

Assessment of the Impact of Commercial Coffee Cultivation on the Sustainable Livelihoods of Small Farmers: A Case Study of Aleta Chuko District, Southern Sidama Zone, Ethiopia

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Abstract

Coffee is a cornerstone of Ethiopia's agricultural economy, contributing 25% of the country's foreign exchange earnings and playing a crucial role in rural livelihoods. However, smallholder farmers, who produce over 90% of Ethiopia's coffee, face persistent challenges, including limited market access, price volatility, insufficient farming inputs, and climate-related risks. This study examines the economic, social, and environmental impacts of commercial coffee cultivation on the sustainability of smallholder livelihoods in Aleta Chuko District. Using a mixed-methods approach, data was collected from 162 participants across purposively selected villages and district-level stakeholders. Quantitative data were analyzed using descriptive statistics, while qualitative insights were assessed through thematic analysis. Findings indicate that smallholder coffee farming not only enhances economic stability but also fosters social capital and access to natural resources. Participation in coffee value chains and certification programs enables farmers to access premium markets, with 28.1% earning over 200,000 Ethiopian Birr (ETB) annually. These farmers are increasingly market-oriented, with direct linkages to international buyers. The value chain significantly improves economic outcomes by connecting smallholders to domestic and global markets, with 36 out of 128 surveyed farmers possessing sufficient livelihood capital. However, structural barriers limit the full potential of commercial coffee farming. Key challenges include weak cooperative governance, price opacity, input shortages, and the dominance of intermediaries. Environmental stressors, such as erratic rainfall and inadequate irrigation, alongside low literacy rates and income disparities, further constrain the efficiency of the coffee value chain. While stakeholders provide essential support through training and financial services, fragmented interventions reduce their effectiveness. Strengthening cooperative governance, fostering multi-stakeholder collaboration, and strategic investments are vital for long-term sustainability.

Keywords: Commercial coffee cultivation; Smallholder farmers; Livelihood sustainability; Climate resilience; Value chain

Introduction

Ethiopia, the fifth-largest coffee producer globally and the leading exporter in Africa, primarily cultivates *Coffea Arabica*. The beverage has been enjoyed worldwide since its discovery by Kaldi in the 6th century [1]. Coffee production is concentrated in southern regions, such as Sidama and Yirgacheffe, as well as central Oromia, where approximately fifteen million people rely on it for their livelihoods. Over 90% of Ethiopian coffee production comes from smallholder farmers who manage farms smaller than two hectares. Coffee accounts for one-fourth of Ethiopia's export revenues, contributing to food security and providing income for millions of Ethiopians [2]. It also generates jobs for over a quarter of the nation's workforce and sustains one-third of the rural population. Ethiopia's coffee industry is a vital economic driver, accounting for nearly one-fifth of the country's foreign exchange

earnings and providing a source of income for rural Ethiopians [3]. The region's climate and geography are ideal for cultivating high-quality Arabica coffee, which accounts for a significant percentage of the global coffee market [4]. However, Ethiopia faces challenges such as volatile international coffee prices, low credit ratings, inadequate physical infrastructure, and limited opportunities for skill development. A significant portion of coffee production comes from smallholder growers who rely on family labor for their livelihood. Ethiopia has generated \$1.43 billion in coffee export investments since 2024 (*The Ethiopia Coffee Export Report 2024*). However, the country faces constraints in its coffee production, including a lack of disease-resistant coffee varieties, low yields, and long-growing coffee trees. Solutions lie in implementing macroeconomic reforms within the commercial coffee trade, aiming to support coffee farmers and ensure the quality of the product.

Cooperative structures and government interventions are crucial in supporting Ethiopian smallholder farmers by providing technical training, facilitating access to credit, and promoting effective farming techniques. Enhanced infrastructure, processing plants, and market facilities are necessary to support coffee production and processing, reducing costs and enabling competitiveness in global markets. Climate change is also affecting Ethiopia's coffee sector, resulting in a decline in suitable coffee-growing areas and a decrease in arable land [5]. To ensure a sustainable future, Ethiopia must combine traditional knowledge with modern agricultural techniques, cooperative support, and policy interventions to manage market fluctuations and climate-related impacts. Coffee production in Ethiopia is a commercial activity that improves the living standards of smallholder farmers, particularly in districts where coffee is the leading export commodity. According to Minten et al. [6], commercial coffee cultivation is financially beneficial for farmers, as it provides additional income, enables them to meet their family's needs, allows for reinvestment in agriculture, and funds their children's education. It also contributes to stability in rural income through value addition and access to regional and international markets.

Ethiopia is known for its high-quality coffee, particularly from the Sidama region. Factors such as high altitude, quality soil, favorable climate, and access to labor resources all contribute to the production of premium coffee [7,8]. Coffee production receives strong support from both political and regional levels, along with increasing private investments aimed at improving productivity among smallholder farmers. The coffee value chain is vital in supporting smallholder farmers' livelihoods by improving their yields. However, challenges such as intermediaries, limited international market presence, and the impacts of climate change pose threats to sustainability.

The Aleta Chuko District in Sidama is a significant coffee-producing area, with smallholder farmers cultivating a variety of crops, including mangoes, false bananas, Khat, avocados, teff, and maize. This diversification helps meet communal development goals related to food security and improves rural living standards. Enhancing coffee farming productivity and sustainability creates employment opportunities and additional income sources for economically disadvantaged families. The district engages in commercial coffee cultivation, using improved seedlings and sustainable practices. Key stakeholders, such as the Sidama Coffee Farmers' Cooperative Union, provide resources and training to help farmers participate effectively. However, resource constraints, fluctuating prices, and environmental factors pose significant challenges to sustainable coffee production. The coffee value chain structure also requires deliberate efforts to enhance the quality of coffee cultivation as a means of livelihood. Addressing these issues is critical to improving the sustainability of smallholder livelihoods in Aleta Chuko. Commercial coffee production presents both opportunities and challenges for small-scale coffee producers. However, transitioning from subsistence

to commercial farming requires substantial capital investment and introduces additional difficulties for smallholders who lack access to institutional buyers or financial support.

The research focuses on making coffee cultivation in the Galma, Gure, and Chuko Lamalla villages of the Aleta Chuko district commercially viable. It emphasizes smallholder financing, sustainable use of inputs, markets, and post-harvest handling. The findings aim to improve production and income variability, mitigate livelihood vulnerability, and enhance competitive engagement in the coffee supply chain. The study also addresses knowledge gaps in the socio-economic, environmental, and institutional context of commercial coffee farming in Sidama, Ethiopia. It provides policymakers with essential data to promote sustainable commercial coffee farming and protect traditional agroforestry methods.

Research objectives

This study investigates the impact of commercial coffee Cultivation on the sustainable livelihoods of small farmers in Aleta Chuko District, Southern Sidama Zone, Ethiopia. With a focus on economic, social, value chain, environmental, and coffee commercial concepts

Specific research objective

- I. To assess the impact of smallholder coffee cultivation and commercialization on sustainable livelihood assets in the Aleta Chuko district.
- II. To Analyze the Role of the Coffee Value Chain in enhancing Smallholder Economies and fostering Sustainable Growth.
- III. To identify the key factors influenced by smallholder farmers engaged in commercial coffee farming in the study area.
- IV. To explore the role of various actors in developing and implementing strategies to minimize the impact of commercial coffee farming on the sustainability of smallholder farmers' livelihoods.

Conceptual framework

This study examines the dynamics between smallholder farmers and commercial coffee cultivation in Ethiopia's Aleta Chuko District, with a focus on the sustainability of smallholder-dependent livelihoods within a commercialized coffee economy. The framework identifies several threats and mediators that impact the resilience of smallholder farmers' livelihoods, including limited access to international markets, weak infrastructure, and inadequate financing structures. Commercial coffee producers with large land sizes and higher productivity have an edge, leading to market control strategies that consolidate resources and create credit risks for small-scale producers. However, the framework suggests several routes for smallholder farmers to overcome these obstacles, including fair trade markets, cooperation

systems, climate-smart agricultural practices, capacity building, and training activities. The framework also acknowledges the importance of policies, regulations, and public-private partnerships at the sub-national Level that affects smallholder farmers' participation. To improve sustainability, collaboration between the public and private sectors, direct trade partnerships

within the private sector, and climate change adaptation are recommended. The study concludes that while smallholder farmers are disadvantaged compared to market-oriented commercial coffee farmers, interventions like fair trade, farmer cooperatives, and organic farming can help create a productive and sustainable coffee sector (Figure 1).

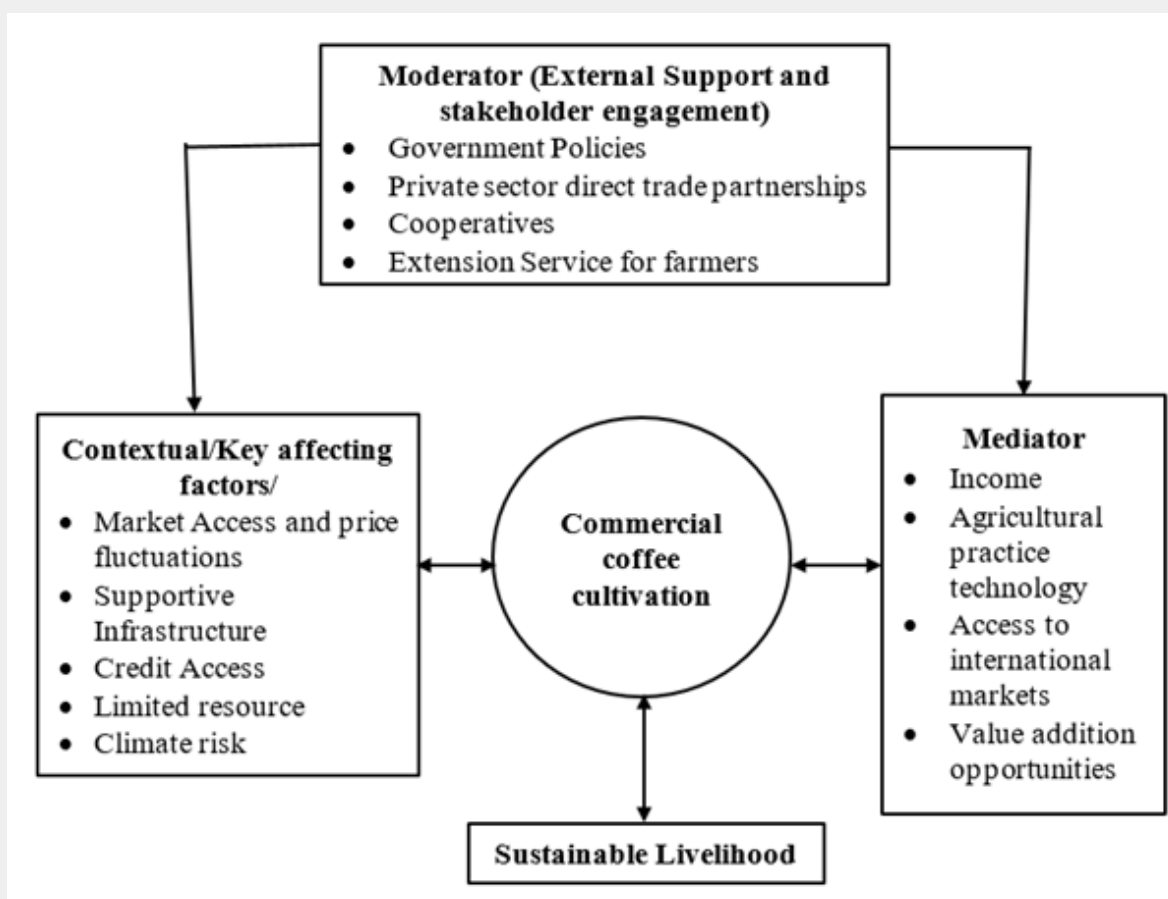


Figure 1: Conceptual framework of commercial coffee cultivation by small farmers.

Source: Own illustration based on survey and literature, August 2024.

Research Methodology

Description of the aleta chuko district

Aleta Chuko is a district in Ethiopia's southern Sidama zone, located 17 kilometers from Aleta Wondo town, 62 kilometers from Hawassa, and 337 kilometers from Addis Ababa. The district comprises 23 rural and four urban villages, with 11 rural villages actively engaged in commercial coffee farming. For this research, the three villages of Galma, Chuko Lamala, and Gure were selected due to their small-scale commercial coffee farming activities, which provide a detailed understanding of the district's commercial coffee production trends and capabilities. The Aleta Chuko District Coffee and Tea Sector has a significant agricultural landscape, comprising 71.9% arable land, 3.7% grasslands, 16.4% swampy areas, and 8.0% degraded land. Coffee is the main

cash crop, covering about 10,866.09 hectares (75% of the total cultivated area). Other cash crops include Khat, false banana, pineapple, avocado, maize, barley, haricot beans, tef, sweet potatoes, and cabbage. The district has twenty coffee pulpers and six cooperatives registered under the new cooperative law, with an estimated 18,371 members.

Research design

This study analyzed smallholder coffee cultivation in Aleta Chuko using a cross-sectional research design that combined quantitative and qualitative approaches (Dawadi et al. 2021). Data was collected through semi-structured interviews and a mixed-methods approach, ensuring a comprehensive understanding of the research problem [9]. The study captured the complexities of commercial coffee cultivation and its impact on smallholder

livelihoods, utilizing quantitative data on production costs, market prices, and profitability. Qualitative data provided valuable insights into farmers' experiences, social relationships, and the natural barriers they faced. The exploratory research design allowed for adjustments in case new themes were identified, capturing the dynamism and complexity of smallholder coffee farming systems.

Research method

This study employed a mixed-methods approach, incorporating both qualitative and quantitative data collection methods. One hundred sixty-two participants were selected, including smallholder farmers, cooperative executives, extension agents, private sector representatives, and stakeholders. Data were collected from three purposively sampled coffee-growing Villages: Galma, Gure, and Chuko Lamalla. Quantitative data were analyzed using descriptive statistical methods, while qualitative data underwent thematic content analysis to identify key trends and challenges (Dawadi et al. 2021). By doing so, this study aims to bridge the gap between farmer-level analysis and the micro- and macro-level structures of institutions that impact sustainability in smallholder coffee farming.

Sources of data

The study used both primary and secondary data sources. Secondary data supplemented the primary research. Data collection methods included structured and unstructured questionnaires, key informant interviews (KIIs), focus group discussions (FGDs), and document reviews. However, long-term factors, such as policy changes and climate variability, may not have been fully captured. Additional qualitative interviews with coffee experts and agricultural extension officers, who specialize in rules and regulations, provided more profound insights into the historical impacts of policy.

Data collection procedures

Data for this study were collected using three primary techniques: surveys, key informant interviews (KII), and Focus Group Discussions. Each method was selected to provide us with a collection of research questions about the topic and to offer diverse and sound data sources.

Sampling techniques and sample size

The Aleta Chuko district in Ethiopia, one of the largest producers of organic commercial coffee, was chosen for its potential in coffee cultivation due to its central location and diverse production processes. Stratified random sampling was employed within each village to ensure that participants reflected diverse farming experiences, including differences in landholding size, gender, cooperative membership, and access to extension services. The study purposively selected three villages, Galma, Gure, and Chuko Lamala, from the 11 coffee-producing villages

to focus on commercialization. The chosen villages offered varied levels of engagement in the commercial coffee value chain, enhancing the generalizability of the findings within the district's coffee-growing context. The sample size of 128 respondents was calculated using the Kothari [10] sampling formula, which was selected for its effectiveness in studies involving finite populations with known proportions and variability. This approach allowed for a 90% confidence level and a 7% precision margin. Although alternative sampling models such as Slovin's or Cochran's formulas were considered, Kothari's method was deemed more appropriate given the availability of prior estimates of population variability and the practical field constraints.

$$n = \frac{Z^2 \times p \times q \times N}{e^{2(N-1)} + Z^2 \times p \times q}$$

$$n = \frac{2.70625 \times 0.5 \times 0.5 \times 1,794}{0.0049(1,794 - 1) + 2.70625 \times 0.5 \times 0.5} = 128.263 = 128$$

Where N = 1,794, the Total population of the purposively selected Village household, e²= Level of precision taken as 7% or 0.0049, Z²= Value from table = 1.645=2.706025, p = 0.5 and q = 0.5.

Quantitative data was collected through a structured questionnaire distributed to 128 coffee producers across the three selected villages. Qualitative data were collected through focus group discussions involving 21 purposefully selected participants, divided into three groups. Factors influencing the determination of the sample size included time limitations, budget constraints, and guidance from the academic advisor to ensure a methodologically sound yet practical approach to addressing the research objectives. The sample composition was strategically based on their connection to commercial coffee production to ensure a comprehensive perspective.

Data analysis

The study used a mixed-methods approach to analyze data from smallholder farmers, focus group discussions, and stakeholder interviews. The data was systematically coded and categorized to understand the impact of commercial coffee cultivation on smallholder livelihoods. Thematic content analysis was employed to identify recurring themes and patterns [11]. Descriptive statistics summarized socioeconomic variables, including household size, education level, farm size, and income, through frequencies, means, and standard deviations. Comparing analysis in SPSS (version 20) examined relationships such as the comparison between education levels and income disparities. Data visualization techniques, including charts and tables generated in Microsoft Excel 2021, also illustrated trends in productivity, income, and market participation. These analyses enhanced clarity and assessed the impact of commercial coffee cultivation and key influencing factors on the sustainability of smallholder livelihoods across purposively selected villages, further enriching the study's findings.

Results and Discussion

Socioeconomic and demographic analysis

Demographic characteristics of respondents

The sustainability of smallholder coffee farmers' livelihoods is influenced by factors such as marital status, family size, educational levels, and age distribution. In the Aleta Chuko District, male dominance prevails in households, while women hold a 19.5% share. Limited access to resources and decision-making authority limits women's potential for agricultural growth. Two-person households are rare, with only 2.34% of families struggling with labor-intensive agriculture.

Table 1 shows that 69.5% of the population in Aleta Chuko

consists of large-family households that are engaged in labor-intensive coffee farming. Insufficient land and financial resources prevent farmers from expanding their production scale, leading to subsistence farming. Small families (29%) use their resources for education, healthcare, and modern farming technologies. Young farmers are underrepresented, with only 8.6% aged 20-30. Illiteracy affects farmers' ability to learn new techniques and access financial services. Gender discrimination and limited access to resources hinder development. Policy changes are necessary to accommodate diverse genders and improve education for young farmers. Strategic intervention plans can help smallholder coffee farmers overcome constraints, enhance productivity, and contribute to a more sustainable coffee sector.

Table 1: Demographic characteristics of respondents

Demographic Category		Frequency	Percentage%
Gender	Male	103	80.5
	Female	25	19.5
Age Category	20-30	11	8.6
	31-40	38	29.7
	41-50	54	42.18
	51-60	10	7.8
	Above 60	15	11.72
Marital Status	Married	125	97.67
	Single	3	2.34
Family Size	03-May	37	29
	06-Aug	89	69.5
	Greater than 8	2	1.56
Household Education level	Illiterate	57	44.5
	Primary Cycle (1-8)	52	40.63
	Secondary school (9-12)	15	11.7
	Collage	4	3.13

Source: Field survey (2024).

Farming experience

The survey reveals that most coffee farmers have 6-10 years of experience, with 43 falling into this category. The remaining 41 have been in the field for 11-15 years. Indicates that many of these farmers are not just newcomers but have sufficient experience to handle the complexities of coffee farming and effectively engage in the value chain (Figure 2).

The Aleta Chuko District's coffee sector has a strong base of experienced farmers, with 65.6% having between 6 and 15 years of experience. These skilled farmers can mentor newcomers and promote sustainable practices. However, they may still rely on traditional methods, limiting their innovation potential. The low entry rate presents challenges for newcomers, such as limited resources, technical knowledge, and market factors. Strategies

should focus on knowledge sharing, resource access, and the application of modern techniques to enhance productivity and sustainability.

Productivity level

The study reveals those 58 farmers in the target area experience low productivity levels, mainly due to resource constraints, small landholdings, a lack of technical support, and external issues such as erratic rainfall and pest outbreaks. Seventeen farmers fall into the very low productivity category, requiring tailored support and resources. However, 31 farmers report high productivity levels, demonstrating the potential of the coffee sector when supported by proper resources and knowledge. The average productivity range is 301-500kg/ha, indicating potential for improvement (Figure 3).

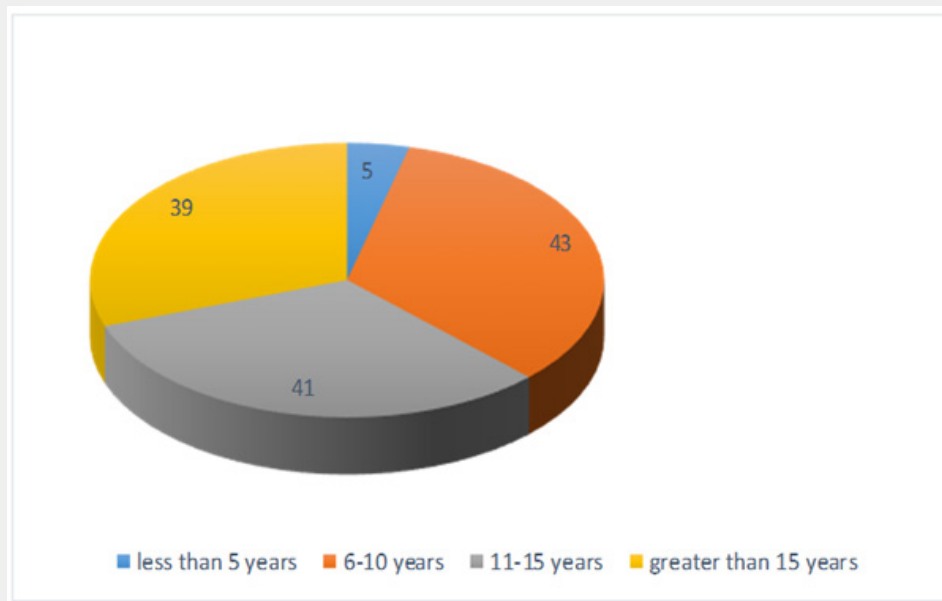


Figure 2: Farming experience among the sample respondents.

Source: Field survey (2024).

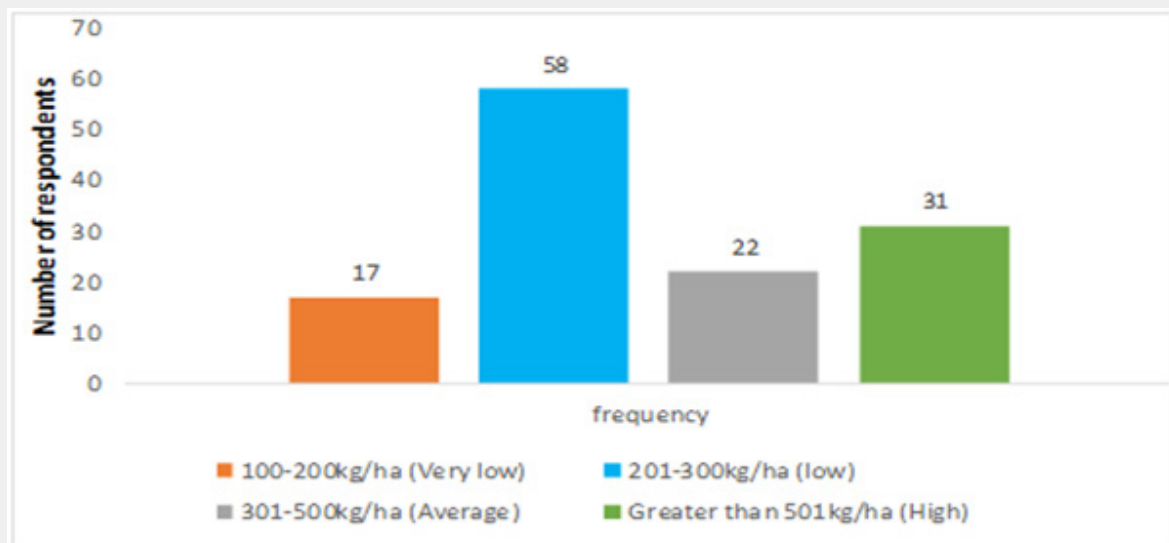


Figure 3: Productivity level.

Source: Aleta Chuko, Agricultural and Natural Resource office, September 2024.

Note: One USD =123 ETB during the field surveys price exchange due to the new economic reform in Ethiopia in September 2024.

The productivity disparities among farmers need tailored strategies to bridge these divides and promote equitable growth. By implementing interventions, a more sustainable growth trajectory can be achieved, fostering resilience and empowerment. This approach requires a nuanced understanding of individual circumstances and impacts, promoting collaboration and shared learning.

Land Holdings Patterns

Landholding size has a significant impact on farmers' economic status and productivity. However, there is an uneven distribution of land ownership among farmers. The majority (50%) are smallholders with less than 0.5 hectares, which restricts productivity and promotes diversified farming practices. Medium-sized farmers (37.7%) have slightly more resources but have

limited cultivated areas. The smaller group (12.3%) has larger plots but is vulnerable to climate variability. This inequitable land distribution affects the productivity of commercial coffee farming, the sustainability of livelihoods, and the adoption of sustainable farming practices.

Table 2 indicates that smallholder coffee farmers face

several limitations, including limited land holdings, insufficient knowledge of modern coffee cultivars, inadequate irrigation infrastructure, and restricted access to agricultural inputs. These barriers hinder farmers' ability to increase productivity and sustainability, perpetuating low-income levels and undermining opportunities for economic advancement. Targeted interventions are needed to address knowledge and material constraints.

Table 2: Classification of sample farmers according to Land Holdings Patterns.

Farm Size	n=Frequency	Percentage%	Irrigated Area(ha)	Rain-fed Area(ha)
Less than 0.5ha	59	50	0.125	≤ 0.5ha
0.5 - 1ha	52	37.7	0.25	≥ 0.5
1 - 2ha	17	12.3	0.5	≤ 1ha
Total	128	100		

Source: Field survey (2024).

Discussion of key findings

The profitability of smallholder coffee producers is demonstrated by their increased ability to support sustainable livelihoods. It was also revealed how coffee cultivation can significantly improve income; for instance, a family with 0.25 hectares of land and 450-625 coffee trees can earn approximately \$3,428 annually. In addition to income earnings, coffee cultivation enables smallholders to accumulate the assets necessary for their livelihoods, as income is only one of several types of capital available to individuals, which helps them build a more secure

future. It is also one of the most critical revenue-generating activities at the commercial Level and a source of employment in densely populated rural areas. They generate employment opportunities by preparing and planting the seedlings, harvesting them, and taking the coffee to the market. Coffee agriculture employs the households of individuals and the overall rural economy; thus, it is an essential factor in livelihood strategies. The study also indicates that commercial coffee farming is a vital source of income for smallholder farmers in Aleta Chuko (Table 3).

Table 3: Compare three selected villages on annual income.

Annual Income (ETB)	Galma	Chuko lamella	Gure	Total	Percentage%
Greater than 200,000 ETB (high)	20	8	8	36	28.13
100,000-200,000ETB(Average)	3	11	10	24	18.75
50,000-100,000ETB(Low)	9	8	8	25	19.53
Less than 50,000 ETB (Very Low)	20	11	12	43	33.59
Total	52	38	38	128	100

Source: Survey September (2024).

Note: One USD =123 ETB during the field surveys price exchange due to the new economic reform in Ethiopia in September 2024.

However, significant income disparities exist. While 28.1% of smallholders earn over 200,000 ETB annually due to direct market linkages and certification benefits, 33.6% earn less than 50,000 ETB annually. Farmers with higher earnings are market-oriented and have access to premium international markets, while resource-poor farmers rely on intermediaries and face lower profits.

Participation in cooperatives and certification programs, such as Fair Trade and organic labels, enhances farmers' access to premium markets. The coffee value chain is crucial for improving the economic prospects of smallholder farmers and promoting sustainability in coffee-growing regions. It connects

farmers to local and global markets, improving market access, income stability, and knowledge transfer. However, challenges such as price volatility, poor infrastructure, and limited access to finance can undermine the benefits. Investment in infrastructure and climate-smart practices is crucial for enhancing economic resilience and long-term sustainability for smallholder coffee farmers.

Key Factors Influencing Smallholder Farmers in Commercial Coffee Cultivation: Social and Structural Challenges. The study highlights several socioeconomic barriers that hinder the sustainability of smallholder coffee cultivation, including gender disparities. Women-headed households have limited access to

financial resources, cooperative leadership roles, and extension services. Gender inequality in decision-making restricts women's participation in commercial coffee farming. Youth Disengagement: The research indicates that only 8.6% of household heads in Aleta Chuko are aged 20-30, reflecting a broader trend of youth migration away from agriculture. Limited access to financial support and technology discourages young people from engaging in coffee farming. Low Literacy Rates: The study finds that 44.5% of smallholder farmers are illiterate, which hinders their ability to adopt modern farming techniques, understand market systems, and negotiate fair prices.

The finding indicates the distribution of 71,287.05 tons of annual coffee production among various stakeholders and categories within the coffee-producing system. This finding

highlights insights into market dynamics, production efficiency, and opportunities for improvement. A significant portion of the produce is controlled by traders (ECP & other stakeholders), indicating heavy reliance on intermediaries for distribution and export. This dominance suggests smallholder farmers may have limited direct market access and bargaining power. Meanwhile, 17,132 tons (24.07%) are retained for household consumption, reflecting a dual-purpose system in which coffee serves both subsistence and commercial needs. This practice is common in smallholder-driven economies where farmers rely on coffee for domestic use and local trade. Private businesses also hold notable shares. Buruhi Coffee, a mid-sized enterprise, handles 6,351 tons (8.9%), likely engaging in bulk trading, branding, or export (Table 4).

Table 4: Produce, coffee industries share, traders, consumption share, and loss.

Item	Coffee Industries	Production in Tons	Percentage%
Total produce /Year		71,287.05	100
Agro-industry	Yirgalem IAI park	1,824	2.56
Business Share	Buruhi Coffee	6,351	8.9
HH consumption	Smallholder farmers	17,132	24.07
Trader business share	ECP & different stakeholders	30,688.05	43
Loss		15,312	21.47

Source: Aleta chuko district Trade, industry, and Market Office Annual report September 2024.

Value Chain and Market Challenges: The coffee value chain plays a crucial role in connecting smallholders to domestic and global markets; however, several inefficiencies hinder farmers' economic progress. One key challenge is intermediary dominance, where traders and brokers control 43% of total production, reducing farmers' direct access to buyers and limiting their

bargaining power. Lack of Price Transparency: Many smallholders report being unaware of market prices, resulting in lower profits. Poor Infrastructure: Inadequate rural road networks and lack of processing facilities limit farmers' ability to transport and store coffee efficiently, leading to quality deterioration and financial losses.

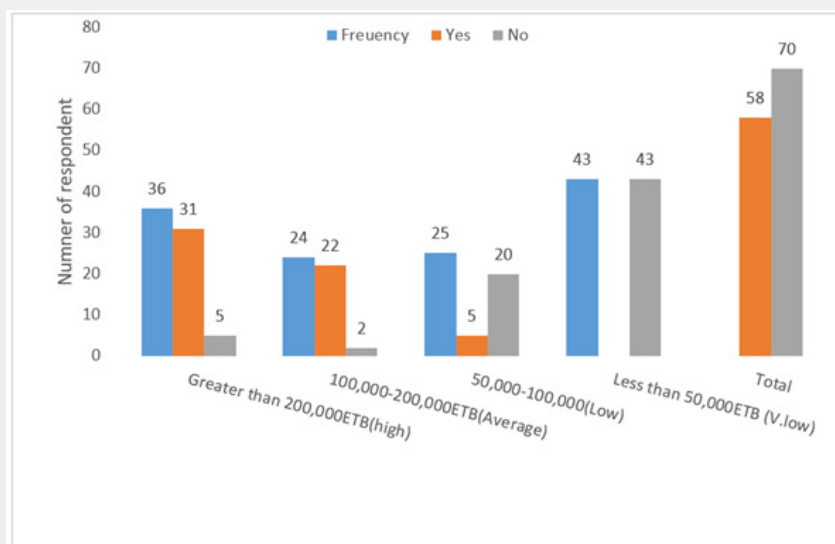


Figure 4: Access to extension service and income level.

Source: Field survey, September 2024.

Note: One USD =123 ETB during the field surveys price exchange due to the new economic reform in Ethiopia in September 2024.

Gap in Agricultural Extension Services: The study indicates that coffee farmers in the study area receive extension services from various sources, including district agricultural offices, NGOs (such as TechnoServe), and regional government agents. However, the quality and frequency of these services are inconsistent. Less than half of the respondents (45.3%, $n = 58$) reported receiving training in coffee production and processing. In contrast, (54.7%, $n=70$) had never received extension service training on commercial coffee production. Similarly, 45.3% stated that coffee technicians or extension workers had visited them (Figure 4).

Environmental Sustainability and Climate Challenges: Environmental stressors have a significant impact on coffee production and the sustainability of smallholder farmers. **Climate Variability:** Unpredictable rainfall patterns and rising temperatures negatively affect coffee yields. **Soil Degradation:** Continuous farming without proper soil management leads to reduced productivity over time. **Irrigation Challenges:** A lack of reliable irrigation facilities forces farmers to depend on inconsistent rainfall, increasing production risks.

Stakeholder Roles in Mitigating Challenges and Enhancing the Sustainability of Smallholder Coffee Farming: To support smallholder farmers effectively, various stakeholders, including cooperatives, government agencies, NGOs, and private entities, play vital roles. They offer services like training, financial support, and market access. However, the impact of these efforts often diminished due to fragmented and poorly coordinated approaches. To truly make a difference, effective collaboration among stakeholders is necessary, along with improved governance of cooperatives and strategic investments in infrastructure and climate-smart agricultural practices. These steps are critical for overcoming the systemic challenges and ensuring the long-term sustainability of smallholder livelihoods in Aleta Chuko.

Conclusion and Policy Recommendation

This study critically examined the impact of smallholder commercial coffee cultivation on the sustainability of livelihoods in Aleta Chuko District, Southern Sidama Zone, Ethiopia. Coffee remains the cornerstone of the local economy, contributing significantly to income generation, educational attainment, and rural employment. However, the research findings highlight that these benefits are unequally distributed. A large proportion of farmers earn below subsistence levels, with over 33.6% making less than 50,000 ETB annually. In contrast, only a smaller group of small farmers have market-linked producers who earn above 200,000 ETB. Land fragmentation, where most households own less than 0.5 hectares, combined with financial exclusion and market intermediation, constrains productivity and income stability. The value chain is dominated by intermediaries who control 43% of production, limiting farmers' access to markets and eroding bargaining power.

Furthermore, a lack of local processing facilities forces most producers to sell raw cherries at minimal prices, perpetuating

income disparities. Structural challenges, including inadequate transportation, limited storage infrastructure, and inefficient cooperative governance, as well as environmental stressors such as erratic rainfall and declining soil fertility, pose significant threats to the long-term sustainability of the sector. These challenges prompt some farmers to shift toward faster-maturing crops, such as Khat, thereby jeopardizing Ethiopia's coffee heritage.

Despite these challenges, cooperatives, along with certifications such as Fair Trade and organic labels, demonstrate the potential to enhance market access and income stability. However, legislative reforms, such as Proclamations 602/2008 and 1051/2017, while boosting quality standards, impose compliance burdens that strain the resources of farmers who are already resource-poor. The study concludes that without targeted interventions to address these systemic issues, the sustainability of Aleta Chuko's coffee sector and, by extension, Ethiopia's global leadership in specialty coffee remains precarious.

The findings align with broader research on smallholder coffee systems in Ethiopia [6,12] but highlight unique regional dynamics in Aleta Chuko. The income disparities observed reflect national trends, where market-oriented farmers benefit from global demand while others remain marginalized due to structural inequities. This study corroborates Bacon et al. (2008), who identified certification costs as a barrier and adds nuance by linking these costs to Aleta Chuko's specific agroecological and institutional context. The dominance of intermediaries' echoes findings by Daviron & Ponte [13], who noted similar patterns across African coffee sectors. However, Aleta Chuko's cooperative-driven "tree-to-market" system, although innovative, suffers from governance flaws, price opacity, and weak representation, which diminish trust and equity. These issues resonate with Francesconi & Ruben's [14] critique of cooperative inefficiencies, but emphasize the urgency of reforms in Sidama's high-stakes specialty coffee market.

Climate vulnerabilities, particularly erratic rainfall and soil degradation, align with warnings [15] about climate risks in Sidama. However, this study uniquely quantifies produce losses (20-30%) in drought-prone highlands, underscoring the need for localized adaptation strategies. The gender and youth disparities further highlight socio-cultural constraints often overlooked in macroeconomic analyses, reinforcing the call for inclusive policies [16]. Commercial coffee cultivation in Aleta Chuko holds immense potential to improve the livelihoods of smallholders; however, realizing this potential requires dismantling structural barriers and fostering multi-stakeholder collaboration. By prioritizing equity, resilience, and innovation, Ethiopia can secure its position as a global leader in coffee production while ensuring sustainable prosperity for its smallholder farmers.

Policy Recommendation

This study highlights the necessity of policy interventions to enhance agricultural production, marketing systems, facilities,

and climate resilience for smallholder farmers in the Aleta Chuko District.

1. Agricultural extension programs should improve resource mobilization, efficiency, and financial management. They should also educate farmers on new technologies, such as precision farming tools and disease-resistant varieties, which can lead to improved yields and increased income.
2. The coffee value chain faces irregular market information, hindering farmers' income. To improve conditions, authorities should introduce digital platforms or standardized pricing systems, enabling farmers to discuss prices and prevent exploitation by intermediaries.
3. Strengthen cooperative governance to improve efficiency and credibility among members, focusing on financial responsibility, accountability, and value chain effectiveness while also developing performance standards.
4. The study highlights the significant challenge of infrastructure constraints in the coffee supply chain, necessitating substantial investments to enhance access, reduce costs, and integrate isolated farming communities into the coffee market.
5. Policies should encourage climate-resilient farming practices, support extension education on agroforestry, organic farming, and soil conservation, and promote their adoption in extension services and cooperatives to manage future environmental challenges.
6. The study highlights the negative impact of small farm size on income capacity and economic longevity. Policies should encourage off-farm income sources, such as agro-processing, trading, and crafts, while communities and NGOs can help smallholders access microfinance and vocational training.
7. Land management should address low soil fertility and small parcel sizes through holistic policies, encouraging consolidation, crop rotation, compost production, and making organic fertilizers more accessible to farmers at lower costs.

The implementation of LEAD and aligned priorities can address complex issues in smallholder coffee farming, enhancing efficiency, produce, and income while promoting fair and sustainable agriculture in Aleta Chuko District.

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