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Article

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Determinants of livelihood diversification and its contribution to food security of rural households in Gozamin Woreda, Ethiopia

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ABSTRACT

This study was conducted to assess the determinants of rural households' livelihood diversification and its contribution to household food security status in Gozamin Woreda, Amhara region, Ethiopia. A cross-sectional research design and mixed research approach were used. Primary data were collected with the aid of household surveys, key informant interviews, and focus group discussions. A multi-stage stratified random sampling method was used to select 218 households. The Simpson diversity index result showed that 22.94%, 11.93%, 44.5%, and 20.64% of the households were no, low, average, and high livelihood diversifiers. The food consumption score result indicated that 41.28%, 10.09%, and 48.62% of households were found in poor, borderline, and acceptable food security status respectively. In addition, the ordered logistic regression model revealed that education level, agroecology, memberships of cooperative, access to training, access to transport, access to credit, agricultural risk, and total annual income positively affect while sex negatively affect the status of livelihood diversifications. The ordered logistic regression analysis also revealed that the status of livelihood diversification with has a positive and highly significant effect on the status of food security. The study concluded that when the status of households' livelihood diversification increased, the status of food security also highly increased in the study area. Therefore, to improve the status of food security, extension workers, local governmental and non-governmental organization and policymakers should give higher attention to increasing the status of livelihood diversification of rural households. Finally, policy implications were made according to the finding of the study.

IMPACT STATEMENT

Rural livelihood diversification is a key issue to improve food security. This study aims to identify the determinants of livelihood diversification and its contribution to food security of rural households. As a result, this study revealed that education level, agroecology, memberships of cooperative, access to training, access to transport, access to credit, agricultural risk, and total annual income are the determinants of rural livelihood diversification in Gozamin Woreda, Ethiopia.

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1. Background

In Ethiopia, like in many other African nations, there is an urgent need to enhance household food security. Food insecurity in Ethiopia is closely related to reliance on undiversified livelihoods based on low-input and low-output rain-fed agriculture (Kassegn & Endris, 2021). Furthermore, agriculture is the primary source of food and income for many rural households in Ethiopia, making it a critical component of initiatives aimed at alleviating poverty and achieving food security. Since the sector is faced with many challenges, rural households are compelled to develop strategies through diversification to cope with the increasing vulnerability associated with agricultural production (Abebe et al., 2021).

Moreover, in Ethiopia, undiversified livelihood alternatives and total reliance on agricultural output are the key issues that cause food insecurity in rural regions. The capacity to diversify at all is frequently

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vital to the food security of the most vulnerable rural people (Ellis & Freeman, 2004). As Zeleke et al. (2017) the limited opportunity for livelihood diversification, due to the absence of supplementary income from other non-farm activities has made the Ethiopian rural poor more vulnerable. In addition to the above, Zeleke et al. (2017) also specified the inability of most Ethiopian smallholders to make a living from agriculture, because of resource constraints and recurrent shocks, increasing policy attention has turned to support alternative livelihood activities. Similarly, the decline in the size of cultivable land is envisaged to further exasperate the currently observed worse food insecurity situation unless non-farm activities are made to compensate for the livelihood stress prevalent in the rural areas.

Further, according to FDRE (2002), rural livelihood diversification aims to reduce risk which is related to agricultural activity and to supplement farm income. Although livelihoods are predominantly agriculture-based, labor productivity is low and most Ethiopians are net cereal buyers. Because of the primary dependence on subsistence crop production in the country, harvest failure leads to household food deficits, which in the absence of off and non-farm income opportunities leads to asset depletion and, increasing levels of destitution at the household level (FDRE, 2002). Even though agriculture is the dominant economic activity and the primary source of livelihood in rural households, to solve the above problem in Ethiopia people to look for alternative employment options other than agriculture for achieving food security and reducing poverty in rural areas due to small farm size and uncontrolled population growth, agricultural production has declined over time and has forced (Abebe et al., 2021).

Nowadays, due to the issue of food insecurity is increased, to solve this problem, several scholars studied livelihood diversification and food security. As a result, related to this study in different countries different scholars at different times studied to solve the problem of food insecurity (Abebe et al., 2021; Amaka & Muhammad, 2022; Chavas et al., 2022; Dedehouanou & McPeak, 2020; Dev et al., 2016; Ebenezer & Abbyssinia, 2018; Echebiri et al., 2017; Matsuura-Kannari et al., 2023; Osarfo et al., 2016; Yazdanpanah et al., 2021; Yenesew & Masresha, 2019; Zeleke et al., 2017) Similarly related to this research in Ethiopia, some research is conducted (Asfaw et al., 2019; Challa et al., 2019; Kassegn & Endris, 2021; Weldegebriel, 2016).

Therefore, to do this research, there were three reasons. The first and major reason was by using similar and different methodologies studied at different places and times, determinates of livelihood diversification were different. For example, Bekata (2016) studied determinants of household livelihood diversification status in the Hawassa Zuria District of Sidama Zone using ordered logistic regression. He found that education, land size, extension service, membership of cooperatives, credit access, and household income positively affected household livelihood diversification, while age and family size of the household head negatively affected livelihood diversification. Gebru et al. (2018) conducted on determinants of livelihood diversification strategies in the Eastern Tigray Region of Ethiopia, using the multinomial logistic regression model. They found that the households' level of education, access to credit, income, membership of cooperatives, remittance income, farmland, access to irrigation, and access to credit positively affected households' choice and adoption of livelihood diversification strategies. Whereas age, dependency ratio, family size, access to extension services, distance to market, livestock ownership, and agroecology were found to have negative relationships and significantly affect households' choice and adoption of livelihood diversification strategies (Gao & Mills, 2018). Wondem (2020) also studied similar to this research in Degadamot District, Amhara National Regional State, Ethiopia using ordered logistic regression. He found that age, educational level, access to transport, and total annual income of household heads positively affected the livelihood diversification status of the households, whereas, land size and market distance of household heads negatively affected their livelihood diversification status. Moreover, Yenesew and Masresha (2019) studied the impact of livelihood diversification on rural household food security in Goncha-Siso Enesie woreda of Amhara Regional State using Binary logistic and PSM model they found that farm size, adult-equivalent, irrigation, and crop diversification determined diversification of household's livelihood negatively. On the other hand, cart ownership, mobile phone, and access to formal credit were statistically influencing livelihood diversification positively.

The second reason, even in Ethiopia these some researchers (Abebe et al., 2021; Wondem, 2020; Yenesew & Masresha, 2019; Zeleke et al., 2017) have done similar to this study, there is limited empirical evidence to assess factors affecting of the status of livelihood diversification and its effect on food security in a rural

household. The last reason was in the Gozamn woreda had not studied like to this study yet. Therefore, to fill these gaps the researchers studied with more focus on factors affecting the status of livelihood diversification and its relationship with food security in rural households in the Gozamn woreda, Amhara Regional State, Ethiopia.

2. Conceptual framework of the study

The review of the literature leads to the development of a conceptual framework that defines the relationship between dependent and independent variables. The conceptual framework serves as the foundation for the data-collecting process, displaying the data that must be gathered, processed, and evaluated. It connects the determining elements associated with wealth accumulation and livelihood activities to household food security. The conceptual framework for this study (Figure 1) is based on the context of the study area, which is taken from institutional, socioeconomic, and demographic variables. This framework consists of variables of household endowment that affect the behavior of these households in terms of livelihood diversification. Asset endowments have a significant effect on rural household activity participation in livelihood diversification status (Amare & Belaineh, 2013; Gebru et al., 2018). These assets serve as the foundation for a household's ability to engage in income-generating activities and livelihood diversification and also household assets are the ability to improve their status of food security (Abebe et al., 2021; Yenesew & Masresha, 2019; Zeleke et al., 2017). Therefore, based on the empirical literature evidence the assumption is dependent variables which is the status of livelihood diversification is influenced by independent variables (institutional, socioeconomic, geographical, and demographic variables) (Getinet & Lorato, 2020; Kassegn & Endris, 2021). And also as explanatory variable livelihood diversification influences the status of food security.

3. Methodology

3.1. Description of the study area

Gozamen is one of the 18 woredas in the East Gojjam zone of Amhara National Regional State. It is located in the southwest part of the zone between 37°23'50" E latitude and 37°55'03" E and 10°00'50" N and 10°

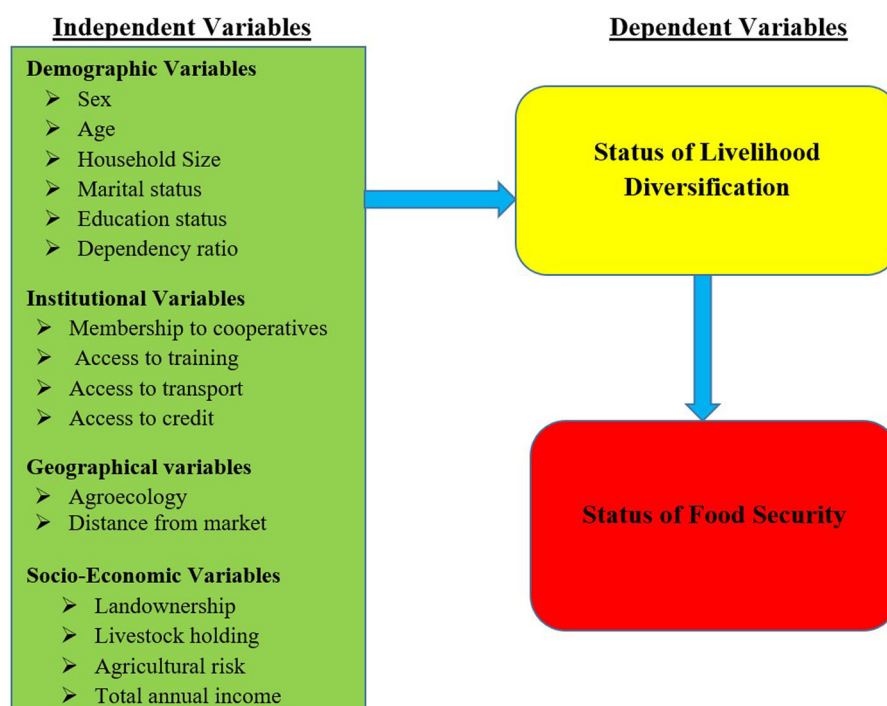


Figure 1. Conceptual Framework of the Study.
Source: Developed by authors (2023).

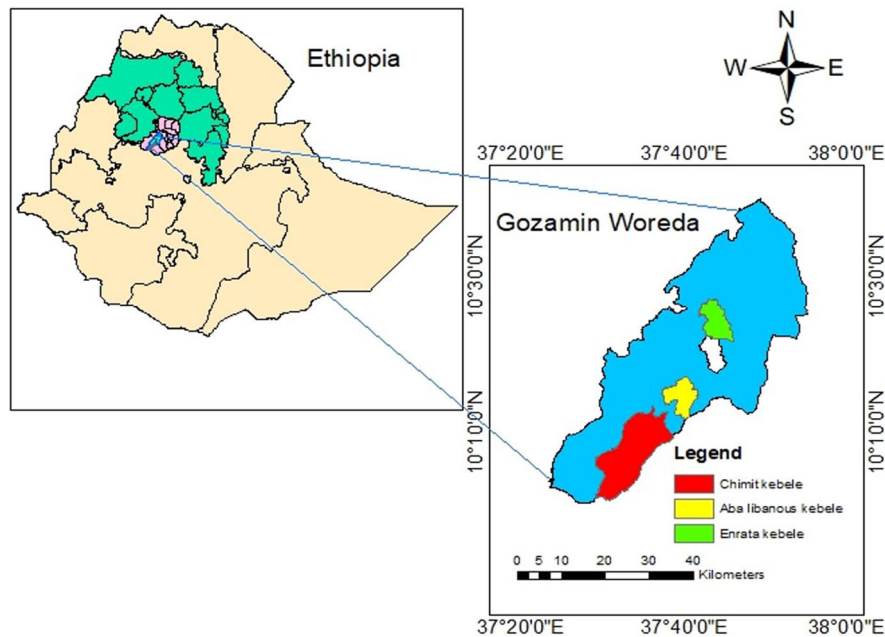


Figure 2. Maps of the study area.

Source: Authors production, 2023.

41°10' N, longitude and at a distance of 300 and 264 km from Addis Ababa and Bahir Dar, respectively (Figure 2). It has a total area of 1174 Km² (GDAO, 2022). Debre Markos is the capital of the woreda and it contains 25 rural kebeles. The woreda has a projection of a total population of 162,070 of which 80,419 and 81,651 are male and female respectively where a 4.82% of the population lives in urban and 95.18% in rural areas (GDAO, 2022). The woreda has an altitudinal difference of 1200–3510 meters above sea level. Based on these altitudinal differences, the woreda has three agro-climatic zones namely, high-land, midland, and low-land meters above sea level. The average annual rainfall of the district was 1628 mm. The maximum and minimum average temperatures are 25 °C and 11 °C, respectively.

Agriculture is the mainstay of farmers in the woreda which is characterized by mixed crop-livestock production systems (Negussie & Leul, 2006). The most important crops grown in the woreda are cereals like wheat, teff, maize, barley, and oats. Pulse crops such as horse beans and chickpeas are produced. Oil seed crops [linseed and Niger seed], Vegetables [onion, garlic, potato, tomato, pepper, and carrot], and fruits [banana, mango, papaya, orange, and lemon] are also produced in the woreda (Negussie & Leul, 2006). The woreda has a livestock population of 155,287 cattle, 97,263 sheep, 8577 goats, 25,473 equines, 56,920 poultry, and 10,019 beehives (Gashe et al., 2017).

3.2. Research design and research approach

A cross-sectional research design was used for this research. The purpose of adopting a cross-sectional research design for the study was to assess the factors that affect the status of livelihood diversification, and its contributions to food security at a given point in time. To conduct the study in a representative way and to increase its reliability and validity, both purposive and simple random sampling procedures were employed.

For this study, mixed research approaches were employed which include both qualitative and quantitative research approaches. A qualitative approach was used to gain a deep understanding of the sources of household, livelihood diversification, and opinions of households regarding how to improve livelihood diversification and ensure food security in the study areas. Semi-structured interviews and focus group discussions were carried out to gather qualitative data. The quantitative approach involves the measurement of quantity or amount and was used to quantify and see the relationship among variables. The household survey was carried out to conduct a cross-sectional study to collect data on the socioeconomic and demographic information of households, the factors that affect the status of rural livelihood diversification, and its relationships to food security.

3.3. Sampling technique and sample size determination

Sampling technique

For this study, multi-stage stratifying random sampling was used to choose the sample region and sample respondents. First, the East Gojam zone is purposively selected from the entire Amhara region zone, because the East Gojam zone was one of the highest prevalence of food insecure area because of the highly cereal-based which is a crop-producing area, and the diet of the households lacks animal source foods and vegetables (Wolelie, 2021). And then, from the entire 18 East Gojam zone woreda, the Gozamin woreda was purposively selected because, in Gozamin woreda, 49% of rural households live below the poverty line (Molla et al., 2014). And also no prior research has been conducted on the factors that effect on the status rural household livelihood diversification and its contributions to food security in the Gozamin woreda. Second, by stratifying into three strata, three rural Kebele Administrations, Enrata from 5 high-lands, Aba Libanous from 18 mid-lands, and Chimit from 2 low-land kebeles randomly were chosen from the 25 kebeles. Third, 218 sample households were chosen at random from a total of 3090 households in three different kebeles.

Sample size determination

Choucheran's formula was used to get the sample size for this study. To determine the right sample size, three criteria (parameters) must be stated. These include precision ($e = 5\%$), confidence or risk ($t = 1.96$), and degree of variability in the qualities being assessed (p) (Greene, 2017; A. S. Singh & Masuku, 2014). When p is uncertain, it is usually advisable to set it to 0.5 (Greene, 2017). However, a proportion of 50% indicates a higher level of variability than either 80% or 20% (Greene, 2017; A. S. Singh & Masuku, 2014) and a proportion of 0.5 indicates the maximum variability in a population, and it is frequently used in determining a more conservative sample size, that is, the sample size may be larger than if the true variability of the population attributes were taken into account. But, for this study, according to Molla et al. (2014), the proportion of the population to be included in the sample is 9.5%.

$$\text{Therefore } n = \frac{t^2 p(1-p)}{e^2} = \frac{(1.96)^2 0.095(1-0.095)}{(0.05)^2} = 132$$

where $t = 1.96$, $P = 0.095$, $q = 1 - p$, $e = 0.05$

Considering the design effect as 1.5 from the multi-stage stratifying random sampling technique and a non-response rate of 10%, the total sample size becomes $(132 + 10\%) * 1.5 = 217.8 \approx 218$.

3.4. Method of data collection

This study used both quantitative and qualitative data which was collected from both secondary and primary sources.

Primary data source

Primary data was collected by using the household survey to collect quantitative data and also focus group discussion, and key informant interviews were used to gather qualitative data. A household survey was used to collect quantitative data. The questionnaire was pre-tested with randomly selected 10 male-headed and 10 female-headed households who were not members of the sampled households. In addition, key informants interview were employed with purposively selected local leaders, extension workers, elders and credit and saving association leaders. Furthermore, Focus Group Discussion (FGDs) were per kebele engaging 8 participants.

Secondary data source

In addition to primary data collection techniques, intensive desk reviews of published and unpublished literature such as journals, books, articles, thesis, dissertations, and reports of relevant offices to get information on the total population living in the study area and the numbers of household live in three kebeles were used.

3.5. Method of data analysis

Quantitative data analysis method

The raw quantitative data collected from the household survey was edited, coded, entered, and analyzed using Excel and STATA-17 software. To analyze the collected data the study used descriptive statistics and inferential statistics. Descriptive statistics such as frequency, percentage, minimum, maximum, mean, and standard deviation, and tables, and bar graphs were used to summarize and present the data in a manageable form, and to describe the socioeconomic characteristics and types of livelihood strategies of sample households. Likewise, in inferential statistics, the chi-square test and F- test were used to show the relationship or mean difference between a group of variables or pair of variables for categorical or dummy, and continuous variables respectively. Simpson Diversity Index and Food Consumption Score were used to measure the status of livelihood diversification and status of food security respectively. Spearman's rank correlation analysis was used to test the relationship between the status of livelihood diversification and the status of food security because these two variables are ordered. And also the Ordered Logistic Regression Model was employed to identify the determinants of livelihood diversification and examine the effects of livelihood diversification on the status of food security in rural households.

Qualitative data analysis method

For this study, the thematic analysis method was used to analyze the qualitative data in a qualitative form about rural households' perceptions, opinions, and understandings of the status of food security in the study area, types of livelihood strategy activity, the determinates of livelihood diversification, the status of livelihood diversification, and the relationships of livelihood diversification and food security status in rural households in the study area. Because, the thematic analysis was used to analyze data obtained from focus group discussions and key informant interviews and also it was used to support, and triangulation.

3.6. Livelihood diversification and food security analysis method

The Simpson Diversity Index (SDI) was used to measure the status of livelihood diversification. Among the several indices available, this study prefers SDI over the various methods because it considers both the number of sources of livelihood income as well as how equally the income distributions amongst the different sources are distributed. SDI has a value between 0 and 1. Thus, zero represents specialization (having only one source of income, where $Z = 1$), while one represents the extreme of diversification. Furthermore, SDI was chosen due to its wider application, computational simplicity, and reliability in capturing household income from livelihood diversification.

Therefore, $SDI = 1 - \sum_{i=0}^n Z^2$

where: SDI is a measure of livelihood diversification and Z is the income share of each activity, and Z is expressed mathematically as $Z = \frac{k_i}{K_t}$ n is the number of income sources; k_i is the income from each activity, and k_t is the household's total livelihood diversification strategy income. When SDI is less than 0.01 there is no diversification; between 0.01-0.25 low diversification, Between 0.26-0.50 average diversification, and When greater than 0.50 there is high diversification (Aboaba et al., 2019; Addisu, 2017; Ahmed et al., 2018).

For this study, food consumption score was used to measure the status of food security of households because as stated by Jones et al. (2013) food consumption score is very important for monitoring food security measures and it needs to be low cost to collect data. FCS also helps us to assess the linkage between dietary diversity and household food access (WFP, 2008). The food consumption score is a food security metric that considers the diversity, quantity, and adequacy of food intake. It is a frequency-weighted dietary variety score determined using a 7-day recall of the frequency with which a family consumed eight food types (i.e. staples (2), pulses (3), vegetables (1), fruits (1), meat/fish/egg (4), milk (4), sugar (0.5) and oil (0.5)). The frequency of food intake should not exceed 7 times the number of recall periods.

The FCS is calculated by multiplying each food intake frequency by its weights (which are given in brackets above) and then summing them. The score goes from 0 to 112, with 0 indicating that a family did not consume any food in the previous 7 days and 112 indicating that the household ingested each food category every day for the previous 7 days. According to WFP (2008), for this study, the 21 and 35 criteria were used to

evaluate food security status. As a result, everything below 21 is regarded bad or poor, anything over 35 is considered good or acceptable, and anything between 21 and 35 is considered borderline (WFP, 2008).

3.7. Econometrics model (ordered logistic regression model)

In this study Ordered logistic regression model was used to examine the determinants of rural households' livelihood diversification. The ordered logistic regression model is used to predict an ordinal dependent variable given one or more independent variables. An ordinal variable is a categorical variable for which there is a clear ordering of the category levels. The explanatory variables may be either continuous or categorical (Parry, 2020). In this study, the dependent variable is livelihood diversification status, which includes, income sources of livelihood strategies activities from on-farm only, off-farm, non-farm, on-farm + off-farm, off-farm + non-farm, on-farm + non-farm, and onfarm + off-farm + non-farm based on the cut point used by Aboaba et al. (2019), Addisu (2017), and Ahmed et al. (2018): ($y < 0.01$) no diversification, ($y = 0.01 - 0.25$) low diversification, ($y = 0.26 - 0.50$) average diversification, and ($y > 0.50$) high diversification.

Based on the conceptual and empirical literature review, explanatory variables which have been logical and rationale in influencing status livelihood diversification in rural households are identified. Thus, this section presents the independent explanatory variables of the study with their hypothesized influence on the dependent variable.

Dependent variables

Livelihood diversification status is a dependent categorical variable and indicates the level of livelihood diversification of a household engaged in on-the-farm, off-farm, nonfarm, on-farm + off-farm, on-farm + nonfarm, off-farm + non-farm, and on-farm + off-farm + nonfarm income-generating activities (Wondem, 2020). It is measured by Simpson Diversification Index (SDI) as ordered values with four levels of categories such as "No diversification ($SDI \leq 0.01$); Low level of diversification ($SDI = 0.02-0.25$); Average level of diversification ($SDI = 0.26-0.50$) and high level of diversification $SDI > 0.50$) because it has wider application, computational simplicity, and reliability in capturing household income from livelihood diversification (Aboaba et al., 2019; Ahmed et al., 2018).

Household food security

Household food security is a categorical variable. It was measured by using food consumption scores. It is a dependent variable and was examined by taking livelihood diversification status as an explanatory variable.

Explanatory variables

Based on the information obtained from an in-depth review of both theoretical and empirical literature on similar topics of this study, the potential explanatory variables of livelihood diversification status are identified, and described, and their relationship with the dependent variables is presented in Table 1.

The effect of explanatory variables on livelihood diversification status was estimated with the ordered logit model, because livelihood diversification status outcome was ordered or ranked.

For more than one independent variable, the ordered logit model can be written as:

$$Y^*_i = \sum_{j=1}^J \beta_j X_{ji} + \varepsilon = Z_i + \varepsilon$$

Y^* = livelihood diversification status of households (0, 1, 2, 3)

Prob ($Y_i = j$) = J = livelihood diversification status of households in the order set as:

$j = 0$, if no livelihood diversification;

$j = 1$, if low diversification;

$j = 2$, if average livelihood diversification, and

$j = 3$, if high livelihood diversification.

Table 1. Definition and relationship of variables.

Variable	Definition	Variable type	Measurement	Expected effect	Reference
SEX	Sex of household head	Dummy	1 if male, 0 female	-	(Amare & Belaineh, 2013)
AGE	Age of household head	Continuous	Years	+	(Zeraï & Gebreegziabher, 2011)
HHsize	Household size	Continuous	Number of household members	+	(Amare & Belaineh, 2013; Zeraï & Gebreegziabher, 2011)
EDU	Education level of the household head	Categorical	1. No educated 2. Informal 3. Primarily 4. Secondary & above	+	(Akinyemi et al., 2021)
MRTS	Marital status of household head	Categorical	1.single,2.married,3.divorced,4.widowed	+	(Muluneh, 2022)
LAOWS	Land ownership of household	Continuous	Land held by the household in Hectare	+	(Akinyemi et al., 2021)
ACT	Access to training	Dummy	Yes/no, 1 if yes, 0 otherwise	+	(Aragie & Genanu, 2017)
DM	Distance from market	Continuous	Kilometer	-	(Daniel et al., 2016)
ACRT	Access to credit	Dummy	Yes/no, 1 if yes, 0 otherwise	+	(Akinyemi et al., 2021, Muluneh, 2022).
MSCO	Membership to cooperative	Dummy	Yes/no 1 if yes, 0 otherwise	-	(Abebe et al., 2021)
DR	Dependency ratio	Continuous	number of non-working force/number of working adults	-	(Aragie & Genanu, 2017).
TLU	Livestock Holdings	Continuous	TLU	+	(Zelege et al., 2017)
ACTR	Access to Transport	Dummy	Yes/no 1 if yes, 0 otherwise	+	(Wondem, 2020)
Agroso	Agricultural Shock	Dummy	Yes/no 1 if yes, 0 otherwise	+	(Ellis & Woldehanna, 2005)
Agroeco	Agroecology	Categorical	Low, mid, and high land	+	(Yenesew & Masresha, 2019)
TINCOM	Annual Total Income	Continuous	ETB	+	(Gebru et al., 2018; Wondem, 2020)

Source: Author compilation based on literature (2023).

Note: + = positive relationship; - = negative relationship.

3.8. Ethical issues of the study

The ethics committee of Institute of Disaster Risk Management and Food Security Studies in Bahir Dar University assesses and approves the research methodology and ethical issues of the study. Furthermore, verbal consents were found for household survey, key informants interview and focus group discussion participants. Data of the study were used in compliance to the ethical standards of a scientific study.

4. Results and discussion

4.1. Type of livelihood strategy activity

In the study area, rural households engaged in different combinations of livelihood strategy activities. As can be seen from the survey results in Table 2, in the study area out of 2018 sampled households, 42(19.27%) participated in only on-farm livelihood strategy, 7(3.21%) households participated in non-farm livelihood strategy, 48(22.02%) households were participated in both on-farm + off-farm livelihood strategy, 52(23.85%) households were participated in both on-farm + non-farm livelihood strategy, 18(8.26%) households have participated in both off-farm + non-farm livelihood strategy, and the rest 51(23.39%) respondents engaged into on-farm + off-farm + non-farm livelihood strategies. This study is in line with the study of Getinet and Lorato (2020).

Similarly to the above, as pre result of three FGD interviews such as Chemet, Abalibanous, and Enrata kebeles also explained that:

“Households in the study area engaged in a variety of livelihood strategies, including on-farm activities (crop production and animal production activities, poultry production, and beekeeping), off-farm activities (local daily wage labor at the village level, agricultural work at another person’s farm in exchange for a portion of the harvest in kind, and selling firewood and charcoal), non-farm activities (handicraft activities like carpentry and house remodeling), and petty trade (grain trade, fruit trade, and vegetable trade). Transfers of goods and remittances both inside and within the country” (FGD, 2023).

4.2. Status of livelihood diversification

As indicated in Table 3 below livelihood diversification status was calculated by using the Simpson diversity index (SDI). The second specific objective is intended to be addressed here. Accordingly; the SDI result revealed that the majority 97 (44.5%) of the households typically diversify their livelihood on average (0.26-0.50). The percentage of no, low and high diversifiers were 50(22.94%), 26(11.93%), and 45(20.64%) respectively. The mean SDI among the households was 0.331 which implies that the majority of the households averagely diversify their livelihood. This result is in agreement with the findings of Aboaba et al. (2019). As compared with the result of other previous studies, the result is less than the mean livelihood diversification score of 0.5775 (Addisu, 2017), and 0.34 (Wondem, 2020) in Ethiopia.

Table 2. Types of livelihood strategy of household.

Types of livelihood strategy of household head	Freq	Percent	Cum
on-farm only	42	19.27	19.27
non-farm	7	3.21	22.48
on-farm + off-farm	48	22.02	44.50
on-farm + non-farm	52	23.85	68.35
off-farm + non-farm	18	8.26	76.61
on-farm + off-farm + non-farm	51	23.39	100.00
Total	218	100.00	

Source: Own survey result (2023).

Table 3. Status of livelihood diversification.

Status of livelihood diversification	Frequency	Percent	Mean	Min	Max
No-diversification (<0.01)	50	22.94	0	0	0
Low-diversification (0.01-0.25)	26	11.93	0.176	0.088	0.245
Average diversification (0.26-0.5)	97	44.50	0.402	0.261	0.5
High-diversification (>0.5)	45	20.64	0.633	0.501	0.667
Total	218	100	0.331	0	0.667

Source: Own survey result (2023).

As per the result of focus group discussions and key informant interviewees, several factors hinder households' livelihood diversification in the study area. These include; access to credit, access to transport, lack of resources, lack of awareness, inability to promote a culture of work on different activities, and agroecology. As a result, the livelihood diversification status of households in the study area is not as high score 0.5775 Addisu (2017), and 0.34 Wondem (2020) in Ethiopia.

One key informant from the Credit and Savings Association said that;

Because of the frustration of the high credit interest rate; households don't want to take credit to improve their livelihood diversification status. They want to rely on their only agricultural livelihood diversification which means no diversification. Even though some of the households have got access to credit, the status of livelihood diversification is low because they are used for daily consumption rather than diversifying their livelihood and improving their status of food security. This made them being trapped by food insecurity easily. They worry about their daily consumption rather than enhancing their capacity to escape from food insecurity (KII, 2023).

Furthermore; regarding the status of livelihood diversification from FGD in Chimit Kebele said that.

Our status of livelihood diversification is low because we do not have the resources, we do not have access to credit, my living area is not able to diversify my livelihood because we are living in low-land area, and also still we didn't take training on how to diversify my livelihood (KII, 2023).

Contrary to the above, FGD participants from Abalibanous Kebele, participants who are living in the mid-land area spoke the following;

Our status of livelihood is average, we have been educated up to grade 8, we have got access to credit, we have got access to transport and we are using it to diversify our livelihood into different livelihood strategies rather than relying on only one type of livelihood strategy which depends on only on-farm activities to survive agricultural risk and to increase my income and then to improve my status of food security (FGD, 2023).

It is also possible to show the household Simpson diversity index on a continuous scale by using a kernel density graph (Figure 3). Therefore, the following graph shows the distributions of the overall Simpson diversity index. This graph simply implies some rural households have a probability to respond to the phenomenon than others. Particularly, significant segments of households score more than the mean value, indicating that variation in Simpson diversity is driven mostly by the upper part of the distribution, i.e. by households that are supposed to perform much better than the mean.

4.3. Determinants of household livelihood diversification status

Before analyzing the econometric data, this study conducted the entire necessary model diagnosis test including the model specification test for the overall model fit (goodness of fit), multi-collinearity problem, and link test or test for a model specification error test. The explanatory variables were checked for the existence of multi-collinearity or association between the dependent variables to identify the determinant factors affecting household livelihood diversification status by using the contingency coefficient

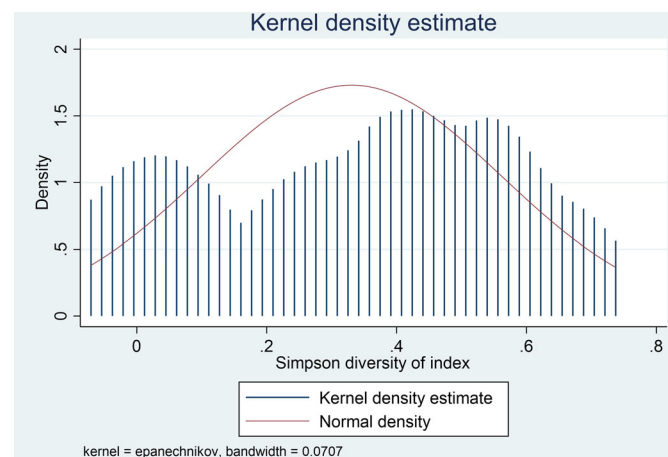


Figure 3. Distribution of Simpson Index of Diversity.

Source: Own survey result (2023).

and variance inflation factor (VIF) for dummy or categorical and continuous independent variables respectively. The contingency coefficient value ranges between 0 and 1, and as a rule of thumb variable with a value below 0.75 shows a weak association, and the value above it indicates a strong association of variables. A contingency coefficient value of 0.75 or above indicates a stronger relationship between explanatory variables and shows the presence of multicollinearity (Gujarati, 2022). Since the value for dummy or categorical variables was less than 0.75 that did not suggest a multicollinearity problem.

The larger value of the variance inflation factor (usually values equal to 10 or above) indicates a serious multicollinearity problem and a variance inflation factor of less than 10 is believed to have no multicollinearity. Variance Inflation Factor (VIF) as the rule of thumb, (a variable those have 1 VIF not correlated, between 1-5 moderately and greater than 5 have highly correlated) (Mooi et al., 2018). From this respect, the mean of VIF was 1.73 has medium colinearity for each variable. Multicollinearity indicator- VIF ranged from 1.29 to 2.41 and the Tolerance Index ranged from 0.414 to 0.774. As a result, it suggested that regression coefficients did not suffer from Multicollinearity among the independent variables. Hence, all explanatory variables were used for estimating the model. Furthermore, the Pseudo R^2 result (0.7660) indicates that the ordered logit model was observed as an appropriate measure of the predictive power of ordered response models. This implies 76.6% of the variation in livelihood diversification was explained by the model. According to K. Singh (2007), Pseudo R^2 of above 75 percent is very good; 50–75 percent is good; 25–50 percent is fair, and below 25 percent is poor in the given case, the model can be termed as very good.

As explained by Gay (2010) chi-square value criteria were also used to evaluate the effectiveness of the model. The result revealed that the chi-square value of ($X^2 = 426.58$, $p = 0.000$) shows that variables in the model are fit to explain the livelihood diversification status of households, also the value of the probability of chi-square of $p = 0.000$ shows the overall significance of the model at 1% probability level ($p < \mu_2 < \mu_3$ implies that these categories are ranked in an ordered way (Qushim et al., 2015).

The survey result of ordered logistic regressions showed that the livelihood diversification status of households is significantly influenced by nine explanatory variables such as sex of household head, educational status of household head, agroecology, memberships of cooperative, access to training, access to transport, access to credit, agricultural risk, and total annual income, all significant variables which affect the livelihood diversification status of households. However, other variables like the age of the household head, marital status of the household head, family size, dependency ratio, distance from the market, land ownership of the household head, and Tropical Livestock Unit were statistically insignificant for the livelihood diversification status of households in the study area (see Table 4).

Table 4. Determinants of rural household status of livelihood diversification.

Variables	Odds ratio	Std. Err	P> z	Marginal effect (dy/dx) status of livelihood diversification			
				No	Low	Average	High
SEX	0.227	0.196	0.086*	0.017	0.034	0.190	−0.070
AGE	0.958	0.031	0.185	0.000	−0.001	0.001	−0.002
MRTS	0.77	0.386	0.601	0.003	0.006	0.003	−0.012
EDE	13.424	6.978	0.000***	−0.030	−0.060	−0.030	0.122
HHSIZE	0.843	0.164	0.382	0.002	0.004	0.002	−0.008
DR	0.805	0.497	0.725	0.002	0.005	0.003	−0.010
Agroecology	5.984	3.292	0.001***	−0.021	−0.041	−0.022	0.084
MSCO	5.855	4.345	0.017**	−0.020	−0.041	−0.022	0.083
ACT	14.874	12.123	0.001***	−0.031	−0.062	−0.034	0.127
DM	0.9	0.063	0.132	0.001	0.002	0.001	−0.005
ACTR	17.117	12.561	0.000***	−0.033	−0.065	−0.035	0.133
ACRT	5.717	4.207	0.018**	−0.020	−0.040	−0.022	0.082
LAOWS	0.997	0.576	0.996	0.00003	0.000067	0.000036	−0.000138
Agrisk	9938.506	16290.398	0.000***	−0.106	−0.211	−0.115	0.432
TLU	0.996	0.141	0.975	5.03e-5	0.0001	5.47e-5	−0.0002
TINCOME	1	0	0.000***	−6.32e-7	−1.27e-6	−6.88e-6	2.59e-6
Number of obs = 218				Log likelihood = −65.170992			
LR chi2(16) = 426.58				Pseudo R ² = 0.7660			
Prob > chi2 = 0.0000				Conf.interval = 95%			

*** $p < .01$, ** $p < .05$, * $p < .1$ indicate significance at less than 1% and 5% and 10% probability levels respectively.

Source: - Own survey result (2023).

The result of the ordered logistic regression model revealed that the educational level of the household head had a positive association with livelihood diversification status at $P < 0.01$ or 1% ($P = 0.000$) significant level. This implies that as the level of education increased by one unit, the odds of the status of livelihood diversification increased by 13.424, given that all other variables in the model are held constant. The positive coefficient of education agrees with the results of Gebbru et al. (2018), Tizazu et al. (2018), Wondem (2020), Zeleke et al. (2017), and Zerihun (2017) indicated as education gives individuals access to many different economic activities, either as a formal requirement for wage-earning jobs or because it helps them set up and manage their small businesses. The positive sign also indicated that when the level of education increases the level of livelihood diversification also increases. This result is also consistent with the works of Akinyemi et al. (2021) where the level of education was found to be an important determinant factor of the level of livelihood diversification.

The marginal effect result of educational level revealed that as the educational level of the household head increased by one year, keeping other variables constant, the probability of the status of livelihood diversification found in no, low, and average decreased (less likely) by 3%, 6%, and 3% respectively (Table 4). They stated that educated persons specialized in one activity rather than diversification. On the other hand, keeping the influence of other variables constant, as the educational status of a household head increased (more likely) by one year, the probability of being high livelihood diversification status increased (more likely) by 12.2% in Table 4. This result is in harmony with the study of Gecho (2017) and Muluneh (2022) which indicated that educated persons have better skills, experience, knowledge, and capability to search for different sources of income and jobs. Besides this, the result agrees with the prior findings of Ahmed et al. (2018).

As per the result shown in Table 4, agroecology affected the status of livelihood diversification of the household's head positively at $P < 0.01$ or 1% ($P = 0.000$) probability level. The positive sign indicates that the level of agroecology increases more likely, and the odds of the status of livelihood diversification is 5.984 times greater, Keeping all other variables in the model held constant. This implies that, when households live in better level of agroecology, the status of household livelihood diversification is increase. This result contradicts the result reported by Gebbru et al. (2018). Keeping other variables in the model constant, the marginal effect result indicated that agroecology increased more likely, the status of livelihood diversification no, low, and average diversifier households decreased less likely by 2.1%, 4.1%, and 2.2% respectively. On the other hand, keeping other influence variables constant, the agroecology increased more likely, and the marginal effect indicated that high livelihood diversification status increased more likely by 8.4%. This indicates that, when households live in high-land, the status of household livelihood diversification is increase.

Membership of cooperatives has a positive and significantly affect the status of diversification of households at less than a 5% level of significance. The positive sign indicates that for one unit increase in memberships of cooperatives, the odds of livelihood diversification status are 5.855 times greater, given that all other variables in the model are held constant. This result is in harmony with the study of Gebbru et al. (2018); Kassie et al. (2017); and Tizazu et al. (2018) and contradicts the study of Zeleke et al. (2017). The marginal effect result indicated that access to memberships of a cooperative of the households increased by one unit, keeping other variable influences constant, and the livelihood diversification status of no, low, and average diversifier households decreased by 2%, 4.1%, and 2.2% respectively. On the other hand, other factors in the model being constant, the marginal effect result revealed that access to membership to cooperative households increased by one unit, and the livelihood diversification status of high diversifier households increased by 8.3%.

Access to training has a positive and significantly affect the status of livelihood diversification of households at less than a 1% level of significance. The positive sign indicates that for one unit increased in access to training, the odds of livelihood diversification status is 14.874 times greater, given that all other variables in the model are held constant. This result is in harmony with the study of Getinet and Lorato (2020). This result contradicts the result reported by Bealu (2019), Gebbru et al. (2018), and (Tizazu et al., 2018), who noted that access to training has a negative and significant effect on the status of livelihood diversification of households at less than a 1% level of significance. The marginal effect result showed that as access to training of the households increased by one unit, keeping other variable influences constant, the livelihood diversification status of no, low, and average diversifier households was

decreased by 3.1%, 6.2%, and 3.4% respectively. On the other hand, other factors in the model being constant, the marginal effect result revealed that access to training of household increased by one unit, and the livelihood diversification status of high diversifier households was increased by 12.7%.

Access to transport positively and significantly affects the households' livelihood diversification status at less than a 1% level of significance. The positive sign indicates that for one unit increased in access to transport, the odds of livelihood diversification status is also increased by 17.117, given that all other variables in the model are held constant. This result is in agreement with the study (Wondem, 2020). Keeping other variables in the model constant, the marginal effect result indicated that as access to transport of the households increased by one unit, the livelihood diversification status of no, low, and average diversifier households decreased by 3.3%, 6.5%, and 3.5% respectively. On the other hand, other factors in the model being constant, the marginal effect result revealed that access to transport of household increased by one unit, and the livelihood diversification status of high diversifier households was increased by 13.3%. This result revealed that the households' access to transport strongly and positively affected their livelihood diversification status. This implies that households that have good transport access were more likely to diversify their livelihood into on-farm; off-farm and non-farm livelihood activities because they can easily move into different places and market centers, sell their animal and crop products as well as their labor to different on-farm, off-farm and non-farm livelihood activities.

Access to credit positively and significantly affects the status of livelihood diversification of households at less than a 5% level of significance. This result is in agreement with the study of Derbe (2020), Gebru et al. (2018), and Tizazu et al. (2018). Other factors in the model being constant, the marginal effect result indicated that as access to credit of the households increased by one unit, the livelihood diversification status of no, low, and average diversifier households decreased by 2%, 4%, and 2.2% respectively. On the other hand, other keeping other variables constant, the marginal effect result revealed that as access to credit of household increased by one unit, the livelihood diversification status of high diversifier households increased by 8.2%.

The agricultural risk is positive and significantly affected the status of livelihood diversification of households at less than a 1% level of significance. The positive sign shows that for one unit increased in agricultural risk, the odds of livelihood diversification status is 9938.506 times greater, given that all other variables in the model are held constant. The marginal effect result indicated that as the agricultural risk of the households increased by one unit, keeping other variable influences constant, the livelihood diversification status of no, low, and average diversifier households was decreased by 10.6%, 21.1%, and 11.5% respectively. On the other hand, other factors in the model being constant, the marginal effect result revealed that the agricultural risk of households increased by one unit, and the livelihood diversification status of high diversifier households increased by 43.2%.

The total annual income of the households positively and significantly affected the status of livelihood diversification at 1% levels of significance. The positive sign indicates that for one unit increased in total annual income of households, the odds of livelihood diversification status is also increased by 1, given that all other variables in the model are held constant. This result is in harmony with the study of Gebru et al. (2018); Gebreyesus, 2016; Tizazu et al., 2018; Wondem, 2020). The result indicated that households with high annual income have a higher probability of choosing and diversifying their livelihood into high-income return off-farm and non-farm livelihood activities. However, households with low income were less likely to diversify their livelihood into off-farm and non-farm activities. The reason is that households with adequate income sources could overcome financial constraints initially to enter into off-farm and non-farm livelihood activities.

Keeping the effect of all other variables in the model constant, the marginal effect result revealed that as the total annual income of the households increased by one unit or increased by one Ethiopian birr, the livelihood diversification status of no, low, and average diversifier households decreased by 0.0000632%, 0.000127%, and 0.0000688% respectively. On the other hand, other factors in the model being constant, the marginal effect result revealed that the annual income of households increased by one birr, and the livelihood diversification status of high diversifier households was increased by 0.000259%.

4.4. Food security status of households

According to WFP (2008), for this study, the status of food security of households was calculated by food consumption score. As a result, everything below 21 is regarded bad or poor, anything over 35 is considered good or acceptable, and anything between 21 and 35 is considered borderline (WFP, 2008). Therefore, as shown in Table 5, from the total sample of households 218, 90(41.28%), 22(10.09%), and 106(48.62%) were found to be poor, borderline, and acceptable of the status of food security of rural households respectively. Furthermore, as shown below in Table 5 in low-land (Chimit kebele) from a total of 50 (100%) sample of households 36 (72%), 4 (8%), and 10 (20%) were found in poor, borderline, and acceptable of the status of food security of rural households respectively. In mid-land (Abalibanous kebele) from a total of 95(100%) sample of households 52 (54.74%), 14(14.74%), and 29 (30.53%) were found in the poor, borderline, and acceptable status of food security of rural households respectively. In high-land, (Enrata kebele) from a total of 73(100%) sample of households 2(2.74%), 4 (5.48%), and 67 (91.78%) were found in the poor, borderline, and acceptable status of food security of rural households respectively in Table 5. The mean FCS among the households is 27.15 which indicates that the majority of the households are borderline status of food security.

Based on the findings of KII households living in different agroecology zone, even though some households were living in poor and acceptable status of food security, most of the households are living in borderline status of food security in the study area.

4.5. Effects of households' livelihood diversification on food security

Under this subsection, to examine the effect of livelihood diversification on the food security status of households in the study area, by taking livelihood diversification status as an explanatory variable and the status of food security as a dependent variable, the study used a similar model to the above second subsection (ordered logistic regression model).

The survey result shows that from the total of 50 (22.94%) no livelihood diversification status of households 48 (53.33%), and 2(9.09%) were only found in the poor and borderline status of food security respectively. From the total of 26 (11.93%) low livelihood diversification status households 23 (25.56%), and 3 (13.64) were only found in the poor and borderline status of food security respectively. From the total of 97(44.5%) average livelihood diversification status of households 19 (21.11%), 17 (77.27%), and 61 (57.55%) were found in poor, borderline, and acceptable status of food security respectively. Of the total 45(20.64%) high livelihood diversification status of households all 45(100%) were only found in the acceptable status of food security (see Table 6). As hypothesized, Spearman's rank correlation analysis result showed that livelihood diversification status has a positive and highly statistically significant association with the food security status of households at a 1% level of

Table 5. Food security status of the households.

Agroecology	Low-land		Mid-land		High-land		Total		Mean
	Ferq	%	Ferq	%	Ferq	%	Ferq	%	
Poor	36	72	52	54.74	2	2.74	90	41.28	13.818
Borderline	4	8	14	14.74	4	5.48	22	10.09	27.818
Acceptable	10	20	29	30.53	67	91.78	106	48.62	38.26
Total	50	100	95	100	73	100	118	100	27.15

Source: Own survey result (2023).

Table 6. Relationship between livelihood diversification and food security status.

Status of Livelihood Diversification	Poor		Borderline		Acceptable		Total		$\hat{\rho}$ -value	P-value
	Freq	%	Freq	%	Freq	%	Freq	%		
No	48	53.33	2	9.09	0	0	50	22.94	0.787***	0.000
Low	23	25.56	3	13.64	0	0	26	11.93		
Average	19	21.11	17	77.27	61	57.55	97	44.50		
High	0	0	0	0	45	45	45	20.64		
Total	90	100	22	100	106	100	218	100		

Source: Own survey result (2023).

Table 7. Effect of livelihood diversification on the status of food security.

Status of food security	Odds ratio	Std. Err	p> z	Marginal effect (dy/dx) status of food security		
				Poor	Borderline	Acceptable
SDI	21.683	8.746	000***	−0.265	−0.097	0.362

*** $p < .01$, indicates significance at less than 1%.

Source: - Own survey result (2023).

significance. This indicated that as livelihood diversification increased, the food security status of the household also increased. The reason is that households diversify their sources of livelihood into on-farm, off-farm, and non-farm livelihood strategy activities providing an additional income that enables them to spend more on their basic needs like food consumption, education, clothing, and health care of household members. An increase in the level of livelihood diversification helped the households to regenerate from the shocks that made them food insecure. The result is consistent with the study of Onunka and Olumba (2017), and Olawuyi and Olawuyi (2022) found that food security among farming households was influenced by livelihood diversification.

As per the result shown in Table 7, the status of livelihood diversification affected the status of food security of the household's head positively and significantly at $P < 0.01$ or 1% ($P = 0.000$) probability level. The positive sign indicates that for one unit increase in the status of livelihood diversification, the odds of food security status also increased by 21.683, given that all other variables in the model are held constant. This result is in harmony with the study of Abebe et al. (2021), Wondem (2020), Yenesew & Masresha (2019), and Zeleke et al. (2017). By assuming keeping another variable in the model constant, the marginal effect result indicated that the status of livelihood diversification increased by one unit (more likely), the status of food security poor, and borderline households decreased (less likely) by 26.5% and 9.7% respectively. On the other hand, keeping other influence variables constant, the status of livelihood diversification increased (more likely) by one unit, and the marginal effect indicated that acceptable food security status increased (more likely) by 36.2%.

5. Conclusions and recommendations

In general, this study aimed to assess the factors that affect the status of livelihood diversification and its contribution to rural household food security in the Gozamin woreda. Based on descriptive analysis, and FGD, in this woreda, rural households participated in different livelihood diversification strategies, including on-farm activities (crop production and animal production activities, poultry production, and beekeeping), off-farm activities (local daily wage labor at the village level, agricultural work at another person's farm in exchange for a portion of the harvest in kind, and selling firewood and charcoal), non-farm activities (handicraft activities like carpentry and house remodeling), and petty trade (grain trade, fruit trade, and vegetable trade) to sustain their life.

The result of the Simpson Index of diversity shows that the uppermost (44.5%) households typically diversify their livelihood average status of livelihood diversification. The percentage of no, low and high diversifiers were (22.94%), (11.93%), and (20.64%) respectively. The mean SDI among the households was 0.331 which implies that in the study area, the majority of the households averagely diversify their livelihood.

Similarly, the results of the Food Consumption Score revealed that a sample of households (41.28%), (10.09%), and (48.62%) were found in poor, borderline, and acceptable status of food security in rural households respectively. The mean FCS among the households is 27.15 which indicates that in the study woreda, the majority of the households are borderline status of food security.

Furthermore, ordered logistic regression model results indicate that out of sixteen explanatory variables, nine variables significantly influenced the livelihood diversification status of households. From these variables, educational level, agroecology, access to training, access to transport, agricultural risk, and annual total income positively affect the livelihood diversification status of households at less than a 1% level of significance. Membership in cooperatives and access to credit positively affect the livelihood diversification status of households at less than 5% significance levels. But sex has a negative effect on the level of livelihood diversification at less than 10% significant levels. In line with this, several factors

such as access to credit, access to transport, lack of resources, lack of awareness, inability to promote a culture of work on different activities, and agroecology hinder the status of household livelihood diversification in the study area as explained by FGD and KII.

Finally, as shown in both Spearman correlation and ordered logistic regression analysis results, the status of household livelihood diversification has a positive and statistically highly significant effect on the status of food security at a 1% level of significance. Therefore, the study concluded that when the status of household livelihood diversification increased, the food security status of households also highly increased in the study area.

Based on the findings of the study, the following recommendations have been provided for possible interventions and help to enhance the status of household livelihood diversification to improve the status of food security in the study area. On-farm activities (crop production and animal production activities, poultry production, and beekeeping), off-farm activities (local daily wage labor at the village level, agricultural work at another person's farm in exchange for a portion of the harvest in kind, and selling firewood and charcoal), non-farm activities (handicraft, pottery, activities like carpentry and house remodeling), and petty trade (grain trade, fruit trade, and vegetable trade) should be more expand and continue in this woreda. And also households should get supporting training to strengthen their livelihood strategies activities.

Further, to increase the status of household livelihood diversification, governmental and non-governmental organizations, extension workers, policy makers, strategies, programs, and other concerned bodies should give more attention to the variables education level, agroecology, memberships of cooperative, access to training, access to transport, access to credit, agricultural risk, and total annual income. Finally, policies improving the food security status of households in the study area should focus on increasing the status of livelihood diversification. Any policies targeted at promoting food security should go beyond just increase food production only; it needs to diversify rural household livelihood through the development of alternative livelihood opportunities to make it sustainable and self-resilience. Moreover, additional research should be carried out to acquire more empirical findings on the factors that affecting of rural household livelihood diversification and its contribution to the food security status situation in the Gozamn woreda as well as in other similar rural areas in Ethiopia.

Consent form

The authors provide consent for publication of this manuscript in this journal.

Authors contributions

Anteneh Tenaw Taye engaged on conception and design, analysis and interpretation of the data; and drafting of the manuscript. Yilebes Addisu Damtie and Tesfahun Asmamaw Kassie worked on advising the overall work, revising it critically for intellectual content; and the final approval of the version to be published. All the authors agree to be accountable for all aspects of the work.

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Anteneh Tenaw Taye, Yilebes Addisu Damtie, and Tesfahun Asmamaw Kassie are all young researchers in Institute of Disaster Risk Management and Food Security Studies. They have ample experience in the area disaster risk management, food security, livelihoods, climate change, early warning systems and related concepts.

Data availability statement

The dataset supporting the conclusions and recommendations of the study are included in the article.

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