Research Article

Determinants of Smallholder Farmers' Income Diversification in *Sodo Zuria* District, Southern Ethiopia

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The research aimed to estimate income diversification and investigate demographic, socioeconomic, and institutional factors that determine the smallholder farmer's diversification of income in the *Sodo Zuria* district, southern Ethiopia. Cross-sectional data were collected from 353 randomly selected households. The Simpson Index of Diversity was used to summarize income diversification, and the Tobit econometric model was implemented to explore the factors affecting the income diversification of smallholder farmers. Accordingly, the mean earnings diversification among smallholder farmers was estimated at 0.56. The primary household income sources are livestock rearing, crop production, mixed farming, nonlabor income, agricultural wages, and nonagricultural wage employment. We found household age, family size, livestock ownership, use of agricultural inputs, access to credit, and participation in training activities significant factors determining smallholder farmers' income diversification in the research area. Lack of initial capital and market access were the principal challenges to diversifying income sources. Therefore, decision-makers should work on the indicated predictors to improve income diversification activities in the study area; particularly, it is required to focus on effective credit provision systems by using modern technologies, improving agricultural input supply, and equipping farmers with better knowledge and skills on income diversification through short-term training.

1. Introduction

Agriculture is the basis for the Ethiopian economy. It contributes over 50% of the GDP, 90% of the raw material requirements of the country's small and medium-sized industries, and approximately 85% of the labor force [1]. However, it is characterized by low productivity. Over the last two decades, it has yet to be able to produce enough food to feed the country's rapidly growing population. A closer look at the country's declining agricultural outputs and ever-increasing population growth begs a search for alternatives [2].

The farm-level income diversification entails adding income-generating activities to the mixed household level, including livestock, crop, nonfarm, and off-farm activities [3, 4]. These activities generate a set of income portfolios with different degrees of risk, expected returns, liquidity, and seasonality. The process involves the allocation of households among various productive assets and income-generating activities [5, 6].

The main farm activities of the country include crop production and livestock rearing, with many smallholder farmers participating in nonfarm business activities [5, 7]. The studies indicate that 83% of Ethiopia's smallholder farmers participated in farming activities and only 27% in nonfarm economic enterprises [8].

Even if more than 80% participate in farm activities, most of the population can access only one or less than one hectare of land, and their farm income needs to be increased for the whole year's consumption. It also varies considerably, exposing most rural households to chronic poverty [1, 6, 9]. It is increasingly believed that diversifying household income sources have impacted food security, reduced poverty, and improved livelihood [10–18]. Therefore, it needs research to understand the economic contributions and bottlenecks of income diversification at different levels and places to sustain its immense contributions.

Theoretically, researchers list the push and pull factors as reasons for income diversification [4, 19, 20]. Whatever the

factors are, income diversification helps to decrease poverty and the household food insecurity status of the country at the national or household levels, which should gain policy attention [21, 22]. Apple of recent research addressed the determinants of income diversification in Ethiopia [6, 23] and synergy/trade-off between Agroforestry and farm income diversification [24]. However, these studies implemented different methodological approaches and were conducted at different scopes, production systems, and agroecology.

Therefore, it is important to investigate determinants of income diversification at the district level. It has massive implications for reducing the challenges of smallholder farmers under poverty, food and nutrition insecurity, and risk. Even though massive studies on income diversification have been conducted in the sub-Saharan region, as discussed above, these studies still failed to identify the various sources and levels of income from different sources, estimate the level of income variations and distribution between these sources, and find demographic, socioeconomic and institutional factors of income diversification among smallholder farmers in the *Sodo Zuria* district in Wolaita Zone, southern Ethiopia.

2. Literature Review

In Ethiopia, the study by Abera et al. [25] indicated that agriculture only took 43.2% of household livelihood diversification, agriculture plus nonfarm took 25.5%, agriculture plus off-farm took 19.3%, and a combination of agriculture plus nonfarm plus off-farm took 12%. Income diversification plays a big role in reducing household poverty and food and nutrition insecurity, and risk [10–18, 23, 26–29].

Numerous empirical studies in sub-Saharan Africa reported various socioeconomic determinants of income diversification [5–8, 16, 25, 30–50]. Mainly the recent studies in Ethiopia identified demographic, socioeconomic, and institutional variables such as gender, age, the quantity of economically active family members, education level, livestock holding, size of cultivated land, proximity to market, land ownership, income from irrigation, price fluctuation problem, credit access, having saving account, proximity to town and market, agro-ecological zone, access to electricity, extension agent training and frequency of contact, access to mass media, total annual household income, and urban linkage, membership in cooperatives, poor infrastructure, lack of training, number of diversification strategies and lack of technical skill as factors of household income diversification [5, 6, 23, 32, 33, 35, 36, 49, 51–56].

As indicated above, solving the challenges of smallholder farmers' income diversification problems through identifying the constraints at the root level will have a big implication for designing effective policies to solve the challenges of the majority of the country's population, smallholder farmers. It has the maximum effect on the country's economy as well. Therefore, finding the determinants of smallholder farms' income diversification at the district level is critical to use as input in designing effective policies. Thus, this study identified specific factors determining income diversification in the *Sodo Zuria* district where no past empirical evidence

addressed the issue using household characteristics, socioeconomic and institutional variables such as household head sex, age and education, family size, land size, livestock ownership, fertilizer use, participation in skill training, and access to credit in the research area.

As a theoretical framework, the study is based on the theory of rational choice on the assumption that rural farmers take up income diversification activities. Farmer's utility controls the household in settling on their choosing. In this investigation, it is accepted that the option to participate in various income diversification is impacted by the anticipated utility, which will be higher if the advantages obtained from various income diversification activities are more heightened. The noticed result of participation choice can be displayed under the structure of the random utility function. The household's welfare will reflect the development of the choice to participate in income diversification. Households are relied upon to setting income diversification when they see the net advantages of participating as more noteworthy than the situation without it. Since utility cannot be noticed straightforwardly, it may be found in economic agents' decisions. In this situation, the choice will be to be interested in income diversification activities. The current study found that the behavior of rural smallholder farmers can be directed by this theory when making decisions in the making choice from various income diversification activities. The research investigates factors affecting farmers' choice of income diversification activities.

3. Research Methodology

3.1. Study Area. The research was conducted in the *Sodo Zuria* district of Wolaita Zone, southern Ethiopia. The district is 390 km southwest of the capital city of Ethiopia, Addis Ababa. It is located at 6.4°–7.1° N and 37.4°–38.2° E latitude and longitude (Figure 1). According to the Zonal Socioeconomic profile, the district has two Agroecological zones, namely, *Dega*/Highland/13%, *Woyna-Dega*/Midland/87%, characterized by 89.6% plain, 6.89% undulated, and 3.51% mountainous topography. Its altitude ranges from 1,800 to 2,950 m above sea level with a mean annual temperature of 18°C. The nature of rainfall is bimodal, with a mean yearly rainfall of 1,201–1,600 mm. The short rain ("*Belg*") starts from February to April, and the prolonged rain ("*Meher*") starts from June to September. Currently, the district is composed of 24 kebeles. Administrations (the lowest administrative unit in Ethiopia), of which 20 are rural and four are urban [57]. The total population of *Sodo Zuria* district was 20,2913, of which 99,781 are men and 103,132 are women. The district's population density is 502 km^2, much higher than the regional density of 141/km^2 and the zonal density of 414 people/km^2, which leads to a minimal average land holding per farm household, i.e., 0.07–0.33 ha/household [57]. The district's total area is 404 km^2 and 60.4% of the land is cultivated, forests and bushes cover 7.8%, 16% is grazing, irrigable land is 0.77%, cultivable land is 1.23%, uncultivable land is 0.98, and others cover 12.82%. The most prominent mountain in the district is Damota Mountain, which has a height of 2,950 m above sea level [57].
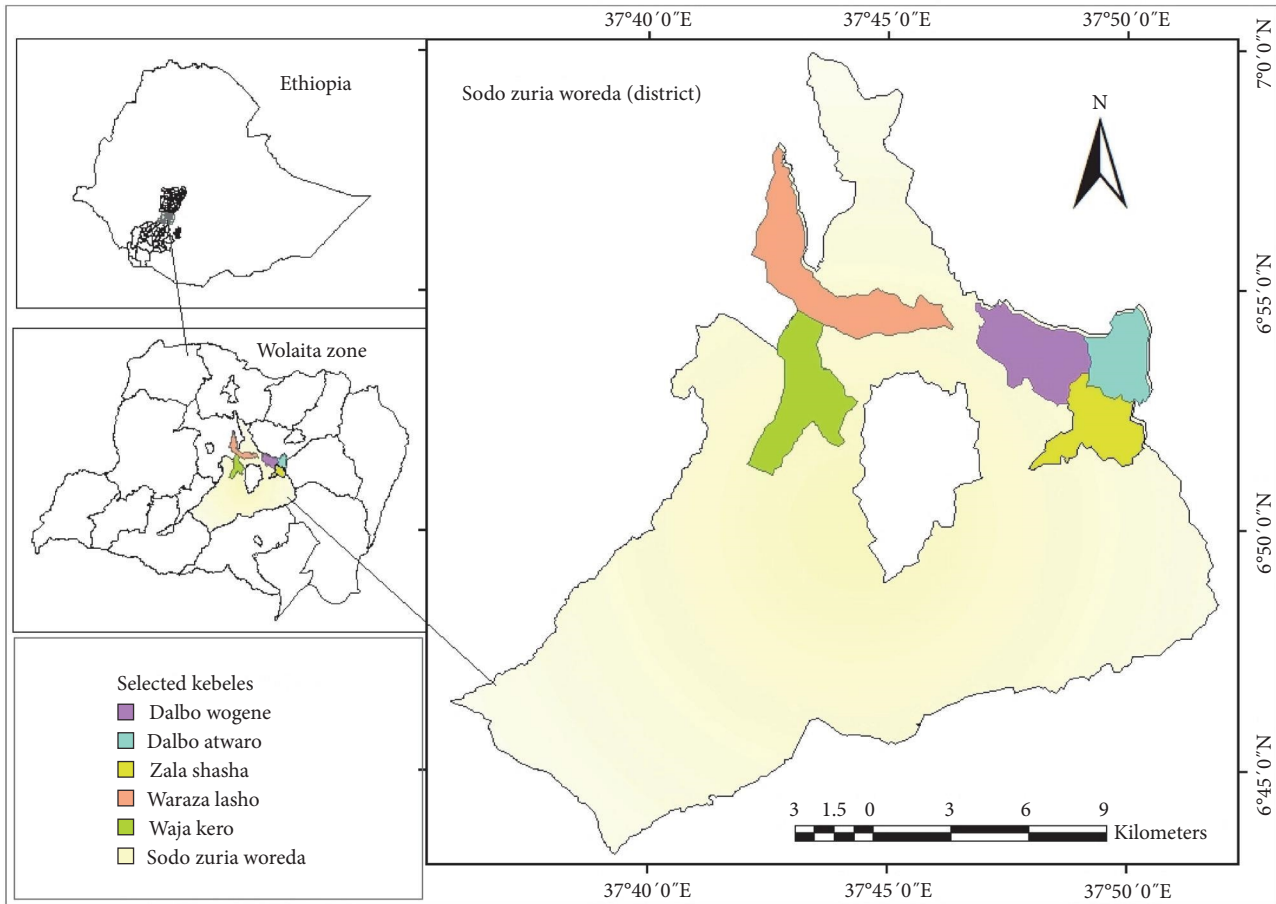
FIGURE 1: The map of the study area.

3.2. Data Collection. A cross-sectional study was conducted from April to June 2021 in the *Sodo Zuria* district to investigate the area's income diversification and associated factors of smallholder farmers. Inclusive households in the district were considered source populations. The data used were quantitative and qualitative in their characteristics, and both primary and secondary data sources were used. Primary data were collected from sampled farm households represented, and secondary data on area description, quantities of *kebeles* and households, off-farm activities, and previous research works in the area of off-farm activities were gathered from different sources from the district, zonal, and regional level agricultural and natural resource office reports, and published and unpublished reports were obtained to support the primary data. The primary data were collected using structured questionnaires, which were appropriately developed and improved after an appropriate preliminary study. The sample size was determined using the [58] formula as indicated below (Equation (1)):

$$n = \frac{Z^2 \times P(1-P)N}{e^2(N-1) + Z^2 P(1-P)} = 353, \qquad (1)$$

where n denotes sample size; N represents total population (4,442); Z represents 95% confidence interval under the normal curve (1.96); e indicates error term (0.05), and P and q are estimations of the proportion of the population to be sampled (p equals 0.5, and the sum of p and q equals 1).

As indicated above, the data were collected from sample households using structured interviews with four well-trained and experienced agricultural extension experts as data collectors and enumerators. We supervised the data enumerators and cross-checked for completeness and consistency before data entry. The study used multi stages sampling procedure. First, *Sodo Zuria* district was selected as the target district from the 16 rural districts in the Wolaita zone. Second, five of the 24 *kebeles* discovered in the district were drawn through simple random sampling techniques. Then households were chosen by systematic random sampling (with an interval of 12) from the selected *kebeles* until the required sample size. It was used by assuming all households in selected *kebeles* have equal possibility to involve in off-farm activities. The chosen *kebeles* were *Waja Kero*, *Zala Shasha*, *Waraza Lasho*, *Dalbo Atwaro*, and *Dalbo Wogane*, as indicated below (Table 1).

3.3. Analytical Framework. Income diversification can be analyzed using the asset-based approach, an activity-based approach, and an income-based approach. However, using an asset-based approach is difficult due to allocating productive assets to a particular activity instead of being used across

TABLE 1: Distribution of sample households in selected *kebele*s.

Kebele	Household population (%)	Number of sampled households
Waja Kero	956 (21.5%)	76
Zala Shasha	1,409 (31.7%)	112
Waraza Lasho	629 (14.2%)	50
Dalbo Atwaro	1,107 (24.9%)	88
Dalbo Wogane	341 (7.7%)	27
Total	4,442 (100%)	353

activities. In addition, calculating the actual value of some assets is difficult due to the need for more development of asset markets in the least developing countries. Similarly, due to the difficulty in fully valuing activities, aggregating single money, and ignoring unearned income sources, the second approach also has problems [1, 2].

However, if researchers purposively ignore unearned income sources and define diversification as participation in income-generating activities, activity diversification can be adopted as a suitable measure. Thus, the time allocated to or income earned from each activity may be used to analyze diversification. Unfortunately, another weak point is that the reported employment share of nonfarm activities is believed to be understated [1, 2, 4]. Nevertheless, given the shortcomings of the asset and activity-based approaches and several advantages, such as two motives of its maximization and stabilization as a natural factor, it is the end outcome of income-generating activities and more straightforward to convert in-kind payments into a money metric, and due to the higher development of the goods market compared with the asset market [1, 2, 4]. Due to these reasons, defining diversification in terms of income may be the most suitable approach. Therefore, we used an income-based approach to estimate income diversification through Simpson Index Diversification (SID) and analyze its determinants.

Thus, the SID index was used to determine income diversification, which merges income diversification from multiple income sources into one variable and properly measures the level of income diversification of the smallholder farmers. Besides, the univariate description was carried out using features considered for the challenges and opportunities of income diversification among smallholder farmers in the study area. The study mainly used quantitative data analysis methods. Descriptive statistics were used to summarize demographic and socioeconomic characteristics, household income sources, and diversification. The formula for SID [59] was used (Equation (2)) to estimate household income sources and diversification of income:

$$\begin{aligned} \text{SID} = 1 - ((\text{ILR}/\text{TI})^2 + (\text{ICP}/\text{TI})^2 + (\text{IMF}/\text{TI})^2 \\ + (\text{INFE}/\text{TI})^2 + (\text{INL}/\text{TI})^2 + (\text{IAW}/\text{TI})^2 \\ + (\text{INAW}/\text{TI})^2), \end{aligned}$$

$$(2)$$

where TI denotes the total income of the household, ILR denotes income from livestock rearing, ICP denotes income

from crop production, IMF denotes income from mixed farming, INFE denotes income from none farm self-employment, INL represents income from none labor source, IAW represents income from agricultural wages, and INAW denotes income from nonfarm wages.

Later, to address the factors that affect income diversification, the Tobit econometric model was carried out to indicate those variables' effect on the income diversification values of smallholder farmers obtained by using SID as the dependent variable. The Tobit regression model is called the censored regression or the Tobit model. It is selected because it fits the censored outcome variable within a fixed interval. It measures the latent feature more appropriately than competing models (such as fractional response, Hackman two-stage sample selection, double hurdle, and logit models). The Tobit model was used for the current study because all sampled households participated in income diversification activities except for the difference in the status of participants as indicated in the Simpson Index. Hence, models such as Hackman and Double hurdle were not found appropriate for the current study due to the nature of the data and since there is no need to be concerned about sample selection bias. The general formulation of the Tobit model is provided in terms of an index function. The lower and upper censoring was made at 0 and 1, respectively, considering the income diversifications of the smallholder farmers and households [60]. The Tobit framework relation between nine independent variables (Table 2) (x_1, x_n), their weights (β_0, β_1,..., β_n), and the observed default score (yi) is described by the latent variable (yi^*). The difference between the experimental default score (yi) and the latent variable (yi^*) is that the observed default score has a lower limit, equal to zero, and the latent variable is unlimited.

Therefore, the latent variable (yi^*) represents the relation between the risk indicator score ($\beta_0 + \beta_1 x_1 + \cdots + \beta_n x_k$) and the default score for both the observable ($yi^* > 0$) range and unobservable ($yi^* \leq 0$). *Observable* $yi = (yi^* \text{ if } yi^* > 0, 0 \text{ if } yi^* \leq 0)$ *with latent variable* $yi^* = \beta_0 + \beta_1 x_1 + \cdots \cdots + \beta_n x_k$, where ($yi^*$) dependent variable (SID), βs are parameters to be estimated, and Xs are independent variables (Table 2).

4. Results and Discussions

4.1. Demographic and Socioeconomic Features of Surveyed Households.
As depicted in Table 3, the respondents' mean age was 46. On the other hand, the smallholder farmers' mean family size was about five. It was also found that sampled households, on average, owned 0.19 hectares of land. This shows the high intensity of land size fragmentation in the research area. This result aligns with the national level of 0.15–0.5 hectares [61].

Moreover, Table 4 shows the categorical socioeconomic characteristics of sampled households. Accordingly, 244 (69%) of the households were male, and the rest (31%) were female-headed households. On the other hand, among the sampled farmers, 303 (86%) use agricultural input, fertilzer. This implies that many sampled farmers do not use agricultural

TABLE 2: Description, measurements, and hypotheses of independent variables.

Variables	Variables descriptions	Measurements	Hypothesis	Previous findings
Dependent variable				
SID	Income diversification index	(0–1)		
Independent variables				
Sex	Sex of household head	One if the household head is male; zero, if female	+	Asfir [34]
Age	Age of household head	Years	+	Abera et al. [25]
Education	Formal education of household head	One if not attended formal grades at least primary school and zero otherwise	+	[5]
Family size	Family size of household	In number	+	Etea et al. [7]
Land size	Total farm size of household	Hectare	–	Gebreyesus [8]
Livestock ownership	Livestock ownership by the farm household	One if owned at least one livestock and zero, if no livestock is owned	+	[25]
Fertiliser use	Application of fertilizer for agricultural production	One if a household uses fertilizer and zero otherwise	+	
Training received	The household head attended formal agricultural training	One, if yes; zero, otherwise	+	[7]
Credit	Household received formal credit	One, if yes; zero, otherwise	+	[5]

TABLE 3: Quantitative socioeconomic variables.

Variable	Mean	Standard deviations (SD)	Minimum	Maximum
Age	46	5.2	30	60
Family size	4.8	1.68	2	9
Land size	0.19	0.10	0.01	0.25

TABLE 4: Descriptive statistics of categorical socioeconomic variables.

Variables	Frequency	Percentage (%)
Sex	244	69
Education	148	42
Fertilizer use	303	86
Credit access	241	68
Agricultural training	252	71
Livestock ownership	167	47

TABLE 5: Farmer's income diversity sources or scores, SID in the study area.

Farmer's income sources: SID	Mean	Standard deviation
Livestock rearing	0.24	0.16
Crop production	0.34	0.24
Mixed farming	0.08	0.16
Nonfarm self-employment	0.17	0.22
Nonlabor income source	0.01	0.08
Agricultural wage employment	0.05	0.12
Nonagricultural wage employment	0.07	0.14
Overall Simpson Index of Diversity (SID)	0.56	0.21

inputs in the study area. Moreover, about 148 (42%) of the sampled farmers were illiterate, and the rest (58%) of the participants were trained in at least primary school and to the maximum of college and above. Furthermore, 252 (71%) of the sampled farmers received agricultural training, and the rest still required it. Similarly, 167 (47%) owned livestock and the remaining did not.

4.2. Household Income Sources and Diversification. The findings of this study, as depicted in Table 5, indicates the sampled farmer's sources of income and the average income from these sources. Farmers Simpson Index of Diversity (SID) is 0.24, 0.34, 0.08, 0.17, 0.01, 0.07, and 0.05 for livestock rearing, crop production, mixed farming, nonfarm self-employment, nonlabor income sources, nonagricultural wage employment, and agricultural wage employment, respectively. The overall SID was found to be 0.56. This can be restated as, on average, smallholder farmers diversify their incomes inside 0.56 in the research area. As Saha and Bahal [62] indicated, households with the most diversified incomes will have the largest SID, and the less diversified incomes are associated with the smallest SID. The higher the number of income sources and the more evenly distributed income shares, the higher the value of SID. This study's finding is higher than a similar study by Adem and

Tesafa [1], who reported a 0.24 SID index of farmers' income diversification. However, it is comparable with another similar study by Gecho [6], who reported an equivalent level of income diversification of 0.59 SID. The probable reason for the disparities might be the likely relative discrepancies in the study settings of the present study. The level of income diversification

TABLE 6: Tobit estimates of predictors of smallholder farmers' income diversity.

	Coefficients (SE)	Delta method dy/dx (SE)
Sex	−0.011 (0.035)	−0.027 (0.035)
Age	−0.006* (0.003)	−0.006 (0.003)
Educational status	−0.038 (0.028)	−0.038 (0.028)
Family size	−0.049** (0.010)	−0.049 (0.011)
Livestock ownership	−0.084** (0.029)	−0.084 (0.028)
Own land size	0.277 (0.156)	0.267 (0.156)
Use of fertilizer	−0.245** (−0.051)	−0.243 (0.051)
Access of credit	−0.145** (0.036)	−0.144 (0.036)
Training received	−0.208** (0.036)	−0.207 (0.036)
Constant	1.976*** (0.185)	—

Note: *, **, and ***represent statistical significance at 10%, 5%, and 1% significance levels, respectively.

shows as there are efforts (leveled as the medium) to diversify income sources in the study area than in parallel settings, and the probable reason for limitedness might be inadequate income to their demand in the study area.

4.3. Determinants of Income Diversification.
The Tobit econometric model result depicted in Table 6 shows that nine independent variables considered in regression, six were found to determine farm household income diversification in the study area significantly. Thus, we found the age of the household head, family size, livestock ownership, farmers' use of fertilizer, access to credit, and participation in formal agricultural training of the surveyed farmers as significantly associated factors of the income diversification of the smallholder farmers in the study area.

The age of the household head is statistically significant and negatively relates to farmers' income diversification. The marginal effect result shows that a year increase in age decreases the probability of income diversification of smallholder farmers in the study area by 0.6%. The possible reason for this might be a decrease in the possibility of farmers' risk-taking behavior to be involved in additional income diversification activities with an increase in age [63]. The finding was in line with Maniriho and Nilsson [64], Toyin and Abbyssiania [65], Demissie and Legesse [5], and Shaga et al. [66].

Likewise, family size also has analogous interpretations with the age of the sampled farmers. An increase in it decreases the likelihood of diversifying income by 5%. This is likely due to the increased probability of participation in income diversification with the family size, as every member may practice income-generating activities with labor availability. This finding contradicts Abera et al. [25] and Maniriho and Nilsson [64]. On the other hand, it is in line with the result of Teji [67]. The possible reason for the differences in evidence is the disparities in the study settings, which create differences in working culture among smallholder farmers and the variation in the extent of productive family members in the farmers in the varied study areas.

Similarly, livestock ownership was also found as a negative and statistically significant factor of income diversification.

It decreases income diversification by 8.4%. The result is in line with the finding of Adem and Tesafa [1], Gecho [6], and Demissie and Legesse [5]. The likely reason for the negative effect of livestock ownership on income diversification might be that the higher income generated from it may discourage farmers from searching for an extra income source.

Using fertilizer also has a negative and statistically significant relation with farmers' income diversification compared to prior expectations. An increase in it decreases the likelihood of diversifying income by 24.3%. The possible reason might be increased income from improved agricultural productivity. The result is different from Gebru et al. [42].

Moreover, access to credit is negatively related to farmers' income diversification. Households who received credit are 14.4% less likely to participate in income diversification activities. This might be due to household utilization of credit obtained on nonproductive activities. This finding aligns with Kassa [22] and Gebru et al. [42]. However, it is in contrast with Maniriho and Nilsson [64].

Agricultural training found as a negative and statistically significant factor in income diversification. The probable reason might be farmers' concentration on agricultural activity rather than other income sources that resulted from participation in the agricultural training. The current result is similar to the study conducted by Abera et al. [25] in southwestern Ethiopia.

4.4. Constraints and Opportunities of Income Diversification in the Research Area.
It is also found that lack of initial capital is the principal challenge of income diversification of smallholder farmers in the research area. It is reported by 111 (31.4%) farmers as the challenge of income diversification. Lack of skill and market access were also mentioned as the constraint of income diversification by 91 (26%) surveyed farmers. On the other hand, 146 (41.4%) of surveyed farmers mentioned other related challenges (poor soil fertility and market instability) as income diversification challenges in the study area (Table 7).

Moreover, the opportunities to gain income from diversified sources were essentially mentioned as the availability of credit linkage by 160 (45.3%) framers. Good agroecological conditions by 64 (18.1%) of farmers were mentioned as another opportunity for income diversification in the research area. These findings are similar to Kassa [22]. The probable solution mentioned by surveyed farmers for increased income diversification in the research area was government direct and indirect support (through providing training services, accessing credit, improved modern rural technologies, hardworking, and increased savings).

5. Conclusions and Policy Implications

The mean income diversification among smallholder farmers in the *Sodo Zuria* district was 0.56, as indexed by the SID. Livestock rearing, crop production, mixed farming, nonlabor income, agricultural wage employment, and nonagricultural wage employment are mainly identified farmer's income sources. The principal income sources of the smallholder farmers were crop production and livestock rearing. The

TABLE 7: Challenges and opportunities for income diversification in the study area.

Variables	Categories	Frequencies (%)
Challenges and constraints to diversify income Sources	Initial capital	111 (31.4)
	Skill gap and lack of market access	91 (25.8)
	Other related challenges	146 (41.4)
Opportunities to diversify income sources	Credit linkage	160 (45.3)
	Favorable agroecological conditions	64 (18.1)
	Other related opportunities	124 (35.1)
Possible solutions for the challenges	Government support	228 (64.6)
	Hard work and saving	101 (28.6)
	Support from others (relatives, friends, etc.)	19 (5.4)
Likely solutions to use opportunities to diversify income sources	Training	124 (35.1)
	Saving and credit	99 (28.0)
	Improved modern rural technologies	124 (35.1)

study also discovered that the respondent's age, family size, number of livestock, use of fertilizer, access to credit, and access to training on agricultural activities as significant socio-economic and institutional factors that affect the income diversification of the smallholder farmers. Moreover, it was found that lack of initial capital, skill, and market access were the principal challenges of income diversification; credit linkage and favorable agroecological conditions were mentioned as opportunities to gain income from diversified sources. Therefore, based on these findings, it is recommended that owning better credit accessibility helps smallholder farmers to improve income diversity. It is also required to provide skill development training on livelihood diversification options. It needs to give attention to aging smallholder farmers and households with higher family members to enhance income diversification activities in the research area. The government and other decision-makers should also work on opportunities for smallholders in rural areas through supportive policies, including creating a market for their products.

Data Availability

The data for this research will be available upon request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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