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Determinants of Smallholder Farmers Quantity of *Coffea arabica L.,* Supply to Market: A Case of Gimbo District, Kaffa Zone, Ethiopia

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Abstract

This study investigates the factors influencing the market supply of coffee in various districts of the Gimbo District, Kaffa Zone, in Southwest Ethiopia. Coffee is Ethiopia's most significant export crop, recognized for its extensive genetic diversity and its substantial contribution to the country's GDP. Despite the district's strong production capacity, the marketing structure remains predominantly traditional, compelling producers to sell through conventional channels that do not offer premium prices, thereby limiting market margins. The research utilized both secondary data from existing sources and primary data collected directly from respondents. In 2023, primary data was gathered from 200 coffee producers, 22 traders, and 22 consumers, while secondary data was sourced from local agricultural offices. The econometric analysis revealed four key factors that positively and significantly impacted market supply: the educational level of the household head, participation in coffee cooperatives, vehicle ownership, and the volume of coffee produced. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were employed for the analysis. However, the distance to the nearest market had a statistically significant negative effect on market supply. Based on these findings, policy recommendations include expanding adult education programs to enhance farmers' knowledge, promoting experience-sharing initiatives among coffee producers, strengthening farmers' cooperatives, improving their financial capacity through the establishment of functional collection centers, and enhancing access to transportation services and infrastructure. Additionally, increasing productivity through improved extension services is crucial for enhancing the supply efficiency of the coffee sector. The quantity of coffee supplied to the market was significantly influenced by various factors, as demonstrated by the results of the Two-Stage Least Squares (2SLS) regression model. Previous studies have shown that the quantity of coffee produced positively affects market supply; specifically, an increase of one quintal in production leads to a 0.635 quintal increase in supply. Furthermore, supply is significantly affected by the distance to the nearest market, with supply decreasing by 0.651 quintals for every kilometer, underscoring the logistical and transportation challenges faced by farmers located further away. The supply of coffee is positively correlated with the educational attainment of household heads, as more educated farmers supply 1.12 quintals more coffee, reflecting their greater market awareness and adoption of modern practices. Improved marketing decisions and investment in inputs that enhance production are also encouraged, with cooperative membership and access to transit further promoting increased market participation.

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INTRODUCTION

Ethiopia is recognized as the origin of Coffea arabica L., featuring rich genetic diversity that includes over 2,000 indigenous strains and at least

24 officially recognized varieties [1, 2]. The country's various agro-ecological zones, ranging from 550 to 2,750 meters above sea level, provide favorable conditions for coffee cultivation. Optimal production of Arabica coffee occurs between 1,300 and 1,800 meters, where temperature, rainfall, and soil fertility are ideal [3]. Major coffee-producing regions include Oromia (Wellega, Hararghe) and the Southwest Region (Becni Sheko, Kaffa, and Sheka), each exhibiting variations in cropping systems, soil types, and rainfall distribution, which lead to differences in yield and quality [2].

In Ethiopia, coffee is cultivated through four main systems: forest, semi-forest, garden, and plantation coffee. Smallholder farmers, who typically manage farms of less than 0.5 hectares, contribute around 95% of national production [1]. Despite the country's high production potential, average yields for smallholders remain low, ranging from 500 to 600 kg/ha, primarily due to aging trees, limited access to improved varieties, pests and diseases, and inadequate extension services [3]. The area harvested for coffee is growing, with estimates suggesting 790,000 hectares by 2025/26, driven by demographic pressures and policy incentives [4]. Coffee marketing in Ethiopia utilizes various channels, including local traders, cooperatives, and the Ethiopian Commodity Exchange [5], with only a small portion of exportable coffee sold directly to foreign buyers [1].

Previous studies in Ethiopia and elsewhere indicate that smallholder market participation is influenced by a mix of production levels, education, access to credit, market information, distance to markets, and cooperative membership [6, 2]. Research from regions such as Sidamo, Gedeo, and Bench-Sheko emphasizes the importance of institutional support and infrastructure in determining coffee market supply [3]. International studies from Kenya and Uganda similarly highlight that transport infrastructure, extension services, and financial access are key determinants of smallholder farmers' marketed surplus [2, 1].

In Gimbo District, despite significant production potential, farmers face weak marketing connections mainly due to inadequate infrastructure and limited access to reliable market information. These challenges impede farmers' ability to influence farm-gate prices and decrease the volume of coffee supplied to formal markets. Furthermore, the district's conventional marketing system forces producers to rely on traditional channels, restricting opportunities for value addition and premium pricing.

While many studies have explored national-level coffee production, marketing systems, and determinants of market participation in Ethiopia, there is a lack of empirical evidence at the district level, particularly in Gimbo. Existing literature does not sufficiently investigate how production, socioeconomic, and institutional factors interact to affect smallholder coffee supply, nor does it analyze the structure, conduct, and performance of the market chain in this district. This gap underscores the need for a comprehensive market chain analysis to identify key actors, marketing channels, and factors influencing farmers' market outlet choices and supply decisions in Gimbo District.

RESEARCH METHODOLOGY

Description of the Study Area

The Gimbo District is located in the southwest of Ethiopia, within the Kaffa Zone, approximately 18 km from Bonga town and 442 km from Addis Ababa, along the road from Jimma to Bonga. Geographically, the district is situated between 07°00'–07°25' N latitude and 35°55'–36°37' E longitude. It borders Shebe District (Oromia Region) to the southwest, Decha District to the north, Addiyo District to the northwest, and Gewata District to the southeast.

According to the Gimbo District Agricultural and Natural Resource Development Office [7], the district's agro-ecology is classified as 10.3% highland, 74.4% midland, and 15.3% lowland, with an altitude range of 1,750 to 2,750 meters above sea level. The district experiences minimum temperatures of 15°C and maximum temperatures of 35°C, with an average annual rainfall of 1,750 to 2,750 mm.

Demographic and Socioeconomic Characteristics

The total population of Gimbo District is 117,588, comprising 58,559 men and 50,059 women [8]. The population distribution consists of 25% young individuals, 60% economically active individuals, and 15% elderly individuals. On average, each household in the district consists of four members. The majority of residents (approximately 88%) are rural dwellers, while 13,438 individuals live in urban areas. The total number of households is 12,311, including 10,942 male-headed and 1,369 female-headed households. Among these, 10,311 households are engaged in agriculture [7].

Land Use and Agricultural Practices

The district covers a total land area of 88,129 hectares, allocated as follows: 1,064 hectares of arable land, 28,240 hectares of forest cover, 30,531 hectares dedicated to permanent crops, 10,177 hectares covered by annual crops, 855 hectares of grazing land, 7,257 hectares classified as wetlands, and 1,259 hectares of private forest plantations [7].

The primary rainy season extends from April to October, supporting traditional cash crop farming, which dominates the district's economy. The main crops produced include coffee, sesame, haricot beans, and maize [7]. Figure 1 indicates the location of the Gimbo district where this study was conducted.

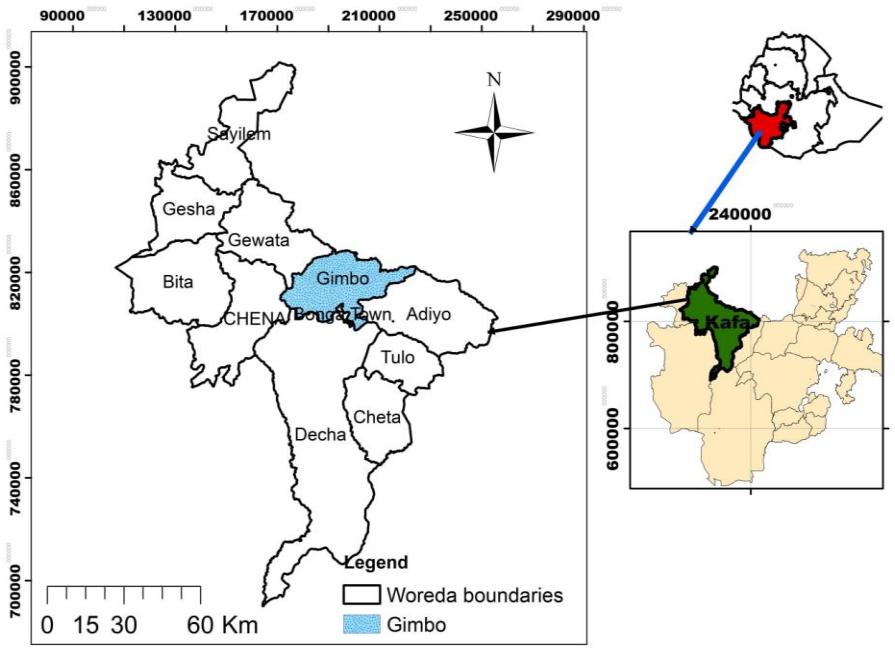

Figure 1. Location of the study area

Data Type, Sources, and Method of Data Collection

This study utilized both primary and secondary data to analyze factors influencing coffee market supply and outlet choice. Primary data were collected from randomly selected smallholder coffee producers across four rural kebeles, as well as from traders and consumers at different levels of the coffee market chain. The farmer-level data collection focused on key determinants such as market supply, outlet choice, output size, distance to the nearest market, cooperative membership, credit access, transport facilities, land allocation for coffee, extension services, and household demographic characteristics.

For coffee traders, the interview schedule covered buying and selling strategies, capital requirements, sources of market information, capital ownership, and demographic characteristics. Additionally, a structured questionnaire was designed for consumers to capture their preferences, purchasing behavior, and market accessibility.

To ensure reliability and validity, a semi-structured questionnaire was developed for each category of respondents. Before formal data collection, the questionnaire was pre-tested on five randomly selected farmers to assess the clarity, appropriateness, and interpretability of the questions. The instrument was modified to improve its accuracy and effectiveness.

Secondary data were obtained from institutional records and official reports from the Gimbo District Office of Agriculture, Office of Trade and Industry, District Cooperative and Marketing Office, District Environmental Protection Office, Ethiopian Commodity Exchange (ECX), and Kaffa Zone Office of Agriculture. These sources provided valuable information on coffee market prices, production levels, the number of licensed traders, and socioeconomic variables. Furthermore, relevant websites and published reports were reviewed to supplement the collected data with broader market trends and policy insights.

Sampling Procedure and Sample Size

The sample for this study was drawn from all key participants involved in the coffee market chain, including producers, local collectors, wholesalers, retailers, and cooperatives. A multistage sampling procedure was employed to select sample household heads, as shown in Table 1. In the first stage, four kebeles were randomly selected from among the coffee-producing kebeles in the study district. In the second stage, households were randomly chosen from a complete list of households within the selected kebeles. The sample size was determined using [9] formula, based on a 93% confidence level and a 7% margin of error (e = 0.07). Accordingly, a total of 200 households will be surveyed, using probability proportional to size sampling.

$$n = \frac{N}{1+N(e)^2}, \text{ n} = \frac{10311}{1+10311(0.07)^2} = 200 \quad (1)$$

Where, n = sample size, N= population size (sampling frame), and e = level of precision considered 7%.

Table 1. Sample Distribution of Coffee Producers in Selected Kebeles

No	Names of Kebeles	Total Number of Coffee Producers	Number of Sample Households Selected
1	Beyemo	512	38
2	Kuti	637	47
3	Michit	825	61
4	Tula	723	54
Total		**2,697**	**200**

Source: Gimbo District Agriculture Office (2023).

In addition to coffee producers, purposive sampling was used to select 22 coffee traders from key market locations. Similarly, 22 consumers were chosen and interviewed to capture consumer-level insights regarding coffee purchasing behavior and preferences.

Methods of Data Analysis

Both descriptive statistics and econometric methods were employed to analyze the collected data. Descriptive statistical tools, such as percentages, means, standard deviations, and frequency distributions, were used to summarize and interpret key characteristics of farm households, market participation, and production attributes.

For econometric analysis, the study applied multiple linear regression (MLR) to examine the factors determining coffee market supply. Since coffee is primarily produced for commercial purposes, all sampled farmers supply coffee to the market. Given that the dependent variable, the quantity of coffee supplied to the market, is continuous, an MLR model was deemed appropriate. However, a potential endogeneity problem was identified due to the inclusion of quantity produced as an explanatory

variable. To address this, the Two-Stage Least Squares (2SLS) estimation method was applied to satisfy the exogeneity assumption of the Classical Linear Regression Model (CLRM) [10].

The general econometric model for multiple linear regression is specified as:

$$Yi = \beta Xi + \varepsilon i \quad (2)$$

Where: Yi = coffee supplied to the market,
β = a vector of the estimated coefficients of the explanatory variables,
Xi = a vector of explanatory variables,
εi = disturbance (error).

The diagnostic tests performed to validate the econometric model included:

- Multicollinearity test (Variance Inflation Factor - VIF) to check for correlation among explanatory variables.
- Heteroskedasticity test (Breusch-Pagan test) to assess variance inconsistency in the error terms.
- To verify the appropriateness of the functional form, the model specification was tested using the Ramsey RESET test.

Data analysis was performed using Stata 17 and SPSS 26 software to ensure accuracy in estimating and interpreting results.

Table 2. Hypothesized variable that affect the quantity of coffee supplied to market.

Independent variables	Type of variable	Definition	Expected effect	Supported by
Quantity produced	Continuous	Killo gram of coffee yield	+	Bosena (2008)
Market information	Dummy	1=yes 0=no	+	-
Access to credit	Dummy	1=yes 0=no	+	Debashis and Debajit (2013)
Price of coffee	Continuous	Price of 1 kg of coffee in Ethiopian birr	+	-
Household size	Continuous	Numer of family member	+	-
Level of education	Continuous	Year of schooling	+	Zekarias *et al*. (2012
Sex of household head	Dummy	1=male 0= female	+	Bizualem *et al*. (2015),
Distance from market	Continuous	Distance of market from home in kilometer	-	-

Source: Survey result, 2023

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of Coffee Producers

The socio-demographic characteristics of the sampled coffee producers were analyzed based on key variables such as sex, marital status, age, family size, and education level (Table 3). The survey results indicate that 92.5% of coffee producers were from male-headed households, while only 7.5% were from female-headed households. This finding supports previous studies [11], which suggest that male-headed households dominate agricultural production in Ethiopia due to greater land ownership rights, access to financial resources, and decision-making authority.

In terms of marital status, 97% of respondents were married, while 3% were single, reflecting the prevalence of family-based farming systems in the study area. The average age of coffee producers was 43.26 years, with a range from 26 to 65 years, indicating that coffee farming is primarily managed by individuals in their productive age group. The average household size was 5.22 members (±1.65), which aligns with national averages [12]. A relatively large household size may suggest sufficient family labor availability, which is crucial for labor-intensive agricultural activities, particularly during the coffee harvesting and post-harvest periods. The average education level of respondents was 5.65 years,

suggesting that most coffee producers had completed at least primary education. This finding is consistent with national reports from [12], which indicated that approximately 60% of Ethiopian farmers have completed primary education. Education is vital for adopting improved agricultural practices and making informed marketing decisions [13]. Table 3 presents the socio-demographic characteristics of coffee producers.

Table 3. Socio-Demographic Characteristics of Sampled Coffee Producers

Variable	Response	Frequency	Percentage (%)
Sex	Male	185	92.5
	Female	15	7.5
Marital Status	Single	6	3
	Married	194	97
Age (years)	Mean = 43.26	Std. dev = 6.99	Min = 26
Household Size	Mean = 5.22	Std. dev = 1.65	Min = 2
Education Level (years)	Mean = 5.65	Std. dev = 2.47	Min = 0

Source: Survey result, 2023

Coffee Production Experience and Household Income

The average coffee production experience of the sampled producers was 14.9 years, ranging from 5 to 34 years (Table 4). This suggests that most farmers possess extensive expertise in coffee farming, which could lead to improved agronomic management and productivity.

Regarding household income, coffee producers engaged in multiple income-generating activities. The average annual income from crop sales was 38,282.75 ETB, while income from livestock sales was 32,897.2 ETB. Additionally, farmers earned an off-farm income of 3,776.19 ETB from activities such as pensions, petty trade, house rent, and remittances. The total annual income from all sources averaged 74,956.14 ETB, demonstrating that coffee farmers utilize diverse livelihood strategies to sustain household income.

Table 4. Coffee Production Experience and Household Income

Variable	Mean	Std. dev.	Min	Max
Coffee production experience (years)	14.90	5.76	5	34
Annual Income (ETB)				
Crops	38,282.75	12,621.53	15,000	90,000
Livestock	32,897.2	14,278.24	0	857,000
Off-farm activities	3,776.19	7,704.63	0	50,000
Total income	**74,956.14**			

Source: Survey result, 2023

Coffee Production Characteristics of Sampled Households

Land ownership is a key determinant of coffee production capacity. The results (Table 5) show that the average landholding size of the sampled households was 3.47 hectares, ranging from 0.5 to 10 hectares. This figure is significantly higher than the national average of 1.38 hectares per household, as reported by [12]. On average, 3.14 hectares were specifically allocated for coffee production, indicating that coffee is the primary crop in the district.

During the 2023 production season, the sampled households produced a total of 5,589 quintals of coffee, with an average production of 27.94 quintals per household. The quantity of coffee marketed was 25.79 quintals, implying that most of the harvested coffee was intended for sale rather than household consumption. The average selling price per quintal of coffee was 20,500 ETB, with prices

ranging from 12,000 ETB to 17,000 ETB. Price fluctuations may be attributed to seasonal variations, quality differences, and market conditions [14].

Table 5. Landholding and Coffee Production Characteristics

Variable	Mean	Std. dev.	Min	Max
Landholding size (ha)	3.47	1.73	0.5	10.0
Land rented in (ha)	0.09	0.28	0	2
Land allocated for coffee (ha)	3.14	3.24	1	9
Quantity of coffee produced (qt)	27.94	29.87	7	207
Quantity of coffee sold (qt)	25.79	28.85	1	198
Selling price per quintal (ETB)	20,500	92.21	12,000	17,000

Source: Survey result, 2023

DISCUSSION

The study findings suggest that coffee production in Gimbo District is largely commercialized, as evidenced by high market participation rates among producers. The average household landholding for coffee (3.14 ha) exceeds the national average, reinforcing the economic significance of coffee in the study area [12].

Household income diversification strategies play a critical role in mitigating financial risks and ensuring sustained agricultural investment. The significant contributions of livestock sales and off-farm activities to total household income align with findings by [11], who noted that diversified income sources enhance agricultural resilience and who noted that varied income sources enhance agricultural resilience.

Furthermore, a higher level of education among coffee producers may improve their access to market information and facilitate the adoption of agronomic practices, which can further benefit production and market participation [13]. The findings also highlight challenges related to price volatility, which can impact farmer profitability and investment in coffee cultivation.

Moreover, a higher level of education among coffee producers could lead to better market information access and improved adoption of agronomic practices, further contributing to enhanced production and market participation [13].

The results also highlight challenges related to price volatility, which could impact farmer profitability and investment in coffee farming.

Access to Institutional Services and Market Information

Access to Agricultural Extension Services

Access to agricultural extension services is essential for influencing how farmers produce and market their goods. Those who frequently interact with development agents are generally more receptive to adopting new technologies, which can enhance their productivity and market engagement. The survey results in Table 6 show that 98.00% of the sampled producers have access to extension contacts, while only 2.00% reported no access. This indicates that most coffee producers in the district benefit from extension services, which are vital for information dissemination, knowledge transfer, and the practical use of scientific findings. Additionally, extension services are crucial for encouraging the adoption of improved agricultural technologies among farmers.

Distance to the Nearest Market

Proximity to markets significantly affects farmers' access to inputs, sales opportunities, and overall market participation. The survey results in Table 6 indicate that the average distance for producers to

reach the nearest marketplace is approximately 3 km. This distance may impact transportation costs, the ease of selling produce, and farmers' ability to obtain timely price information.

Access to Credit

Access to financial resources is a vital element in smallholder coffee production. The availability of credit enables farmers to overcome financial limitations, allowing them to acquire essential agricultural inputs like fertilizers and improved coffee seedlings. As shown in Table 6, only 46.00% of the sampled producers had access to credit, while 54.00% did not have access to any form of credit. In the study area, credit is primarily obtained from various sources, including local moneylenders, some traders, an organization called Vision Fund, and a credit institution known as Omo-Microfinance. Despite its potential to enhance agricultural productivity, access to credit remains limited, and government efforts to improve access to agricultural finance appear insufficient.

Table 6. Access to Institutional Services and Market Information

Variables	**Mean**	**Std. Dev**	**Minimum**	**Maximum**
Distance to the nearest market (km)	2.97	1.40	0.5	9
Variable	Response	Frequency	Percent	Cumulative (%)
Access to market information	1, if access	196	98.0	98.0
	0, otherwise	4	2.0	100.0
Access to credit	1, if access	92	46.0	46.0
	0, otherwise	108	54.0	100.0
Frequency of extension contact	1, if access	196	98.0	98.0
	0, otherwise	4	2.0	100.0
Total		200	100	

Source: Survey result, 2023

Access to Market Information

Market information is a critical factor that allows farmers to make informed decisions regarding market outlet selection, price negotiations, and interactions with traders. According to the survey results in Table 6, 98.00% of sampled producers have access to market information from various sources, including traders, friends/neighbors, and agricultural extension agents. Conversely, 2.00% of respondents reported a lack of access to market information. These findings suggest that most coffee producers in the study area are well-informed about market prices, types of buyers, and demand fluctuations, which may enhance their bargaining power and income stability.

Demographic Characteristics of Sampled Traders

The demographic characteristics of traders significantly influence market interactions, decision-making, and business performance. The survey results indicate that 81.8% of the sampled traders were male, while 18.2% were female. In terms of marital status, 72.7% of traders were married, while 27.3% were single. Experience in coffee trading is another important factor affecting business success. The study findings reveal that the average trading experience among sampled traders was approximately six years, suggesting that most traders possess a reasonable level of experience that aids them in navigating market challenges and fluctuations. Furthermore, a trader's educational background influences their ability to interpret market trends and make informed decisions. According to the survey, the average educational attainment among the sampled traders was grade four. The data also indicate that the average family size of respondents was approximately four members (Table 7), offering insights into the demographic characteristics of the sampled traders. This information may help explain how they navigate market challenges and fluctuations.

Table 7. Demographic Characteristics of Sampled Traders fluctuations.

Variable	Response	Frequency	Percent
Sex	Male	18	81.8
	Female	4	18.2
Marital status	Married	16	72.7
	Single	6	27.3
Mean	Std. Dev		
Education level	4.318	2.254	
Family size	4.409	1.259	
Experience (years)	5.772	2.114	

Source: Survey result, 2023

Socio-Economic Characteristics of Sampled Traders

Socio-economic characteristics include various financial assets such as initial capital, working capital, sources of capital, and sources of loans. These factors significantly affect how coffee traders manage their business operations and maintain financial sustainability. The survey results show that the average initial capital among sampled coffee traders was 559,090.90 birr, with a standard deviation of 75,018.03 birr. Furthermore, the average working capital of the sampled traders was 366,818.18 birr, with a standard deviation of 45,891.83 birr. All sampled traders reported obtaining their working capital through loans, highlighting the crucial role of financial credit in sustaining coffee trade activities. The survey results also revealed that 36.4% of traders secured working capital from friends, while 63.6% borrowed from microfinance institutions. This finding emphasizes the importance of microfinance institutions as the primary source of credit for traders, facilitating financial liquidity and business expansion (Table 8).

Table 8. Capital Status of Sampled Traders

Variable	Mean	Std. dev.	
Initial capital	559,090.90	75,018.03	
Working capital	366,818.18	45,891.83	
	Response	**Frequency**	**Percent**
Sources of working capital	Loan	22	100.00
Sources of loan	Microfinance	14	63.6
	Friends	8	36.4

Source: Survey result, 2023

Determinants of Quantity of Coffee Supplied to Market

Coffee is a significant cash crop, and all sampled farmers in the study area primarily produce it for commercial purposes. Consequently, the quantity of coffee supplied to the market is a continuous variable influenced by various socio-economic and market-related factors. While a multiple linear regression model could analyze these factors, it does not address endogeneity issues. To remedy this, the Two-Stage Least Squares (2SLS) method was employed to ensure unbiased and consistent parameter estimates.

Test of Multicollinearity

A variance inflation factor (VIF) test was conducted to check for multicollinearity among the independent variables. Since all VIF values were below 10, it indicates that multicollinearity was not a significant concern (Appendix Table 1).

Test of Endogeneity

The endogeneity of coffee quantity produced was assessed using the Hausman test and the Durbin-Wu-Hausman (DWH) test, which yielded the following results:

Durbin (score) chi² (1) = 0.0064 (p-value),

Wu-Hausman F (1,188) = 0.0077 (p-value).

Both tests rejected the null hypothesis of exogeneity at a 1% significance level, confirming that including coffee production as an explanatory variable would result in endogeneity. Therefore, the 2SLS method was utilized to correct for this issue (Appendix Table 4).

Test of Heteroskedasticity

The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity yielded a chi² (1) value of 223.04 ($p < 0.0001$), leading to the rejection of the null hypothesis of homoscedasticity. To address this issue, a Robust 2SLS regression model was estimated, utilizing a heteroskedasticity-consistent covariance matrix (see Appendix Table 4).

Instrumental Variables and First-Stage Regression

In the first stage of the 2SLS regression, the endogenous variable (quantity of coffee produced) was regressed on exogenous variables to obtain predicted values. The instrumental variables employed were land under coffee cultivation and years of farming experience, as these were correlated with coffee production but uncorrelated with the error term. The F-statistic for the first-stage regression was 49.26, which significantly surpassed the critical threshold, resulting in the rejection of the null hypothesis of weak instruments (see Appendix Table 5).

Over-Identification Test

The Hansen-Sargan and Basmann tests were performed to assess instrument validity. The Basmann test reported a p-value of 0.1147, confirming that the instruments were correctly specified and valid (see Appendix Table 3).

Regression Results

The findings from the second-stage 2SLS regression indicate that five key variables significantly affect the market supply of coffee (see Table 9).

Table 9. Determinants of Coffee Market Supply

Variable	Coefficient	Robust Std. Error	Z-value
Quantity Produced (QUANPROD)	0.635***	0.112	5.64
Market Information (MarktInfo)	3.241*	1.783	1.82
Access to Credit (CreditAcc)	3.590**	1.280	2.80
Price of Coffee (PriceCoffe)	0.075	0.071	1.05
Household Size (HHSIZ)	-0.362	0.473	-0.77
Education Level (Edulevl)	1.123*	0.648	1.73
Sex of Household Head (SEXHH)	2.730*	1.464	1.86
Distance to Market (DNMkt)	-0.651***	0.164	-3.96
Constant	-7.525	6.621	-1.14
Number of Observations		200	
Prob > chi²		0.0000	
R-squared		0.8862	

***Note:** The dependent variable is the quantity of coffee supplied (quintals). ***, *, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: Survey result, 2023.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The findings of this study indicate that the coffee market supply among smallholder farmers in Gimbo District is influenced by various production-related, socioeconomic, and institutional factors. The positive correlation between coffee production volume and market supply supports previous research

that highlights production as a key factor in farmers' market participation, suggesting that enhancing productivity is crucial for increasing smallholder involvement in coffee markets. Additionally, the significant negative impact of distance to the nearest market reinforces existing literature that indicates longer travel distances diminish marketed surplus due to higher transportation costs and time constraints. In Gimbo, inadequate rural road infrastructure further limits farmers' full participation in the coffee market.

Moreover, the positive effect of farmers' education levels aligns with earlier studies showing that education enhances decision-making, access to information, and the adoption of improved practices. In Gimbo, where formal education is relatively limited, even small advancements in education or training could significantly influence marketing behaviors. The importance of market information in increasing supply also corroborates previous findings that informed farmers can negotiate better prices, time their sales effectively, and choose appropriate buyers. This underscores the need to strengthen local information systems to address the persistent challenge of information asymmetry in rural Ethiopia.

Access to credit emerged as another critical factor positively affecting quantity supplied, which aligns with studies demonstrating how credit alleviates liquidity constraints and facilitates investment in productive inputs, thus boosting output. In Gimbo District, where credit access is low, expanding financial services could directly enhance production and supply levels. Lastly, cooperative membership was found to significantly increase market supply, supporting previous research that indicates cooperatives lower transaction costs, provide reliable markets, and enhance farmers' bargaining power. Therefore, cooperatives in Gimbo serve as a vital institutional mechanism for improving farmer participation in the coffee value chain.

Recommendation

To increase coffee market supply, interventions must simultaneously address production challenges, information gaps, financial constraints, and barriers to market access. Key recommendations include investing in productivity-enhancing extension services, with government and development partners prioritizing programs that promote effective agronomic practices to boost production and ensure a greater marketable surplus. Improving rural market access infrastructure is also essential; local governments should establish satellite buying centers or enhance transport availability in remote areas to reduce travel distances and transportation costs.

Furthermore, strengthening market information dissemination channels is crucial. Supporting cooperatives, local radios, and mobile-based platforms can provide timely and reliable information on prices and buyer demand, helping to bridge information gaps that hinder farmers' market engagement. Expanding tailored credit services for coffee farmers is necessary, with financial institutions creating flexible and seasonal loan products that align with coffee production cycles. Promoting farmer education and targeted training programs on production, quality management, and marketing strategies is vital, delivered through cooperatives or extension offices to enhance farmers' decision-making skills.

Lastly, policies aimed at strengthening and expanding cooperative membership should be prioritized. Building governance capacity, transparency, and service delivery of cooperatives can attract non-members and improve collective marketing, enabling farmers to access better prices, reduce transaction costs, and enhance their participation in the market.

DISCLOSURE

None of the authors have any conflict of interest.

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APPENDICES

Appendix Table 1. Test for Multicollinearity of the explanatory variable to indicate determinants of quantity of coffee supplied to market.

Variable	VIF	1/VIF
QUANPROD	3.75	0.266
Edulevl	2.29	0.436
Farmexpr	1.77	0.566
Landcoffe	1.74	0.574
MarktInfo	1.52	0.657
EXTAGECON	1.48	0.673
PriceCoffe	1.23	0.813
CreditAcc	1.16	0.861
HHSIZ	1.14	0.877
DNMkt	1. 14	0.880
NONOFFAF	1.07	0.935
SEXHH	1.05	0.956
Mean VIF	1.61	

Appendix Table 2. Factors affecting the quantity of coffee produced to indicated Determinants of Coffee Market Supply

QUANPROD	Coef.	Robust Std. Err.	t-value
MarktInfo	2.867	3.127	0.92
CreditAcc	3.707	2.389	1.55
PriceCoffe	0.377	0.165**	2.28
HHSIZ	1.162	0.716	1.62
Edulevl	4.544	0.460***	9.88
SEXHH	3.936	4.240	0.93
NONOFFAF	0.000	0.000	0.45
EXTAGECON	-0.134	1.697	-0.08
DNMkt	-0.067	0.467	-0.14
Landcoffe	0.956	0.168***	5.67
Farmexpr	2.652	0.385***	6.88
_cons	-50.525	12.451	-4.06

Note: The quantity of coffee produced is the dependent variable. ***, ** and * are statistically significant at 1%, 5% and 10% respectively. Farmer experience and land used for coffee applied are instrumental variables for the quantity of coffee produced.
Source: survey result of 2023.

Appendix Table 3. Tests of over-identifying restrictions variables significantly influence the market supply of coffee**:**

Tests of overidentifying restrictions:
Sargan (score) chi2(1) = 2.18304 (p = 0.1060)
Basmann chi2(1) = 2.0747 (p = 0.1147)
Source: survey result of 2023

Appendix Table 4. Heteroskedasticity and Endogeneity test result to indicated Determinants of Coffee Market Supply

Breusch-Pagan / Cook-Weisberg test for heteroscedasticity
Ho: Constant variance
Variables: fitted values of QUANPROD
chi2(1) = 223.04

Prob > chi2 = 0.0000
Tests of endogeneity
Ho: variables are exogenous
Durbin (score) chi2(1) = 7.43668 (p = 0.0064)
Wu-Hausman F(1,188) = 7.26045 (p = 0.0077)

Source: Survey result of 2023

Appendix Table 5. First stage regression summary statistics to indicates that regression model reveal several significant factors influencing the quantity of coffee supplied to the market.

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(2,188)	Prob > F
QUANPROD	0.7331	0.7175	0.3439	49.26	0.0000

Minimum eigenvalue statistic = 49.26
Critical Values # of endogenous regressors: 1
Ho: Instruments are weak # of excluded instruments: 2

2SLS relative bias	5%	10%	20%	30%
	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	19.93	11.59	8.75	7.25
LIML Size of nominal 5% Wald test	8.68	5.33	4.42	3.92

Source: Survey result, 2023
economics, 14(2), 101-119.

