

# Factors affecting coffee farmers' production in Jimma Zone, Southwest Ethiopia

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## ABSTRACT

Coffee yield has good potential in the welfare of growers in coffee cultivation in Ethiopia in general and particularly in Jimma zone, southwest Ethiopia. Therefore, this study attempts to investigate the factors affecting coffee farmers' production in Jimma Zone, Southwest Ethiopia, using cross-sectional field survey data collected from 204 sample coffee growers in the 2023 main growing season. Primary and supplementary data such as secondary data were collected in this study. Descriptive and binary logistic regression methods were employed for the data analysis. The results of binary logistic regression analysis showed that age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, access to infrastructure, distance to the nearest market and distance to the nearest road were the factors significantly influencing coffee production. Overall, the findings indicate that to enhance and sustain coffee yield in the study area, improved coffee varieties and agronomic practices can be better options to expand coffee yield. Therefore, the bodies involved can use the results of this work to formulate public policies focused on coffee production, which is a crucial basis for boosting food security. The summary of coffee production by policymakers could help to achieve improved living standards for the people in the Jimma Zone.

**Key words:** Coffee production; Ethiopia; Jimma zone; coffee varieties; food security.

## 1 INTRODUCTION

Achieving sustainable agricultural development is key to enhancing agricultural growth, reducing yield instability, ensuring food security, and maintaining economic stability in least-developing countries (Gebremariam et al., 2021; Food and Agriculture Organization - FAO, 2021; Debele; Gebeyehu; Abebe, 2019; Minten et al., 2019). Agriculture is one of the most widespread and foremost powerful sectors to boost food security and prosperity in developing countries, particularly in Ethiopia (Central Statistical Agency - CSA, 2019; Al-Zebari; Kahlel; Al-Hamdan, 2021). The sector accounts for the largest portion of income, employment, exports, job creation, and foreign exchange in Ethiopia (Anbes, 2020; CSA, 2018; Ikuemonisan et al., 2020). However, agriculture in Ethiopia is highly dominated by smallholder farmers, rain-fed subsistence agricultural systems, and backward technologies (FAO, 2021; Röder, 2018; Takele; Negese, 2020). Therefore, the agricultural development policy in Ethiopia is most important for the improvement of production, productivity, and quality (Ekin, 2019; Negese, 2022; Sadiq; Singh; Ahmad, 2020). However, the agricultural cultivators have not achieved and improved the required goals, because the sector is characterized by input management problems, poor extension and credit use, backward marketing and technologies, poor infrastructure, inappropriate inputs and policy use, and rain-fed subsistence agriculture (Alebachew; Yilkal; Negese, 2020; CSA, 2019; Cheng et al., 2017; Sanait; Negese, 2020; Tesfaye; Negese, 2021). Consequently, the sector generates Ethiopia's over 36% of the national GDP, 50% GDP,

90% of export income, 85% of the country's labor force, and 73% of the inputs to the country's productive industries (Anbes, 2020; CSA, 2018; Negese; Sanait, 2023). In 2018/19, Ethiopia earned 2.3 billion USD from agricultural export (United State Development of Agriculture - USDA, 2020). However, in 2018/19, the share of agriculture in the real GDP 3.8% was lower as compared to the service sector 11%, and the industry sector 2.6% in Ethiopia (National Bank of Ethiopia - NBE, 2019). Hence, the production status of agriculture is generally lower than the world average due to the low attention and position given to the sector (CSA, 2019; Negese; Jemal, 2021). In particular, Ethiopians driving food security and poverty alliance policies highly depend on the agricultural sector (CSA, 2017). Despite its potential, the agricultural sector faces low productivity and is unsatisfactory with population pressure (Wichrowska; Szczepanek, 2020). This means that Ethiopia dominates a major portion of the population with low yield (CSA, 2018). Therefore, this low agricultural production and quality drives food insecurity and poverty (CSA, 2017; CSA, 2018; CSA, 2019; Central Intelligence Agency - CIA, 2018). In particular, there is high population pressure through birth rate, conflicts, pest infestation, drought, lack of relief assistance, lack of access to credit use, absence of non-farm, shortage of food availability, land degradation, high unemployment level, poverty, shortage of housing, poor or traditional cultural practices, high cost of living, and poor access to social services is the major existed challenges with low yield in Ethiopia in general and particularly in the study area (Berhanu; Negese, 2022; Bonsa et al., 2022;

Islam et al., 2021; Negese, 2023; Lalisa et al., 2020; Tesfaye; Negese, 2021; Schrama et al., 2018).

Coffee is the second most prominent worldwide traded commodity and it accounts for export worth 36.3 billion US dollar in 2021 marketing year after oil (Minten et al., 2019; Workman, 2022). Coffee is the main cash crop commodity cultivated in the world, particularly in Ethiopia (Debele; Gebeyehu; Abebe, 2019; Negese; Sanait, 2023). As the recent data, coffee produced in more than 70 countries globally with Brazil, Vietnam, Colombia, Indonesia, and Ethiopia being the major global coffee growers in the world (International Coffee Organization - ICO, 2016). Particularly, Ethiopia is the largest grower of coffee in Africa and the fifth producer globally, next to Brazil, Vietnam, Colombia, and Indonesia, accounting for more than 4.2% of the world coffee yield, which is lower than aforesaid countries (El-Rasoul; Shehab; Maghraby, 2020; ICO, 2016). Despite the good opportunities for a suitable coffee cultivating environment and efficient use of the labor force in improving coffee cash crop production, the mean coffee yield (0.71t/ha) is significantly lower than in other coffee-cultivating countries, such as Brazil (0.78 t/ha), Colombia (0.76 t/ha), and Vietnam (1.31 t/ha) (FAOSTAT, 2020). This low coffee productivity is due to many factors such as diseases, pests, recurrent drought, rainfall fluctuation, low soil fertility, traditional coffee cash crop management, lack of adoption of improved coffee varieties, and slow adoption of agronomic practices (Fekede; Gosa, 2015; Jima et al., 2017; Tadesse; Tesfaye; Abera, 2020). Low production of coffee cash crops is a major problem in Ethiopia in general and particularly in the study area and has different causes, which is attributed to poverty in study areas (FAO, 2021). Coffee cash crop plays a crucial role in achieving food security, leaving poverty, improving income generation, increasing export revenue, enhancing the foreign exchange rates, and creating job opportunities, and employment (Ikuemonisan et al., 2020). In Ethiopia, shortage of landholding, poverty, drought, and high population pressure have led to a decline in subsistence agricultural production, and leading in rural areas is the driver of food insecurity and poverty (CIA, 2018; CSA, 2019). In particular, coffee is the most important dominant cash crop in the world, ranking fifth place in terms of production and coverage (El-Rasoul et al., 2020). The average yield of coffee is low due to lack of disease-resistant varieties, drought-resistant varieties, input varieties, soil infertility, lack of yield with desirable market qualities, lack of appropriate infrastructure, limited knowledge of agronomic coffee management, problems of poor harvest handling, and limited production technologies (CSA, 2019).

Arabica and Robusta have highly grown coffee cash crop species in Ethiopia and the country is the birthplace of Arabica coffee. Ethiopia is the origin of coffee which is good potential to improve coffee yield (Negese; Sanait, 2023). The

average annual coffee production is 229,351.3 tons and the average yield of coffee is 0.71 tons/ha. The country has an impressive potential to increase coffee production with good temperature, suitable elevation, quality of planting materials, recommended soil fertility, and appropriate rainfall in coffee cash crop growing belts of Ethiopia (Taye, 2013). Though Ethiopia with a good for enhancing coffee cash crop yield, the average/ha production remains low at 0.71 tons/ha. Coffee directly or indirectly contributes 15% of the country's agricultural yield, it improves the well-being of the citizens of the country. Coffee plays a key role in Ethiopia's economy and contributes 25% of the national GDP, 40% of export earnings, 60% of the exports, 10% of the revenue, and 25% of the population (International Trade Centre - ITC, 2011). In Ethiopia, about 70%-80% of the coffee planted is the dry-processed coffee and 20%-30% is the wet-processed coffee. In Ethiopia, export also accounts for 70%-80% of the dry-processed coffee and 20%-30% of the wet-processed coffee (Tefera; Bickford, 2021).

It is an important deriving source of Ethiopia's spiritual life, economy, and socio-culture of the society (Taye, 2013). To derive better yield, supply chain bottlenecks and low productivity issues will need to be addressed. Farmers in the coffee growing system use irrigation, proper coffee tree management, and have access to improved seed varieties, they could derive a high yield of coffee cash crop. Coffee is an important cash crop in Ethiopian culture and society. An invitation to drink coffee is assumed to be a symbol of respect, hospitality, and friendship in Ethiopia. Ethiopia's coffee production estimate is presented for the year 2018/19-2022/23 concerning area (metric tons/ha) (Table 1).

**Table 1:** Ethiopia's coffee production estimate concerning area (metric tons/ha).

	2018/19	2019/20	2020/21	2021/22	2022/23
Production (000 tons)	441	447	450	489	496
Area (1000ha)	535	538	540	585	590
Productivity (ton/ha)	0.82	0.82	0.82	0.84	0.84

Understanding the determinants underlying coffee production is important for reducing food insecurity and poverty through increased agricultural production. An important growing body of empirical literature focuses on the factors affecting coffee production (Fekede; Gosa, 2015; Cheng et al., 2016; Girma; Gure; Wedajo, 2020; Jima et al., 2017; Negese; Sanait, 2023; Tadesse; Tesfaye; Abera, 2020; Tolessa et al., 2017). Particularly, several studies have significantly focused on the different aspects of factors affecting coffee production.

However, some of these studies were limited in their ability to identify the factors affecting coffee production. Further, there is limited empirical literature and specific information on the yield practices of coffee in the study area. Therefore, this study attempts to investigate the factors affecting coffee production in the Jimma Zone, Southwest Ethiopia. Specifically, to investigate the challenges and key factors affecting coffee production, producers and non-producers people are facing, and to investigate the attitudes and trends of coffee producers and non-producers towards coffee production in the study area.

The current research study estimation strategy was based on a conceptual framework. The current research study conceptual framework was conducted and modified according to a review of the empirical literature (Negese; Sanait, 2023). This study conceptual framework, presented in Figure 1, revealed that coffee farmers' characteristics such as age, sex, educational status, family size, marital status, off-farm activity, labor force; economic factors such as landholding, livestock holding, soil fertility, fertilizer use, use of pesticides; institutional factors such as credit use, extension services, provision of improved seed, access to market information, access to infrastructure, membership of cooperatives; social factor such as distance to nearest market, distance to nearest road are the most important factors that affect coffee farmers' production. The presented conceptual framework showed the most crucial factors and their associations with each other. The conceptual framework is shown in Figure 1.

total population of the Jimma Zone is 2,773,730 (100%), of which 1,382,460 of the population are male while 1,391,270 of the population are female, and 2,432,562 of the population in Jimma Zone are rural dwellers. Jimma Zone is located 333 km southwest of Addis Ababa, which is the capital city of Ethiopia. The Zone lies between 7°13' to 8°56'N latitude and 35°49 to 38°38'E longitudes. Jimma Zone was agroecologically categorized into three categories highland (35%), midland (47%), and lowland (8%). The mean yearly rainfall varies from 1,200 to 2,500 mm with a mean annual temperature lying between 20 °C and 25 °C. The total land elevation in Jimma Zone ranges from 880 to 3,340 m asl. The total land area of the Zone is 1.1 million hectares of which 0.1 million hectares is potentially coffee cultivated land. The Jimma Zone is bordered by the east Wollega zone in the north, east, and southwest; Shoa Zone in the northeast, south; Nation, Nationalities and People's Region in the southeast and south; and the Ilu-Ababora Zone in the west. The largest part of the Jimma Zone is midland and the zone is suitable for agricultural cash and cereal crop production. Agriculture is the major activity of smallholder farmers in the Jimma Zone. In particular, the coffee cash crop is the major commodity produced in the Jimma Zone. Coffee is an important cash crop and plays a key role in livelihood such as the economic and cultural welfare of the farmers. The majority of farmers in the Jimma Zone are young coffee cultivators with suitable coffee farming reasons, such as high potential for coffee yields, introduction and application of coffee production technologies, and widely applicable extension of coffee cultivation applied in the Jimma Zone.

## 2 MATERIAL AND METHODS

### 2.1 Description of the study area

The research was conducted in the Jimma Zone, located in the Oromia regional state, Southwest Ethiopia. The

### 2.2 Sampling technique

Multi-stage sampling was applied to select the sample respondents. In the first stage, the Jimma Zone was purposely

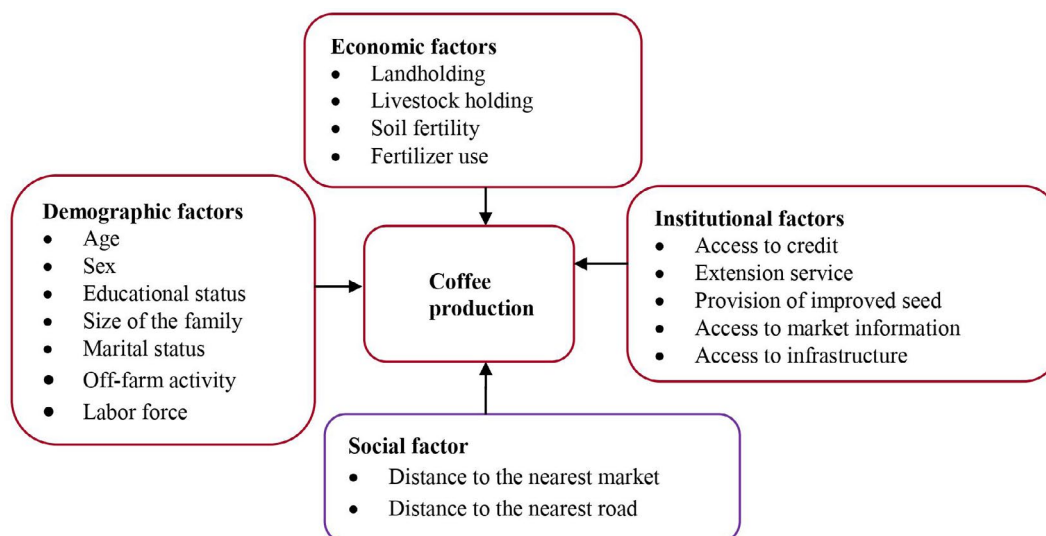


Figure 1: Conceptual framework.

selected based on the status of coffee production and the introduction and application of strategies to improve coffee production. In the Jimma Zone, coffee production is higher than in the remaining zones in the Oromia regional state. In the second stage, the four high coffee production districts such as Manna, Limmu Kosa, Gera, and Gomma in the Jimma Zone were selected on the level and status of coffee production. In the third stage, the number of households in the production year 2023 was identified. The total number of households (101,662) was selected from the total production districts stratified by coffee production status. The sample size was developed in (Yamane, 1973).

$$n = \frac{N}{1 + N(e)^2} = \frac{101662}{1 + 101662(0.07)^2} = 204$$

A total of 204 respondents were selected from all the selected districts using proportionate selection procedures.

$$n_i = \frac{N_i}{N} n$$

Where  $n_i$  is the number of samples selected from each  $i^{th}$  selected districts,  $N_i$  is the number of households from the  $i^{th}$  selected district,  $N$  is the number of households in the selected districts,  $e$  is an acceptable error margin, and  $n$  is the total sample size. Finally, 204 sample respondents were selected from the four districts by applying simple random sampling techniques (Table 2) (Negese; Jemal, 2021; Negese, 2023). The current research study employed simple random sampling method to decrease the data bias involved during data collection.

**Table 2:** Sample of households based on the level of coffee production status (n = 204).

Selected Districts	Total number of households ( $N_i$ )	A total number of sample size ( $n_i$ )
Manna	30540	61
Limmu Kosa	24893	50
Gera	16229	33
Gomma	30000	60
Total	101662	204

Source: Authors proportionate sample size, 2023; Note:  $n_i$  = total sample size  $i$  ( $i = 1, 2, 3, 4$ );  $N_i$  = total number of households.

### 2.3 Types and sources of data

In this study, primary and secondary data sources, as well as quantitative and qualitative primary data sets were applied. Primary data were collected from the demographic, economic, institutional, and social characteristics of the study population. For the primary data collection, open and closed-ended questionnaires were administered to 204

sample households in Jimma Zone, Southwest Ethiopia. The structural questionnaires developed were prepared considering demographic, economic, institutional, and social factors that affect coffee production. Responsible persons were contacted to respond to questionnaires that had good knowledge and information about coffee farmers. The developed questionnaires for primary data were distributed and collected at a later date after completion from March to July 2023. Supplementary data, such as secondary data, were collected from books, unpublished materials, published articles, the Internet, and empirical literature. The study was developed using survey data from the 2023 main coffee cultivating season. This current research study was approved by the institutional research ethical review committee of Jimma University. All sample respondents received a detailed purpose of the study. All the data acquired through the research study was kept confidential and also run as an ethical guideline.

### 2.4 Data analysis

Data analysis was performed using descriptive and binary logistic regression analyses. The descriptive analysis investigated demographic, economic, institutional, and social characteristics of coffee production carried out using frequency, percentages, maximum values, minimum values, tables, averages, standard deviation, t-test, and  $\chi^2$ -test. In particular, the study conducted  $\chi^2$ -test to investigate the relationship between coffee production status and qualitative determinants. In addition, a t-test was applied to evaluate the association between coffee production status and quantitative determinants. Furthermore, the study conducted a binary logistic analysis model to provide and check more appropriate in-depth analysis and to explore determinants that influence coffee production and its level as well as status (Gujarati, 2004). To evaluate the empirical relationship between dependent and independent variables, the study used a binary logit model, because the dependent variable coffee production is a dummy variable 1 if people produced and 0 otherwise. A binary logit model was used to investigate the determinants of coffee production (Gujarati, 2004). Therefore, this study primarily focuses on investigating the factors that affect coffee production, which is important in determining the livelihood of people. Therefore, the probability of coffee production is: (Equation 1 and 2):

$$P_i = Z(y = \frac{1}{x_i} = \alpha + \beta_i x \tag{1}$$

Representation of people produced

$$P_i = F(Z) = \alpha + \sum_{i=1}^n \beta_i x_i = \frac{1}{1 + e^{-(\alpha + \sum \beta_i x_i)}} \tag{2}$$

Where  $P_i$  is the probability status of the  $i^{\text{th}}$  respondent not produced,  $e$  is the base of natural logarithms (2.718),  $X_i$  is the dependent variable,  $n$  is the number of dependent variables,  $i = 1, 2, 3 \dots, n$ , and  $\alpha$  and  $\beta_i$  are parameters to be estimated. (Equation 3, 4, 5, 6 and 7):

$$1 - P = \frac{e^z}{1 + e^{-z}} = \frac{e^z}{1 + e^z}, \text{ where } z = \alpha + \beta_i x_i \quad (3)$$

If  $P_i$  is the probability status of the produced and  $(1 - P_i)$  is the probability of not producing.

$$\text{Thus, } 1 - P_i = \frac{e^z}{1 + e^z}, \text{ then } \frac{1}{1 - P_i} = \frac{1 + e^z}{1 + e^z} = e^z \quad (4)$$

Forming natural logarithm

$$\frac{P_i}{1 - P_i} = \frac{1 + e^z}{1 + e^z} = e^{(\alpha + \sum_{i=1}^n \beta_i x_i)} \quad (5)$$

Binary logistic regression model

$$Z = \ln \frac{P_i}{1 - P_i} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \quad (6)$$

This binary logistic regression model becomes

$$CP_i = \alpha + \beta X_i + u_i \quad (7)$$

Where  $CP_i$  is the coffee production status of household  $i$ , which takes the value of 1 if households are coffee producers and 0 otherwise;  $X_i$  is a vector of covariates or explanatory variables such as demographic, economic, institutional, and social factors that affect coffee production (Table 2);  $u_i$  is the stochastic or error term of the model  $u_i \sim N(0, \sigma^2)$ ; and  $\alpha$  and  $\beta$  are model parameters to be investigated. The dependent variable of this study is dichotomous; binary logistic models are the most commonly used models to investigate coffee production and its factors (Equation 8):

$$CP_i = \alpha + B1Age + B2Sex + B3Fsize + B4Edu + B5Mas + B6Ofa + B7Laf + B8Lah + B9Lih + B10Sof + B11Feu + B12Acc + B13Exs + B14Pis + B15Air + B16Mec + B17Ami - B18Dnm - B19Dnr + u_i \quad (8)$$

The code of the independent variables used for the binary logistic regression is given as Age is the age of household head, Sex is the sex of household head, Fsize is the size of family, Edu is educational status, Mas is marital status, Ofa is off-farm activity, Laf is labor force, Lah is landholding, Lih is livestock holding, Sof is soil fertility, Feu is fertilizer use, Acc is credit use, Exs is extension services, Pis is the provision of improved seed, Air is access to infrastructure, Mec is a membership of cooperatives, Dnm is the distance to nearest to market, Dnr is the distance to nearest to road, and Ami is access to market information.

## 2.5 Description of explanatory variables

The econometric model for data analysis, such as the binary logistic model, investigates the factors that affect coffee production. The dependent variable for the binary logistic regression is coffee production. The dependent variable, coffee production is a dummy it takes 1 if produce and 0 otherwise. The demographic, economic, institutional, and social factors such as age, sex, educational status, size of family, marital status, off-farm activity, labor force, landholding, livestock holding, soil fertility, fertilizer use, use of pesticides, credit use, extension services, provision of improved seed, access to infrastructure, membership of cooperatives, distance to nearest to market, distance to nearest to road, and access to market information are independent variables that influence coffee production (Table 3).

## 3 RESULTS

### 3.1 The summary status of the coffee production in the study district

The descriptive analysis in Table 4 presents a summary of the coffee production status in the study area. From a given total sample of 204 (100%), about 82 (40.19%) were producers of coffee cash crops and 122 (59.81%) were non-producers. This summary of descriptive analysis reveals that there were relatively fewer coffee producers 82 (40.19%) than those who did not produce 122 (59.81%) during the main 2023 coffee growing season. According to Table 4, there is low coffee cash crop production due to high food insecurity and poverty in the study area. The descriptive analysis results indicate that the major reasons for low production, such as low coffee production knowledge/awareness, input management problems, inappropriate extension services, poor credit use, backward marketing, traditional agricultural technologies, poor infrastructure, inappropriate inputs and policy use, and rain-fed subsistence agriculture. In addition, there is no suitable market for inputs, outputs, and credit with low infrastructure in the study Zone.

### 3.2 Descriptive results

The following Table 5 presented the descriptive results of this study by using means, standard deviations, and minimum value, maximum value and P-value of the explanatory variables by achievement status. The summary of the descriptive results revealed that explanatory variables such as educational status, landholding, livestock holding, fertilizer use, provision of improved seed, off-farm activity, labor force, soil fertility, credit use, extension services, distance to nearest to market, and distance to nearest to road were determine coffee production in the study district.

**Table 3:** Description of independent variables.

Variable name	Variable type	Variable description and its measurement	Expected Sign
Age	Continuous	In year	+
Sex	Dummy	If 1 = males, 0 = otherwise	+
Family size	Continuous	Number of family members	+
Educational status	Dummy	If 1= literate, 0 = otherwise	+
Marital status	Dummy	If 1 = married, 0 = otherwise	+
Off-farm activity	Dummy	If 1 = Yes, 0 = otherwise	+
Availability of labor force	Dummy	If 1 = Yes, 0 = otherwise	+
Landholding	Continuous	Hectare	+
Livestock holding	Continuous	TLU	+
Soil fertility	Dummy	If 1 = Yes, 0 = otherwise	+
Fertilizer use	Continuous	Kilograms/hectares	+
Access to credit	Dummy	If 1 = Yes, 0 = otherwise	+
Extension services	Dummy	If 1 = Yes, 0 = otherwise	+
Provision of improved seed	Continuous	kilogram	+
Access to market information	Dummy	If 1 = Yes, 0 = otherwise	+
Access to infrastructure	Dummy	If 1 = Yes, 0 = otherwise	+
Membership of cooperatives	Dummy	If 1 = Yes, 0 = otherwise	+
Distance to the nearest market	Continuous	Km	-
Distance to the nearest road	Continuous	Km	-

Source: Authors hypothesis 2023.

**Table 4:** Sample coffee production status.

Coffee production status	Frequency	Percent	Cumm. Percent
Coffee producers	82	40.19	40.19
Coffee non-producers	122	59.81	100
Total	204	100	

Source: Computed from own survey data 2023.

The descriptive analysis in Figure 2 presented the descriptive results by using means and standard deviations. The summary of the descriptive analysis showed independent variables such as educational status, landholding, fertilizer use, provision of improved seed, soil fertility, credit use, extension services, distance to nearest to market, and distance to nearest to road were most important variables that influence coffee yield in the study area.

### 3.3 Econometric analysis

The binary logistic regression in the Table 6 indicated that out of 19 explanatory variables, 14 explanatory variables such as age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, access to infrastructure, distance to the nearest market and distance to the nearest road were significantly affected coffee production in the study district.

**Table 5:** Descriptive analysis for explanatory variables.

Continuous Variables	Mean	Std. Dev.	Min	Max	P-value
Age	61.3	12.26	24	86	0.668
Fsize	5.62	1.72	2	10	0.543
Lah	2.6	0.41	1.36	3.28	0.000***
Lih	11.58	3.46	3	19.85	0.000***
Feu	109	3.12	54.54	218	0.000***
Pis	89.45	3.14	81.81	109	0.000***
Dnm	3.81	0.58	2.18	4.92	0.000***
Dnr	2.17	0.46	1.72	3.91	0.000***
Dummy Variables	Mean	Std. Dev.	0 (%)	1 (%)	P-value
Sex	0.76	0.5	32.68	78.85	0.333
Edu	0.71	0.61	40.17	71.69	0.000***
Mas	0.65	0.49	41.3	71.48	0.287
Ofa	0.57	0.35	35.61	63.64	0.000***
Laf	0.53	0.32	34.45	62.56	0.000***
Sof	0.88	0.8	50.18	61.5	0.000***
Acc	0.56	0.53	53.85	56.13	0.000***
Exs	0.79	0.73	37.32	75.66	0.000***
Ami	0.82	0.62	34.52	76.88	0.000***
Air	0.82	0.62	36.85	64.75	0.465
Mec	0.74	0.54	30.95	69.84	0.532

**Note:** Source: Computed from Survey Data 2023. T-values were used to measure continuous explanatory variables, and Pearson's c2 values were used to measure dummy explanatory variable.

Descriptive analysis of respondents by mean & Std. Dev.

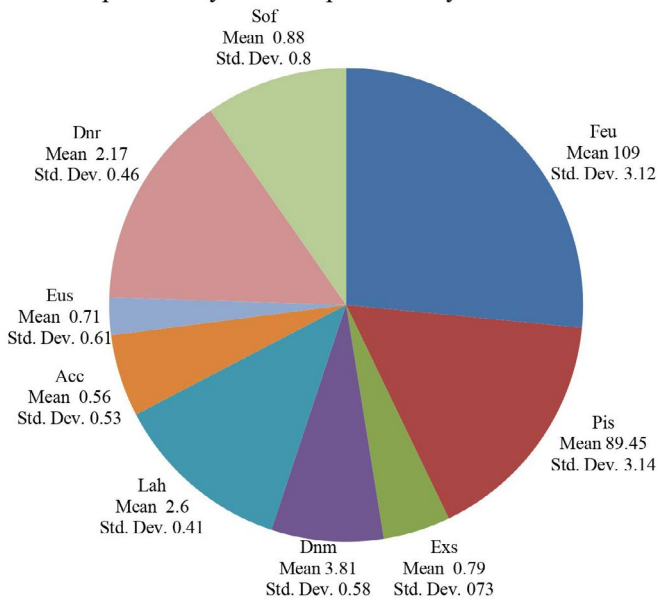


Figure 2: Descriptive analysis for explanatory variables

Note: Source: Computed from Survey Data 2023.

Table 6: Estimates of factors of coffee production (n = 204).

Variables	Robust coef.	Std. Err.	Z-value	P >  z	dF/dx
Age	0.258**	0.147	1.22	0.023	0.0919
Sex	1.543	0.277	0.73	0.514	0.0563
Fsize	1.653	0.247	2.13	0.472	0.0756
Edu	0.478***	0.27	0.23	0.000	0.3728
Mas	1.797	0.373	2.31	0.537	0.0208
Ofa	0.744***	0.231	1.23	0.004	0.2580
Laf	0.864	0.542	1.13	0.273	0.0863
Lah	0.668**	0.471	1.76	0.029	0.2811
Lih	0.576***	0.811	1.26	0.000	0.2983
Sof	0.704***	1.012	0.61	0.003	0.3581
Feu	0.805***	0.517	0.56	0.002	0.3295
Acc	0.679***	0.476	1.407	0.000	0.3451
Exs	0.476***	0.418	1.11	0.000	0.3751
Pis	0.622***	0.232	1.35	0.006	0.2571
Ami	0.951**	0.811	1.94	0.032	0.1731
Air	0.879**	0.583	0.78	0.428	0.1342
Mec	0.956	0.675	0.82	0.531	0.1367
Dnm	- 0.562**	0.505	- 1.36	0.034	0.2713
Dnr	- 0.485**	0.493	- 0.89	0.041	0.2275
Constant term	5.098***	1.383	2.57	0.000	-

Note: Source: Computed from own survey data 2023; total observations = 204; LR chi2 (19) = 65.22; probability > chi2 = 0.0000; log-likelihood = -81.228; Pseudo R2 = 0.591; \*\*\*, \*\*, and \* represent 1%, 5%, and 10% significance level, respectively.

4 DISCUSSION

The descriptive summary presented the means, standard deviations, and minimum and maximum values of the explanatory variables by achievement status in Table 5. This study used the t-test and  $\chi^2$ -test to evaluate the mean of the independent variables across the coffee produced and did not produce. According to the descriptive data analysis results in Table 5, landholding, livestock holding, fertilizer use, provision of improved seed, distance to the nearest market and distance to the nearest road from continuous explanatory variables and educational status, off-farm activity, labor force, soil fertility, credit use, extension use, and access to market information from dummy explanatory variables were significantly associated with household coffee production. According to the results, the majority of households were more educated 71.69%. This finding is in line with that of (Gebrehaweria; Regassa; Stein, 2012; Girma; Gure; Wedajo, 2020; Jima et al., 2017; Negese and Sanait, 2023). The majority of respondents have a labor force of 62.56% per household implying that there is a significant average variation in the labor force between coffee producers and non-producers households. Hence, the average labor force of coffee-producer households is lower than that of non-producers households. This result is similar to that of (Tadesse; Tesfaye; Abera, 2020; Tolessa et al., 2017). The landholding was used as an indicator of household wealth, with an average landholding of 2.6 ha of land. In addition, the average 63.64% of off-farm activity indicates that there is an important average difference between coffee growers and non-growers of households. Furthermore, the descriptive summary results showed that the average livestock holding was 11.58. The mean distance from the nearest market was 3.81km and the mean distance from the nearest road was 2.17 km. In addition, the majority of respondents had access to credit 56.13%, extension services 75.66%, and access to market information 76.88%. This finding is similar to that of (Beyan; Jema; Endrias, 2013; Hong et al., 2019). As mentioned, 61.5% on average, soil fertility, on average 109 kilograms per hectare fertilizer use, and an average 89.45 kilograms per hectare provision of improved seed were used. This finding is consistent with the findings of (Alebachew; Yilkal; Negese, 2020; Cheng et al., 2017). Particularly, the summary of descriptive analysis results showed that coffee production in the study area was largely related to landholding, livestock holding, better fertilizer use, good provision of seed, distance to nearest to the marketplace, distance to nearest to the road, more literate household heads, better off-farm activity, productive labor force, high soil fertility, appropriate credit access to use, appropriate extension services, better access to market information. Furthermore, all the above-listed explanatory variables were statistically significant at the 1% probability level.

According to the binary logistic regression function, out of 19 independent variables in the function, fourteen variables such as age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, access to infrastructure, distance to the nearest market and distance to the nearest road influenced coffee production. Among all significant explanatory variables education status of the household head, off-farm activity, livestock holding, soil fertility, fertilizer use, credit uses, access to extension service, provision of improved seed, and distance to the nearest market affect coffee production at a 1% statistical significance level. Coffee production is also significantly influenced by age, landholding, access to market information, access to infrastructure, and distance to the nearest road at a 5% statistical significance level. The coffee production elasticity concerning age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, and access to infrastructure shows that as all listed explanatory variables increase, coffee production will increase. The distance to the nearest market and distance to the nearest road increase, the coffee production will decrease. This implies that these two variables are negatively related to coffee production. Coffee production increases access to extension service, education status, soil fertility, credit use, fertilizer use, livestock holding, distance to the nearest market, off-farm activity, and provision of improved seed on average for coffee production by 1%, they can increase the status of coffee production by 37.51%, 37.28%, 35.81%, 34.51%, 32.95%, 29.83%, 27.13%, 25.8%, and 25.71%, respectively. In addition, increasing the distance to the nearest market and the distance to the nearest road, on average, will decrease the decision to participate in the production of coffee. This reveals that there is a high potential for coffee production in the Jimma Zone (Table 6).

The binary logistic regression model investigates the factors that affect coffee production decisions to improve livelihoods as presented in (Table 6). Specifically, the goodness fit of the coffee producer's status concerning predictive coffee production was significantly high, with 170 (83.33%) of the 204 (100%) coffee producer samples included in the binary logistic regression model perfectly predicted.

According to (Table 6), from a total of 19 independent variables, fourteen variables, such as age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, access to infrastructure, distance to the nearest market and distance to the nearest road were found to have a strong association with the status of coffee production. Specifically, the age of the household head was indicated to have a better positive association with

coffee production. Therefore, keeping all other things constant, an extra year of sample household head age is expected to be found in a 9.19% increase in the probability of coffee production ( $P < 0.01$ ). Moreover, producers who are on average 10 years old are 91.9% more likely to produce coffee in the study Zone than young, and age is a scientific driver of coffee production. This binary logistic regression result is similar to those of (Mesay et al., 2013; Wudineh; Endrias, 2016). As mentioned, the important reasons for producers are the elderly household head's experiences, knowledge, information, physical capacity, skills, and ability increase at the older age of the household head. All these above-listed characteristics of the older age of growers such as experiences, knowledge, information, physical capacity, skills, and ability were found to have a strong positive relationship with coffee yield.

According to the binary logistic regression results, all explanatory variables such as age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, and access to infrastructure are expected to have strong positive associations with coffee production and mostly affect coffee production. Keeping all other things constant, the marginal effect of the regression shows that all significant independent variables range from 9.19% to 37.51% on average in this study. Moreover, all else being constant, the marginal effect of the 1% significant explanatory variables ranges from 25.71% to 37.51% higher probability of coffee production, on average. Furthermore, access to extension services and educational status are expected to be 37.51% and 37.28% higher, respectively, than those of non-producers. Education and extension service are key drivers of higher coffee yield in terms of product needs by solving food insecurity problems. People with more education and extension services in a given season are expected to have higher productivity rates than their counterparts. Specifically, there is a positive association between the extension service and coffee production at a 1% probability significance level. This result is similar to that reported by (Alebachew; Yilkal; Negese, 2020; Cheng et al., 2017; Negese and Sanait, 2023). Soil infertility, degradation, and agricultural production loss are also considered problems in the study area in terms of reducing incomes at the household level. Therefore, soil fertility is the base for enhancing the production and income of a household in the agricultural sector, especially, in coffee production. This result is in line with that of (Girma; Gure; Wedajo, 2020; Jima et al., 2017; Negese and Sanait, 2023; Tadesse et al., 2020 ). Landholding was found to be positively associated with coffee production at the 5% probability significance level. An average landholding increase at the household level increases the coffee production status by 28.11%, all other things being constant. This binary logistic regression result is similar to those of (Jima et al., 2017; Negese and Sanait, 2023). The regression results

indicate that there is a positive significant relationship between soil fertility and coffee production status in the study Zone and variables significant at the 1% significance level. The binary regression model expected that household head soil fertility would increase by 1% on average, and members of households would produce 35.81% more than infertile areas. Therefore, in the study area, producers were more likely to be affected by soil infertility problems than non-producers. Rural farm households suffering from soil infertility are unable to produce enough and adequate agricultural production, which is a key issue in ensuring food security and poverty alleviation. This result is in line with those of (Beyan et al., 2013; Bizuayehu, 2014).

The distance of household residence from the nearest market and the distance to the nearest road were important factors of coffee production and were mostly found to have a significant negative association with coffee production. A greater distance in kilometers between the coffee farm, and the market and road decreased coffee production by 27.13% and 22.75%, respectively. This result is similar to that of (Alebachew et al., 2020; Al-Zebari et al., 2021; Cheng et al., 2017; Negese; Sanait, 2023). Further, fertilizer use is another significant explanatory variable at the 1% level, which is positively related to coffee production. In addition, the regression results indicate that keeping all other variables constant, the marginal effect shows that the fertilizer use increases by 1% on average, with a higher probability of 32.95% coffee production in the study area. This binary logistic regression result is similar to those of (Alebachew et al., 2020). Credit is a vital component of the coffee cultivating activity in terms of improving coffee cultivators' needs by alleviating capital problems. Coffee cultivators who get more credit at a given main growing season are expected to have more 34.51% coffee production than those who did not get credit, keeping all other things constant. This result is similar to that of (Cheng et al., 2017). The regression result implies that coffee growers' participation in off-farm activity would increase by 1% on average, the coffee growers' would produce more of 25.8% coffee than those who did not participate in off-farm activity. In addition, livestock holding, and provision of improved seed are other significant variables that influence coffee production in the study area. Specifically, there is a positive relationship between livestock holding and the provision of improved seed, and coffee production at a 1% probability significance level. Furthermore, citrus paribus, livestock holding, and provision of improved seed would increase by 1% on average; the coffee growers' would produce more of 29.83% and 25.71% coffee respectively. This result is in line with that of (Negese; Sanait, 2023). As mentioned, access to market information and access to infrastructure were also other variables that positively influence coffee production. Particularly, access to market information, and access to infrastructure would increase by 5% on average; the coffee growers' would produce

more of 17.31% and 13.42% coffee respectively. According to the binary logistic regression, all the remaining explanatory variables, such as sex of the household, size of family, marital status, labor force, and membership of cooperatives did not have any significant relation to coffee production in the study area.

## 5 CONCLUSIONS

Agriculture is vital in improving the economy by increasing yield to derive food security. Low agricultural production is a central challenge in achieving food security in Ethiopia in general and particularly in the Jimma Zone. In this study, to improve the households' livelihood and leave poverty, agriculture needs enhancement by improving coffee production. Coffee yield plays a key role in improving growers' income and food security for many cultivators in the study area. Therefore, this study attempts to investigate the factors affecting coffee production in the Jimma Zone, Southwest Ethiopia. The primary and secondary data were used in this study. Cross-sectional survey data were collected from 204 sample households during the 2023 main coffee cultivating season. Both descriptive and binary logistic regressions were applied for the data analysis. The binary logistic regression analysis revealed that coffee production was affected by age, education status, off-farm activity, landholding, livestock holding, soil fertility, fertilizer use, use of credit, access to extension service, provision of improved seed, access to market information, access to infrastructure, distance to the nearest market, and distance to the nearest road. The result of the current study implies that enhancing coffee yield through best agronomic practices was an important option to improve coffee cultivators' livelihood in the study area. Therefore, the concerned bodies such as the agricultural sector, government organizations, non-government organizations, stakeholders, and policymakers should give important attention to boosting coffee yield, which is a vital base for deriving food security in the study area.

## 6 AUTHORS' CONTRIBUTION

Conceptual Idea: Negese, T.; Sanait, T.; Methodology design: Negese, T.; Sanait, T.; Data collection: Negese, T.; Sanait, T.; Data analysis and interpretation: Negese, T.; Sanait, T.; and Writing and editing: Negese, T.; Sanait, T.

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