

Research article

Does non-farm employment increase rural households' consumption in western Ethiopia? Empirical evidence from the horo guduru wollega zone

Wakuma Dufera Tesgera^{a,*}, Amsalu Bedemo Beyene^b, Temesgen Kebede Wakjira^c^a Department of Agricultural Economics, College of Natural Resource Management, Salale University, Ethiopia^b School of Policy Studies, Ethiopian Civil Service University, Ethiopia^c Department of Economics, College of Business and Economics, Haramaya University, Ethiopia

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ABSTRACT

In rural areas where farming is the primary source of income for farmers, engaging in non-farm activities can provide an additional source of income and improve household consumption. However, several social and economic factors present challenges to the involvement of rural households in non-farm activities. This study aimed to examine the impact of non-farm participation on household consumption in rural areas. A multistage sampling method was used to select the sample households from the study area. Heckman's two-step procedure was utilized to analyze survey data obtained from 383 rural household heads. The results indicated that participating in non-farm employment had a positive and significant effect on household consumption levels. The result indicated that households that engage in non-farm activities had higher levels of consumption compared to those who do not participate in such activities. The study also identified several factors that influence household consumption in rural areas. These factors include education, access to credit, distance to market, TLU (Tropical Livestock Unit), membership in "iqub" (a social financial system), health status, non-farm training, and gender. It was found that gender disparities exist, with female-headed households experiencing lower consumption levels than male-headed households. Based on the findings, the research recommended addressing gender disparities and improving rural infrastructure, particularly in relation to enhancing health services, electricity supply, road transport, and education. Efforts should also be made to overcome the challenges related to access to training and credit. The study emphasized the significance of recognizing the impact of supporting existing social financial systems, such as *iqub*, in improving household consumption in rural areas.

1. Introduction

Rural households in developing nations, areas such as Ethiopia, play a crucial role in the economy, as they make up a significant portion of the population. However, these households often face challenges in meeting their consumption needs because of limited access to resources and few opportunities to earn income [1–5]. Numerous studies [2,6–10] have investigated the impact of non-farm participation in rural household consumption in various global regions, including Africa. These studies have provided valuable insights

* Corresponding author.

E-mail address: wakuma.dufera2009@gmail.com (W.D. Tesgera).

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into the potential benefits and challenges associated with participating in non-farm activities. For instance, studies in Sub-Saharan Africa have shown that non-farm activities can significantly contribute to the income and consumption of rural farmers. In a study conducted by Ref. [11] in Burkina Faso, it was discovered that households engaged in non-farm activities experienced higher income levels and subsequently higher levels of consumption compared to those relying solely on farming.

The study highlighted the vital role of diversifying income through non-farm activities in reducing poverty and improving living standards among rural households. As a result, there has been a growing interest in exploring alternative sources of income, such as non-farm activities, to enhance the consumption of rural households [12]. Non-farm activities refer to any economic activities or employment opportunities outside of conventional agricultural practices [10,13–15].

Non-farm participation plays a significant role in increasing consumption levels in Western Ethiopia, especially in rural areas. According to Ref. [16], non-farm participation is crucial for boosting consumption levels. A study on women's non-farm participation by Ref. [17] in Ethiopia indicates that involvement in non-farm activities enables households to diversify their income sources beyond traditional agriculture. According to Ref. [18], non-farm income helps to mitigate the risks associated with relying solely on farming, such as unpredictable weather patterns and fluctuating agricultural productivity. Similarly [6,7,19–23], supported this finding, indicating that households have greater stability and a higher capacity to meet their consumption needs when earning income from non-farm activities.

Non-farm income enables families to improve their consumption and spending habits, be more financially stable, and achieve their goals. Poorer farm households that engage in non-farm activities increase their assets, which are needed for children's education, agricultural land ownership, input purchases, and the adoption of productivity-enhancing technology, all of which help to increase agricultural production and yields [15]. According to Refs. [14,18], the non-farm sector facilitated upward mobility and increased consumption among low-educated households. The impact of non-farm activities has usually been viewed as having the ability to increase employment possibilities and household consumption [24]. Non-farm activities provide a significant portion of the revenue and so attract a large rural labor force [25]. Non-farm income accounts for 35–50 percent of rural family income and 33 percent of rural labor force income in developing countries [3,26].

Previous research conducted in rural areas of Ethiopia has primarily concentrated on identifying the factors that influence non-farm activities, rather than exploring the connection between these activities and household consumption. Several studies have been conducted to assess the impact of non-farm activities on income inequality, considering demographic and economic factors as determinants [27–30]. Meanwhile, a limited number of studies, such as those by Refs. [31,32], have specifically examined the impact of non-farm activities on the food security of farming households, considering demographic, institutional, and economic factors. Moreover, existing investigations have mainly focused on determining correlations between non-farm activities and farm income, while failing to establish causal effects [25].

This study contributes to the existing literature by employing the Heckman two-step approach and considering factors such as traditional saving (*iqub*), *idir*, and access to mobile phones to investigate the impact of non-farm participation on the consumption patterns of rural households. To the best of the researcher's knowledge, there have been limited empirical studies that have incorporated traditional saving (*iqub*), *idir*, and household dependents as determinants of non-farm activities and examined their influence on consumption in Ethiopia, specifically in the context of rural household livelihood activities [33,34]. included traditional saving (*iqub*), *idir*, and access to mobile phone but focused primarily on determining the factors influencing non-farm activities. It has been observed that traditional saving (*iqub*) and *idir* yield positive outcomes for non-farm activities in rural areas, while access to mobile phone may experience a negative impact on non-farm activities [35]. Furthermore, this study will also contribute to the literature by incorporating gender equality indicators, which will offer insights into the dimensions that have a significant impact on rural households' consumption in Ethiopia's rural areas. Furthermore, incorporating the negative effects of access to mobile phone and gender indicators in this study will facilitate the development of precise policies that are customized to address each specific consumption indicator [26,36]. To address this research gap, the study aimed to achieve several objectives: (1) Assess the impact of non-farm participation on the consumption of rural households. (2) To provide policy recommendations and interventions that can enhance the positive impact of non-farm participation on rural household consumption. (3) Analyze the factors that influence the rural households' ability to convert non-farm income into improved levels of consumption.

Hypothesis of the study.

Null hypothesis (H0): Non-farm participation has no impact on household consumption.

Alternative hypothesis (HA): Non-farm participation has a positive/negative impact on household consumption.

2. Methods and materials

2.1. Ethical approval and consent to participate

The study conducted herein obtained ethical clearance from the Institutional Review Board of Wollega University. The privacy and confidentiality of all participants' personal information were strictly maintained. Any data collected during the study was stored securely, and all identifying information was kept separate from any research findings or publications to ensure participants' anonymity.

2.2. Conceptual framework

Here was a conceptual framework for studying the impacts of non-farm activity on household consumption, incorporating

demographic, economic, social, and institutional factors. Demographic factors can include variables such as age, gender, education level, family size, and household composition. These factors may influence household consumption through their impact on earning capacity, preferences, and resource allocation within the household. Economic factors play a significant role in shaping household consumption patterns. Key economic variables to consider in this study were TLU, access to credit, distance to market, own mobile. These factors have a direct impact on the financial resources available to households and their ability to afford and sustain consumption levels.

Social factors encompass cultural norms, social networks such as *iqub* and *idir*, which are community support systems. These factors can affect household consumption through peer pressure, social expectations, and the influence of social norms on spending behavior. Institutional factors include policies, regulations, and market structures that shape the environment within which non-farm activities operate. These may include factors such as access to markets, land holding, business support services, own saving, and governance structures. Institutions can influence the profitability and sustainability of non-farm activities, thereby affecting household income and ultimately consumption. The diagram in (Fig. 1) demonstrates that demographic, economic, social, and institutional factors all influence household consumption. The arrows in Fig. 1 represent the relationships between each factor, indicating the direction in which they impact non-farm and consumption.

2.3. Description of the study area

The Horo Guduru Wallega zone, depicted in Fig. 2 below, is a constituent part of the Oromiya National Regional State in Ethiopia and represents one of the 18 administrative regions. The administrative center is Shambu, which is located 310 km west of the national capital, Addis Abeba. According to the 2007 national population census, the total population in the area was 511,737 people, with roughly equal percentages of males and females. The majority of the population, about 89%, resides in rural areas. The total land area of the study area is 712,766.22 square kilometers [38]. Agroecologically, the region is classified into three categories: the dega region occupies 36.9% of the area, the woinadega region occupies 53.75%, and the kola region covers 9.35%. The rainy season in this region typically occurs from May to September, while the period from October to April is characterized by dry weather. However, it is important to note that the duration and intensity of rainfall can vary from year to year. On average, the rainy season in the region lasts for about five months [38].

2.4. Sample size determination

The study used a multistage sampling method to select the sample household heads. In the initial stage, the researchers purposefully selected the Horro Guduru Wallaga zone from among the different zones in the Western Ethiopian region. The decision to use a purposive sampling approach to select the Horo Guduru Wollega zone was justified by the concentration of economic, political, and social activities in that area. Furthermore, the area is well-known for its significant agricultural production, including food crops and animal husbandry.

In the second stage of the sampling process, three districts within the Horo Guduru Wollega zone were selected using a systematic sampling approach. Systematic sampling involves selecting every kth element from a sampling frame. This approach ensures a systematic and unbiased selection of districts within the study area. By selecting districts from various parts of the zone, the study can capture potential variations and diversity within the area in terms of socio-economic factors and agricultural practices. This improves the representativeness of the sample and enables a more comprehensive understanding of the factors influencing households' decisions

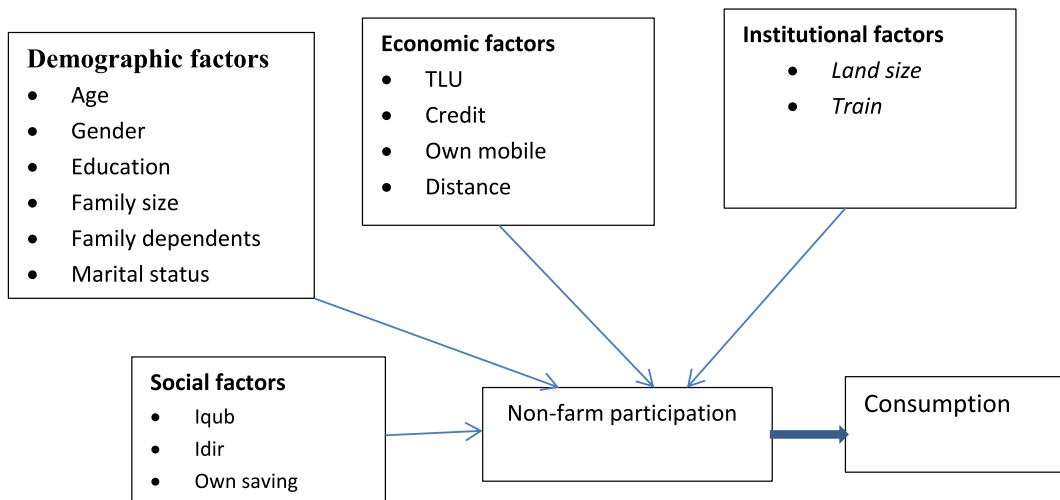


Fig. 1. Conceptual framework of the study. Source: Developed from [37].

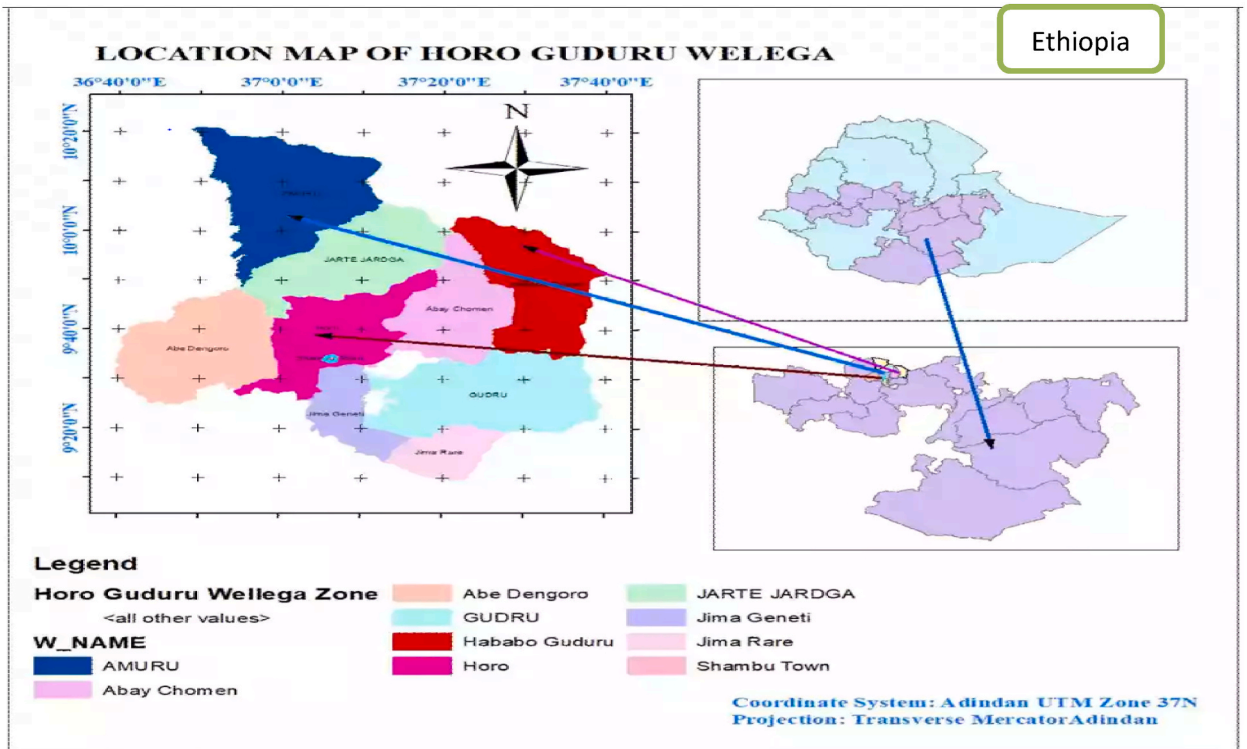


Fig. 2. Map of horo guduru wallaga. Source: [38].

to engage in non-farm activities in the Horo Guduru Wollega zone.

In the third stage of the sampling process, the sample was distributed proportionately among the three districts: Horo, Hababo Guduru, and Amuru. This means that the number of sample heads in each kebele was determined based on the proportion of households it represents relative to the total number of households in the selected district. For example, if a kebele represents 10% of the total households in the district, then 10% of the total sampled individuals would be allocated to that specific kebele. Moving on to the fourth stage of the study, we implemented a simple random sampling approach to select sample households from each kebele. The study aimed to create a representative sample by using a random selection method, ensuring that each household in the kebele had an equal chance of being included. This approach enhances the validity and reliability of the findings and ensures a fair representation of the population being studied (see Table 1 for details).

The sample size for the study was determined using the formula proposed in equation (1) below [39].

$$n = \frac{Z^2 pqN}{e^2(N - 1) + Z^2 pq} \tag{1}$$

Where n = total sample

Z = confidence interval (95% = 1.96), p= (0.5), q = 1-p which is equal to 0.5

E = ±5 % precision/margin of error by examining the anticipated criteria [31].

When we apply the formula

$$n = \frac{(1.96)^2 0.5(0.5)106,038}{(0.05)^2(106,037) + (1.96)^2 (0.5)(0.5)} = \frac{101,838.8952}{266.0529} = 382.7 \approx 383$$

Therefore, the minimum required sample size for this study was 383 households. The sample size was divided among the three districts using the proportionate stratification technique. The sample size was distributed among the districts using the following equation:

$$\text{Horo Woreda} = \frac{5703 \times 383}{20,318} = 107.$$

$$1. \text{ Hababo Guduru Woreda} = \frac{6,728 \times 383}{20,318} = 127.$$

$$2. \text{ Amuru Woreda} = \frac{6,436 \times 383}{20,318} = 149.$$

Table 1
Allocation of sample family heads in selected districts.

S-N	Districts	Total rural household heads	Sample farmers/heads	Proportion (%)
1	Horo district	5703	107	28.07 %
2	Hababo Guduru	6728	127	33.11%
3	Amuru district	7887	149	38.82%
	Total sample	20,318	383	100

Source: own computation from HGWRA¹ report of (2022)

The allocation of kebeles within the three districts was done proportionately, with the following distribution: four kebeles from Horo, four from Hababo Guduru, and eight from Amuru. To determine the distribution of sample households, the total number of households in each sampling district served as the basis. The assignment of sample families was carried out in proportion to the selected kebeles, as outlined in equation (2). The specific proportionate sample size for each kebele was expressed in equation (2) as follows:

$$n_{ki} = \frac{N_{ki}}{\sum N_k} X n_k \quad (2)$$

whereas $i = 1, 2, 3$, etc. Is a list of each kebele, $k =$ represents the name of each kebele, and $n_{ki} =$ a sample of a kebele.

$N_{ki} =$ each kebele's total housetotal.

$\sum N_k =$ total farmers in each woreda

2.5. Data types, sources and methods of data collection

This research relied on primary data obtained through personal interviews with 383 farmers. Structured and semi-structured questionnaires were used to gather information from the participants. Additionally, focus groups and key informant interviews were conducted to gain insights into the current consumption patterns of households and the difficulties farmers encounter when engaging in non-agricultural employment. To investigate the factors influencing non-farm participation and the subsequent impact on household consumption in the study area, data on economic, demographic, and institutional characteristics of the households were collected through the survey questionnaire.

The data for this research was collected from households in three woredas (Horo, Habaabo Guduru, and Amuru districts) within the study area. To ensure clear and effective communication, a questionnaire was initially designed in English and then translated into Afan Oromo, a language known and understood by the respondents. The translated questionnaire was used during the data collection process. Prior to their participation, respondents were provided with an invitation to take part in the study. They were advised to carefully consider the study's objectives and their involvement before deciding whether or not to participate. Additionally, they were encouraged to read the provided information thoroughly and reach out to the researcher if they had any questions or needed further clarification on the study's objectives. Each respondent had the opportunity to ask questions after hearing the presented information read out or read for themselves, and each question he or she asked was answered satisfactorily. Hence, respondents were informed that the researcher will make every attempt to protect the privacy of every respondent in this survey. In order to complement the main data, additional data were gathered from relevant district offices (such as the district's administrative office, the zone agricultural office, and the Central Statistical Authority) as well as both published and unpublished sources. Thus, interviews with the household heads of the study sample were carried out using the production year 2021/2022.

2.6. Method of data analysis

The survey data collected for the study were analyzed using the legally obtained STATA software version 15, which was acquired from the copyrighted and licensed website <http://www.stata.com>. In order to achieve the study's objectives, the data were analyzed using econometric models and descriptive statistics. To examine the livelihood choices of rural households, descriptive statistical techniques were employed, including percentages, means, standard deviations, and tests of significance such as t-tests and chi-square tests. Furthermore, a two-stage analysis was conducted to examine the impact of non-farm participation in household consumption. The first stage involved using a probit marginal effect model to assess the instrumental effect, while the second stage utilized a Heckman model to analyze the output result.

2.7. Procedure of data analysis

2.7.1. Empirical methodology

For a cross-sectional dataset, the Heckman two-step model is generally the most suitable and effective econometric model to address selection bias and examine the impact of non-farm participation on rural household [9]. The Heckman two-step model is

¹ HGWRA: Horo Guduru Wollega Revenue authority.

particularly well-suited for addressing selection bias in cross-sectional data, as it allows for the correction of potential sample selection issues [40]. Heckman two-step involves estimating a selection equation to model the likelihood of participating in non-farm activities and using the predicted values from this equation as an instrument in the second step to estimate the consumption equation. By incorporating the selection equation, the Heckman two-step model can help mitigate the bias resulting from the non-random selection of households into non-farm activities [41].

Conversely, the endogenous switching model and endogenous treatment effect models are typically more appropriate for analyzing panel or longitudinal data [42]. These models necessitate information on both pre- and post-treatment periods to accurately assess the impact of non-farm participation. By explicitly addressing the endogeneity of the treatment or switching decision, as well as incorporating dynamic effects over time, these models provide a comprehensive framework for understanding the effects of non-farm participation.

2.7.2. First step

The first step of the Heckman two-step model involves estimating the selection equation, also known as the probit equation. The logit and probit models are both commonly used methods for modeling binary outcomes, but they differ in how they link the outcome variable to the predictor variables. The coefficients in a probit model are more easily interpretable compared to those in a logit model [43]. In a probit model, the coefficients represent the change in the probability of the dependent variable being equal to one for a one-unit change in the independent variable [44]. This makes it easier to understand the impact of the non-farm participation on rural household consumption. Probit models assume a normal distribution of the errors, which can be more appropriate in some cases [40]. This assumption is often satisfied in social science research where the dependent variable takes on a limited number of values. In contrast, logit models assume a logistic distribution of the errors.

Probit models tend to be more efficient than logit models when the assumptions are met. This means that probit models can provide more precise estimates of the coefficients. However, the difference in efficiency between probit and logit models may not be substantial in practice. Probit models allow for alternative forms of error distribution if the normal distribution assumption is not appropriate. This flexibility is advantageous when the true error distribution is not known or if there is heteroscedasticity in the data [45]. Probit models are estimated using maximum likelihood estimation (MLE), which is a widely used and robust estimation method. MLE provides consistent and efficient parameter estimates under certain assumptions. Logit models also use MLE, but some argue that probit models are more robust to violations of distributional assumptions [20]: [6]: [2]: [46].

As a result, the selection equation takes the following form from equation (3) below:

$$pr(Y^* = 1 \mid X) = \Phi(X\beta + \gamma W) \quad (3)$$

where:

$Pr(Y^* = 1 \mid X)$ is the probability of participating in non-farm activities given a set of observed characteristics X , $\Phi(x)$ is the cumulative distribution function of the standard normal distribution, X is a vector of explanatory variables such as demographic characteristics, household income, education level, and access to resources, β is the vector of coefficients to be estimated, W represents additional instrumental variables, if necessary, to control for endogeneity or selection bias.

The estimation of the selection equation involves using a suitable method, such as maximum likelihood estimation (MLE), to obtain estimates of the coefficients β and γ . These estimates provide information on the factors that influence the decision to participate in non-farm activities. The predicted values of the selection equation from the first step are then used as an instrument in the second step to correct for potential selection bias and estimate the impact of non-farm participation on rural household consumption.

2.8 Heckman two-step selection model (Second Step)

In the second step of the Heckman two-step model, the consumption equation is estimated to evaluate the influence of non-farm participation on rural household consumption, taking into account selection bias. The coefficients obtained from the selection equation in the first step are employed as instruments in this step.

The consumption equation can be represented in equation (4) as:

$$C = \beta_0 + \beta_1 X + \beta_2 W + \beta_3 Z + v_1 \quad (4)$$

where:

C = represents the rural household consumption, the dependent variable of interest.

X = denotes the non-farm participation variable, which indicates whether the household is engaged in non-farm activities or not.

W = represents a set of control variables that capture other factors influencing household consumption, such as income, education level, and household size.

Z = signifies the instruments obtained from the first step of the Heckman two-step model, which address the potential selection bias.

$\beta_0, \beta_1, \beta_2, \beta_3$ are the estimated coefficients representing the relationships between the variables and the household consumption. And v_1 is the error term.

In the second step of estimating the consumption equation, the Heckman two-step model utilized the instrumental variable approach to address selection bias. Ordinarily, the ordinary least squares (OLS) method is employed for estimating the consumption equation. However, in the presence of selection bias, instrumental variables were utilized. In this approach, the predicted values of the selection equation (Z) were used as instruments for non-farm participation (X) in the consumption equation. By incorporating these predicted values and employing the instrumental variable approach, the second step of the Heckman two-step model effectively

corrected for selection bias and estimated the impact of non-farm participation on rural household consumption.

2.8. Description of the variables and their expected magnitude

The factors that can affect participation in rural non-farm activities and its impact on household consumption are outlined in [Table 2](#) based on the context of the study.

3. Results

3.1. Descriptive statistics

According to the descriptive results presented in [Table 3](#), there are notable differences between participants and non-participants in terms of various variables. The average age of non-farm participants was reported as 37.25 years, whereas non-participants have an average age of 44.42 years. This indicates a significant age difference between the two groups. Regarding years of education, the average number of years of schooling for non-farm participants is 2.63, while non-participants have an average of 1.97 years of education. This suggests that non-farm participants tend to have higher levels of education compared to non-participants.

In terms of Tropical Livestock Units (TLU) ownership, participants have an average TLU ownership of 5.74, while non-participants have an average TLU ownership of 6.72. The difference in the average TLU ownership suggests that non-participants tend to have a higher number of livestock units which indicates that they have better income sources than non-farm participants. Similarly, there is a difference in land size between the two groups. Participants have an average land size of 1.71 ha, whereas non-participants have an average land size of 1.98 ha. This indicates a variation in the extent of landholding.

[Table 4](#) presents the dummy variable for the involvement of the household head in non-farm activities. The data shows that among the participants in non-farm activities, 48.5% were *Iqub*² members, indicating the significance of social financial arrangements in their participation. Additionally, 91.2% of the participants had better health, suggesting that physical well-being may contribute to their engagement in non-farm activities. Access to training appears to be a significant factor, as 58.6% of participants have reported having access to training opportunities. Additionally, 95% of non-farm participants have a spouse, indicating that family support plays a role in their involvement.

Moreover, the data reveals that saving for personal needs is prevalent among non-farm participants, with 75.5% of them engaging in this practice. Additionally, a majority of male respondents (75.7%) are involved in non-farm activities, while a lower percentage of females (68.6%) do not participate. Conversely, characteristics associated with non-participants in non-farm activities include a high percentage (86.7%) being members of *Idir*,³ indicating that traditional mutual aid associations may serve as alternative economic activities for them.

3.2. Sensitivity and specificity test

The only criterion for selecting variables for probit regression was that they passed the chi-square pretest and were potential predictors. According to the cross-tabulation results presented in [Table 5](#), all explanatory variables satisfied the chi-square criteria, qualifying them to be considered as predictors in a probit regression analysis.

Specificity, also known as the True Negative Rate, refers to the proportion of correctly classified negatives. To illustrate, in the probit model, the actual dataset correctly identified individuals who did not participate in non-farm activities. Specifically, out of the 202 farmers who were non-participants, the probit model predicted that 197 of them would be non-participants, indicating a specificity rate of 95.63%. Additionally, when considering all sampled household heads in this study, whether they participated or not, the improved probit model accurately predicted 97.18% of them, as shown in [Table 5](#).

(a) Hosmer-Lame show goodness fit test

The Hosmer-Lemeshow test is a statistical method used to assess the goodness of fit of probit regression models. In the present study, the probit regression model demonstrated the best fit for the provided dataset, as indicated in [Table 5](#). This conclusion is supported by the Hosmer-Lemeshow test, where the P-value (0.96) for this analysis was below the threshold of 10%.

3.2.1. Endogeneity tests

The first stage F-statistic test measures the strength of the relationship between the instrumental variables and the endogenous treatment variable. This test provides information about the extent to which the instrumental variables explain variations in the treatment variable, indicating whether there is a robust relationship between them.

[Table 6](#) presents the results of various diagnostic tests in the endogenous treatment effect model. The over identification test does

² *Iqub*: is a traditional rotating saving and credit association commonly practiced in the area and many other Ethiopians.

³ *Idir*: is a community-based association where members contribute regular payments, either in money or kind, into a shared fund. These funds are then used to provide financial assistance and support during times of need, such as during funerals, medical emergencies, or other social and economic hardships.

Table 2

An explanation of the study's key variables, measuring methods, and proposed linkages.

Variables	Variable type	Unit of measurement	Expected signs
Dependent variable			
Non-farm participation (instrument)	Dummy	Yes = 1, No = 0	+
Outcome variable (consumption)	Continuous	ETBirr (Ethiopian currency)	
Independent variables			
age	Continuous	Years	-ve/+ve
Year of schooling	Continuous	Year	+ve
Membership to <i>iqub</i>	Dummy	Yes = 1; No = 0	+ve
TLU	Continuous	Livestock unit (TLU)	-ve
Land size	Continuous	Hectare (ha)	-ve
Household health status	Categorical	1 if Health issues, 0 Otherwise)	+ve
Access to train	Dummy	Yes = 1; No = 0	+ve
Marital statuses	categorical	With spouse = 1, without spouse = 0	+ve
Distance to market	Continuous	Km	-ve
Own save	Dummy	Yes = 1; No = 0	+ve
Membership to <i>idir</i>	Dummy	Yes = 1; No = 0	+ve
Household Dependent	Continuous	Number of dependents	-ve
Gender	Dummy	Male = 1; Female = 0	-ve
Access credit	Dummy	Yes = 1; No = 0	+ve
Own mobile	Dummy	Yes = 1; No = 0	+ve

Table 3

statistics of continuous variables in brief.

Variable	Non-participant (No = 0)		Participant (Yes = 1)	
	Mean	St.Dev	Mean	St.Dev
Age	44.42	4.8	37.25	4.86
Year of schooling	1.97	2.17	2.63	2.52
Total livestock	6.72	0.24	5.74	2.94
Land size	1.98	1.32	1.71	1
Distance from market	11.84	3.67	9.5	2.4
Number of dependent	6.6	2.37	5.22	1.82

Source: Own calculation Of Survey Results (2022)

Table 4

Summary statistics of dummy variables.

Variables	Non-participant (No = 0)		Participant (Yes = 1)	
	Mean	St.Err	Mean	St.Err
<i>iqub</i>	0.47	0.25	0.486	0.251
Health status	0.312	0.216	0.912	0.081
Access to train	0.381	0.237	0.586	0.244
Marital status	0.72	0.201	0.95	0.048
Own save	0.213	0.167	0.757	0.185
Gender	0.686	0.101	0.757	0.185
Member <i>idir</i>	0.564	0.25	0.867	0.116
Own mobile	0.46	0.25	0.923	0.072
Access to credit	0.75	0.187	0.79	0.167

Source: Own calculation Of Survey Results (2022)

Table 5

Proportion properly expected on sample data.

Decision	Actual number	Predicted by the logit model as	
		Participate	Not-participated
Participate	181	172	9
Non-participate	202	5	197
Sensitivity	97.18		
Specificity	95.63		
Overall correctly classified	96.79		

Source: Own data survey, (2022)

not reject the null hypothesis, indicating the validity of the instrumental variables used. On the other hand, the weak instrument test (Stock Yoko) does not reject the null hypothesis, indicating that there is a strong and reliable relationship with the treatment variable. The Sargan test also does not reject the null hypothesis, indicating that the instruments used have no relation with unobserved variable (error term) and are relevant in the analysis. Lastly, the first stage F-test does not reject the null hypothesis, suggesting a strong relationship between the instruments and the endogenous treatment variable.

4. Discussions

4.1. First-step (probit) results

The estimated marginal effects provide valuable information about the impact of the explanatory variables on the probability of households participating in non-agricultural activities. Based on the results in Table 7, it was observed that 14 out of the 15 explanatory variables have a statistically significant impact on the participation of households in non-agricultural activities. This suggests that these variables are important factors influencing the likelihood of households engaging in non-agricultural activities.

Factors like age, education, and training indicate the importance of skills and knowledge in pursuing non-agricultural activities. Gender, marital status, and family dependency highlight social and demographic factors that can influence household decision-making. Health status, access to credit, distance to the market, and membership in support groups like *iqub* and *idir* reflect the role of resources and support networks in facilitating non-farm participation. The presence of TLU and land size suggest that households with greater agricultural resources may have more options and flexibility to engage in non-farm activities. Lastly, the availability of technology, as represented by access to mobile phones, and personal savings showcase the role of financial and technological resources in enabling non-farm participation.

Demographics have a significant role in comprehending the transformations in attitudes, habits, and lifestyles that occur as individuals grow older. By using the age squared to age calculation, we can model the impact of different ages more accurately than by assuming a linear effect for all ages, as exemplified in Table 7. This demonstrates a quadratic effect, which emerges when a factor interacts with itself. Here, we are examining how the connection between age and the dependent variable (non-farm participation) changes at different values of the age variable or, in other words, at varying ages.

Based on the findings presented in Table 7, year of schooling has a positive impact on the involvement of rural households in non-farm activities. The probability of household heads engaging in non-farm activities increases by 0.025 points (at a statistically significant level of 5%) with each additional year of education, assuming that all other factors remain constant. This emphasizes the importance of education in improving rural livelihoods. Furthermore, as the number of years of schooling increases, the household head's influence on decisions related to non-farm activities becomes stronger or more pronounced. An interpretation for the result may be that individuals with higher levels of education are more likely to possess the skills and knowledge necessary to pursue non-farm activities. They may have gained specific technical expertise, business acumen, or managerial skills through their education, which can be applied to non-agricultural sectors.

Additionally, higher education levels can enhance individuals' ability to adapt to changing market demands and technologies. This adaptability is crucial for participating in non-farm activities that may require new and diverse skill sets. Moreover, education can empower individuals to seek out and seize non-farm opportunities. It can provide them with the confidence and capabilities to explore and exploit entrepreneurial ventures, navigate market complexities, and take calculated risks. The results of the study conducted by Ref. [37] on women's labour force involvement in non-farm occupations and its factors in the Afar Regional State support this finding.

Access to training has a positive impact on the engagement of individuals in non-farm activities, at a statistical significance level of 5%. When all other variables are held constant, household heads who participate in non-farm training have a 0.169 points higher probability of engaging in non-farm activities. Training programs provide individuals with new or improved skills that are relevant to non-farm activities. This can include technical skills, such as specific vocational training, or soft skills like communication, problem-solving, and entrepreneurship. These expanded skill sets enhance individuals' market competitiveness and increase their ability to actively participate in non-farm sectors. Training programs often instill confidence in individuals, enabling them to take on new challenges and explore non-farm opportunities. By acquiring new knowledge and abilities, individuals feel more self-assured and capable of successfully engaging in non-farm activities. Training can equip individuals with knowledge about potential markets, customers, and competitors, allowing them to make more informed decisions about the feasibility and viability of engaging in non-farm sectors. These findings align with a study conducted by Ref. [5] in the Western Wollo region of Ethiopia that states training programs often provide insights into market trends, opportunities, and demands for non-farm activities.

Distance to the market has a significant negative effect on the engagement of households in non-farming activities. The statistical analysis shows that for every unit increase in distance, the likelihood of family heads choosing to participate in non-farm activities decreases by 0.063 points. The reason for this negative effect was primarily attributed to the higher costs associated with engaging in

Table 6
Tests of endogenous treatment effect.

Test	Test statistic	Critical value	Result
Over identification/Sargan	3.21	7.3**	Not reject
Weak instrument/Stock Yoko	10.23	43.13***	Not reject
Under identification test	4.75	238.71***	Not reject
First stage F statistic	8.62	219.47***	Not reject

Source: Calculated from own survey data, (2022)

Table 7
First-step of the probit regression result.

Variables	Coef.	Robust. St.Err.	dy/dx	Std.Err.	Sig
Non-farm participation					
Access to credit	2.318**	0.932	0.462***	0.101	0.000
acctrain	0.613**	0.28	0.169**	0.084	0.043
age	1.48**	0.51	0.042***	0.013	0.001
Age 2	-0.153***	0.028	-0.072*	0.032	0.025
Dependent number	-0.147**	0.066	-0.041**	0.019	0.034
Distance to market	-0.228***	0.045	-0.063***	0.016	0.000
education	0.087*	0.052	0.025**	0.015	0.100
gender	-0.875**	0.427	-0.308**	0.153	0.044
Household health status	2.024***	0.506	0.453***	0.074	0.000
<i>Idir</i> membership	0.528	0.614	0.076*	0.048	0.119
Land size	-0.338**	0.123	0.347**	0.171	0.042
Marital status	1.22**	0.589	0.268***	0.099	0.007
Membership to <i>iqub</i>	0.906***	0.302	0.242*	0.123	0.067
Own mobile	-1.594*	0.83	-0.505**	0.253	0.046
Own saving	0.699***	0.271	0.195**	0.081	0.015
TLU	-0.123**	0.049	-0.035**	0.016	0.025
Constant	7.477	10.3			
LR Chi2 (15)	404.56		-		
Pseudo R-squared	0.764		-		
Number of obs	383		-		
Prob > chi2	0.000		-		

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(*) dy/dx is for discrete change of dummy variable from 0 to 1.

Source: Own calculation Of Survey Results (2022)

non-farm activities for farmers who are located far from roads or market regions. Transportation costs and the expenses associated with reaching the market are significant barriers for these farmers. Additionally, being further away from the main market area reduces the farmers' profit margins, as they may have to rely on more expensive middlemen. Therefore, the availability and quality of infrastructure, such as roads and market access, have a substantial impact on the participation of household heads in non-farm activities. These findings are consistent with a similar study conducted by Ref. [2] in the Eastern Harerghe region of Ethiopia, which also highlighted the importance of infrastructural development in influencing non-farm activities at the household level.

When all other variables are held constant, being a member of an *Iqub*⁴ increases the likelihood of non-farm participation by 0.242 points at a significance level of $p < 0.1$. This finding is consistent with the research conducted by Ref. [20]. The study by Ref. [23] also demonstrates that joining an *Iqub* enhances social connections and strengthens ties between individuals. This sense of community and camaraderie within the *Iqub* contributes to the promotion of a culture of saving. By participating in an *Iqub*, individuals are encouraged to save regularly, which can provide them with the means to establish a non-farm business over time. The research survey also found that being a member of an *Iqub* has simplified the process for household heads to initiate a non-farm business. The gradual accumulation of savings through the *Iqub* has provided individuals with the necessary financial resources to invest in their non-farm ventures.

Credit is crucial for entrepreneurs and small business owners who need capital to start or expand their businesses. It enables them to purchase equipment, inventory, hire employees, invest in marketing, and manage cash flow. Credit can provide the necessary funds to fuel business growth and support the establishment of non-farm enterprises. According to the study findings, access to credit is

⁴ *Iqub*, also known as "equb" is a traditional rotating saving and credit association commonly practiced in the area and many other Ethiopians. It is a community-based financial arrangement where a group of individuals come together and contribute a fixed amount of money at regular intervals, typically on a monthly or weekly basis. The total amount collected is then given to one member of the group on a rotational basis until every member has received their share. This system allows participants to access a lump sum of money at a specific time, which can be used for various purposes such as investment, starting a business, or covering personal expenses. *Iqub* serves as a means of informal banking and enables individuals to save collectively, access funds, and meet their financial needs without relying on formal financial institutions.

associated with a statistically significant increase the likelihood of 0.462 points in farm participation at 1%. The research reveals that family heads who have access to credit are more likely to engage in non-farm activities compared to those without access to credit. This implies that the availability of credit has a significant influence on increasing the likelihood of participating in non-farming activities. One possible explanation for this relationship is that having credit available provides individuals with working capital for starting and sustaining non-farm businesses. With access to credit, entrepreneurs can invest in necessary resources, equipment, or inventory to establish their non-farm ventures. This financial support enables them to overcome initial capital constraints and engage in non-farm activities.

Additionally, credit availability can also help balance out consumption patterns for households. By having access to credit, individuals can smooth out their cash flow and address any temporary financial gaps or emergencies. This allows them to allocate funds towards non-farm activities without compromising their daily household needs. The findings of the study support the assertions made by Ref. [9] with the notion that farmers with access to credit options are less vulnerable to market fluctuations and more stable in non-farm environments.

Women in rural families were found to be 0.31 points less likely to participate in non-farm activities. This finding is statistically significant at the probability level of $p < 0.05$. The lower likelihood of women's participation in non-farm activities can be attributed to various factors, including limited access to higher-paying employment opportunities in the area. Women often face barriers and discrimination in accessing employment that would enable them to financially support their families. In many cases, women in rural areas face challenges in accessing essential resources like land, water, and wood, as these resources are often controlled or owned by men. As a result, women are often compelled to negotiate or pay in order to gain access to these resources. This dynamic can limit women's opportunities for economic participation and empowerment. The interpretation of traditional inheritance laws in Ethiopia may also contribute to the lower participation of rural women in non-farm activities. In many cases, women are unable to inherit land or assets, which can limit their economic opportunities and ability to engage in non-farm ventures. Additionally, the dominance of long-standing cultural systems that assign little to no social status to women in the research area may also play a role in their limited participation in non-farm activities. These cultural norms and practices can create social barriers and discourage women from pursuing economic empowerment opportunities. The findings of this study support [3] research on the factors affecting the economic empowerment of rural women in Western Ethiopia of Dibate district.

At a 1% level of significance, it has been found that the size of landholding has a negative impact on household non-farm participation. Specifically, for every hectare of land owned, the likelihood of engaging in non-farm activities decreases by 0.347 points. This result is supported by a study conducted by Ref. [47], which reached the same conclusion. Landholding is negatively correlated with household non-farm participation. An interpretation of the result could be due to the fact that managing and working on a large farmland requires significant time and effort, leaving less room for individuals to pursue non-farming opportunities. Additionally, households with larger landholdings may be more financially dependent on their agricultural activities, making them less likely to seek alternative sources of income through non-farm activities. Therefore, the size of landholding can limit the willingness and ability of households to actively participate in non-farming endeavors.

The health status of the household head is a crucial factor that influences their participation in non-farm economic activities and their capacity to manage risks. The analysis of the marginal effects in Table 7 reveals that good health has a significant positive impact on the likelihood of household members engaging in non-farm activities, as indicated by a p-value of less than 0.05. This suggests that, all other factors being equal, households with good health have a 0.453-point higher probability of diversifying their economic activities. Conversely, poor health hampers productivity and limits access to better economic opportunities. Physically unfit or disabled individuals may encounter difficulties in engaging in non-farm labor activities because of the extra resources and time needed. This conclusion is consistent with a study conducted by [48].

According to Ref. [49], health issues pose significant challenges in many Sub-Saharan African countries, leading to underinvestment in human capital and resulting in a depletion of labor and productive resources, particularly in rural areas. According to a study by Ref. [14], more than two-thirds of HIV/AIDS patients in Africa reside in rural areas. However, due to limited access to affordable healthcare, these individuals often struggle to receive the necessary treatment for HIV/AIDS. These challenges significantly hinder their ability to flourish and adjust. Furthermore, when a family member faces health issues, children are particularly vulnerable because their well-being and future prospects can be negatively affected. For example, denying children education in order to prioritize household chores and save money can have detrimental long-term consequences. These issues underscore the crucial role of addressing health problems in promoting sustainable development in rural communities.

To evaluate the livestock holdings of agricultural households, a metric called Tropical Livestock Unit (TLU) was used. The findings reveal that households in Ethiopia typically maintain small-scale, open cattle farms. Research has shown that farmers who focus solely on farming activities tend to have larger livestock holdings compared to those who also participate in non-farm activities [9]. This is because larger livestock size has a negative impact on the likelihood of participating in non-farm labor, with statistical significance at a probability level of less than 0.01. The study specifically reveals that for every additional Tropical Livestock Unit (TLU), the probability of a farm family seeking employment outside of farming decreases by 0.035 points, while holding other variables constant. One interpretation of the result is that wealthy families, who can meet their needs by selling animals, often choose not to pursue additional sources of income unless it helps to increase their asset base. Conversely, families with fewer cattle are motivated to diversify and stabilize their income by establishing non-farm enterprises, which expedites the process of diversification. This finding is consistent with the research conducted by Ref. [49], which suggests that larger livestock size reduces participation in higher-paying jobs.

Being married has a positive and statistically significant impact on the decision to engage in non-farm activities, with a p-value of ≤ 0.01 . According to the probit marginal effect findings in Table 7, being married increases the likelihood of choosing to participate in non-farm activities by 0.268 points. One explanation for this was that married individuals can benefit from the division of labor within

the household, enabling them to allocate more time and resources to non-farm activities. Additionally, having a spouse can provide support and assistance, enabling married individuals to better balance their work commitments and participate in non-farm ventures. The study's findings suggest that married individuals, especially when both spouses co-lead the family, are not impeded from seeking non-farm employment and can work together effectively. This supports the rationale presented in the study area and is also in line with the results of the study conducted by Ref. [50] on women's empowerment and resources.

The establishment and growth of non-farm businesses significantly rely on the accumulation of savings over time. At a significance level of 1%, possessing a savings account has a positive and statistically significant effect on participation in non-farm activities. This suggests that individuals or household heads who are unable to obtain microfinance or *idir* loans choose to save through *iqub* (a form of rotating savings and credit association and use these savings as initial capital to start a non-farm enterprise). This emphasizes the significance of saving as a way for individuals who may have difficulty obtaining formal loans to access financial resources, allowing them to engage in non-farm economic activities. This result supports the finding of [4].

The presence of family dependents, such as children, elderly individuals requiring special care, or those who are bedridden due to illness, is an important factor in household dynamics. The study reveals that at a 5% level of significance, these variables have a statistically significant negative impact on non-farm participation. Specifically, for each additional dependent, the probability of engaging in non-farm activities decreases by 0.041 points. One possible explanation for this result may be that family heads choose not to participate in non-farm activities due to the significant time and effort required to care for these dependents. Balancing household responsibilities, such as caregiving, with participating in non-farm economic activities can be challenging and may result in reduced participation. This finding aligns with research conducted in rural Ethiopia by Ref. [17], supporting the notion that household responsibilities related to dependent family members can hinder participation in non-farm economic activities.

Belonging to an *idir*⁵ (a social support group) is found to have a positive impact on engagement in non-farm activities, although this effect is not statistically significant. The interpretation of this finding suggests that the primary purpose of *idir* was not related to financial savings or providing credit. Instead, *idir* focuses on providing support to its members during times of trouble and celebration. Consequently, the influence of being *idir* members in non-farm activities is minimal. This highlights that the primary role of *idir* is in social matters rather than economic pursuits. *Idir* is a traditional form of social insurance or mutual aid practice that is commonly found in Ethiopia. It is a community-based organization where members make regular contributions, either in money or goods, to a shared fund. These funds are utilized to offer financial aid and support during times of need, such as funerals, medical emergencies, or other social and economic hardships. The primary goal of *idir* is to foster solidarity and cooperative assistance within the community, ensuring that individuals and families have a safety net during challenging times.

The improved accessibility of mobile networks in rural areas of Ethiopia has brought several benefits for farmers. It enables them to stay informed about job opportunities and developments in agriculture through mobile phone connectivity. Access to market information and job opportunities can be advantageous for farmers in enhancing their agricultural practices and pursuing additional employment in the agricultural sector. However, the study finds a significant negative effect on non-farm decisions when individuals have access to cell phones. This implies that the likelihood of engaging in non-farm activities decreases by 0.505 points when individuals have access to mobile phones. The interpretation of this finding suggests that in the real-world circumstances of the research area, households may face challenges related to limited access to electricity. This limitation can result in frequent switching off of mobile devices and limited access to recent information. The lack of consistent access to mobile charging may hinder the utilization of mobile phones as a tool for exploring non-farm employment opportunities or accessing market information. This study result is consistent with the study by [12].

4.2. Second step result (the outcome) effects

Heckman's two-step estimation method from Table 8 involves two stages of analysis. In the first step, a selection equation is used to estimate the likelihood of participating in non-farm activities (Z). The predicted values of Z are then used as instrumental variables in the second step to estimate the consumption equation (C). In this study, the coefficient (λ) associated with the instrumental variable were found to be 0.1264, and the predicted value of Z was 5310. By interpreting these results, we can conclude that for each additional unit of non-farm participation (Z) predicted, the consumption (C) was expected to increase by 0.1264 units, with a statistical significance level of 10%. This finding suggests a positive correlation between non-farm participation and consumption, indicating that individuals involved in non-farm activities tend to have higher levels of consumption compared to non-participants. These findings were consistent with a previous study conducted by Ref. [7], which also identified a positive relationship between non-farm activities and household consumption.

By participating in such activities, rural households gain access to broader markets for their products, which leads to increased sales and income. This increased income can then be used to improve consumption. Furthermore, participating in non-agricultural activities often necessitates the acquisition of specific skills and knowledge. Acquiring these skills can enhance household productivity and income potential, ultimately leading to higher consumption levels. When households engage in non-farm activities, it can stimulate local economic activity and create opportunities for other community members. This, in turn, can lead to increased job opportunities, higher wages, and improved overall economic conditions. This outcome is consistent with the argument presented by Ref. [18] that households participate in non-farm activities for a variety of reasons, such as enhancing their well-being, boosting consumption, and

⁵ *Idir*: is a traditional form of social insurance or mutual aid practice that is commonly found in Ethiopia. It is a community-based association where members contribute regular payments, either in money or kind, into a shared fund.

Table 8
Second step Heckman (outcome equation estimation result).

Variable	Coef.	St.Err.
C (Outcome variable)		
Non-farm participation	5310.119	3215.283**
Family size	348	221*
Access to credit	1253.688	4143.625**
Access to train	55.305	2282.579**
age	268.753	223.949***
Age2	-1262.748	1469.796**
Dependent number	-644.28	473.17**
Distance to market	-571.054	375.366***
Year of schooling (education)	84.901	385.292*
gender	-2512.71	3023.902**
Health status	4677.792	3980.305***
Land size	-153.428	860.909*
Marital status	1728.498	3365.929**
Membership to <i>idir</i>	1266.356	2770.954
Membership to <i>iqub</i>	862.441	1982.39***
Own mobile	2228.432	2742.752**
Own save	28.179	2365.578**
TLU	49.545	301.86*
Inverse Mills Ratio	0.1264	1469.796*
Constant	7103.632	11072.016***
Statistical tests		
Under identification test (Anderson Canon)	238.71***	
F-statistics (4,378)	219.47***	
Reho	0.4076	-
Sigma	0.31	-
Wald chi2 (2)	609.99	-
Prob > chi2	0.000	-
Number of observation	383	-

***p < 00.01, **p < 00.05, *p < 00.1.

Source: Own calculation Of Survey Results (2022)

reducing vulnerability (see Table 8).

The level of education significantly influences employment opportunities, potential earnings, and long-term financial security. The statistical significance of the household's educational status factor, with a probability level of $p < 0.1$, indicates a positive correlation. This indicates that individuals living in rural areas, regardless of their level of education, are more likely to participate in non-farm activities, resulting in an 84.90 Ethiopian Birr increase in consumption. Essentially, as the level of education increases, spending also increases. An interpretation of this is that farmers with higher levels of education tend to have higher consumption compared to those with lower literacy rates. The study also shows that attaining a higher level of education enhances access to higher-paying non-farm jobs. Education has a positive impact on individuals' earning capacity and their ability to accumulate resources, leading to an improved standard of living. These findings align with the research conducted by Ref. [5], which identified a correlation between low levels of formal education and increased poverty rates.

According to the results from the second-stage Heckman estimation in Table 8, being female has a significant negative impact on consumption, leading to a decrease of 2512.71 ETB. This finding is statistically significant at the $p \leq 0.05$ level. In Ethiopia, households led by women often have limited access to higher-paying job opportunities, which in turn affects their ability to financially support their families. A research study by Ref. [38] supports this idea by highlighting that women in the Amuru district of Horo Guduru Wollega zone are more likely to be employed in low-paying "residual" jobs, earning considerably less than the prevailing wage. As a result, women earn only one-third of what men earn from non-farm activities. The lower consumption levels of women compared to men can be attributed to various factors, including societal and structural inequalities, the gender wage gap, unpaid care work, limited access to resources and financial services, and discriminatory social norms and practices. This suggests that gender disparities in access to higher-paying jobs and wage gaps significantly affect the consumption levels of female-headed households. Women may encounter greater challenges in enhancing their economic situation and provide for their families because of limited earning opportunities.

The impact of age and age squared on household consumption was statistically significant, with p-values of ≤ 0.01 and ≤ 0.05 , respectively. Age has a positive impact on household consumption, indicating that younger individuals may have lower levels of consumption because of factors such as limited income and financial obligations. As individuals progress in their careers and accumulate more income and assets, their household consumption tends to increase. On the other hand, age square has a negative impact on household consumption, indicating a nonlinear relationship between age and consumption. As people age, they may face challenges such as reduced earning potential, limited job opportunities, increased financial responsibilities, and health-related issues. These factors can diminish their capacity to allocate funds toward household consumption, resulting in a decrease in consumption levels. This observation aligns with a study conducted by Refs. [26,51], which found a negative correlation between the square of age and household consumption. The study suggests that as people age, their healthcare needs and related expenses tend to increase, affecting their ability to allocate funds toward non-medical consumption.

Ownership of total livestock (TLU) has a positive impact on the consumption levels of rural households. Individuals with higher Total Livestock Units (TLU) have better access to livestock products such as meat, milk, and eggs, which enhances their overall consumption and food security. According to the study, a one-unit increase in TLU results in a significant 49.545 ET Birr increase in households' consumption, assuming all other factors remain constant. The interpretation of this result was that larger TLU sizes create opportunities for rural households to participate in non-agricultural activities related to livestock, such as selling livestock or its derived products. These activities can generate extra income that can be used to meet additional consumption needs. This finding is consistent with [5] the argument that rapid urbanization and income growth lead to an increased demand for livestock and more sustainable commodities, thereby stabilizing overall consumption levels.

In rural families, having a larger number of dependents negatively impacts consumption. The data from the outcome effect in Table 8 shows that for each additional dependent, there is a consumption loss of 644.28 ETB. An interpretation of the result was that households with a larger number of dependents have more individuals who rely on the income and resources of the household. This increased dependency can strain the available resources, resulting in a decrease in overall consumption. Additionally, meeting the needs of dependents requires extra financial resources. Expenses such as food, clothing, education, and healthcare for dependents can significantly diminish the disposable income available for household consumption. Consequently, households with more dependents may need to allocate a larger portion of their income to meet the needs of their dependents, leaving less money available for other consumption purposes. This can further contribute to a decrease in overall consumption. Furthermore, caring for dependents often requires significant time and energy from household members. This limitation can hinder their ability to participate in income-generating activities, thus reducing the income available for consumption. The discovery that household dependency has a negative effect on consumption aligns with the findings of a study by Ref. [2] on the influence of non-farming activities on food security in rural Ethiopia, thus reinforcing this interpretation. The presence of dependents can hinder household members from participating in income-generating activities, ultimately restricting overall consumption due to limited financial resources.

The distance to the market negatively affects the consumption of rural households. Rural households located far from cities or markets face various challenges when attempting to engage in non-farm activities. These households often incur additional costs to participate in non-farm activities, such as transportation expenses. Consequently, their profits from non-farm activities decrease. The findings of this study suggest that as rural households move further away from urban centers, they experience a decrease in consumption of approximately ETB 571. This result aligns with the findings of the study conducted by Ref. [18], which examined the relationship between agricultural and non-farm activities. It further supports the idea that proximity to the market can hinder economic opportunities and limit the consumption potential of rural households.

The health status of households plays a crucial role in determining whether their consumption increases or decreases. Families with better health are more likely to be able to work and generate income, which allows them to increase their consumption. On the other hand, households with an unwell head of the family must depend not only on healthier family members but also on external support, as the unwell head is unable to work and provide for the family. This often results in individuals spending a significant portion of their income on healthcare expenses in an effort to regain their health. As a result, their levels of consumption decrease. The study results show that farmers with better health have, on average, 4677.792 more Ethiopian Birr (ETB) in consumption compared to those with worse health. This difference is statistically significant at a p-value of less than 0.01. This finding is consistent with the results of the study conducted by Ref. [46], which investigated the influence of non-farm activities on farm activities in rural Bangladesh. The statement supports the idea that improved health allows individuals to participate in income-generating activities, leading to higher consumption levels. Conversely, poor health can limit both income generation and overall consumption.

Married household heads have a greater chance of securing employment, both within and outside the farm, compared to farmers who are not married. This is due to the practicality of coordinating agricultural activities among multiple individuals, given the extensive agricultural holdings of local farmers. Individuals who attempt to operate independent farms or non-farm businesses often encounter numerous challenges. Farmers who live alone consume 1728.498 ETB less than farmers who live in partnerships, which is statistically significant at $p < 0.01$. An interpretation of this result was that married couples often have the advantage of dual incomes, with both partners contributing to the household's financial resources. This additional income can offer greater financial stability and resources for consumption compared to individuals who rely solely on their own income. Married couples can share expenses such as housing, utilities, and groceries, which can help reduce individual living costs. Singles, on the other hand, bear these expenses individually, which can potentially lead to higher overall costs and reduced consumption levels. Another reason may be that married relationships can sometimes allow households to benefit from economies of scale. This implies that specific costs, such as buying goods in large quantities or sharing transportation expenses, can be distributed among several individuals, leading to cost savings. On the other hand, individuals who are single may not benefit from the same economies of scale and may have to cover the entire cost of such expenses, which can affect their consumption levels. The results of the study support the findings of [28] regarding the impact of on-farm activities on rural household food security in rural areas.

5. Conclusion and recommendation

Non-farm activities have the potential to significantly impact rural households' consumption by increasing income, diversifying income sources, creating employment opportunities, and promoting local economic development. Heckman's two-step estimation method was used to examine the relationship between non-farm activities and household consumption in rural of Western Ethiopia. The study identified significant factors influencing consumption levels. The analysis revealed that non-farm participation has a significant positive impact on the consumption of rural households in the study area. Households involved in non-farm activities had higher levels of consumption compared to those dependent solely on agricultural production. This finding suggests that diversifying

income sources through non-farm participation can contribute to improving living standards and reducing poverty in this particular region. Furthermore, the study revealed that specific factors influence the effect of non-farm participation on consumption in the study area. Education, access to credit, membership in *idir* and *iqub*, training, and proximity to markets were identified as important factors that can enhance the consumption benefits of non-farm participation. This indicates that offering support in these areas, such as enhancing educational opportunities, facilitating access to credit and training, and developing market infrastructure, can further amplify the positive impact of non-farm involvement on consumption in rural households.

The implications of the study emphasized that examining the impact of non-agricultural activities on consumption has significant implications for economic development, poverty reduction, and the enhancement of rural livelihoods. These activities serve as supplementary sources of income, reducing vulnerability to changes in agriculture and fluctuating prices. Furthermore, non-farm activities contribute to reducing poverty by providing stable incomes, improving quality of life, and reducing rural poverty rates. Furthermore, they play a role in driving migration from rural to urban areas, which can affect factors such as food security and income distribution. Understanding the influence of non-agricultural income on consumption patterns and overall well-being is essential, particularly for the development of policies that take into account gender disparities. Furthermore, non-farm activities have the potential to enhance local economic growth by creating market opportunities and generating employment. The results of this research can guide policy decisions and the establishment of support systems to encourage non-farm activities. Additionally, it is important to consider the potential environmental consequences that may arise from the expansion of non-agricultural activities, such as pollution or the depletion of natural resources.

Based on the findings of the study on the relationship between non-farm activities and household consumption in rural area, important recommendations were proposed:

1. **Promotion of Non-Farm Activities:** Governments and development agencies should implement policies that promote and support the development of non-farm activities in rural areas. This can include providing training programs, access to credit, and infrastructure development to facilitate the expansion of non-agricultural businesses.
2. **Education and Skill Development:** Due to the positive correlation between education and consumption, there should be an emphasis on enhancing educational opportunities in rural areas. Initiatives aimed at enhancing skills and knowledge can lead to higher productivity, income, and ultimately, increased consumption levels.
3. **Gender Equality Initiatives:** It is crucial to address gender disparities in access to higher-paying jobs. Programs aimed at empowering women, providing equal opportunities, and challenging discriminatory practices can contribute to improved levels of consumption in households headed by women.
4. **Healthcare Access:** Improving access to healthcare can have a positive impact on household consumption. Investments in healthcare infrastructure, preventive measures, and awareness campaigns can enhance overall health, enabling individuals to participate in income-generating activities.
5. **Livestock Development Programs:** Considering the positive impact of Total Livestock Units (TLU) on consumption, there should be targeted programs to support livestock development in rural areas. This could include veterinary services, breeding programs, and marketing support for livestock products.
6. **Support for Dependent Care:** Acknowledging the adverse effect of having a larger number of dependents on consumption, social support programs or policies that alleviate the financial burden of caring for dependents can be beneficial. This might include targeted subsidies for essential needs such as education and healthcare.
7. **Infrastructure Development for Market Access:** Enhancing infrastructure, particularly transportation, to shorten the distance to markets, can improve economic opportunities for rural households. This, in turn, can have a positive impact on income from non-farm activities and overall consumption.
8. **Financial Inclusion:** Initiatives that support financial inclusion, such as providing access to credit and savings facilities, can empower rural households to invest in income-generating activities and manage consumption patterns more effectively.
9. **Marriage and Family Support Programs:** Acknowledging the benefits of dual incomes in married households, there could be programs that offer assistance for family stability and marital relationships. This may involve counseling services, financial literacy programs, and initiatives aimed at strengthening family bonds.

In conclusion, a comprehensive approach that tackles education, gender disparities, healthcare, livestock development, infrastructure, financial inclusion, and family support is essential for promoting non-farm activities and improving household consumption in rural Ethiopia. Policymakers, non-governmental organizations (NGOs), and development agencies should work together to implement these recommendations in a coordinated manner in order to achieve sustainable economic development and reduce poverty.

Limitation

The Heckman two-step method is specifically designed to address sample selection bias, which is commonly present in studies of non-farm participation. However, the effectiveness of this approach relies on the assumption that the selection process is based on observable factors. If there are unobserved determinants of non-farm participation that are also correlated with household consumption, the method may not fully account for this bias. To address the limitations of the Heckman two-step approach, this study used sensitivity analysis by examining model specifications, alternative variable definitions, and different analytic approaches can help explore the robustness of the results. Sensitivity analysis allows researchers to assess the potential impact of measurement errors,

omitted variables, and other potential sources of bias. In addition, This study exclusively focuses on the impact of non-farm activities on consumption, overlooking the fact that rural households engage in various farming, non-farm, and off-farm activities to improve their consumption levels. The study overlooks the significance of off-farm work and fails to consider its contribution to rural household consumption. Future researchers interested in this field should note this omission and aim for a comprehensive understanding by including an analysis of off-farm activities in their studies.

Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Wakuma Dufera Tesgera: Methodology, Formal analysis, Data curation, Conceptualization. **Amsalu Bedemo Beyene:** Visualization, Validation, Supervision. **Temesgen Kebede Wakjira:** Supervision, Software.

Declaration of competing interest

The authors declare no conflict of interest for this study.

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Annex. Livestock conversion factor in to TLU

Appendix 1 a

Conversion factor of tropical livestock unit(TLU)

Livestock category	TLU	Livestock category	TLU
OX	1	Donkey (young)	0.35
COW	1	Horse and meul	1.1
Bull	0.34	Sheep & goat (adult)	0.13
Heifer	0.75	Shep (young)	0.06
Calf	0.25	Goat (young)	0.06
Donkey	0.7	Hen	0.013

Source [28].

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