livestock increased by one TLU, the likelihood of the households being in the food secure category is 2.16 times higher than the base outcome. On the other hand, the probability of households falling into the severe food insecure category was reduced by 50% when TLU increased by one unit. The finding of Misgina (2014) also found a positive contribution of livestock to food security.

The marital status of the household also affected the multidimensional food security status. It is positively correlated with the severe food insecurity category. The result shows that as compared to the base outcome, the probability of widowed households falling into the food insecure household is 6 times higher. In other words, being married is more critical for being food secured household than the widowed and divorced households. This could be because married households are stable while they live with their spouses, which could play a positive role in helping each other and producing in a better manner than widowed and divorced households. Moreover, during divorce, there is property sharing and cost incurred for an accusation of the counterpart that negatively affects the food security status of the households. The result is similar to that of Sisay (2021), who found a positive effect of marriage with per day calorie intake.

Table 8: Multinomial logit model results

Mildly Food insecure (Base outcome)						
Variables	Food secure			Moderately food insecure		
	Coeff.	St. error	z	Coeff.	St. error	z
Age of HH	.0619018	.0295165	2.1**	.0854251	.0315976	2.7***
Family size	.4540338	.2518483	1.8*	-.7388558	.3200172	-2.31**
Dependency ratio	-1.28184	.3688151	-3.48***	2.262347	.6251413	3.62***
Distance of market	-.0088025	.0042635	-2.06**	.0078958	.0042382	1.86*
Annual farm (Birr)	.0000666	.00002	3.32***	-.0001166	.0000236	-4.94***
Off-income (Birr)	-.0000349	.0000452	-0.77	-.000035	.0000404	-0.87
Total land size (ha)	-1.070945	.5659641	-1.89*	-.1222712	.481881	-0.25
Sex of HH (Male)	-.2722271	.7310851	-0.37	-.3216457	.8685768	-0.37
TLU	.7719692	.1538485	5.02***	-.0351752	.1534966	-0.23
Education (Literate)	. .0856559	.5898804	0.15	.3730471	.6710503	0.56
Credit (Users)	-.0205502	.5635269	-0.44	-.2669645	.6129937	-0.44
Marital status						
Widowed	-.3803084	.6440288	-0.59	.9753887	.6892712	1.42
Divorced	-.8866691	1.215969	-0.73	-1.446849	1.306487	-1.11
Chemical fertilizer (Users)	-.8394621	.8137619	-1.03	.3332134	.797529	0.42
Constant	-7.998541	2.158946	-3.70***	-3.571374	2.271085	-1.57
Severe Food insecure						
Age of HH	.1229357	.0487209	2.52***			
Family size	-.7488844	.4576394	-1.64**			
Dependency ratio	2.877628	.8664912	3.32***			
Distance of market	-.0002409	.0068865	-0.03			
Annual farm(birr)	-.000147	.0000396	-3.71***			
Off-income(birr)	-.0000119	.000049	-0.24			
Total land size(ha)	.670652	.5676042	-1.18			
Sex of HH (male)	1.157498	1.357182	0.85			
TLU	-.6820979	.2592047	-2.63*			
Education (literate	1.281428	.9342081	1.37			
Credit (users)	-.8299392	.9249467	-0.90			
Marital status of						
Widowed	1.808024	1.043592	1.73*			
Divorced	1.355079	1.07697	1.26			
Chemical Fertilizer						
(users)	-.1129844	.9398946	-0.12			
Constant	-6.568807	3.944395	-1.67			
Pseudo r-squared			0.531		205	
Chi-square			277.351		0.000	
Akaike crit. (AIC)			335.305	BIC:484.841		

* and ***, indicates the significance level at 5% and 0.1%

4. Conclusions

This study examined the multidimensional food security status of households in Dera Woreda and found that, despite the area's high potential for crop and livestock production, most households are

classified as mildly food insecure. Accordingly, livestock holding, farm income, land size, dependency ratio and family size are identified as key determinants of households' multidimensional food security. Short- and long-term actions should be done to improve the food security in the area. Annual farm income was found to impact the household food security positively. Therefore, the Dera Woreda Office of Agriculture, in collaboration with kebeles, micro-enterprises, and credit providers, should expand opportunities for farmers to increase their annual income through both on-farm and off-farm activities. The Office of Gender Affairs should prioritize support for widowed and divorced women, who are particularly vulnerable to food insecurity. Including them in the productive safety net program to meet their basic needs is proposed. Interestingly, total farm size was found to have a negative impact on food security in the study area. Thus, extension service providers in collaboration with other relevant bodies should focus on land management, income allocation, and devising strategies to address this issue.

Data availability statement

Data will be made available on request.

Conflicts of interest

The authors declared that there is no conflict of interest.

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