Sustainable Land-Use Practices, Improved Livelihood and Forest Restoration in FOLUR Project Implementation Districts of Oromia, Ethiopia

Commissioned by Oromia Environment Protection Authority (OEPA)

Research Conducted by Oromia State University (OSU)

May 2026, Finfine, Ethiopia

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List of Acronyms

CPR	Common Pool resource Theory
CSA	Central statistical authority
DFID	Development Fund for International Development
ECTA	Ethiopian Coffee Tea Authority
FAO	Food and Agriculture Organization
FOLUR	Food Systems, Land Use, and Restoration
GEF	Global Environmental Fund
ILUP	Integrated land Use Planning
MEPD	Ministry of Economic Planning and Development
NGO	Non-Government Organization
OEA	Oromia Environmental Authority
OFA	Oromia Forest Authority
OSU	Oromia State University
SLT	sustainable land use theory
UNISCO	United Nation Institute of Science and
USAID	United State Agency for International Development
WHO	World Health Organization

Abstract

Smallholder farming systems in rural Ethiopia face multiple socioeconomic and environmental challenges, including heavy dependence on traditional biomass energy, declining coffee productivity and limited adoption of sustainable land management practices. This study assessed the socioeconomic and ecological outcomes of Food Systems, Land Use and Restoration (FOLUR) interventions in Oromia, Ethiopia, focusing on improved cook stove adoption, coffee rejuvenation practices, community participation in forest restoration, and determinants of technology uptake. A convergent mixed-methods research design was employed using quantitative and qualitative approaches. Quantitative data were collected from 345 households through structured surveys, while qualitative information was gathered through key informant interviews and stakeholder discussions. Descriptive statistics and binary logistic regression were used for quantitative analysis, whereas thematic analysis was applied for qualitative data analysis. The findings revealed substantial improvements in household energy utilization following the intervention. Improved cook stove adoption reached 88.4%, replacing the previous heavy reliance on traditional firewood energy sources. Households reported reduced fuel wood consumption, lower labor burdens, improved indoor air quality, and positive forest conservation outcomes. However, sustained utilization remained constrained by cultural cooking preferences, inadequate rural infrastructure, limited local production capacity, and continued biomass dependence for heating and lighting. Coffee rejuvenation practices, particularly tree stumping and replanting, were widely promoted, although implementation remained inconsistent. Other practices such as pruning, sucker removal, and soil fertility management showed relatively lower adoption levels. Econometric results indicated that improved cook stove adoption was significantly influenced by age, household income, labor allocation, fuel wood dependence, and conservation awareness, while adoption of coffee rejuvenation practices was positively associated with education level, income, landholding size, and coffee tree age. The study concludes that energy-efficient technologies and coffee rejuvenation interventions can improve rural livelihoods and environmental sustainability when supported by continuous extension services, culturally appropriate technologies, improved rural infrastructure, and integrated conservation awareness programs. The study recommends strengthening financial and material support, including seed capital, microcredit, and improved agricultural technologies, to enhance coffee rejuvenation and sustainable livelihoods. It also emphasizes scaling up technical assistance, extension services, and training on sustainable coffee management, agroforestry, soil fertility, and forest restoration practices. Promoting women's economic empowerment, adoption of fuel-efficient technologies, and participatory natural resource management is essential to improve livelihood and environmental outcomes.

***Key words**: Improved Mirt Cook Stove; Coffee Rejuvenation; Technology Adoption; Sustainable Land Management; Rural Livelihoods*

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Ethiopia's economy particularly, rural livelihoods are deeply interconnected with land, forests, and other natural resources. The Oromia Region is home to some of the country's most ecologically significant forest landscapes and the global center of origin for *Arabica* coffee. Anthropogenic environmental pressures such as land degradation, deforestation, declining soil fertility, and climate variability increasingly threaten both ecological sustainability and community wellbeing (FAO, 2020; MEFCC, 2018). Unsustainable land-use practices, agricultural expansion into forested areas, limited livelihood alternatives, and weak conservation incentives have accelerated ecosystem degradation, undermining biodiversity, watershed stability, and agricultural productivity (World Bank, 2021).

Coffee is Ethiopia's most important export commodity and a cornerstone of rural livelihoods, supporting nearly 15 million households and generating over USD 1.3 billion annually in foreign exchange (ICO, 2023; FAO, 2021). The Oromia Region produces the majority of Ethiopia's *Arabica* coffee, mainly from zones such as Jimma, Iluu Abba Bora, Bunno Bedele, Guji, and West Guji (CSA, 2021). Coffee-based agroforestry systems in these areas are ecologically vital, contributing to biodiversity conservation, carbon sequestration, microclimate regulation, and watershed protection, while serving as a key income source for smallholder farmers (Borelli et al., 2019; Cerda et al., 2020).

Despite its importance, Ethiopia's coffee sector faces persistent structural and environmental challenges. Productivity remains low, averaging only 0.7–0.8 tons per hectare compared to the global average of 1.5 tons (Mitiku et al., 2017; USAID, 2022). The primary causes include aging tree stocks, declining soil fertility, limited access to improved seedlings, and weak extension services. Many coffee trees in Oromia are between 30 and 50 years old, resulting in declining yields, reduced quality, and heightened vulnerability to pests, diseases, and climate stresses such as drought (Alemayehu, 2015; Worku et al., 2020).

In response to these interconnected challenges, the Food Systems, Land Use, and Restoration (FOLUR) initiative to promote integrated landscape management approaches that unify sustainable commodity production, forest and land restoration, and livelihood diversification. Launched in Ethiopia on 10 June 2022, the FOLUR initiative prioritizes sustainable land management, climate-resilient agroforestry systems, and inclusive coffee value-chain

development, positioning coffee landscapes at the center of its interventions (GEF, 2020; World Bank, 2021).

Within Oromia, women and youth are central to agriculture, agroforestry, and natural resource management, yet they continue to face systemic barriers. Limited access to land, finance, extension services, and limited decision-making power hinder their ability to fully benefit from agricultural and environmental interventions (UN Women, 2020; Asfaw et al., 2023). Gendered divisions of labor further limit women's participation in profitable enterprises and leadership roles, while youth often lack meaningful opportunities for engagement in value chains and entrepreneurship. Empowering women and youth is therefore essential for enhancing equity and inclusion but also for achieving sustainable landscape management and resilient livelihoods (IFAD, 2021).

Another critical yet often overlooked dimension of sustainable land-use and livelihood strategies concerns household energy use. In Ethiopia, rural households rely predominantly on traditional biomass fuels and inefficient cook stoves, leading to high levels of indoor air pollution, negative health impacts, and ongoing pressure on forest resources (WHO, 2024; MOWE, 2025). The Oromia Region, where FOLUR operates extensively, has some of the highest concentrations of traditional stove use, making it a priority for clean-cooking initiatives. Improved biomass cooks stoves such as the locally adapted *Mirt medeja* (improved stove) have demonstrated potential to significantly reduce fuel consumption, lower emissions, and save time and labor especially for women while simultaneously contributing to forest conservation and carbon mitigation goals (LaFave et al., 2021; Phillip et al., 2023).

The integrated nature of the FOLUR program provides a unique opportunity to link sustainable coffee production, diversified livelihoods, land restoration, and clean energy solutions within a unified landscape framework. However, systematic evidence remains limited regarding how these interventions interact, complement one another, and influence the empowerment and wellbeing of women and youth within project areas. Strengthening understanding in these areas is critical for scaling best practices and ensuring that FOLUR's landscape interventions achieve inclusive, sustainable, and transformative outcomes across rural Ethiopia.

1.2 FOLUR Project Description and Background Context

1.2.1 Background Context

The FOLUR project in Ethiopia is a vital initiative designed to promote sustainable practices across agriculture, forestry, and land management sectors. Ethiopia, endowed with exceptional biodiversity and vast agricultural potential, plays a pivotal role in advancing global food security and environmental sustainability. Central to this role is coffee, which stands as both a cultural and economic cornerstone of the nation. As the birthplace of Arabica coffee, Ethiopia is globally renowned for its diverse varieties, distinctive flavours, and centuries-old cultivation traditions. The coffee sector remains an essential component of the national economy, contributing over half of Ethiopia's export revenue and supporting nearly 15 million households—representing about one-quarter of the population engaged in production, processing, and marketing activities (ECTA, 2018). Beyond its economic significance, coffee holds a profound social and cultural value, forming an integral part of daily life, family gatherings, and religious festivities. Notably, about 50% of national production is consumed domestically, reflecting not only deep cultural attachment but also growing demand for both higher quality and greater quantity of coffee (Ethiopian Coffee Evaluation Report, 2024).

Ethiopia's coffee sector is predominantly smallholder-based, with around 95% of production taking place on farms averaging less than two hectares (Mitiku et al., 2017). The production systems are diverse, encompassing forest coffee, semi-forest coffee, garden coffee, and plantation coffee. Between 1993 and 2017, national coffee production increased from 180 million tons to 471 million tons growth attributed more to land expansion than to yield improvement. Productivity remains relatively low, averaging between 0.7 and 0.8 tons per hectare compared to the global average of 1.5 tons (USAID, 2022). Nevertheless, an estimated 5.47 million hectares remain suitable for coffee cultivation, underscoring significant opportunities for sustainable production expansion (ECTA, 2018).

Coffee is Ethiopia's largest export commodity, generating over USD 1.3 billion annually (International Coffee Organization, 2023). For smallholder farmers, coffee contributes up to 60% of household income (FAO, 2021). Despite this, the sector faces substantial challenges such as climate change, price volatility, and limited access to production inputs, and outdated farming technologies. Climate projections suggest a 40–60% reduction in suitable coffee-growing areas by 2050 (Moat et al., 2017), highlighting the urgency for improving productivity, resilience, and sustainability across the value chain.

In response to these challenges, the Ethiopian Coffee and Tea Authority re-established in 2016 has launched a series of transformative initiatives aimed at modernizing and strengthening the coffee sector (ECTA, 2018). Key actions include rejuvenating aging coffee plants, doubling national production, improving quality control, and maximizing foreign exchange earnings. The development of a National Coffee Strategic Plan and Roadmap further supports these efforts by prioritizing research, production, processing, value addition, and marketing (Ethiopia Coffee and Tea Authority, National Coffee Strategy 2025). Furthermore, policies fostering vertical integration and direct marketing of certified premium coffee are intended to replace the flat-price system, thereby incentivizing quality production, improving smallholder incomes, and promoting a fair and transparent value chain. By rewarding excellence, farmers are motivated to maintain sustainable agroforestry systems, enhance soil fertility, and contribute to biodiversity conservation.

Building upon this foundation, the FOLUR project aims to reinforce these national priorities through integrated and evidence-based approaches. The project's success relies heavily on strategies that engage a wide array of stakeholders, particularly smallholder farmers, within the coffee value chain. As part of this approach, a comprehensive baseline assessment is essential to understand the socioeconomic characteristics of coffee-producing households, including gender roles, land use patterns, income sources, technology adoption, and perceptions of climate change. Establishing clear benchmarks for key indicators such as coffee yield, household income, and biodiversity levels is critical for evaluating long-term project outcomes. Ensuring active community participation guarantees that interventions align with local capacities and needs, fostering both livelihood resilience and ecosystem sustainability.

Enhancing smallholder productivity and ensuring stable, reliable market channels remain central to the long-term viability of Ethiopia's coffee sector. Increased coffee quality improves incomes and encourages farmers to preserve traditional agroforestry systems that support landscape restoration and biodiversity conservation. By improving quality, traceability, and international market recognition, initiatives such as FOLUR can simultaneously strengthen export earnings, bolster national food security, and protect Ethiopia's unique coffee species and forest ecosystems. Ultimately, promoting sustainable coffee production is vital not only for improving rural livelihoods but also for conserving biodiversity, stabilizing agricultural frontiers, and reinforcing Ethiopia's position as a global leader in the production of high-quality, environmentally sustainable coffee.

1.2.2. Project Description

The Government of Ethiopia has positioned the FOLUR programme as a strategic national intervention implemented by the Ministry of Planning and Development, in collaboration with the Ethiopian Forest Development and the Ethiopian Coffee and Tea Authority (MoPD, 2023). The programme is being implemented across major coffee-producing regions, including Oromia, Sidama, and Central Ethiopia, where natural forests, coffee agroforestry systems, and rural livelihoods are closely linked in shared landscapes. The FOLUR intervention is across five zones in the Oromia region West Arsi, Jimma, Ilu Abba Bore, Buno Bedele, Gujii and with implementation focus on 10 districts such as Yayo, Chora, Gomma, Qarsa, Adaba, Dodolla, Nansabo, Bulehora, Qarcaa, and Abaya.

A central pillar of the programme is strengthening Integrated Land Use Planning (ILUP) systems to improve coordination between agriculture, forestry, and environmental management. Initial assessments identified significant gaps in land governance, including weak spatial planning systems, limited data integration, and inadequate monitoring of land use change (FOLUR Technical Assessment Report, 2024). In response, the programme developed a series of technical knowledge products and tools focused on ILUP frameworks, land use zoning approaches, and Land Use/Land Cover (LULC) analysis to support evidence-based decision-making and long-term landscape planning (FOLUR Knowledge Products, 2024).

One of the most visible areas of progress is the restoration of degraded coffee landscapes. Across intervention sites, 6,611.4 hectares of old coffee gardens have been identified for rejuvenation. These aging coffee systems, which had experienced declining productivity due to poor management and environmental stress, are being rehabilitated through pruning, stumping, and systematic replanting approaches. By 2025, 743.83 hectares had already been restored, while additional areas were prepared for replanting interventions, supported by the establishment of over 334,000 planting pits. These activities not only improve productivity but also enhance long-term resilience of coffee agroforestry systems. Importantly, approximately 4,246 smallholder farmers, half of whom are women, have directly benefited from these rehabilitation efforts (FOLUR Annual Progress Report, 2025).

In parallel, the programme is making substantial investments in forest restoration and participatory forest management (PFM). A total of 33,983.6 hectares of degraded and high-value forest landscapes have been identified for restoration and improved management. This includes 3,500 hectares of Coffee Forest Biosphere Reserve landscapes, which are globally significant for biodiversity conservation (UNESCO, 2024). The remaining restoration areas

include degraded communal lands and natural forests being integrated into strengthened PFM systems, enabling communities to actively participate in forest protection and sustainable use. To ensure transparency and accountability, restoration sites are being mapped and monitored using digital tools such as KoboToolbox and ODK Collect, allowing real-time data collection, spatial analysis, and progress tracking (FOLUR MEL Report, 2024).

To support these restoration efforts, the programme has also invested heavily in nursery development and seedling production systems. A total of 28 nursery sites covering nearly 22 hectares have been established and strengthened across multiple regions, including Oromia, Sidama, and Southwest Ethiopia. These nurseries play a critical role in producing indigenous tree species for reforestation and agroforestry expansion. Collectively, they are producing approximately seven million seedlings annually, ensuring sufficient planting material for large-scale restoration and landscape rehabilitation activities (FOLUR Nursery Development Report, 2024–2025).

Beyond environmental restoration, the programme places strong emphasis on social inclusion and livelihood diversification, particularly for women and vulnerable rural households. Through cooperative-based income-generating activities such as vegetable production, poultry farming, and small livestock fattening, women are being supported to diversify income sources and reduce dependency on forest resources. In addition, the distribution of more than 26,000 improved cook stoves and the training of 132 women community facilitators have contributed to reducing fuel wood consumption, lowering household energy costs, improving health outcomes, and reducing pressure on surrounding forests. These interventions have reached more than 22,673 households, demonstrating a strong link between clean energy access and forest conservation outcomes (MoPD Energy Report, 2025).

Capacity building is another cornerstone of the programme. A total of 1,120 experts and community members have been trained in key technical areas including GIS, remote sensing, watershed management, and land administration. These skills are essential for improving land use planning and strengthening institutional capacity at federal, regional, and district levels. In addition, 390 development agents have been trained in climate-smart agriculture practices, and these skills have been cascaded to more than 2,200 model farmers across 110 kebeles, ensuring that improved agricultural technologies reach grassroots farming communities. Furthermore, community learning exchange visits involving 345 participatory forest management members

have strengthened peer-to-peer learning and local innovation in sustainable land management practices (FOLUR Capacity Building Report, 2025).

The programme has also invested significantly in knowledge management and institutional collaboration. Partnerships with nine Ethiopian universities have facilitated the identification of 32 priority research areas focused on integrated landscape management, forest ecosystem restoration, and sustainable coffee value chains. These partnerships are intended to strengthen evidence-based policy making and improve long-term sustainability outcomes. In addition, 45 journalists have been trained in climate change reporting, biodiversity conservation, and sustainable land use, enhancing public awareness and media engagement on environmental issues (FOLUR Media Engagement Report, 2024).

Overall, the FOLUR programme has directly benefited approximately 49,762 individuals, with women representing 86.4% of total beneficiaries, highlighting its strong gender-responsive approach. Most interventions have been implemented at the community level, reinforcing grassroots participation in sustainable land management and rural development processes (FOLUR Results Framework, 2025).

In conclusion, the FOLUR Impact Programme in Ethiopia represents a comprehensive and integrated approach to addressing the interconnected challenges of deforestation, agricultural productivity decline, and rural poverty. By combining forest restoration, sustainable coffee production, climate-smart agriculture, clean energy access, and institutional capacity building, the programme is supporting Ethiopia's transition toward a more resilient, inclusive, and deforestation-free coffee production system while strengthening livelihoods and protecting critical ecosystems for future generations.

1.3 Statement of the Problem

Empirical evidence from Oromia indicates that diversified livelihood strategies significantly enhance household food security, nutritional outcomes, and economic resilience. Increased agency of women and youth over resources and decision-making has been linked to improved dietary diversity and overall well-being (Debela & Mansingh, 2016; Heliyon, 2024). Livelihood activities such as agroforestry, fruit tree production, small-scale livestock rearing, and micro-enterprise development provide multiple economic, environmental, and socio-cultural benefits (Asfaw et al., 2023).

Despite the economic and ecological importance of coffee-based agroforestry systems in Oromia, productivity has steadily declined due to aging coffee tree stocks, deteriorating soil conditions, and intensifying climate stress (Alemayehu, 2015; ICO, 2020). Older coffee trees produce lower yields and are increasingly susceptible to diseases and drought, threatening both household incomes and the sustainability of local value chains (Worku et al., 2020; Minten et al., 2018). Although proven revitalization practices such as replanting, stumping, compost application, pruning, and shade-tree management have been successful elsewhere, their adoption in Oromia remains limited. This is largely due to high labor and financial costs, delayed economic returns, weak seedling supply systems, land-tenure insecurity, and limited extension support (Jena et al., 2017; CSA, 2021).

Gender and youth dynamics further complicate adoption and impact patterns. Women and youth often have limited control over land and productive assets, inadequate access to finance and training, and minimal participation in household and community decision-making. These socio-economic constraints limit their ability to adopt sustainable agricultural practices, engage in coffee value addition, and benefit equitably from diversification and livelihood interventions (Bosselmann, 2012; Asfaw et al., 2023).

At the landscape level, ongoing deforestation, soil degradation, and the loss of shade-tree diversity are eroding the ecosystem services traditionally supported by coffee agroforestry systems. These include biodiversity conservation, carbon sequestration, and watershed regulation (Cerda et al., 2020; Davis et al., 2019). Population pressure, agricultural expansion, and weak coordination across the landscape exacerbate ecosystem degradation, undermining long-term sustainability within FOLUR target areas. As a result, essential ecosystem services necessary for sustainable food systems and climate resilience continue to decline, threatening Ethiopia's commitments to biodiversity conservation and land degradation neutrality.

Similarly, despite the existence of national clean-cooking policies and the documented benefits of improved cook stoves, most households in FOLUR districts still rely on inefficient traditional stoves. In practice, stove performance often falls short of laboratory estimates, and adoption remains inconsistent due to affordability issues, weak supply chains, limited after-sales service, and gendered decision-making dynamics (LaFave et al., 2021; Phillip et al., 2023; MOWE, 2025). Moreover, the potential landscape-level benefits of fuel-efficient stoves—such as reduced pressure on forest resources, improved biomass availability for soil enrichment, and

carbon mitigation—have not been systematically measured within the coffee-dominated landscapes of FOLUR.

Despite the scale and ambition of the FOLUR program, knowledge gaps persist. These include the lack of evidence on: (i) the socioeconomic and livelihood outcomes of women and youth engaged in FOLUR-supported income diversification; (ii) the effectiveness of integrated interventions linking coffee agroforestry, land restoration, and clean energy; (iii) gender- and youth-specific empowerment experiences; and (iv) scalable and financially sustainable models for replication. Institutional challenges, including weak landscape-level coordination, inadequate monitoring systems, and limited integration among value-chain actors, further constrain the adoption of regenerative land-use practices. Persistent gender and youth inequalities continue to restrict equitable participation in restoration, enterprise development, and benefit-sharing mechanisms.

A gap remains in systematically documenting the outcomes, impacts, and lived experiences associated with FOLUR interventions. While quantitative indicators often capture aspects of income improvement, livelihood diversification, and resource sustainability, they are rarely complemented by qualitative insights that reflect the agency, aspirations, and challenges of women and youth. This imbalance limits opportunities to draw lessons, influence policy, and replicate successful models.

FOLUR Ethiopia, operating under the Ministry of Planning and Development across ten districts in Oromia, provides a unique opportunity to address these knowledge gaps. In collaboration with the Oromia Forest Authority (OFA), there is a pressing need to document and publish evidence-based accounts demonstrating tangible impacts in sustainable land management, agroforestry adoption, community-led restoration, and livelihood transformation. Understanding community perceptions and attitudes toward these interventions is particularly critical, as participation, acceptance, and behavioral change are strongly shaped by local values and experiences. Without incorporating such insights, interventions risk being misaligned with community priorities, thereby undermining their sustainability and effectiveness in promoting resilient livelihoods and environmental stewardship.

Therefore, this study aims to systematically assess and document the livelihood outcomes, empowerment experiences, adoption of coffee-based agroforestry, and fuel-efficient energy interventions, as well as the perceptions of women and youth involved in FOLUR-supported

income diversification and enterprise initiatives in the South East and South West Zones of Oromia.

1.4 Research Questions

Based on the above problem statement, this research answers the following basic questions:

1. How have women engaged in income diversification activities experienced changes in income and livelihoods in the study area?
2. To what extent have households adopted and used improved cook stoves in the study area?
3. To what extent have households adopted coffee rejuvenation in the study area?
4. What are household perceptions and attitudes toward sustainable land use and forest restoration in the study area?
5. What evidence based success stories and lessons can be documented from FOLUR interventions to support scaling up and replication in similar contexts?

1.5 Research Objectives

1.5.1 General Objective

The main objective of this study is to assess household livelihoods, sustainable land use, and forest restoration in the target study area in Oromia

1.5.2 Specific Objectives

This study is aimed to:

1. assess income and livelihood improvements among women engaged in income diversification activities in the study area.
2. examine the extent of improved cook stove adoption and use practices in the study area.
3. examine the extent of household adoption of coffee rejuvenation in the study area.
4. explore household perceptions and attitudes toward sustainable land use and forest restoration in the study area.
5. document evidence based success stories and lessons learned to inform scaling and replication.

1.6 Significance of the Study

This research is significant for several interconnected reasons. It provides empirical evidence of the effectiveness of FOLUR interventions in promoting sustainable land management, agroforestry, and community-led restoration in Oromia's selected districts. By systematically documenting and analyzing success stories and lessons learned, the research generates concrete evidence that can validate the project's approach and demonstrate tangible outcomes to stakeholders, policymakers, and potential donors.

It provides empirical evidence that enriches the academic literature on sustainable land use and restoration while simultaneously providing practical insights that development practitioners can learn from and adapt to their own contexts. The dissemination of these findings through academic channels enhances the credibility and reach of development lessons beyond the immediate project area.

By capturing and sharing success stories, the research creates a knowledge resource that supports the scaling and replication of effective practices. This knowledge-sharing function amplifies the impact of FOLUR beyond its current implementation areas and contributes to evidence-based policy development in land restoration and sustainable agriculture in Ethiopia and similar agro-ecological contexts.

1.7 Scope of this study

This study examines FOLUR interventions across five zones in the Oromia region West Arsi, Jimma, Ilu Abba Bore, Buno Bedele, and Gujii with implementation focus on five districts such as Yayo, Chora, Gomma, Adaba, and Abaya and two kebeles from each district where livelihood diversification and enterprise development activities are operational. It is composed of interconnected districts contributing a distinct ecological and socio-economic function within the broader FOLUR landscape system.

Thematically, the study assesses income and livelihood improvements among women engaged in FOLUR-supported income diversification practices. The study further examines the extent of fuel-efficient cook stove adoption and use practices and their contribution to household welfare, biomass consumption reduction, and sustainable land-use advancement. Additionally, it documents evidences-based success stories and lessons learned to inform scaling and replication of best practices in sustainable land management, agroforestry, and community-led restoration.

Methodologically, the study employs a mixed-methods approach combining quantitative household surveys to measure key economic and social indicators with qualitative methods, including Focus Group Discussions and Key Informant Interviews to capture participants' perceptions, experiences, and contextual insights.

The study integrates up to five detailed case studies of transformative success stories, supported by observational visits to enterprise sites and production areas to assess actual implementation and practices. Documentary analysis of FOLUR reports, monitoring data, log frames, and technical progress reports complements primary data collection.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

The intersection of agricultural production, forest conservation, and rural livelihoods represents one of the most critical development challenges of the twenty-first century. Globally, food systems are responsible for a significant portion of greenhouse gas emissions and biodiversity loss, necessitating a shift toward sustainable land-use practices that integrate restoration with production (FAO, 2020). In Sub-Saharan Africa, and specifically Ethiopia, this challenge is compounded by rapid population growth, reliance on rain-fed agriculture, and high dependence on biomass for energy (World Bank, 2021). The Ethiopian highlands, particularly the Oromia region, serve as a vital landscape for coffee production, a sector that is economically crucial yet environmentally vulnerable. Recent interventions, such as the Food and Land Use Restoration (FOLUR) project, aim to address these complexities by promoting integrated value chains. Understanding the theoretical and empirical underpinnings of land restoration, livelihood diversification, and energy adoption is essential for evaluating the efficacy of such integrated development approaches.

2.2 Sustainable Land-Use and Forest Restoration

Sustainable land-use (SLU) is defined as the management of land resources to meet changing human needs while maintaining the long-term productive potential of these resources and preventing environmental degradation (Hurni et al., 2015). In the context of the Ethiopian highlands, SLU is inextricably linked to agroforestry, particularly within coffee production systems. Coffee agroforestry, which involves growing coffee under the shade of native or planted trees, is widely recognized for its dual benefit of enhancing crop resilience and conserving forest biodiversity (Tscharntke et al., 2011). Shade trees contribute to soil fertility through nitrogen fixation and leaf litter, reduce soil erosion, and provide habitat for pollinators, thereby supporting the ecological integrity of the landscape (Place et al., 2018).

However, the implementation of restoration practices faces significant hurdles. Lemenih and Kassa (2014) highlight that while community-based forest management has shown success in re-greening parts of Ethiopia, land fragmentation and tenure insecurity often discourage long-term investment in tree planting. Farmers may prioritize short-term food crops over long-term tree crops if land rights are perceived as unstable. Furthermore, the expansion of agricultural frontiers often leads to the removal of shade trees to increase sun-grown coffee yields, which can degrade soil health over time (Teketay et al., 2018). Policy frameworks, such as Ethiopia's Climate-Resilient Green Economy (CRGE) strategy, aim to mitigate these trends by

incentivizing sustainable practices, yet the on-the-ground integration of these policies into local coffee value chains remains a subject of on-going investigation (FDRE, 2011).

2.3. Rural Livelihood Diversification

Rural households in developing economies rarely rely on a single income source; instead, they engage in livelihood diversification to manage risk and smooth consumption (Ellis, 2000). The Sustainable Livelihoods Framework (SLF) posits that households utilize a portfolio of assets human, social, natural, physical, and financial to pursue livelihood strategies within a specific vulnerability context (DFID, 1999). In Ethiopia, where agricultural productivity is often constrained by climate variability, diversification into non-farm income-generating activities (IGAs) is a critical strategy for resilience.

Gender plays a pivotal role in determining the success of livelihood diversification. Women in rural Ethiopia contribute significantly to agricultural labor and household food security but frequently operate under structural constraints regarding access to land, credit, and extension services (Doss et al., 2018). Research indicates that when women have control over income and productive resources, household welfare outcomes improve, including better nutrition and education for children (Quisumbing et al., 2014). However, cultural norms often limit women's decision-making power regarding the allocation of resources generated from new economic opportunities. Empowering women through skills development and access to markets is not only a social equity issue but also an economic imperative for enhancing the overall productivity of the agricultural sector (World Bank, 2018). Consequently, interventions that target women's economic participation are hypothesized to have multiplier effects on community-level livelihood security.

2.4. Household Energy Consumption and Environmental

The relationship between household energy consumption and forest degradation is a critical component of the land-use nexus. In rural Ethiopia, the vast majority of households rely on traditional biomass, such as fuel wood and charcoal, for cooking and heating (IEA, 2019). This reliance exerts immense pressure on forest resources, contributing to deforestation and soil degradation. Beyond environmental impacts, the combustion of solid fuels in inefficient stoves leads to high levels of indoor air pollution, posing severe health risks, particularly for women and children who spend more time near the hearth (Pattanayak et al., 2019).

To address these issues, the promotion of fuel-efficient cook stoves (ICS) has been a central strategy in rural development. However, the adoption and sustained use of ICS technology are complex. Lewis and Pattanayak (2012) conducted systematic reviews revealing that adoption is not merely a function of technology availability but is influenced by fuel costs, cultural cooking preferences, and the durability of the stove. The concept of "fuel stacking" is prevalent, where households adopt improved stoves but continue to use traditional methods for specific cooking tasks, thereby limiting the potential environmental benefits (Ruiz-Mercado & Masera, 2015). Understanding the drivers of consistent ICS use is vital, as reduced biomass consumption directly correlates with reduced pressure on local forests, linking household energy choices to broader landscape restoration goals.

2.5. Community Perceptions and Project Sustainability

The longevity and impact of development interventions are heavily dependent on community perception and ownership. Top-down approaches to conservation and development have historically faced resistance or failure due to a lack of local engagement (Mansuri & Rao, 2013). In contrast, participatory approaches that involve local stakeholders in the design and implementation of projects tend to yield more sustainable outcomes. In the Ethiopian context, trust in local institutions, such as development groups and extension agents, significantly influences how households perceive and adopt new technologies or practices (Gebremedhin & Swinton, 2003).

Perceptions of fairness and benefit distribution are also crucial. If community members perceive that project benefits are captured by local elites or that the costs of participation (e.g., labor for restoration) outweigh the immediate rewards, adoption rates decline. Social capital the networks and norms that facilitate collective action is a key determinant in the success of community based restoration efforts (Pretty, 2003). Therefore, assessing household attitudes toward interventions provides insight into the social viability of sustainable land-use projects and highlights potential barriers to scaling.

2.6. Knowledge Management and Dissemination of Best Practices

Effective knowledge management is essential for translating pilot project successes into broader policy and practice. Development projects often generate valuable data and lessons learned, yet these insights frequently remain within implementing organizations (GEF, 2020). The systematic documentation of success stories and challenges allows for evidence-based

decision-making and the replication of effective models in similar agro-ecological zones (World Bank, 2018). In the context of landscape restoration, disseminating lessons on what works whether regarding specific tree species, financial mechanisms, or gender inclusion strategies accelerates the transition toward sustainable food systems. Bridging the gap between field-level implementation and national policy formulation requires robust mechanisms for capturing and sharing qualitative and quantitative evidence.

2.7. Theoretical Review Literature

2.7.1 Common-Pool Resource Theory

Common-Pool Resource (CPR) Theory explains how people manage shared natural resources that many individuals depend on, but no single person fully owns. These resources are important for survival and livelihoods, yet they are limited. Because of this, they can be easily overused if there are no rules or cooperation.

CPR theory focuses on resources that have two key features. First, it is difficult to exclude people from using them. This means many users can access the same resource at the same time. For example, forests, rivers, grazing lands, and fisheries are often open to many people. Second, these resources are rivalries, meaning that when one person uses more of the resource, less is left for others. If someone catches many fish, fewer fish remain in the water. If someone cuts many trees, fewer trees remain in the forest.

The theory became widely known through the idea of the "Tragedy of the Commons," introduced by Garrett Hardin (Hardin, 1968). He explained that when individuals act based on self-interest in a shared resource system, they tend to overuse the resource. Each person thinks that using a little more will benefit them personally, while the cost of damage is shared by everyone. Because of this, everyone continues increasing their use until the resource becomes damaged or destroyed. This creates a situation where individual rational behavior leads to collective loss.

For many years, scholars believed that shared resources could not be managed effectively without either privatization or government control. However, this view changed through the work of Elinor Ostrom (Ostrom, 1990). She studied many real-life communities around the world and found that people are capable of successfully managing shared resources without destroying them.

Ostrom showed that communities often create their own systems of governance. These systems include rules about who can use the resource, how much they can use, and when they can use it. Communities also develop ways to monitor behavior, punish rule-breakers, and resolve conflicts. When users participate in making the rules and feel responsible for the resource, they are more likely to cooperate.

Based on her research, Ostrom identified important principles for successful CPR management. These include clearly defined boundaries of the resource and its users, rules that match local conditions, participation of users in decision-making, effective monitoring systems, graduated punishments for rule violations, mechanisms for resolving conflicts, recognition of community rights by external authorities, and coordination across different levels of governance for large systems (Ostrom, 1990).

The main idea of CPR theory is that shared resources do not automatically lead to destruction. Instead, outcomes depend on how people organize themselves. When there is trust, cooperation, and strong institutions, communities can sustainably manage shared resources. When these conditions are weak, overuse and environmental degradation are more likely to occur.

2.7.2 Coffee Forest Integration Theory

Coffee Forest Integration Theory explains how coffee production and forest ecosystems function as a single interconnected socio-ecological system in which conservation and livelihood goals support each other. The theory argues that coffee does not necessarily require forest destruction; instead, it can be cultivated within forest environments, especially under natural shade trees, while maintaining ecological integrity and biodiversity.

In this system, forests provide essential ecological services such as shade regulation, soil fertility, carbon storage, water regulation, and habitat support for biodiversity. Coffee plants benefit from these forest conditions and grow as part of the understory vegetation. In return, coffee production provides economic value to local communities, creating a strong incentive to conserve forest ecosystems rather than clear them.

In countries like Ethiopia, coffee naturally originated in forest ecosystems and continues to be produced in forest and semi-forest systems. Wild and shade-grown coffee systems demonstrate that coffee can be harvested sustainably without removing forest cover. This integration supports both biodiversity conservation and rural livelihoods (Gole, 2003).

The theory also emphasizes that sustainable coffee–forest systems depend on human management and community cooperation. Farmers may selectively manage shade trees, regulate forest access, and maintain ecological balance while harvesting coffee. This controlled use ensures that forest structure and ecological functions are preserved over time (Wiersum, 2004).

Coffee Forest Integration Theory is closely linked to broader environmental and development frameworks. It aligns with in-situ conservation principles because biodiversity is protected within its natural habitat. It also supports Sustainable Livelihoods Theory because forest resources provide natural capital while coffee generates financial income. In addition, it reflects Common-Pool Resource (CPR) Theory since forest resources require collective management to prevent overuse and degradation (Ostrom, 1990).

However, the theory also recognizes risks such as deforestation due to agricultural expansion or unmanaged commercialization of coffee farming. Without proper governance, forest ecosystems may be degraded, leading to loss of biodiversity and reduced ecosystem services. Therefore, strong institutions, community participation, and sustainable management practices are essential for maintaining the balance between conservation and production.

2.7.3 In-situ conservation theory

In-situ conservation theory explains the protection of plants, animals, and entire ecosystems within their natural habitats, where they originally exist and continue to evolve. Instead of removing species and keeping them in artificial environments, this approach focuses on conserving nature in its original ecological setting so that all living organisms and their environment remain intact and functional (Primack, 2014).

A clear real-world example of in-situ conservation is traditional coffee farming in forest ecosystems, especially in Ethiopia. In many parts of Ethiopia, coffee (Arabica coffee) naturally grows under forest canopies. Rather than clearing forests for agriculture, farmers maintain coffee production inside the natural forest itself. This system is known as forest coffee or shade-grown coffee farming.

In this system, tall forest trees are preserved and used as shade for coffee plants. The forest is not destroyed; instead, it remains the natural habitat for many species. Coffee plants grow beneath the trees, benefiting from the ecological conditions created by the forest. The trees regulate temperature, maintain soil moisture, prevent erosion, and support biodiversity. Birds,

insects, wild animals, and other plants continue living in the same ecosystem without disruption.

This closely reflects the principles of in-situ conservation because the ecosystem remains in its original place, biodiversity is protected within its natural habitat, and human use is integrated into the natural system rather than replacing it. Coffee farming in this system depends entirely on the health of the forest. If trees are cut down, coffee productivity declines because shade is lost, soil becomes dry, biodiversity decreases, and pests increase.

Because of this dependency, farmers have a strong incentive to conserve forests. Protecting the forest directly protects their livelihoods. In this way, economic activity and conservation work together rather than in opposition. This system also creates a balance between livelihood and biodiversity conservation. The forest supports coffee production, and coffee production encourages forest protection. As a result, forest ecosystems remain stable while also providing income for local communities.

From a theoretical perspective, in-situ conservation in coffee systems aligns with ecological conservation principles that emphasize maintaining natural habitats for long-term sustainability and genetic diversity (Primack, 2014). It also reflects broader environmental sustainability goals where human activity is integrated into ecosystems without destroying them.

In-situ Conservation Theory, which proposes that maintaining wild *Coffee arabica* populations in their natural forest habitat (wild coffee) is the best way to conserve the genetic diversity of coffee while protecting high-value biodiversity. In situ conservation theory the purpose is the continued evolution of novel traits for breeding, conservation in the wild and on farm (i.e. in situ) is a strategic choice (Biodiversity International, 2016).

According to the theory the wild relatives of crops and animals serve as a large repository of genetic diversity of value for crop and animal improvement. The aim of in-situ conservation is to keep the maximum diversity on farm or in the wild to maintain a large pool of evolving genetic resources, but the use for local communities is low; however, extrinsic incentives can be used, such as providing rewards to communities for conserving target plant or animal populations (Narloch et al. 2011).

2.7.4 Semi Forest Coffee Management Theory

Semi-Forest Coffee (SFC) Management Theory explains a sustainable land-use system where coffee is produced inside natural or semi-natural forests through controlled human management that maintains forest structure while supporting coffee productivity. It represents a middle

approach between strict forest conservation and intensive agricultural plantations. In this system, forests are not cleared for farming; instead, coffee plants grow under the shade of existing trees, while farmers carefully manage forest conditions in a limited and sustainable way.

In countries like Ethiopia, this system is widely practiced because coffee naturally originates in forest ecosystems. In SFC systems, farmers selectively manage shade trees by thinning overcrowded areas, removing unwanted species, and sometimes enriching the forest with native trees while still preserving the overall forest canopy. Coffee grows in the understory, benefiting from shade, moisture, and soil fertility provided by the forest ecosystem.

The main idea of SFC theory is that forests are not untouched systems but can be sustainably managed by humans without destroying ecological integrity. This system maintains key ecosystem functions such as biodiversity conservation, carbon storage, soil protection, and water regulation while also supporting rural livelihoods. Birds, insects, and wild animals continue to live in the same habitat because the forest structure remains largely intact.

The main components of the SFC Management Theory include Canopy Manipulation farmers select preferred shade-providing indigenous trees and thin the upper canopy to allow optimal light penetration for the coffee plants; Understory Clearing farmers annually clear herbaceous vegetation, shrubs, and weeds, focusing on removal around the coffee trees to reduce competition for nutrients and water; Enrichment Planting while relying on naturally regenerated coffee, farmers may bring in seedlings or "wildings" (young coffee plants) from the surrounding forest to increase density; and Harvesting coffee is gathered, often processed locally, and acts as a significant cash crop for local livelihoods (Schmitt et al. 2009).

At the same time, coffee production in SFC systems depends strongly on forest health. If trees are excessively removed, shade decreases, soil fertility declines, and coffee yields drop. Because of this dependency, farmers have a strong incentive to conserve forests, since their income depends on maintaining ecosystem balance. In this way, conservation and production reinforce each other. SFC theory also emphasizes community-based forest governance, where local farmers manage forest use through shared rules, cooperation, and monitoring systems. This helps prevent overexploitation and ensures long-term sustainability.

Forest-based agroforestry systems such as shade-grown and semi-forest coffee represent a form of sustainable forest management where biodiversity conservation and agricultural production can coexist through careful human intervention (Wiersum, 2004). The theory argues that

traditional management (thinning canopy trees, removing undergrowth) can enhance economic returns for smallholders while maintaining forest structure (Aerts et al. 2011). In this approach while it stores less carbon than untouched forests, it helps as a buffer against total conversion of the forest to agriculture.

The "Semi-Forest Coffee" (SFC) management is a traditional agroforestry system mainly practiced in the south western Ethiopian highlands to manage Coffee arabica within natural forest environments by modifying the canopy and understory to enhance coffee yield while maintaining a forest structure (Aerts et al. 2011). The approach is used as an intermediate form of management between Wild Forest Coffee (natural forest with minimal intervention) and Semi-Plantation Coffee (highly modified plantation) strategy (Daba et al. 2022).

2.7.5 Sustainable Livelihoods Theory

Sustainable Livelihoods Theory (SLT) explains how people secure their living and improve their well-being by using different types of resources and strategies in a way that can be maintained over time without damaging the environment. The theory focuses on how households use natural, human, social, physical, and financial capital to build livelihood systems that are resilient and sustainable.

The theory was first strongly developed by Chambers and Conway (1992), who defined sustainable livelihoods as ways of living that can cope with stress and shocks, recover from them, and maintain or enhance capabilities and assets both now and in the future without undermining the natural resource base. Later, the framework was further developed by the Department for International Development (DFID, 1999), which formalized the Sustainable Livelihoods Framework used in development studies.

A key idea of the theory is that people's livelihoods depend on access to resources and are shaped by vulnerability factors such as climate change, economic instability, and environmental degradation. Households respond to these challenges by adopting different livelihood strategies such as farming, forestry, wage labor, or mixed income activities.

The theory also emphasizes that sustainability is achieved when livelihood strategies do not degrade the natural resources they depend on. For example, in forest-based coffee systems in Ethiopia, communities rely on forest ecosystems for shade, soil fertility, and ecological balance while also earning income from coffee production. According to Chambers and Conway (1992), livelihoods are sustainable when they can withstand shocks and stresses while

maintaining or improving assets over time. The DFID framework (1999) further emphasizes the role of institutions and policies in shaping access to resources and livelihood opportunities.

2.8. Empirical Literature Review

2.8.1. Socio- demographic factors

Household's personal and demographic variables are among the most common household characteristics which are mostly associated with farmers' adoption behavior. From this category of variables age, sex, education, family size and farming experience were reviewed in this study.

Age of the household is usually considered with the assumption that older farmers will have more knowledge and skill with farming which enables them to easily understand the benefits of the technology better than others. However, with regard to age different studies report different results. For example a study conducted by Gockowski and Ndoumbe (2004) on the adoption of intensive mono-crop, horticulture in southern Cameroon indicated that younger farmers were more likely to adopt and the effect of age on the probability of adoption was elastic.

Similarly, Mulugeta (1994), on his study on smallholder wheat technology adoption in South Eastern highlands of Ethiopia reported that age had a negative effect on the adoption of wheat technologies. In addition, Kidane (2001) on the study he conducted on factors influencing adoption of improved wheat and maize varieties in Hawzien wereda of Tigray found that age is negatively related with farmers' adoption of improved wheat variety. However, there are also others who reported positive relationship of age with adoption. Asante Mensah and Seepersad (1992), on the study they conducted on factors affecting adoption of recommended practices by cocoa farmers in Ghana reported positive relationship of age with adoption.

Gender differentials are one of the most important factors influencing adoption of improved agricultural technologies. Due to long lasted cultural and social grounds in many societies of developing countries, women have less access to household resources and also have less access to institutional services. Regarding the relationship of household's sex with adoption of agricultural technologies, many previous studies reported that household's gender has positive effect on adoption in favor of males. For example, Techane (2002), in his study on determinants of fertilizer adoption in Ethiopia found that male headed households are more likely to adopt fertilizer than female headed households. Similarly, Mulugeta *et al.* (2001),

reported that gender differentials among the farm households was positively influenced adoption and intensity of adoption of fertilizer use.

With regard to education, there is a general agreement that education is associated with adoption because education is believed to increase farmers' ability to obtain, and analyze information that helps him to make appropriate decision. studies conducted by Itana (1985); Chilot *et al*. (1996); Kansana *et al*. (1996); Asfaw *et al*. (1997); Mwanga *et al*. (1998) and Tesfaye *et al*. (2001) have reported that education had positive relationship with adoption. Similarly, Nkonya *et al.* (1997) reported positive relationship of education with adoption and intensity of adoption improved maize seed.

Family size is one of the other important household demographic variables which have influence on farmers' adoption behavior. Large family size usually implies availability of labor provided that majority or all of the family members are within the age range of active labor force (15-64 years). In most studies family size had positive relationship with adoption of improved agricultural technologies. Kidane (2001) on the study he conducted on factors influencing adoption of new wheat and maize varieties in Tigray reported positive and significant relationship of family size with adoption.

2.8.2. Farm characteristics

Farm related variables such as farm size and other farm characteristics influence farmers' adoption behavior as farm is an important unit where agricultural activities take place. Concerning farm size, different studies reported its effect differently. A study by Itana (1985); Mulugeta (2000); Million and Belay (2004) and Yishak (2005) indicated positive relationship between farm size and adoption. Contrary to this, a study conducted by Gockowski and Ndoumbe (2004) on the adoption of intensive mono-crop horticulture in southern Cameroon reported the negative relation of farm size with adoption. Similarly, Legesse (1992) and Degnet et al. (2001) reported negative relationship between farm size and adoption.

Tadesse et al. (2014) reported that population pressure, agricultural expansion, and insecure land tenure accelerated deforestation and land degradation in southwest Ethiopian coffee agro-ecosystems. The study showed that farmers with larger landholdings and stronger economic capacity were more likely to implement sustainable land management and conservation practices. Likewise, Sisay and Toru (2023) found that landholding size, livestock ownership, and access to extension services positively affected households' willingness to participate in

forest restoration activities in Ethiopia. The study also revealed that households with better economic conditions were more willing to contribute labor and financial resources for environmental rehabilitation programs.

Farm size and landholding security are also important economic factors affecting environmental restoration and land management decisions. Sisay and Toru (2023) studied households' willingness to participate in forest restoration activities in Ethiopia and found that larger landholding size positively influenced participation in restoration programs. Farmers with larger farms were more willing to allocate land and labor for tree planting and conservation activities because they expected long-term economic benefits from improved environmental conditions. The study further indicated that households with secure land tenure had greater confidence to invest in restoration activities and sustainable land management practices.

A study conducted by Mohammed Teshome and Worku Mulatu in southwest Ethiopia investigated the effects of pruning and fertilizer application on Arabica coffee productivity. The researchers found that rejuvenation through stumping significantly increased the number of productive branches and stimulated vigorous shoot development. The study further revealed that rejuvenated coffee trees produced higher yields compared to non-pruned trees because the practice encouraged the emergence of healthy and productive stems. The authors concluded that rejuvenation improves canopy structure, enhances nutrient use efficiency, and restores declining coffee plantations (Mohammed & Worku, 2025).

Empirical evidence from southwest Ethiopia indicates that socio-economic characteristics influence farmers' willingness and capacity to adopt rejuvenation practices. Mohammed and Worku (2025) found that rejuvenation through pruning and stumping significantly increased productive branches, canopy development, and coffee yield. The study further reported that farmers with better access to labor, land, and agricultural inputs were more likely to adopt coffee rehabilitation practices. Similarly, Gonzaga et al. (2021) observed that rejuvenation and replanting practices improved the productivity of old Robusta coffee trees and increased farm profitability. The authors emphasized that management of vigorous suckers after pruning enhanced coffee growth and long-term productivity.

Shade management is another important component of coffee agroforestry systems. Empirical studies demonstrate that shade trees improve soil fertility, conserve moisture, regulate temperature, and support biodiversity conservation. Bote and Vos (2023) found that shade tree

species positively affected soil biogeochemistry, nutrient cycling, and coffee bean quality in Ethiopian coffee plantations. Their findings indicated that shaded coffee systems improved soil organic matter and enhanced ecological sustainability compared to open coffee farming systems. Hergoualc'h et al. (2019) also reported that shade trees increased soil nutrient availability and improved biological activity in organic coffee agroforestry systems.

Improved cook stove adoption has also been identified as an important strategy for reducing deforestation and land degradation. Rural households in Ethiopia heavily depend on biomass fuels such as firewood and animal dung for cooking, contributing to forest depletion and soil nutrient loss. Gebreegziabher et al. (2017) investigated the adoption of improved biomass cook stoves in northern Ethiopia and found that socio-demographic factors such as income, education, household labor availability, and livestock ownership significantly influenced stove adoption. The study showed that households using improved cook stoves consumed less firewood and dung compared to non-adopters, thereby reducing pressure on forests and improving soil fertility because animal dung could instead be used as organic fertilizer. The authors concluded that improved cook stoves contribute significantly to environmental conservation and sustainable land management.

An empirical study carried out in Indonesia by R. T. S. Rohani and colleagues evaluated the effects of coffee canopy pruning and fertilization on coffee growth and soil properties. The study demonstrated that regular pruning significantly improved stem diameter, shoot growth, chlorophyll concentration, and soil organic matter content. The removal of unnecessary suckers reduced competition among stems and improved nutrient distribution within the plant. According to the study, coffee plants that underwent proper pruning and de-suckering produced stronger vegetative growth and better yields than unpruned coffee plants (Rohani et al., 2024).

2.8.3. Environmental and Forest Restoration factors

Empirical evidence shows that well-designed agroforestry can both restore degraded land and sustain production. Review work synthesizing many case studies concludes that integrating trees with crops and/or livestock improves soil physical, chemical, and biological properties, reduces erosion, and enhances on-farm biodiversity, making agroforestry a key tool for reversing land degradation and maintaining long-term productivity (Fahad et al., 2022). Agroforestry systems often exhibit 15% higher soil organic carbon and nitrogen stocks, and higher microbial biomass, than nearby conventional cropping, indicating strong restoration potential (Fahad et al., 2022).

Forest restoration practices are closely linked with coffee agroforestry systems in Ethiopia. Studies show that coffee-based agroforestry contributes to biodiversity conservation, soil fertility improvement, and reduced land degradation. Ango et al. (2020) examined forest cover changes in coffee-growing regions of southwest Ethiopia and found that socio-economic dependence on coffee production significantly influenced forest management practices. Farmers who benefited economically from forest coffee systems were more likely to participate in forest conservation and restoration activities. Similarly, Hylander et al. (2019) observed that continuous coffee cultivation without proper management caused gradual degradation of forest biodiversity and vegetation structure. The researchers emphasized the importance of integrating sustainable coffee management with forest restoration strategies.

An empirical study conducted in Ethiopia by Kindineh Sisay and Tessema Toru examined households' willingness to participate in forest restoration programs in Haramaya District. The study found that soil erosion, declining agricultural productivity, and deforestation motivated households to engage in restoration activities. The researchers also reported that landholding size, access to extension services, and livestock ownership significantly influenced participation in environmental restoration programs. Farmers who experienced severe land degradation were more willing to invest in tree planting and conservation practices (Sisay & Toru, 2023).

Forest cover change is another important environmental factor associated with restoration efforts. Ango et al. (2020) investigated long-term forest cover changes in the coffee-growing areas of southwest Ethiopia. The study revealed that agricultural expansion, population growth, and increasing demand for farmland contributed significantly to forest loss and ecosystem degradation. However, the research also showed that coffee agroforestry systems supported partial forest conservation by maintaining tree cover and biodiversity. The authors emphasized that sustainable coffee management and agroforestry practices can contribute positively to forest restoration and ecological resilience.

Similarly, Hergoualc'h et al. (2019) found that shade trees in organic coffee agroforestry systems significantly improved soil nutrient availability and biological activity. The researchers reported that nitrogen-fixing trees enhanced phosphorus availability and increased soil microbial activity, thereby supporting ecosystem restoration and sustainable agricultural production. The study emphasized that agroforestry systems provide important ecological benefits compared with mono cropping systems.

Energy use and household dependence on biomass fuels are additional environmental factors contributing to deforestation and land degradation. Gebreegziabher et al. (2017) examined the adoption of improved biomass cook stoves in northern Ethiopia and found that improved stove technologies significantly reduced firewood consumption. Households adopting improved stoves used less fuel wood and animal dung, thereby reducing pressure on forests and improving soil fertility because dung could instead be applied as organic fertilizer. The researchers concluded that improved energy technologies contribute to forest restoration and environmental sustainability by reducing deforestation and soil nutrient depletion.

2.8.4 Economic Factors

Recent empirical studies highlight that diversification patterns and benefits are strongly gendered. In rural Zambia, on-farm livelihood diversification (expanding crop types and farm activities) improved food security for female-headed households, and was more effective for them than off-farm diversification (Hegazi & Seyuba, 2024). Diversification income also contributed to women's empowerment by increasing control over resources and enabling further livelihood expansion (Hegazi & Seyuba, 2024).

In Ethiopia's Meket District, multinomial regression on 251 women-headed households shows that access to credit, land, water, inputs, training, and markets significantly increases women's likelihood of diversifying beyond traditional farming, while heavy domestic chores and participation in safety-net programs constrain diversification (Mekonnen et al., 2025). This underscores structural barriers to women's livelihood choices.

A study of the Oraon Indigenous community in South Asia finds a "gender paradox": female-headed households maintain more diversified portfolios, engaging multiple income sources as a coping response to risk, but still earn less than male-headed households (Majumder, 2025). Their diversification is "out of necessity, not choice," highlighting how gendered power relations and resource access shape diversification outcomes (Majumder, 2025).

Household income is a major economic factor influencing the adoption of coffee rejuvenation and restoration practices. Coffee rejuvenation activities such as pruning, stumping, replanting, and fertilizer application require financial investment and labor resources. An empirical study conducted in southwest Ethiopia by Mohammed Teshome and Worku Mulatu found that farmers with better economic resources and access to agricultural inputs were more likely to adopt pruning and rejuvenation practices. The study reported that rejuvenated coffee farms

produced higher yields and improved household income compared to unmanaged coffee farms. The researchers concluded that financial capacity positively influences sustainable coffee management and productivity improvement (Mohammed & Worku, 2025).

Access to credit and financial services significantly affects the adoption of environmental conservation technologies. Empirical evidence suggests that farmers with access to loans and rural financial institutions are more capable of purchasing agricultural inputs, improved seedlings, fertilizers, and conservation technologies. Gebreegziabher et al. (2017) found that income level and economic status significantly influenced the adoption of improved biomass cook stoves in northern Ethiopia. Households with better economic conditions were more likely to purchase improved stoves because they could afford the initial investment costs. The study demonstrated that improved cook stove adoption reduced firewood consumption, decreased deforestation pressure, and improved environmental sustainability.

Livestock ownership is another important economic factor affecting land degradation and restoration practices. In many rural areas, livestock serve as a source of income, savings, and agricultural power. Sisay and Toru (2023) reported that households with larger livestock holdings were more willing to participate in forest restoration activities because livestock ownership improved household income and labor availability. However, empirical studies also indicate that excessive grazing pressure contributes to land degradation and forest destruction when grazing is poorly managed.

Market access and agricultural commercialization also influence sustainable environmental management. Ango et al. (2020) found that coffee farmers with better market access and stronger economic dependence on coffee production were more likely to conserve forest coffee systems and participate in agroforestry practices. The study showed that forest coffee production provided economic incentives for biodiversity conservation and forest restoration because farmers benefited directly from sustainable coffee production systems.

Economic incentives provided through environmental programs also affect restoration participation. Studies indicate that households are more willing to engage in conservation and restoration activities when economic benefits such as payments for ecosystem services, improved productivity, or income diversification opportunities are available. Tadesse et al. (2014) reported that economic pressures associated with population growth and agricultural expansion contributed to deforestation in southwest Ethiopia. However, the study emphasized

that promoting sustainable coffee agroforestry systems and providing livelihood incentives could reduce environmental degradation and support restoration efforts.

2.8.5 Energy Consumption factors

Household energy use is now a major driver of environmental pressure. One of the major factors influencing household energy consumption is income level. Households with higher income are more likely to adopt modern and energy-efficient technologies such as electricity, liquefied petroleum gas (LPG), biogas, and improved cook stoves. In contrast, low-income households often rely on freely available biomass fuels because of limited financial capacity. An empirical study conducted in northern Ethiopia by Zenebe Gebreegziabher and colleagues examined the adoption of improved biomass cook stoves and found that household income positively influenced the use of improved energy technologies. The study revealed that wealthier households were more likely to purchase and adopt improved cook stoves because they could afford installation and maintenance costs. The researchers also found that improved stove adoption significantly reduced firewood and dung consumption, thereby lowering pressure on forests and improving soil fertility (Gebreegziabher et al., 2017).

Education level is another important factor affecting household energy consumption behavior. Empirical studies show that educated households are more aware of the environmental and health impacts of traditional biomass use and are therefore more willing to adopt clean energy technologies. Gebreegziabher et al. (2017) reported that education significantly increased the probability of improved cook stove adoption in rural Ethiopia. Educated household heads were more likely to understand the economic and environmental benefits associated with energy-efficient technologies.

Household size and labor availability also influence energy consumption patterns. Larger households generally consume more fuel wood because of higher cooking and heating demands. At the same time, households with greater labor availability are more capable of collecting biomass fuels from surrounding forests. Research conducted in Ethiopia showed that family size positively affected biomass energy consumption because larger families required more energy for food preparation and domestic activities (Gebreegziabher et al., 2017).

Access to forest resources and fuel availability are important environmental factors affecting rural energy consumption. In many rural communities, households living near forests rely heavily on firewood and charcoal because these resources are relatively accessible and inexpensive. However, excessive harvesting of biomass fuels contributes to deforestation and

environmental degradation. Tadesse et al. (2014) found that increasing population pressure and agricultural expansion in southwest Ethiopia accelerated forest depletion due to rising demand for fuel wood and farmland. The study emphasized that unsustainable biomass energy use contributes significantly to forest degradation and ecosystem decline.

Land degradation and soil fertility decline are also associated with traditional energy consumption practices. In rural Ethiopia, animal dung is commonly used as cooking fuel instead of being applied as organic fertilizer on agricultural land. Gebreegziabher et al. (2005) explained that burning dung for household energy reduces soil nutrient availability and contributes to declining agricultural productivity. The study argued that improved cook stove technologies can reduce dung consumption and allow households to use animal manure for soil fertility management instead of fuel.

Access to electricity and infrastructure significantly affects household energy choices. Rural households without electricity access depend more heavily on traditional biomass fuels. Empirical studies indicate that poor infrastructure, limited rural electrification, and high energy costs constrain the transition toward modern energy sources in developing countries. In many rural Ethiopian communities, limited access to electricity forces households to continue relying on fuel wood and charcoal despite the environmental consequences.

Cultural practices and cooking traditions also influence energy consumption patterns. Traditional food preparation methods often require long cooking times and high fuel consumption, increasing dependence on biomass energy sources. Studies on rural household energy use in Ethiopia show that cultural preferences for traditional cooking systems slow the adoption of modern energy technologies even when improved alternatives are available.

Institutional support and extension services are additional determinants of energy technology adoption. Households receiving training and awareness programs on environmental conservation and clean energy technologies are more likely to adopt improved cook stoves and energy-saving practices. Gebreegziabher et al. (2017) emphasized that government policies, subsidies, and rural extension programs are essential for promoting improved energy technologies and reducing environmental degradation.

2.8.6 Community Perceptions and Project Sustainability factors

Empirical studies show that long-term sustainability of projects depends heavily on how communities perceive impacts and fairness. In Taiwanese community-based tourism areas, surveys of 849 residents across six communities measured perceptions of economic,

sociocultural, environmental, and life-satisfaction sustainability over different development stages (Lee & Jan, 2019). Perceived sustainability differed significantly between pre- and post-development phases and across stages (involvement, development, consolidation), indicating that support is dynamic: economic and sociocultural benefits were valued early, while environmental concerns became more salient at later stages (Lee & Jan, 2019). Managers are urged to tailor strategies to each stage to maintain community support.

A comparative study of two island-based renewable energy projects in Greece and Spain developed a framework linking local perceptions to project "success" across economic, environmental, social, technical, and institutional dimensions (Tsagkari et al., 2022). Survey data showed that economic benefits were not the main driver of positive evaluations; instead, environmental gains, local pride, and strong institutional performance (transparent governance, reliability) were more influential in people's overall assessment and willingness to support future initiatives (Tsagkari et al., 2022).

Research on tourism planning in a US community using mixed methods (surveys with residents, tourists, and business leaders; focus groups with NGOs and land managers) finds that stakeholder groups perceive tourism impacts differently: business leaders are most positive, residents most critical, but residents show the strongest support for sustainability initiatives (Andereck et al., 2025). Collaborative processes and inclusive stakeholder engagement enhanced legitimacy and produced actionable recommendations.

Qualitative work on community-based sustainability projects in UK urban areas reveals that residents constantly compare their own engagement to perceived engagement of "others," a process of "Othering" that can create tensions and undermine collective action if not addressed (Axon, 2020). Ensuring visible, equitable participation and addressing perceptions of free-riding are important for long-term project cohesion (Axon, 2020).

Across these studies, community perceptions of environmental benefits, fairness, institutional quality, and shared commitment strongly condition project sustainability. Initiatives that deliver visible environmental improvements, recognize local values, and involve residents in decision-making are more likely to gain durable support and be sustained over time (Lee & Jan, 2019; Tsagkari et al., 2022; Andereck et al., 2025; Axon, 2020).

Empirical evidence shows that projects involving local communities in planning, implementation, and decision-making processes are more sustainable than projects imposed externally. An empirical study conducted in Ethiopia by Kindineh Sisay and Tessema Toru

found that households were more willing to participate in forest restoration programs when they were actively involved in decision-making and when projects addressed local livelihood needs. The study revealed that community members who perceived restoration projects as beneficial for soil fertility improvement, fuel wood availability, and agricultural productivity showed stronger commitment toward sustaining restoration activities (Sisay & Toru, 2023).

Community awareness and environmental perception also significantly affect sustainability outcomes. Studies indicate that communities with greater awareness of environmental degradation and climate change are more likely to support conservation and restoration programs. Ango et al. (2020) examined forest cover change in coffee-growing areas of southwest Ethiopia and found that local communities who economically depended on forest coffee systems were more supportive of forest conservation and sustainable agroforestry practices. The study showed that positive community perception toward forest resources contributed to reduced deforestation and improved restoration efforts.

Economic benefits and livelihood improvement are additional determinants of project sustainability. Empirical studies demonstrate that communities are more likely to maintain projects that generate direct economic returns. In coffee agroforestry systems, farmers participating in shade coffee production and forest conservation often benefit from improved coffee quality, income diversification, and ecosystem services. Jha et al. (2014) reported that coffee agroforestry systems provided economic incentives for biodiversity conservation because communities derived income from sustainable coffee production while simultaneously conserving forest ecosystems. The study emphasized that projects linked with livelihood improvement are more likely to achieve long-term sustainability.

Institutional support and extension services also influence community perception and sustainability of projects. Households receiving regular training, technical assistance, and extension support are more likely to adopt and sustain conservation practices. Sisay and Toru (2023) found that access to extension services positively affected participation in restoration activities because farmers gained better understanding of the long-term environmental and economic benefits of restoration programs. The researchers concluded that continuous institutional support strengthens local commitment and project continuity.

Socio-demographic factors such as education, age, family size, and gender also influence project sustainability. Educated households are more likely to understand the benefits of

environmental conservation and support sustainable development interventions. Younger farmers are often more open to adopting innovative conservation practices, while women's participation in project management has been associated with improved community cooperation and sustainability outcomes in many rural development projects.

Community ownership and local capacity building are also essential for sustaining development projects after donor withdrawal. Empirical studies indicate that projects are more sustainable when local communities develop technical skills, organizational capacity, and financial management experience during project implementation. Capacity building strengthens local institutions and enables communities to continue project activities independently.

Environmental projects involving improved cook stove adoption also demonstrate the importance of community perception in sustainability. Gebreegziabher et al. (2017) found that households adopting improved cook stoves in Ethiopia perceived benefits such as reduced fuel wood consumption, lower cooking time, and improved indoor air quality. Positive user perceptions contributed significantly to continued use and diffusion of improved stove technologies within communities. However, lack of awareness, cultural resistance, and inadequate technical support limited adoption in some areas.

2.9. Conceptual Framework of the Study

Adoption decisions of different technologies across space and time are influenced by different factors and their associations. Factors such as personal, socioeconomic, institutional and psychological factors determine the probability of adoption and use intensity of technologies such as old coffee stumping and Mirt cook stove. It is obvious that different studies have been conducted to look into the direction and magnitude of the influence of different factors on adoption decisions. A factor, which is found to enhance adoption of a particular technology in one locality at one time, was found to hinder it or to be irrelevant to adoption of the same technology in another locality.

Although some known determinants tend to have general applicability; it is difficult to develop a universal model of the process of technology adoption with defined determinants and hypotheses that hold to everywhere. The dynamic nature of the determinants and the distinctive nature of the areas make it difficult to generalize what factors influence which technology adoption. The framework emphasized mainly on the relationship of the explanatory variables

with the dependent variable. The relationship between explanatory variables was shown in the diagram.

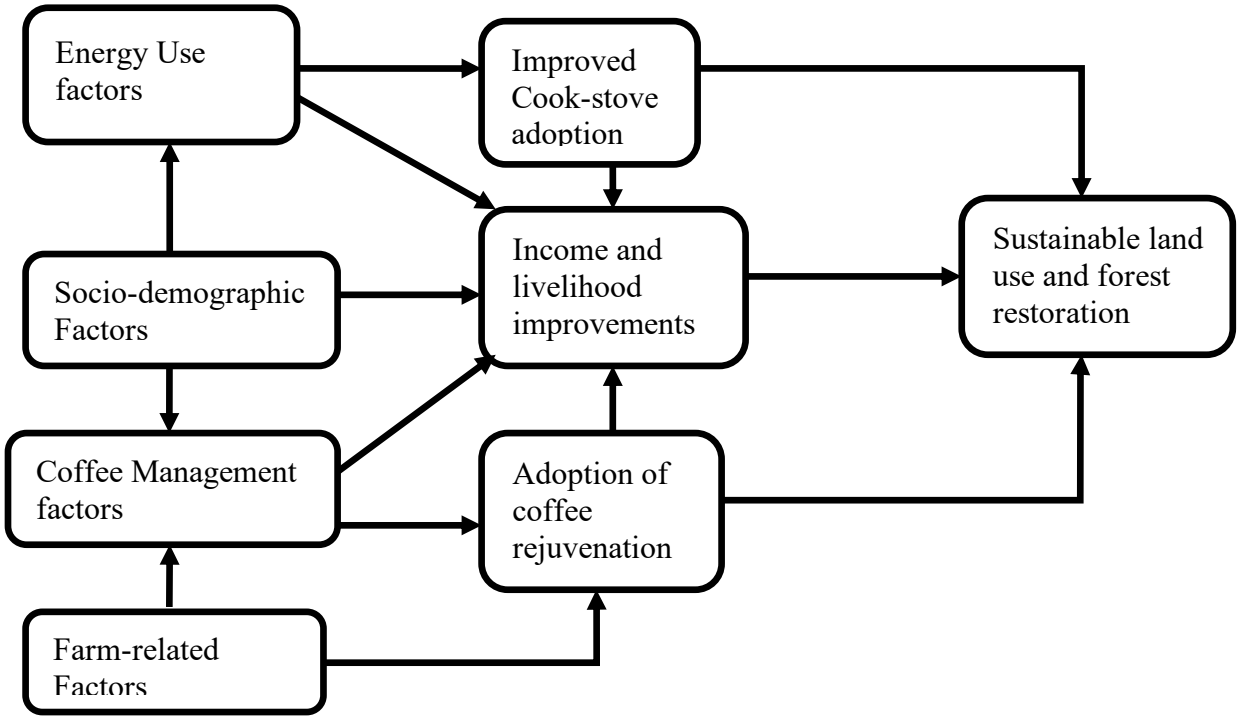


Figure 1: Conceptual framework

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology employed to assess the development interventions under the FOLUR Project in Oromia Region. It outlines the study area, research design, data sources, sampling techniques, sample size determination, data collection methods, analytical techniques, ethical considerations, implementation approach, expected outcomes, key research questions, and quality assurance mechanisms. The methodological approach is structured to ensure rigor, triangulation, and the generation of robust evidence capable of informing program improvement, policymaking, and future interventions.

3.2 Descriptions of Study Area

The study area is located within the Oromia Region of Ethiopia and represents a continuous forest–agriculture–pastoral landscape system aligned with the objectives of the FOLUR (Food Systems, Land Use, and Restoration) project. The FOLUR initiative emphasizes integrated landscape management, aiming to balance environmental conservation, agricultural production, and local livelihoods across interconnected ecological zones (CSA et al., 2013).

The study area covers south eastern and western Oromia, encompassing five ecologically and socio-economically diverse districts: Yayo, Chora, Gomma, Adaba, and Abaya. The landscape exhibits a distinct east–west and north–south environmental gradient, ranging from humid forest ecosystems in the highlands to drier agro-pastoral lowlands, and forms a complex mosaic of interconnected land-use systems. Each district contributes unique ecological functions and socio-economic roles within the broader landscape system.

Yayo District (Illubabor Zone), located at approximately 8.1667° N latitude and 36.0000° E longitude, lies in the western highlands and is one of the most ecologically intact districts in the study area. It encompasses the Yayo Coffee Forest Biosphere Reserve, a UNESCO-recognized site where traditional coffee cultivation coexists with dense moist evergreen forests. The terrain is undulating with gentle to moderately steep slopes, dissected by numerous small rivers feeding larger drainage networks. The district has deep, well-drained soils and consistently high rainfall throughout the year, supporting a continuously green landscape dominated by natural forest cover. Human settlement is sparse, and agriculture is primarily limited to smallholder patches of maize, sorghum, and root crops, while the dominant land-use system remains forest-based coffee agro-ecosystems. Yayo is critical for biodiversity conservation, particularly wild coffee genetic resources and associated flora and fauna.

Chora District (Buno Bedale Zone), at 8.3333° N latitude and 36.2500° E longitude, forms a transition zone between dense forests and cultivated highlands. The district features rolling

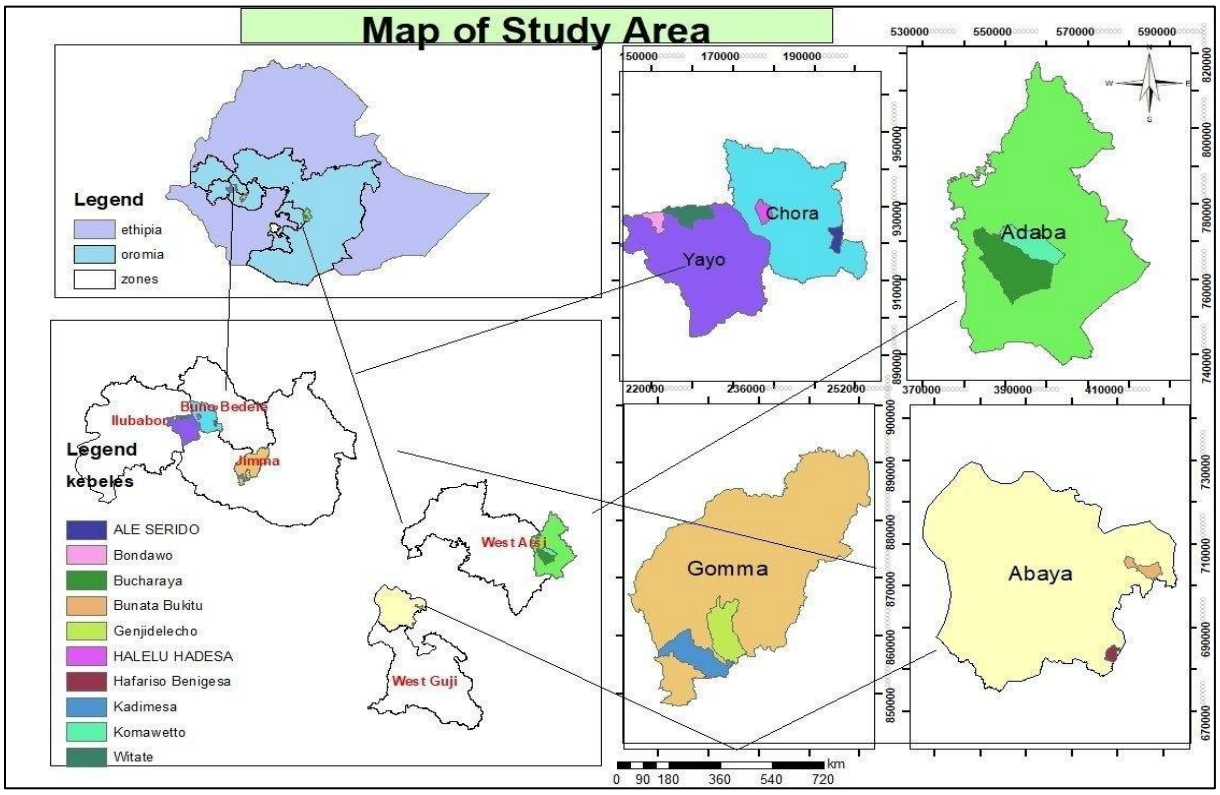
hills, valleys, and occasional flat valley bottoms that are intensively cultivated. Elevation is relatively high, resulting in cooler temperatures and high rainfall, which support both natural vegetation and diverse agricultural production. Remnant forest patches, although more fragmented than in Yayo, provide ecological connectivity and shade for perennial crops. Agricultural activities include mixed farming of cereals (wheat, barley, maize) and coffee production under shaded agroforestry systems, making Chora an important zone for both agricultural productivity and ecological conservation.

Gomma District (Jimma Zone), located at 7.8333° N latitude and 36.6667° E longitude, is widely recognized for coffee production, situated on rolling highlands with fertile volcanic soils and a humid, mild climate. Its landscape consists of a mosaic of agroforestry systems and cultivated land, with coffee as the dominant cash crop grown under shade trees, integrated with *enset*, fruit trees, and other multipurpose vegetation. This system supports soil fertility maintenance, erosion control, and sustainable production. Subsistence crops such as maize, *teff*, and root crops are also cultivated. Despite intensive agriculture, patches of natural vegetation along rivers and less accessible terrain contribute to biodiversity conservation.

Adaba District (West Arsi Zone), at 7.0000° N latitude and 39.5000° E longitude, represents a highland–midland transition zone, featuring rugged terrain, mountainous areas, dissected plateaus, and deeply incised valleys. The district lies within the Shabelle River watershed, providing essential water resources. The climate is cool and moist, supporting a variety of crops including cereals (barley, wheat, and oats), pulses, and maize in warmer zones, alongside livestock production. Forest cover is more fragmented than in Yayo and Chora but provides important ecosystem services such as fuel wood, construction materials, and soil stabilization. Adaba acts as a buffer zone between highland agricultural systems and forested landscapes.

Abaya District (West Guji Zone), located at 6.1667° N latitude and 38.0000° E longitude, lies in the southern lowlands of Oromia along the northern shore of Lake Abaya in the Great Rift Valley. It is characterized by flatter terrain, gently undulating plains, and seasonal river valleys. The climate is warmer and drier with pronounced seasonal rainfall variability. Agriculture relies on crop–livestock mixed systems, with drought-tolerant crops such as maize and sorghum and livestock including cattle, goats, and sheep. Vegetation consists primarily of open shrub lands, scattered trees, and grasslands, reflecting lower tree cover compared to western forested districts. Abaya plays an important role in regional food production and serves as a transition between humid highlands and dry lowlands.

Collectively, these five districts illustrate the ecological, topographical, and socio-economic diversity of Oromia. The study area exemplifies a landscape-scale approach, integrating forest conservation, agricultural productivity, and pastoral livelihoods across highland, midland, and lowland environments. It highlights the importance of maintaining connectivity between forests, farmlands, and grazing areas to support both sustainable development and biodiversity conservation (CSA et al., 2013).



Source: Own design from available GIS data, 2026

Figure 2: Location of the study area

3.3 Research Design/Approach

This study employed **a** mixed-methods approach, combining quantitative and qualitative data collection and analysis to ensure scientific rigor, triangulation, and comprehensive assessments of FOLUR-supported interventions. The quantitative component measures changes in livelihoods, income, household resilience, and participation in sustainable land management. The qualitative component documents experiences, success stories, socio-cultural dynamics,

and contextual factors influencing outcomes. Mixed-methods approaches are particularly effective for capturing both the scale and depth of interventions while validating findings across data sources (Creswell & Plano Clark, 2018; Tashakkori &Teddlie, 2010).

3.4 Data source and type

The study relies on both primary and secondary data sources to ensure reliability, contextual depth, and triangulation. Primary data collected through structured household surveys, Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), field observations, in-depth interviews, and case studies of selected beneficiaries. Secondary data were gathered from project reports, monitoring and evaluation (M&E) datasets, extension office records, baseline assessments, cooperative and enterprise reports, and relevant scholarly literature. Together, these complementary data sources strengthen the validity of the findings and provide a comprehensive understanding of livelihood transformation among women and youth participating in FOLUR-supported interventions.

3.5 Sampling Design

3.5.1 Target Population

The target population for this study comprises both primary beneficiaries and secondary stakeholders. The primary beneficiaries include women and youth who are actively participating in FOLUR-supported income diversification and enterprise development activities (Jemaneh & Shibeshi, 2023). The stakeholders consist of local government officials, FOLUR project staff, community leaders, cooperative leaders, and service providers who play a role in supporting or monitoring the interventions (Debela & Mansingh, 2016). This dual focus ensures that the study captures both the direct participants and the perspectives of key actors involved in program implementation and oversight.

3.5.2 Sampling Techniques, Procedures, and Sample Size

The study focuses on both forest-based and coffee-based landscapes in Oromia, encompassing selected zones, districts, and kebeles to ensure representation of diverse ecological, socio-economic, and livelihood contexts relevant to FOLUR interventions.

Sampling Techniques

This study employed a multi-stage stratified random sampling strategy combining purposive and probabilistic sampling approaches. This mixed-method sampling design is intended to

optimize statistical representativeness while ensuring contextual relevance and adequate coverage of diverse livelihood systems within the project intervention areas. At the primary stage, purposive sampling was used to select representative districts from each agro-ecological zone, thereby ensuring that selected administrative units reflect the distinctive agro-ecological and livelihood characteristics of their respective zones. At the secondary stage, simple random sampling was utilized to select kebeles from each purposively selected district, introducing probabilistic selection to enhance generalizability and minimize selection bias. At the tertiary stage, stratified random sampling was employed to select individual beneficiaries from the combined pool of youth and women participants, maintaining proportional representation that mirrors the actual demographic composition of the project population.

Sampling Procedures

The sampling procedure was executed sequentially across three administrative levels. First, one representative district was purposively selected from each of the five zones (West Arsi, Guji, Jimma, Illu Abbaa boora, and Buno Bedelle), yielding a total of five Districts comprising one forest-based livelihood district and four coffee-based livelihood districts (see Table 1 for details).

Second, two kebeles were randomly selected from each of the five purposively selected districts, generating a total of ten kebeles as the primary sampling units for beneficiary selection. Third, within each of the ten kebeles, individual beneficiaries were randomly selected from the comprehensive list of project participants, stratified by demographic category (youth and women), to ensure that the final sample maintains proportional representation reflecting the actual composition of the project beneficiary population. This sequential procedure ensures systematic and transparent selection while minimizing opportunities for selection bias at each hierarchical level.

Sample Size

The sample size was designed to ensure sufficient statistical power for quantitative analysis. The sample size was determined based on the sampling size determination formula developed by Yamane (1967), indicated below.

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

Where:

n = the required sample size

N = the total population size

e = the level of precision (margin of error), typically expressed as a decimal (e.g., 0.05 for 5%)
A total of 378 beneficiaries was randomly selected from the population of 6,872 project beneficiaries. The sample was distributed across the five districts selected during the secondary sampling stage, with 75 beneficiaries allocated proportionally from each district. Within each district, the 75 beneficiaries were further stratified by demographic category to maintain proportional representation of the project population's composition. Given that the project beneficiary population comprises 453 youth (6.6 percent) and 6,419 women (93.4 percent), the sample allocation across all five districts yields approximately 25 youth beneficiaries and 353 women beneficiaries. This proportional allocation across districts and demographic categories ensured equitable geographic representation while enabling robust disaggregated analysis across gender and age cohorts for differential impact assessment.

Table 1 : Sampling Distribution across FOLUR Intervention Zones

Zone	Innervation District	Selected sample District	Livelihood	No. of sample Kebeles	Sample size	Total number of FGDs and KIIs
West Arsi	Adaba, Dodolla, Nansabo	Adaba,	Forest based	2	75	1 FGDs per kebele; 3 key informant interviews
Guji	Qarcaa, Abayaa, Bulehora	Abayaa,	Coffee based	2	75	1 FGDs per kebele; 3 key informant interviews per district
Jimma	Gomma, Qarsa	Gomma	Coffee based	2	76	1 FGDs per kebele; 3 key informant interviews per district
Illubabor	Yayyoo,	Yayyoo,	Coffee based	2	76	1 FGDs per kebele; 3 key informant interviews per district

Buno Bedele	Cora	Cora	Coffee based	2	76	1 FGDs per kebele; 3 key informant interviews per district
Total Sample size					378	

3.6 Collection Tools and Instruments

This study employed a comprehensive mixed-methods approach utilizing multiple data collection instruments designed to capture quantitative and qualitative information about livelihood outcomes, adoption of sustainable land-use practices, and forest restoration initiatives. The data collection strategy integrates both primary and secondary data sources to ensure triangulation and enhance the robustness of findings.

3.6.1 Primary data collection techniques

Structured Surveys

Structured survey questionnaires were administered to the 378 randomly selected beneficiaries across the ten kebeles. The survey instrument was designed to systematically gather quantitative data, including household income trends and patterns from diverse livelihood diversification activities (agroforestry, livestock rearing, micro-enterprises); household resilience indicators; adoption rates and intensity of land-use and forest conservation practices; participation in women's savings groups and cooperative associations; participation in and satisfaction with capacity-building programs; access to and utilization of finance and market-linkage support; participation in household and community-level decision-making processes; agency and empowerment indicators; and beneficiaries' perceptions and satisfaction regarding overall project performance and relevance. The questionnaire was pre-tested in non-sample kebeles to ensure clarity, cultural appropriateness, and logical flow, with modifications implemented based on pilot findings. Data collection was conducted by project site-trained staff using the KOBO toolbox to enhance data quality.

Case Studies

Purposively selected case studies were conducted with beneficiary households representing diverse outcomes and experiences across the intervention zones. Case studies were designed to generate in-depth, contextually rich narratives documenting individual or household trajectories of livelihood transformation, adoption of landscape management practices, and

empowerment outcomes. Each case study involved in-depth interviews conducted over the study period to capture temporal dimensions of change, household observations documenting livelihood activities and household decision-making processes, and a review of household records, including income documentation and asset inventories where available. Case study narratives were developed through thematic analysis and serve to illustrate pathways of change, identify enabling factors and constraints, and document lived experiences that contextualize quantitative findings. These detailed case studies were particularly valuable for disseminating evidence-based success stories and lessons learned.

Key Informant Interviews**:** In-depth key informant interviews were conducted systematically across all five purposively selected districts to capture diverse stakeholder perspectives on project implementation, outcomes, and contextual factors. Key informants were strategically selected to represent multiple stakeholder categories, including federal and regional level relevant officials and project coordinators, district and kebele administration staff, project implementation team members, community leaders and elders, cooperative association officers, and other institutional actors with specialized knowledge of project activities and community dynamics. A semi-structured interview guide was utilized to ensure consistency while permitting flexibility for exploring emergent themes. Each district was host to approximately three key informant interviews, generating approximately fifteen interviews across all districts.

Focus Group Discussions**:** Focus group discussions were conducted separately with distinct community segments to capture collective perceptions, behavioral changes, social dynamics, and contextual challenges. Each FGD comprised 6 to 12 purposively selected participants representing diverse experiences and perspectives within the targeted segment. Participants were selected based on criteria including duration of project participation, level of project engagement, and livelihood outcomes, ensuring that FGDs capture both successful cases and less successful experiences. A total of approximately ten FGDs were conducted across the ten kebeles, with at least one FGD per kebele, enabling comprehensive geographic coverage and community-level validation of household survey findings.

Field Observations and Site Visits**:** Direct field observations and site visits were systematically undertaken to verify and validate self-reported data and assess ground-level realities. Observation activities were encompass verification of agroforestry plots and assessment of tree adoption and productivity; evaluation of coffee-forest integration plots to document sustainable

land-use practice adoption and productivity; inspection of livestock rearing facilities and assessment of micro-enterprise facilities and income-generating activity sites to evaluate functionality, utilization, and operational capacity; examination of seedling nurseries and tree planting infrastructure to evaluate technical capacity and sustainability; verification of forest restoration sites and assessment of forest regeneration conditions.

Photographic documentation was employed to create visual records of landscape conditions, restored areas, and enterprise facilities. Field observations provide triangulation evidence for validating self-reported data on livelihood activities, sustainable land-use adoption, and enterprise performance.

3.6.2 Secondary Data Collection

Secondary data sources were systematically reviewed and analyzed to triangulate primary findings and provide broader contextual understanding. Secondary data include project reports and documentation such as annual reports, project proposals, and implementation progress reports; monitoring and evaluation records including baseline surveys, monitoring data, and performance reports; relevant academic and literature addressing landscape restoration, livelihood diversification, and forest management in comparable contexts; government policy documents and development plans at district and regional levels; and community-level records maintained by kebele administrations and cooperative associations. This secondary data was reviewed systematically through document analysis to extract relevant information, identify patterns, and contextualize primary data findings within the broader policy and institutional environment.

3.7 Data Analysis Methods

3.7.1. Qualitative Data Analysis

Qualitative data from key informant interviews, focus group discussions, and case study narratives were subjected to rigorous thematic analysis. Data was transcribed from audio recordings and translated into English where necessary. Transcribed data were coded systematically using a combination of deductive and inductive coding approaches. Codes were organized into hierarchical coding structures organized around major themes and subthemes.

Coded data retrieved and analyzed thematically to identify patterns, variations, and relationships. Thematic analysis examines convergences and divergences across different stakeholder groups, geographic contexts, and livelihood systems. Illustrative quotations were extracted to exemplify key themes and support narrative interpretation.

In-depth case study narratives were also analyzed through narrative analysis and case synthesis approaches. Individual case studies were developed through chronological reconstruction of livelihood trajectories, identification of critical turning points and enabling events, documentation of household decision-making processes, and description of livelihood diversification activity adoption and evolution. Case study narratives integrate quantitative baseline data, in-depth interview findings, household observations, and asset/income documentation to provide a holistic household-level understanding. Cross-case analysis was done to identify common patterns, variations, and contextual factors that explain differential outcomes. Case studies were analyzed thematically to extract lessons learned and evidence-based success factors. Case narratives were categorized based on livelihood outcome success, livelihood diversification activity focus (agroforestry-focused, livestock-based, micro-enterprise), and beneficiary category (women and youth). Case studies were analyzed to extract evidence addressing all five themes, including livelihood outcomes achieved, empowerment changes experienced, land-use practices adopted, enterprise support effectiveness, and factors enabling or constraining success.

3.7.2. Quantitative Data Analysis

In this study both descriptive and econometric analysis were employed. Descriptive statistical analysis was employed to form the foundation for quantitative data interpretation. Means, standard deviations, and frequencies were calculated to summarize household characteristics. Adoption of sustainable land-use practices was documented through frequency distributions specifying the percentage of surveyed households implementing specific practices (agroforestry, natural resource conservation, forest restoration, soil conservation), with adoption rates disaggregated by practice type, demographic category, and geographic location. Participation in capacity-building programs and access to finance were analyzed through the calculation of participation rates and frequency of access. Empowerment indicators were analyzed through the calculation of participation rates in household and community decision-making. All descriptive statistics were presented with appropriate measures of dispersion to convey the range and variability of outcomes across the beneficiary population.

We also used econometric analysis to estimate the adoption of improved cook stove. The binary logistic regression model was used to evaluate the determinants for the adoption of improved cook stove and coffee rejuvenation. The model outputs were assessed against its prediction power and explanation of determinants for the improved cook stove and coffee rejuvenation adoption decision. This model was appropriate because the dependent variable was discrete (i.e. binary yes=1, otherwise=0) as it measures whether one had adopted or not. It was preferred to other model because the logit regression model are its heteroskedasticity consistency, the simplicity of the method, and the easiness it offers for the results interpretation (Karacula, 2009).

The Logit model can be mathematically described as:

$$P_i = E(Y = 1|X_i) = \beta_0 + \beta_i X_i \quad (1)$$

$\beta_0$is the constant and β_i =1, 2…n are the coefficients of the independent variables to be estimated. X_i represents the independent variables.

$$P_i = E(Y = 1|X_i) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1)}} \quad (2)$$

$$P_i = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}} \quad (3)$$

where $Z_i = \beta_0 + \beta_i X_i$

If P_i is the probability of adoption, the probability of being non adaptor can be written as:

$$1 - P_i = \frac{1}{1+e^{Z_i}} \quad (4)$$

Then, it can be rewritten by diving equation 2 by equation 3 and simplified forms gives as

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad (5)$$

where, $\frac{P_i}{1-P_i}$, is the odds ratio in favour of adoption. It is the odds ratio in favour of being an adopter. This ratio shows the probability that the farmers being an adopter to the probability of non-adopter.

The logistic regression model is obtained by taking the logarithm of equation (5) as presented here; we obtain:

$$L_i = Ln\left[\frac{P_i}{1-P_i}\right] = \ln\left[e^{\beta_0} + \sum_{i=1}^{m} \beta_1 X_i\right] = Z_i \quad (6)$$

Where Ln is the logarithm of the odds ratio, which is linear in both X and in the parameter.

As a result, when the stochastic disturbance term ui is included:

$$L_i = Z_{(i)} = \beta o + \sum \beta_i X_i + U_i \quad (7)$$

Where, β0 = intercept, which is the estimation of probability of adoption, when X=0, βi = coefficient associated with explanatory variable, xi is independent variables, U_i = error term.

Before running the Logit model all the hypothesized explanatory variables were checked for the existence of multicollinearity problem. Variance inflation factor (VIF) was used to test multicollinearity problem for continuous and dummy variables, respectively. According to Maddala (1992), VIF can be defined as:

$$\text{VIF } (X_i) = \frac{1}{1 - R_i^2}$$

Ri, Where Ri^2 is the squared multiple correlation coefficient between Xi and the other explanatory variables. The larger the value of VIF is the more troublesome. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if Ri^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995)

3.7.2 Variable Description

The dependent variable in this study is adoption which indicates respondent's adoption of old coffee rejuvenation and Mirt cooking stove. Adoption in this case is a dummy dependent variable. The explanatory variables of importance in this study are those variables, which are thought to have influence on adoption of old coffee rejuvenation and Mirt cooking stove.

Table 2: Description and Hypothesized Effects of Explanatory Variables on Mirt Stove Adoption

Variable	Type	Measurement / Coding	Expected Sign
Sex	Dummy	Male = 1, Female = 0	±
Age	Continuous	Age in years	+
Educational level	Dummy	Educated=1, 0=Non educated	+

Household size	Continuous	Number of household members	+
Income level	Continuous	Annual income in ETB	+
Farm land size	Continuous	Land owned in hectare	+
Fuel wood usage before intervention	Continuous	Amount fuelwood use before intervention in bundles	−
Fuel wood usage during intervention	Continuous	Amount of fuelwood use during intervention in bundles	−
Time spent collecting fuel & cooking	Continuous	Hours per day/week spent collecting fuel and cooking	+
Indoor air quality	Ordinal	Perception/score on an ordered scale	+
Forest conservation status	Ordinal	Perception/score on an ordered scale	+

Table 3: Description and Hypothesized Effects of Variables on Household Coffee Rejuvenation Adoption

Independent Variables	**Variable Type**	**Measurement/Description**	**Expected Sign**
Sex	Dummy	1 = Male, 0 = Female	±
Age	Continuous	Age of household head in years	±
Education level	Categorical / Dummy	Years of schooling or education category attained	+
Household family size	Continuous	Number of family members in the household	+
Household income	Continuous	Annual household income (ETB or local currency)	+
Total farm size	Continuous	Total landholding size in hectares	+
Coffee farm size	Continuous	Land allocated for coffee production in hectares	+
Average age of coffee trees	Continuous	Average age of coffee trees in years	±
Average coffee yield	Continuous	Quantity of coffee produced per hectare or per household	+
Replanting of coffee trees	Dummy	1 = practiced replanting, 0 = otherwise	+
Pruning and removing suckers	Dummy	1 = practiced pruning/removing suckers, 0 = otherwise	+

Soil fertility management	Dummy	1 = practiced soil fertility management, 0 = otherwise	+
Shade management	Dummy	1 = practiced shade management, 0 = otherwise	+

3.8 Ethical Considerations

The study adheres to strict ethical standards to protect the rights and well-being of all participants. Informed consent was obtained from each participant before data collection, ensuring that they understood the purpose of the study and their voluntary role in it. Participants' confidentiality and privacy are strictly maintained throughout the research process. All data collected was used solely for research purposes, and findings will be reported in aggregate form to prevent the identification of any individual participant.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the findings of the study based on data obtained from the household survey questionnaire, FGDs, KIIs, Observation and document review. The analysis

focuses on examining socio-demographic characteristics of respondents, livelihood and income improvements (with particular attention to women beneficiaries), adoption of coffee rejuvenation practices, use of improved cook stoves, sustainable land-use and forest restoration practices, and community perceptions toward FOLUR interventions.

The results are presented using descriptive statistical techniques, including summary statistics, frequency distributions, mean, and standard deviation where applicable. The discussion interprets the findings in relation to the study objectives and relevant empirical literature. Emphasis is given to understanding the extent to which FOLUR-supported interventions have influenced household livelihoods, women's economic participation, sustainable agricultural practices, and environmental restoration efforts.

4.2 Background Characteristics of Respondents

4.2.1 Sex

The table 4 summarizes respondents by sex, showing the distribution across male and female categories. This provides a basic overview of the sample's gender composition.

Table 4: Sex of the respondents

Responses	Frequency	Percent
Male	204	59.1
Female	141	40.9
Total	345	100

Source: Fields Survey, 2026

The distribution of respondents by sex reveals that the majority of household survey participants were male, constituting 204 respondents or 59.1% of the total sample. Female respondents accounted for 141 individuals, representing 40.9% of the total. This pattern is broadly consistent with the common practice in rural Ethiopian household surveys where the male household head is typically the primary respondent for household-level questions. However, the notable representation of female respondents at nearly 41% is particularly significant in the context of the FOLUR Project, given that one of the project's core objectives is to improve the livelihoods of women and ensure their meaningful participation in sustainable land-use and forest restoration activities. The near-balanced sex distribution in the sample enhances the reliability and gender-sensitivity of the findings, allowing for a meaningful analysis of how project interventions are experienced differently across sexes. It also reflects

an intentional effort during data collection to capture women's voices and perspectives, which is crucial for assessing gender-responsive outcomes in agricultural and natural resource management programs.

4.2.2 Marital Status

The table 5 reports respondents' marital status categories, describing the sample in terms of relationship and household structure. This information supports interpretation of outcomes that may vary by family arrangement.

Table 5: Marital status of the respondents

Responses	Frequency	Percent
Single	2	.6
Married	335	97.1
Divorced	8	2.3
Total	345	100

Source: Fields Survey, 2026

Regarding marital status, an overwhelming majority of the surveyed respondents were married, accounting for 335 individuals or 97.1% of the total sample. Single respondents constituted only 2 individuals (0.6%), while divorced respondents numbered 8, representing 2.3% of the sample. The predominance of married respondents aligns well with the rural socio-demographic reality of Oromia, where marriage rates are high and households are largely structured around married couples engaged in joint agricultural and land management activities. This finding has important implications for the FOLUR Project's implementation approach, as decisions regarding land use, resource allocation, and livelihood investments in these communities are typically made at the household level, where both spouses particularly married couples play important though often differentiated roles.

The very small proportion of single and divorced respondents, especially divorced individuals who may represent some of the most economically vulnerable members of the community, suggests that future studies and project monitoring frameworks may need to adopt targeted approaches to capture and address the needs of these marginalized subgroups, including female-headed households headed by widowed or divorced women.

4.2.3 Educational Level

The table 6 presents respondents' highest educational attainment, indicating how the sample is distributed across education categories. This helps contextualize differences in knowledge, skills, and socio-economic standing.

Table 6: Educational level of respondents

Responses	Frequency	Percent
No Formal education	115	33.3
Primary Education	171	49.6
Secondary Education	50	14.5
TVET	9	2.6
Total	345	100

Source: Fields Survey, 2026

The educational attainment profile of respondents reveals relatively low levels of formal education among the surveyed population, which is characteristic of rural communities in many parts of Oromia. The largest proportion of respondents, 171 individuals or 49.6%, had attained only primary education, indicating that basic literacy and numeracy skills are present in roughly half of the sample. A substantial proportion of respondents' 115 individuals representing 33.3% of the total reported having no formal education at all, underscoring the significant educational gap that persists in these rural communities. Respondents with secondary education represented 50 individuals or 14.5% of the sample, while those who had completed Technical and Vocational Education and Training (TVET) were the smallest group, with only 9 respondents accounting for 2.6% of the total.

Taken together, these findings indicate that approximately 83% of respondents had either no formal education or only primary-level schooling. This reality has far-reaching implications for the design and delivery of FOLUR Project activities. Low educational attainment can limit households' capacity to access written information, engage with technical extension services, adopt new agricultural technologies, or exercise their rights regarding land tenure and resource governance. It also reinforces the importance of employing participatory, community-based, and culturally appropriate approaches in project implementation — including the use of local languages, visual communication tools, and community-led demonstration methods — to ensure that knowledge transfer and behavioral change are achievable across all educational levels.

4.2.4 Age, Household Size, and Annual Household Income

Table 7 reports descriptive statistics for Age, Household Size, and Annual Household Income showing the distribution of these measures among respondents.

Table 7**:** Age, Household Size, and Annual Household Income

Responses	N	Minimum	Maximum	Mean	Std. Deviation
Age	345	21	76	42.94	10.215
Household size	345	2	16	6.78	2.838
Annual income	345	12300	2200000	204150.86	193447.160

Source: Fields Survey, 2026

With respect to age, respondents ranged from a minimum of 21 years to a maximum of 76 years, with a mean age of 42.94 years and a standard deviation of 10.215 years. This indicates that, on average, the surveyed population consists of middle-aged adults who are in their economically and physically productive years. The relatively high mean age also suggests that the majority of household heads have considerable lived experience with the land, forests, and agricultural systems in the study area an asset for community-led natural resource management and forest restoration, but also a potential challenge in terms of openness to adopting new and improved land-use practices. The standard deviation of approximately 10 years indicates moderate variability in age distribution, confirming the inclusion of both relatively young adults and elderly respondents in the sample, thereby capturing a diversity of generational perspectives and livelihood strategies.

Regarding household size, the surveyed households ranged from a minimum of 2 members to a maximum of 16 members, with a mean household size of 6.78 and a standard deviation of 2.838. The average household size of nearly 7 persons is notably higher than both the national and regional averages typically reported in Ethiopian rural contexts, suggesting that the surveyed communities are characterized by large family units. Large household sizes have dual implications: they represent a greater labor pool that can contribute to land management and restoration activities, but they also translate into higher consumption demands, greater pressure on available land and forest resources, and deeper exposure to food insecurity if household income is insufficient. The wide range in household sizes from 2 to 16 members further highlights the heterogeneity of the sample and the need for differentiated support strategies tailored to household circumstances.

With regard to annual household income, the data reveal considerable economic disparity among the surveyed households. Annual incomes ranged from a minimum of Ethiopian Birr 12,300 to a maximum of Birr 2,200,000, with a mean annual income of Birr 204,150.86 and a strikingly large standard deviation of Birr 193,447.16. The extremely high standard deviation nearly equal to the mean is a strong indicator of significant income inequality within the sampled population, suggesting the presence of a small number of relatively well-off households alongside a large proportion of households living on very modest incomes.

The minimum income of Birr 12,300 per year equivalent to roughly Birr 1,025 per month is particularly concerning, as it points to extreme poverty among the most vulnerable households in the sample. This income disparity underscores the urgency of the FOLUR Project's livelihood improvement objectives and the importance of ensuring that project benefits reach the most economically marginalized households, including those headed by women or those with the least productive land. The wide income range also suggests that project impact assessments must go beyond average-based metrics and examine distributional outcomes to capture the degree to which the most vulnerable households are being meaningfully supported.

Generally, background profile of the respondents reveals a predominantly male-headed, married, and educationally disadvantaged rural population in the working-age bracket, characterized by large household sizes and highly variable income levels. These features collectively define the socioeconomic environment within which the FOLUR Project is being implemented and set the stage for the subsequent thematic analyses of land-use practices, livelihood outcomes, and forest restoration in the following sections.

4.3 Livelihood and Income Improvements

4.3.1 Livelihood activities

Understanding the livelihood strategies of households in the study area is fundamental to assessing the extent to which the FOLUR Project interventions align with and support the economic realities of the target communities. Table 8 presents the main livelihood activities reported by respondents across the five districts of Oromia National Regional State, capturing

the diversity and combination of income-generating activities pursued by households in the project implementation districts.

Table 8**:** Main livelihood activities

Items	Responses	Frequency	Percent
Farming	Yes	284	82.3
	No	61	17.7
Livestock rearing	Yes	177	51.3
	No	168	48.7
Coffee farm	Yes	231	67.0
	No	114	33.0
Off farm	Yes	9	2.6
	No	336	97.4

Source: Fields Survey, 2026

As shown in Table 8, farming emerged as the most widely practiced livelihood activity among the surveyed households, with 284 respondents representing 82.3% of the total sample confirming active engagement in crop cultivation. Only 61 respondents (17.7%) indicated that they do not practice farming. This finding firmly establishes crop farming as the backbone of household livelihoods in the study area, which is consistent with the predominantly agrarian nature of rural communities in Oromia. Empirical studies in Ethiopia consistently show that about 90–97% of rural households depend on agriculture, mainly crop and livestock production, as their primary livelihood activity (Haile et al., 2024; Mulat et al., 2021; Dafar et al., 2020; Temam et al., 2025; Mengistu & Belda, 2024). The dominance of farming as a primary activity also reinforces the centrality of sustainable land-use practices to household wellbeing and underscores the relevance of the FOLUR Project's focus on promoting improved agricultural land management in these communities.

Coffee farming was the second most commonly reported livelihood activity, with 231 respondents or 67.0% of the sample indicating involvement in coffee production, while 114 respondents (33.0%) reported no engagement in this activity. The high prevalence of coffee farming is particularly noteworthy given the ecological and economic significance of coffee in Oromia, which is widely recognized as one of the centres of origin of Arabica coffee. Empirical studies also confirm that coffee is a vital cash crop in Ethiopia and coffee-based production

systems play a major role in rural livelihoods in south western and central Oromia (Ummeta, 2025; Temam et al., 2025; Alamerie, 2020). This finding highlights the dual relevance of the FOLUR Project in this context coffee agroforestry systems, when well-managed, can simultaneously support household income generation, promote biodiversity conservation, and contribute to forest landscape restoration, all of which are core objectives of the project. The strong integration of coffee farming into household livelihood systems therefore presents a strategic entry point for the project to promote shade-grown coffee practices and agroforestry as pathways to both improved livelihoods and sustainable land use.

Livestock rearing was also identified as a significant livelihood activity, with 177 respondents (51.3%) reporting engagement in this practice, compared to 168 respondents (48.7%) who do not keep livestock. The near-even split between those who keep livestock and those who do not suggests that livestock rearing serves as an important but not universal livelihood strategy in the study area. Empirical evidence shows that mixed crop–livestock farming systems dominate rural production systems across Oromia and much of Ethiopia, where households combine crop production with livestock rearing as complementary livelihood strategies (Mulat et al., 2021; Abeje et al., 2019; Dafar et al., 2020; Temam et al., 2025).

Livestock herding in mixed farming systems often places competing pressures on land and forest resources through grazing, which can exacerbate land degradation and hinder forest regeneration efforts. From a FOLUR Project perspective, these finding points to the need for targeted interventions in livestock management such as improved forage production controlled grazing systems, and zero-grazing techniques as complementary strategies to reduce the environmental footprint of livestock on forest landscapes while sustaining household income.

In sharp contrast to the three agricultural livelihood activities described above, off-farm activities were reported by only 9 respondents, accounting for a mere 2.6% of the sample, while the vast majority 336 respondents or 97.4% indicated no involvement in off-farm income-generating activities. This strikingly low level of livelihood diversification beyond agriculture is a critical finding that reflects the limited availability of non-farm employment opportunities in the study area. Empirical studies in Ethiopia similarly report that many rural households have very limited participation in off-farm or non-farm income-generating activities and remain heavily dependent on agriculture (Haile et al., 2024; Abeje et al., 2019; Desulie, 2019; Abera et al., 2021; Mengistu & Belda, 2024).

The near-total dependence of households on farm-based activities intensifies pressure on natural resources, as land and forests represent virtually the only available assets for income generation and subsistence. This situation also heightens household vulnerability to climate shocks, crop failures, and market fluctuations. In this regard, the FOLUR Project's livelihood improvement component must consider promoting off-farm income diversification such as non-timber forest product enterprises, small-scale processing, and skills training as a complementary strategy to reduce resource overexploitation and build household resilience.

Generally, the livelihood profile of the respondents reveals a predominantly agriculture-based economy anchored in crop farming, coffee production, and livestock rearing, with negligible engagement in off-farm activities. This concentration of livelihoods in land-dependent activities simultaneously justifies the importance of the FOLUR Project in this context and highlights the urgency of promoting sustainable land-use practices that can ensure the long-term productivity of natural resources upon which these households so heavily depend.

4.3.2. Coffee Farm and Production Status

Table 9 presents the Coffee farm and Production Characteristics reported by respondents across the five districts of Oromia National Regional State, capturing the Average age of coffee trees in years and Average coffee yield per year (kg/ha) pursued by households in the project implementation districts.

Table 9**:** Descriptive Statistics of Farm and Coffee Production Characteristics

Item	N	Minimum	Maximum	Mean	Std. Deviation
Total farm size(ha)	345	.063	4.500	1.47633	.929
Coffee farm size (ha)	280	.000	3.500	.83263	.636
Average age of coffee trees in years	280	0	60	23.79	9.71
Average coffee yield per year (kg/ha)	280	0	4500	290.21	466.5

Source: Fields Survey, 2026

The descriptive statistics indicate that total farm size was reported for 345 respondents, with land holdings ranging from 0.063 to 4.5 hectares and an average of 1.48 hectares (SD = 0.93), suggesting generally small farms with notable variation in landholding size. This pattern is consistent with empirical evidence showing that smallholder farmers dominate agricultural and

coffee production systems globally, with typical farm sizes in Africa, Asia, and Latin America ranging roughly from 0.3 to 1.4 hectares (Valérie et al., 2024; Samberg et al., 2016; Lowder et al., 2016; Meyfroidt, 2017).

Coffee-specific land area was reported by 280 respondents and ranged from 0 to 3.5 hectares, with a mean of 0.83 hectares (SD = 0.64), implying that coffee is typically cultivated on less than one hectare, although some respondents reported no coffee area. This observation aligns with empirical studies indicating that smallholder farmers with holdings below 2–5 hectares often allocate only a portion of their land to coffee cultivation, with coffee plots typically covering less than 1–2 hectares (Valérie et al., 2024; Acosta-Alba et al., 2019; Apanovich & Nyairo, 2025; Nghiêm et al., 2020).

For the same 280 respondents, the average age of coffee trees ranged from 0 to 60 years, with a mean of 23.79 years (SD = 9.71), indicating that many coffee stands are relatively mature but with substantial differences across farms. This finding corresponds with empirical evidence from smallholder coffee systems where a large share of coffee trees are more than 20 years old, with studies reporting median tree ages of about 25–29 years in some African coffee systems, reflecting aging plantations and varying management practices (Piato et al., 2020; Anaclet et al., 2021; Chemura et al., 2017).

Annual coffee yield also varied widely, ranging from 0 to 4,500 kg/ha, with an average of 290.21 kg/ha (SD = 466.60), highlighting considerable heterogeneity in productivity and the presence of farms reporting zero yield. Similar variability has been widely documented in African smallholder coffee systems, where typical yields often range between 100 and 700 kg/ha, and some plots or seasons may report zero yield due to pruning cycles, pest and disease outbreaks, or poor management conditions (Valérie et al., 2024; Da Silva et al., 2025; Sarmiento-Soler et al., 2020; Piato et al., 2020; Anaclet et al., 2021; Akpertey et al., 2022; Kachiguma & Masamba, 2023).

Table 10**:** Perceived condition of coffee productivity

Responses	Frequency	Percent
Very poor	53	18.9
Poor	128	45.7
Average	73	26.1
Good	26	9.3

Total	280	100

Source: Fields Survey, 2026

The results show that most respondents perceived the condition of their coffee farms in terms of yield to be unfavourable. Out of 280 farmers, 128 (45.7%) rated their yields as poor and 53 (18.9%) as very poor, meaning nearly two-thirds (64.6%) viewed their yields negatively. In contrast, 73 respondents (26.1%) considered their yields average, while only 26 (9.3%) reported good yields. Overall, these perceptions suggest that coffee productivity is generally regarded as low among the surveyed farmers.

4.3.3. Income diversification and livelihood improvement

Table 11 presents respondents perceived livelihood improvement of the respondents a as a result of the programme intervention. As it is indicated, the overall composite mean score of 3.93 falls between "Agree" and "Strongly Agree," indicating that respondents generally perceive an improvement in their livelihoods as a result of the programme.

Table 11: Perceived livelihood improvement of the respondents

Items	SD	DA	NR	AR	SA	Mean Score
My household income has increased due to FOLUR-supported activities	1 (0.3%)	7 (2.0%)	25 (7.2%)	274 (79.4%)	38 (11.0%)	4.00
I have access to productive resources (land, inputs, tools)	7 (2.0%)	35 (10.1%)	247 (71.6%)	56 (16.2%)	–	3.93
I received skills training for income diversification	5 (1.4%)	21 (6.1%)	257 (74.5%)	62 (18.0%)	–	3.94
I actively participate in income-related decision-making	3 (0.9%)	10 (2.9%)	29 (8.4%)	254 (73.6%)	49 (14.2%)	3.96
My economic independence has improved	24 (7.0%)	39 (11.3%)	28 (8.1%)	218 (63.2%)	36 (10.4%)	3.63

Source: Fields Survey, 2026

Note: SA = Strongly Agree; A = Agree; NR = Neutral; DA = Disagree; SD = Strongly Disagree.

Skills training emerged as the strongest perceived benefit, with a remarkable 92.5% of respondents agreeing or strongly agreeing that they received skills training for income diversification, and only 1.4% disagreeing. This suggests the programme's training component is its most visible and well-received intervention. Similarly, household income increase garnered strong endorsement, with 90.4% of respondents agreeing that income had risen due to FOLUR activities, and only 2.3% disagree as notably decisive outcome.

Access to productive resources and participation in income-related decision-making followed closely, with 87.8% agreement each. The absence of any strong disagreement on the resource access item is particularly noteworthy, suggesting the broad reach of the programme's resource distribution efforts.

The most contested item, however, is economic independence, which recorded the lowest agreement rate at 73.6% and, more significantly, the highest levels of strong disagreement (7%) and disagreement (11.3%) among all items. Nearly one in five respondents did not feel their economic independence had improved. This divergence is meaningful it implies that while the programme has succeeded in delivering tangible inputs (income, training, resources), deeper structural empowerment and self-sufficiency remain incomplete for a notable segment of beneficiaries.

Similarly, the mean scores indicate that respondents perceived substantial improvements in household income (4.00), active participation in income-related decision-making (3.96), acquisition of skills for income diversification (3.94), and access to productive resources (3.93). Economic independence showed moderate improvement with a mean score of 3.63. These results suggest that the program effectively enhanced household livelihoods, resource access, skills, and decision-making, while highlighting the need for continued support to further strengthen economic independence.

In general, the findings paint a largely optimistic picture of FOLUR's livelihood impact, but the economic independence gap signals that access to resources and training alone may not be sufficient to translate into autonomous economic agency. Programme implementers may need to address underlying barriers such as market access, financial literacy, or gender-based constraints that prevent some respondents from feeling truly economically independent.

4.4. Household Energy Consumption and Improved Cook stove adoption

In this section, key variables of interest that characterize households' energy consumption patterns are presented. The descriptive analysis and mean score depends on a five point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). A mean score above the neutral midpoint 3.0 indicates that, on average, respondents fall between "Agree" and "Strongly Agree." This statistically demonstrates a very high level of positive perception toward the program's interventions.

4.4. 1 Types of fuel wood used before the FOLUR project intervention

Collection of traditional wood-fuel for cooking and heating is common and can lead to forest degradation where removals exceed regrowth. Where annual harvest of wood-fuel exceeds the forest's incremental growth in biomass, it is considered to be unsustainable, and leads to a decline of woody biomass and to net carbon emissions (Bailis et al., 2015). Bailis et al., (2015) also estimated that 27–34% of wood-fuel harvest was unsustainable, particularly in East Africa and South Asia, and thus lead to significant forest degradation. Accordingly, Ethiopia has lost 140,000 hectare natural forest annually, and fuel-wood collection played an important role in the process (Gebreegziabher, 2010).

Table 12 presents *e*nergy sources used by households prior to the implementation of the FOLUR project provide important baseline information for assessing changes in energy consumption patterns. Understanding the types of fuel wood and alternative energy sources previously relied upon helps to evaluate the level of dependence on traditional biomass fuels and the need for sustainable energy interventions.

Table 12: Types of Fuel wood used before FOLUR project

Responses	Frequency	Percent
Firewood	301	87.2
Charcoal	12	3.5
Crop Residuals	12	3.5
Animal Dug	15	4.3
Kerosene	3	.9
Charcoal	2	.6
Total	345	100

Source: Fields Survey, 2026

The table 12 indicates that out of 345 respondents, the majority of respondents, 301 households (87.2%), reported using firewood as their primary source of energy. 14 households (4.1%) reported using charcoal as fuel. While charcoal is often perceived as more energy-efficient than raw firewood, its production is typically associated with high levels of forest degradation due to inefficient traditional kilns.

Similarly, 15 households (4.3%) reported using animal dung as fuel. Crop residues were used by 12 households (3.5%), reflecting the practice of burning agricultural by-products such as stalks and straw for cooking. Only 3 households (0.9%) reported using kerosene, indicating very limited access to modern or transitional energy sources prior to the FOLUR intervention.

The findings demonstrate that the vast majority of respondents, relied on firewood as their primary source of fuel before the FOLUR project, demonstrating a strong dependence on traditional biomass energy contributing to deforestation, land degradation, and biodiversity loss in project intervention areas.. While charcoal is often perceived as more energy-efficient than raw firewood, its production is typically associated with high levels of forest degradation due to inefficient traditional kilns.

Thus, the findings reveal that firewood is the predominant source of household energy in the study area. Out of the total respondents, prior to the implementation of the FOLUR (Food Systems, Land Use and Restoration) Project in the study area, rural households heavily depended on traditional biomass energy sources for cooking and household energy needs. The survey results show a strong reliance on firewood and other unsustainable fuel sources. This pattern highlights the critical need for integrated interventions under the FOLUR framework, including sustainable forest management, restoration of degraded landscapes, promotion of improved cook stoves, and alternative livelihood and energy options to reduce environmental degradation and improve household resilience.

4.4.2 Adoption of Improved Cook Stove ‘Mirt Medeja’

Firewood remains a key source of energy for households in developing countries, contributing to forest degradation and deforestation (Edwards & Langpap, 2005). consequently, according to Beyene & Koch (2013) agreed that the heavy dependence and inefficient utilization of biomass resources have contributed to the depletion of forest resources in Ethiopia and also use of traditional cooking technology has also been linked to indoor air pollution and poor health.

Table 13 presents the survey findings indicate a substantial shift in household energy practices following the implementation of the FOLUR (Food Systems, Land Use and Restoration)

Project in Ethiopia. Out of the total 345 surveyed households, 305 households (88.4%) reported that they have adopted improved cook stoves, while 40 households (11.6%) indicated that they have not adopted the technology.

Table 13: adoption of improved cook stove

Category	Frequency	Percent
Yes	305	88.4
No	40	11.6
Total	345	100

Source: Fields Survey, 2026

The high adoption rate demonstrates the effectiveness of the FOLUR Project's interventions in promoting sustainable energy solutions at the household level. Improved cook stoves are designed to enhance fuel efficiency, reduce firewood consumption, minimize indoor air pollution, and lower greenhouse gas emissions. By reducing the quantity of fuel wood required for cooking, these stoves directly contribute to decreased pressure on forests and woody vegetation one of the core objectives of the FOLUR initiative.

In addition to environmental benefits, the adoption of improved cook stoves provides important social and health advantages. Reduced smoke emissions improve indoor air quality, thereby lowering the risk of respiratory illnesses, particularly among women and children who are most exposed to household cooking smoke. Furthermore, improved efficiency reduces the time and labor required for fuel wood collection, allowing households especially women to allocate more time to productive activities, education, or income-generating work.

However, those households that have not adopted improved cook stoves suggest that some barriers remain. These may include affordability constraints, limited access to stove supply chains, cultural cooking preferences, lack of awareness, or maintenance challenges. Addressing these barriers through continued awareness campaigns, technical support, financing mechanisms, and market linkages will be essential to achieving universal adoption. Thus, this implies that adoption of new cooking technologies is vital for reducing socio-economic and environmental problems.



Figure 3: Wood-fuel consumption, Didu Kebele, Yayo district

Source: Field observation, 2026

4.4.3 Improved Cook Stove Contribution to Forest Conservation, Environmental and Health Benefits

Table 14 presents the FOLUR-supported improved cook stove 'Mirt' interventions in Oromia have generated strong positive perceptions across all measured outcomes. The survey results indicate that a significant majority of respondents (64.3%) agreed, while 32.8% strongly agreed that fuel wood consumption has decreased. Only a very small proportion disagreed (0.3%), and 2.6% remained neutral. The study shows that 97.1% of respondents expressed agreement to some extent that fuel wood consumption has reduced. Similarly, respondents reported that fuel wood consumption has significantly decreased, with a mean score of 4.30, indicating widespread adoption of improved cook stoves, alternative energy sources, and on-farm tree planting practices.

In addition to environmental benefits, the adoption of improved cook stoves provides important social and health advantages. Reduced smoke emissions improve indoor air quality, thereby

lowering the risk of respiratory illnesses, particularly among women and children who are most exposed to household cooking smoke. Furthermore, improved efficiency reduces the time and labor required for fuel wood collection, allowing households especially women to allocate more time to productive activities, education, or income-generating work.

Reduced fuel wood consumption not only contributes to forest conservation but also helps improve household health, reduce labor burden (especially for women and children), and lower greenhouse gas emissions. This overwhelming response suggests that the FOLUR project interventions are contributing positively toward decreasing dependence on fuel wood.

The survey question "time spent collecting fuel wood and cooking has decreased" was included to assess household perceptions of changes in labor related to traditional energy practices. The survey results from 345 respondents show a very strong positive perception of change in which households in the study areas experienced a decrease in the time required to collect fuel wood. The majority of respondents (65.2%) agreed that the time spent collecting fuel wood and cooking has decreased, while 31.6% strongly agreed. Only 3.2% of respondents remained neutral, and none disagreed with the statement. The study shows that 96.8% of respondents confirmed that there has been a noticeable reduction in time spent on these activities.

This suggests that the FOLUR project interventions are not only addressing environmental sustainability but also improving household efficiency and daily living conditions. Similarly, the time spent collecting fuel wood and cooking was perceived to have reduced (M = 4.28), highlighting meaningful labor savings for households, particularly for women and children who bear primary responsibility for fuel wood collection.

Empirical study indicated that improved cook stove use reduces smoke emissions in indoor environments, lowering exposure to harmful pollutants. This can result in fewer respiratory illnesses and improved overall health outcomes, particularly for women and children who spend more time near cooking areas (World Health Organization [WHO], 2018). Thus, the FOLUR project is making significant progress in improving indoor air quality and enhancing the quality of life for beneficiary communities across its intervention landscapes in Oromia.

Table 14: Perceived Benefits of Improved Cook Stoves

Indicators	SD	DA	NR	AR	SA	Mean
Fuel wood consumption	0 (0.0%)	1 (0.3%)	9 (2.6%)	222 (64.3%)	113 (32.8%)	4.30

Time spent collecting fuel wood & cooking	0 (0.0%)	0 (0.0%)	11 (3.2%)	225 (65.2%)	109 (31.6%)	4.28
Indoor air quality	0 (0.0%)	0 (0.0%)	25 (7.2%)	226 (65.5%)	94 (27.2%)	4.20
Forest conservation	0 (0.0%)	0 (0.0%)	18 (5.2%)	227 (65.8%)	100 (29.0%)	4.24
Forest condition and restoration	0 (0.0%)	1 (0.3%)	24 (7.0%)	268 (77.7%)	52 (15.1%)	4.07
Land degradation & soil erosion	0 (0.0%)	1 (0.3%)	21 (6.1%)	267 (77.4%)	56 (16.2%)	4.09

Source: Fields Survey, 2026

Note: SA = Strongly Agree; A = Agree; NR = Neutral; DA = Disagree; SD = Strongly Disagree.

In many rural areas of Oromia, traditional cooking methods using open fires or inefficient stoves produce high levels of smoke, leading to respiratory illnesses and other health problems, particularly among women and children who spend more time near cooking areas. According to the survey results a substantial majority perceive a positive change in indoor air quality. Specifically, 65.5% of respondents agreed that indoor air quality has improved, while 27.2% strongly agreed. Only 7.2% remained neutral, and none disagreed with the statement. The study shows that 92.7% of respondents acknowledged an improvement in indoor air quality. This strong level of agreement indicates that FOLUR-supported interventions are contributing meaningfully to healthier living environments.

Similarly, respondents reported a notable improvement in indoor air quality (M = 4.20), reflecting reduced smoke exposure from traditional biomass cooking, with direct benefits for respiratory and overall household health. The consistently high mean scores demonstrate that the interventions effectively link environmental sustainability, labor efficiency, and health benefits.

The reported improvement in indoor air quality suggests reduced smoke exposure, which has direct benefits for respiratory health, eye health, and overall household health particularly for women and children who spend more time near cooking areas. Thus, the FOLUR project is

making significant progress in improving indoor air quality and enhancing the quality of life for beneficiary communities across its intervention landscapes in Oromia.

Out of the total respondents, 65.8% agreed that forest conservation has improved, while 29.0% respondents strongly agreed. Only 5.2% respondents reported a neutral stance. Notably, there were no recorded responses in the "disagree" or "strongly disagree" categories. The absence of negative responses further reinforces the perception that the project has generated tangible environmental benefits at the community level. The study shows that 94.8% of respondents expressed agreement or strong agreement that forest conservation has improved under the FOLUR project interventions. Forest conservation improvements were also strongly perceived, with a mean score of 4.24, suggesting that lower fuel wood demand is contributing to reduced pressure on local forests and supporting sustainable land management practices.

The high percentage of agreement may reflect increased community awareness and participation in forest management, strengthened local forest governance structures, improved restoration and reforestation activities and reduced forest degradation through sustainable land-use practices. Empirical studies corroborate these findings, showing that improved cook stoves can reduce fuel wood consumption by 30–60%, decrease deforestation rates, and improve indoor air quality, while also saving household labor and enhancing women's and children's well-being (WHO, 2018; FAO, 2020). Thus, these results indicate that the FOLUR interventions are contributing meaningfully to sustainable resource management, improved forest conservation, and enhanced quality of life in the targeted landscapes of Ethiopia.





Figure 4: Wood-fuel efficient stove production and use, Omo Bekko Kebele, Gomma District and Yayo districts

Source: Field observation, 2026

4.5 Coffee Rejuvenation and Management Practices

We assess the program's short-term impact on the adoption rates and intensity of stumping, a practice that entails properly cutting of old and unproductive coffee trees at its base for a complete renewal which will result in an increase in the quantity and quality of coffee harvests. Table 15 presents Coffee Rejuvenation Practices among smallholder coffee farmers.as a result of the programme intervention.

Table 15: Coffee Rejuvenation and management practices among

Practice	Responses	Frequency	Percent
Replanting of coffee trees	Yes	177	63.2
	No	103	36.8
	Total	280	100
Coffee Rejuvenation/Stumping of an old coffee tree	Yes	181	64.6
	No	99	35.4
	Total	280	100
Pruning and removing suckers	Yes	96	34.3
	No	184	65.7
	Total	280	100

Shade management (planting/adjusting shade trees)	Yes	164	58.6
	No	116	41.4
	Total	280	100
Soil fertility management (fertilizer, compost, mulching)	Yes	199	57.7
	No	146	42.3
	Total	345	100

Source: Fields Survey, 2026

As it is indicated in the table above, stumping of old coffee trees emerged as the most widely practiced rejuvenation technique, with 64.6% of respondents reporting its use. This is closely followed by replanting of coffee trees at 63.2%, suggesting that farmers are broadly willing to undertake structural renewal of their coffee plots. These two practices typically go hand in hand as part of a broader field rehabilitation strategy, and their relatively high adoption rates reflect a meaningful level of engagement with long-term productivity improvement. Empirical studies similarly classify stumping, pruning, and replanting as key renovation practices in coffee production systems, and report that farmers tend to adopt such practices particularly when they receive technical support, training, or extension services (Kudama et al., 2021; Teodoro et al., 2025; Abate et al., 2021; Million et al., 2020; Haryono et al., 2023; Pham et al., 2020).







Figure 5: Sample Coffee rejuvenation practices in the study area (Gomma District, Omo Beko and Funtule kebeles)

Source: Fields Survey, 2026

Shade management through the planting or adjustment of shade trees was practiced by 58.6% of respondents, indicating that more than half of the farmers recognize the role of canopy regulation in maintaining coffee health and yield. Similarly, soil fertility management encompassing fertilizer application, composting, and mulching was reported by 57.7% of the larger sample of 345 respondents, pointing to moderate but not yet universal attention to soil health among coffee farmers. This pattern aligns with empirical evidence showing that shade-based agroforestry systems and soil fertility management practices such as mulching and composting are widely promoted in coffee systems, although their adoption remains incomplete among smallholder farmers due to resource and knowledge constraints (Waktola & Fekadu, 2021; Kiup et al., 2025; Khanal et al., 2025; Million et al., 2020; Begumisa et al., 2024; Wariyo & Negewo, 2023).

The most notable finding, however, is the strikingly low adoption of pruning and removing suckers, with only 34.3% of respondents practicing it making it by far the least adopted technique. This is particularly significant given that pruning is a fundamental agronomic practice that directly influences tree health, air circulation, and fruit production. Empirical studies likewise report that pruning adoption among smallholder coffee farmers often ranges between about 30% and 60%, despite being widely recognized as essential for maintaining productivity. Limited adoption is frequently attributed to constraints such as insufficient technical knowledge, labor requirements, and farmers' perceptions of potential production risks associated with pruning (Kudama et al., 2021; Kiup et al., 2025; Khanal et al., 2025;

Million et al., 2020; Baitelle et al., 2019; Buyinza et al., 2022). These studies also highlight that training and extension services significantly improve the adoption of practices such as stumping, pruning, shade management, and mulching, often when they are promoted as integrated or bundled management practices (Kudama et al., 2021; Khanal et al., 2025; Million et al., 2020; Mukasa et al., 2025).

The table 16 presents the frequency with which farmers who already reported adopting each coffee rejuvenation practice actually carry out those practices, categorized across four levels Rarely, Sometimes, Often, and Always. The sample sizes for each item correspond directly to those who confirmed practicing each technique in the previous table, making this an assessment of practice intensity among existing adopters rather than the broader population.

Table 16: Frequency and intensity of coffee management practice

Items	Rarely	Sometimes	Often	Always	Mean Score
Frequency of replanting of coffee trees	19 (10.7%)	98 (55.36%)	40 (22.6%)	20 (11.3%)	2.34
Frequency of stumping of an old coffee tree	8 (4.4%)	123 (68%)	38 (21%)	12 (6.6%)	2.30
Frequency of pruning of an old tree	12 (12.5%)	73 (76%)	10 (10.4%)	1 (1%)	2.00
Frequency of shade management practice	18 (11%)	86 (52.4%)	37 (22.6%)	23 (14%)	2.40
Frequency of practicing soil fertility management	14 (7%)	145 (72.9%)	33 (16.6%)	7 (3.5%)	2.16

Source: Fields Survey, 2026

A striking and consistent pattern runs across all five practices: the overwhelming majority of respondents fall under the "Sometimes" category, pointing to irregular and non-systematic application of rejuvenation techniques even among those who claim to practice them. This is a critical finding, as occasional practice may yield limited agronomic benefits compared to consistent, well-timed interventions.

Pruning stands out as the most infrequently practiced technique among its adopters, with 76% reporting they do it only sometimes, 12.5% rarely, and a mere 1% doing it always. Combined,

nearly 89% of even those who claim to prune do so inconsistently. This reinforces the concern raised in the previous table not only is pruning the least adopted practice overall, but even its practitioners engage with it in a highly sporadic manner, severely undermining its intended agronomic impact.

Soil fertility management follows a similar pattern of low intensity despite having the largest adopter base (199 respondents). Nearly 73% practice it only sometimes, and only 3.5% do so always, suggesting that while many farmers acknowledge the importance of fertilization, composting, or mulching, they have not yet integrated it into a routine management calendar.

Stumping shows comparable irregularity, with 68% of its practitioners reporting only occasional implementation. Since stumping is inherently a structural intervention that may not need to be done repeatedly in short intervals, this pattern is somewhat expected and arguably less alarming than the case of pruning or soil management.

Replanting of coffee trees follows a similar distribution, with 55.4% practicing it sometimes. However, it records a comparatively higher combined "Often and Always" rate of about 34%, suggesting a slightly more deliberate and recurring approach among a meaningful share of its practitioners.

Shade management emerges as the most consistently practiced technique among those who adopt it, with 22.6% practicing it often and 14% always the highest combined "Often and Always" rate across all practices at approximately 36.6%. This may be because shade tree management is visually observable and more integrated into the farmer's daily farm environment, making it easier to monitor and respond to.

Similarly, the mean scores indicate that shade management practices were the most frequently observed, with a mean score of 2.40, suggesting that households generally practice shade management between “sometimes” and “often.” Replanting of coffee trees followed closely with a mean of 2.34, and stumping of old coffee trees recorded a mean score of 2.30, indicating that these rejuvenation practices are moderately adopted but not consistently performed by all households. Pruning of old trees had a lower mean score of 2.00, reflecting relatively infrequent implementation of this practice. Soil fertility management showed the lowest mean score of 2.16, indicating that while some households practice it regularly, overall adoption remains limited. Thus, the analysis of household engagement in land management practices shows moderate adoption across all activities. There is still room for increasing consistency and intensity to achieve optimal productivity and sustainability outcomes.

The qualitative evidence indicates widespread adoption of practices such as stumping, pruning, and selective removal of senescent coffee trees as effective methods to improve productivity. Field observations in Yaayyo district and Wiixatee and Allee Sardoo kebeles of, Cooraa District revealed that plots had undergone systematic stumping and pruning. The observed regrowth indicates effective technical implementation and community compliance with FOLUR project guidelines. Early evidence suggests potential for improved household coffee productivity.

However, long-term yield data are necessary to validate sustained benefits. In this regard, study by Schmitt et al., (2019) show that Ethiopia's forest coffee landscapes, particularly in Gomma District of Jimma Zone, rejuvenation practices have been shown to significantly improve yields and extend the productive lifespan of coffee trees. Partial shade coverage was also noted, with informants highlighting a need to integrate full agroforestry practices for ecological resilience. Empirical studies similarly classify stumping, pruning, and replanting as key renovation practices in coffee production systems, and report that farmers tend to adopt such practices particularly when they receive technical support, training, or extension services (Kudama et al., 2021; Teodoro et al., 2025; Abate et al., 2021; Million et al., 2020; Haryono et al., 2023; Pham et al., 2020).

Focus group participants from Omo Beko kebele of Gomma District reported that modern coffee stumping techniques were introduced through the FOLUR project. Coffee farming remained the dominant livelihood, and limited land availability made coffee the primary source of income. Approximately one-quarter of coffee lands were rejuvenated to restore productivity and improve product quality. Beneficiaries actively raised coffee seedlings through primary cooperatives for both members and non-members. Improved practices, including pruning, compost application, and seedling care, were widely adopted.

Shade management through the planting or adjustment of shade trees was practiced by 58.6% of respondents, indicating that more than half of the farmers recognize the role of canopy regulation in maintaining coffee health and yield. Similarly, soil fertility management encompassing fertilizer application, composting, and mulching was reported by 57.7% of the larger sample of 345 respondents, pointing to moderate but not yet universal attention to soil health among coffee farmers. This pattern aligns with empirical evidence showing that shade-based agroforestry systems and soil fertility management practices such as mulching and composting are widely promoted in coffee systems, although their adoption remains

incomplete among smallholder farmers due to resource and knowledge constraints (Waktola & Fekadu, 2021; Kiup et al., 2025; Khanal et al., 2025; Million et al., 2020; Begumisa et al., 2024; Wariyo & Negewo, 2023).

The most notable finding, however, is the strikingly low adoption of pruning and removing suckers, with only 34.3% of respondents practicing it making it by far the least adopted technique. This is particularly significant given that pruning is a fundamental agronomic practice that directly influences tree health, air circulation, and fruit production. Key informants from agricultural office reported that nearly 90% of farmers in Gomma District depend on coffee farming**.** Technical and material support, such as pruning scissors, motorized chainsaws, and coffee revitalization machines, were provided. Coffee management practices including stumping, uprooting old plants, pruning, and compost development contributed to improved soil fertility, environmental protection, reduced fuel-wood consumption, and enhanced awareness of sustainable land management**.**

Empirical studies likewise report that pruning adoption among smallholder coffee farmers often ranges between about 30% and 60%, despite being widely recognized as essential for maintaining productivity. Limited adoption is frequently attributed to constraints such as insufficient technical knowledge, labor requirements, and farmers' perceptions of potential production risks associated with pruning (Kudama et al., 2021; Kiup et al., 2025; Khanal et al., 2025; Million et al., 2020; Baitelle et al., 2019; Buyinza et al., 2022).

Researchers field observation confirmed visible stumped coffee trees and ongoing replanting in Omo Beko and Funtule kebeles confirmed widespread adoption beyond direct project beneficiaries, demonstrating positive community-level diffusio**n** of these practices (See Fig. 4). Research shows that stumped coffee trees typically regain productivity within 2–3 years and can increase yields by up to 60% compared to non-rejuvenated plots (Tesfaye et al., 2020).

These studies highlight that training and extension services significantly improve the adoption of practices such as stumping, pruning, shade management, and mulching, often when they are promoted as integrated or bundled management practices (Kudama et al., 2021; Khanal et al., 2025; Million et al., 2020; Mukasa et al., 2025).

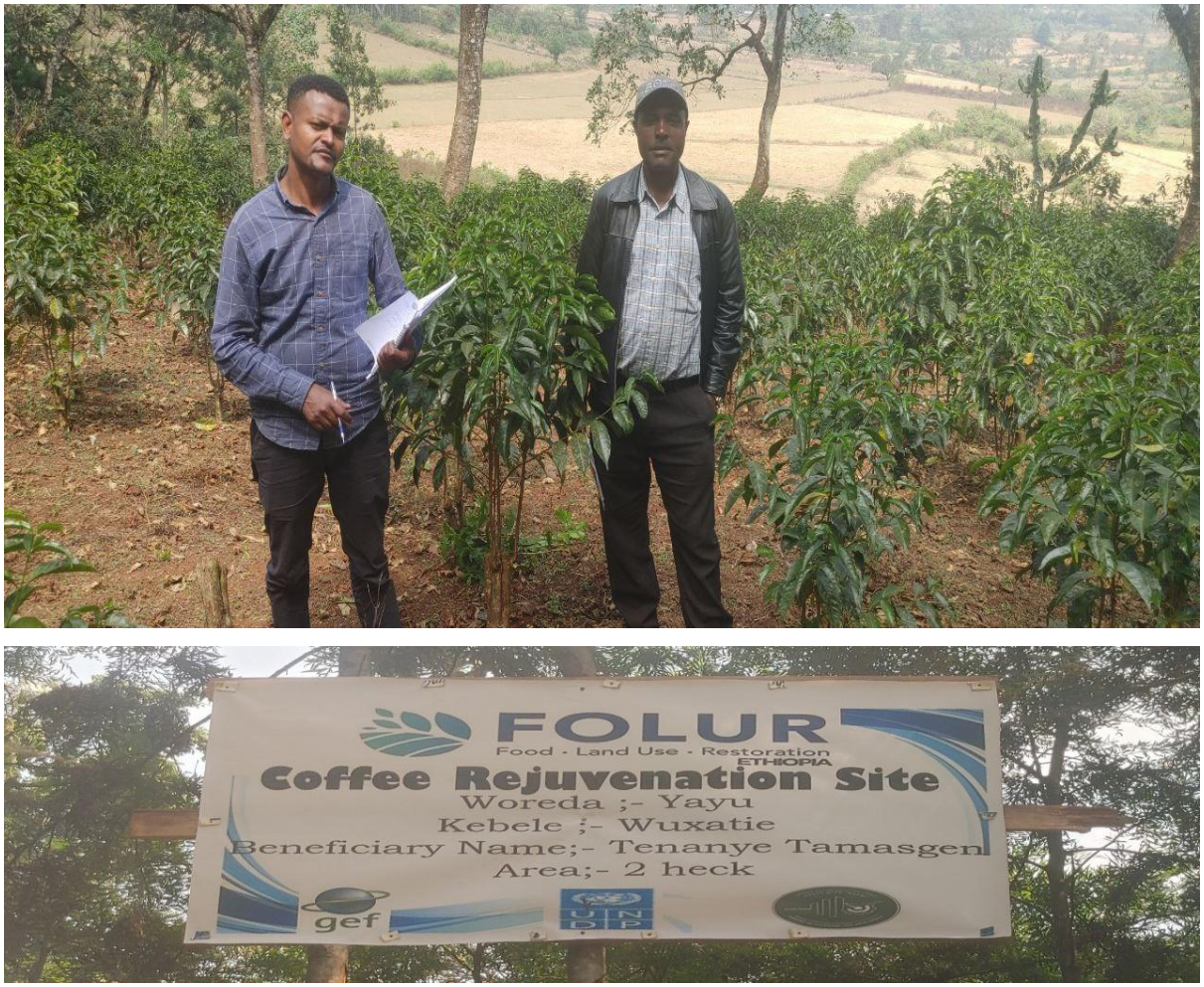


Figure 6: Sample Coffee rejuvenation practices in the study area (Yayo District, Wutate kebeles)

Source: Fields observation, 2026

4.6 Sustainable Land Use and Forest Restoration Practices

Sustainable land-use and forest restoration practices, this part presents household perceptions and adoption of FOLUR interventions in Oromia's coffee landscapes. The results focus on awareness creation, adoption of conservation practices, and participation in restoration activities, improvement in land-use practices, forest condition changes, and reduction of land degradation. Data from 345 households indicate high adoption of sustainable practices and positive perceptions of ecological improvements following FOLUR interventions.

The highest mean score was recorded for awareness and skills on sustainable land management and forest conservation (M = 4.21). A mean of 4.21 is very close to "Strongly Agree" (5) and well above the "Agree" threshold (4). This indicates that respondents overwhelmingly perceive that FOLUR substantially improved their awareness and skills in sustainable land management and forest conservation. Capacity development strengthens long-term sustainability by ensuring that conservation practices are maintained beyond external project support.

This suggested that training and extension services substantially increase adoption of agroforestry and sustainable land management practices. Empirical evidence supports the central role of capacity building in achieving sustainable land outcomes. For example, the Food and Agriculture Organization (2017) emphasizes that farmer training and participatory learning significantly enhance adoption of sustainable land management practices. Capacity development strengthens long-term sustainability by ensuring that conservation practices are maintained beyond external project support.

Table 17: Perceived benefits of sustainable land use and forest restoration practices

Indicators	SD	DA	NA	AR	SA	Mean score
Increased awareness and skills	0 (0.0%)	1 (0.3%)	8 (2.3%)	255 (73.9%)	81 (23.5%)	**4.21**
Practice of soil & water conservation	1 (0.3%)	8 (2.3%)	33 (9.6%)	239 (69.3%)	64 (18.6%)	**4.03**
Participation in tree planting & restoration	0 (0.0%)	2 (0.6%)	6 (1.7%)	266 (77.1%)	71 (20.6%)	**4.18**
Improved land-use practices (training & TA)	0 (0.0%)	2 (0.6%)	12 (3.5%)	266 (77.1%)	65 (18.8%)	**4.14**
Improved forest condition	0 (0.0%)	1 (0.3%)	24 (7.0%)	268 (77.7%)	52 (15.1%)	**4.07**
Land-use practices (land degradation and soil erosion)	0 (0.0%)	1 (0.3%)	21 (6.1%)	267 (77.4%)	56 (16.2%)	**4.09**

Source: Fields Survey, 2026

Note: SA = Strongly Agree; A = Agree; NR = Neutral; DA = Disagree; SD = Strongly Disagree

Households reported actively practicing soil and water conservation techniques**,** including stone bunds, terracing, soil bunds, and area closures**.** Survey results show that 69.3% of respondents agreed and 18.6% strongly agreed that they have adopted these measures, Only a small fraction of respondents were neutral (9.6%) or disagreed (2.6%).The study shows that 87.9% of households adopted soil and water conservation measures such as stone bunds, soil bunds, terracing, and area closures.

Although slightly lower than other indicators, the mean score for practice of soil and water conservation measures (M = 4.03) still reflects strong agreement. This indicates that respondents generally "Agree" that they practice soil and water conservation measures due to FOLUR support. Although slightly lower than other indicators, the mean score for tree planting and forest restoration measures (M = 4.03) still reflects strong agreement.

This high level of adoption suggests that physical land management structures are widely implemented at the household level. Soil and water conservation practices are known to significantly reduce runoff, enhance soil moisture retention, and prevent land degradation (FAO, 2017). The strong positive perception indicates both awareness and practical engagement with land restoration activities. Therefore, the observed adoption mitigating soil loss and land degradation processes and contributes directly to both agricultural sustainability and long-term landscape restoration.

Participation in tree planting and forest restoration activities received the highest overall positive response with 77.1% agreeing and 20.6% strongly agreeing. Only a small fraction of respondents were neutral (9.6%) or disagreed (2.6%).The study shows that 97.7% respondents strong community involvement in ecosystem restoration efforts.

High mean scores were also observed for participation in tree planting and forest restoration (M = 4.18). This reflects strong community involvement in ecosystem restoration efforts. A mean of 4.18 indicates very high agreement and strong community engagement in restoration activities. This value is only slightly lower than awareness (4.21), suggesting that knowledge translated effectively into collective action. The high agreement indicates that households are observing measurable environmental changes, reinforcing the sustainability of the interventions.

The high agreement indicates that households are observing measurable environmental changes, reinforcing the sustainability of the interventions. These empirical studies showing that technical assistance and community-based forest management increase restoration success

and stakeholder engagement (Baynes et al., 2015). Enhanced forest condition supports climate resilience, biodiversity conservation, and watershed protection (FAO, 2020). Forest restoration programs have been empirically linked to measurable improvements in vegetation density and biodiversity indices when community participation is high

Respondents reported improvements in forest condition, including tree growth, biodiversity, and vegetation cover, with 77.7% agreeing and 15.1% strongly agreeing. Only a very small number of respondents 0.3% disagree while 7% were neutral. A total of 92.8% of respondents perceived improvements in forest condition, including enhanced tree growth and biodiversity.

Similarly, the mean of 4.08 reflects improved forest condition (tree growth, biodiversity, vegetation cover) with strong perceived environmental benefits. A mean of 4.08 also indicates positive agreement that forest condition (tree growth, biodiversity, vegetation cover) has improved. While slightly lower than knowledge and participation indicators, it still shows strong perceived environmental outcomes. The slightly lower score compared to practice indicators may reflect the time lag between intervention and visible ecosystem recovery.

Environmental improvements typically take time to become visible. The slightly lower score compared to practice indicators may reflect the time lag between intervention and visible ecosystem recovery. This score suggests that respondents are already observing tangible ecological benefits. This is consistent with global evidence demonstrating that forest restoration programs have been empirically linked to measurable improvements in vegetation density and biodiversity indices when community participation is high (FAO, 2020; Chazdon et al., 2017).

Improved land use practices, including agroforestry**,** sustainable farming, management, and crop land restoration, and on-farm tree planting**.** Survey results show that 77.1% of respondents agreed and 18.8% strongly agreed. Only a very small fraction 0.6% and 3.5% reported disagreement and neutrality respectively. The survey indicates that 95.9% of respondents adopted improved land-use practices, including agroforestry, participatory forest management, cropland restoration, and on-farm tree planting.

Similarly, the mean of 4.14 reflects strong agreement that training and technical assistance improved land-use practices such as agroforestry, participatory forest management, cropland restoration, and on-farm tree planting. This suggests that improved land-use practices (e.g., agroforestry, participatory forest management, cropland restoration, on-farm tree planting) as a result of training and technical assistance.

Sustainable land management practices such as terracing and agroforestry significantly reduce erosion rates and improve soil structure (Hurni et al., 2015. The survey result shows that 77.4% agreed and 16.2% strongly agreed reported reduced land degradation and soil erosion. Only 0.3% Disagree and 6.1% Neutral. The finding that 93.6% of respondents observed reduced land degradation and soil erosion highlights the cumulative impact of integrated land management practices.

The mean score of 4.09 also indicates strong agreement that project intervention practices reduced land degradation and soil erosion. This score closely aligns with the forest condition mean (4.08), suggesting consistency in perceived environment conservation. This suggests that in coffee-dependent systems, reduced erosion preserves fertile soil layers necessary for sustaining perennial crops over decades.



Figure 7: FOLUR sample Restoration sites in the study area

Source: Field observation 2026

4.7 Perceptions on Satiable Livelihoods and Environmental Sustainability

Perceptions on FOLUR interventions positively address the priority needs of the community. Table 18 indicated that a significant majority, 78.8%, respondents agreed, and 18.8% respondents strongly agreed that FOLUR Interventions Address Priority Needs. Only 0.6% respondents disagreed that FOLUR interventions address the priority needs of the community, while 1.7% respondents were neutral. This indicates that 97.6% of respondents perceive FOLUR interventions as relevant and aligned with community priorities, suggesting strong program responsiveness. The minimal disagreement indicates that almost all beneficiaries recognize the relevance of interventions to local needs.

The highest mean score was recorded for addressing priority community needs (Mean = 4.36), which falls within the very high agreement category. This suggests that the program is strongly aligned with local development priorities. Beneficiaries perceive the interventions as relevant and responsive to their socio-economic challenges, reflecting effective needs assessment and participatory planning processes.

With regard to community members' active involvement in planning and implementation, the majority, 76.2% respondents agreed, and 20.3% respondents strongly agreed that they actively participated in planning and implementation. Only 0.3% respondent disagreed and 3.2% respondents were neutral about community involvement. About 96.5% of respondents perceive that community members are involved in decision-making. This demonstrates that FOLUR projects are largely participatory, which fosters ownership, transparency, and accountability.

Meanwhile, community involvement in planning and implementation (Mean = 4.17) fall within the high agreement category, suggesting that participation and environmental benefits are well recognized by beneficiaries. This indicates that respondents generally perceive active involvement of community members in planning and implementation processes. Although slightly lower than other indicators, the score still reflects strong participation and suggests that the program promotes inclusive engagement, enhancing ownership and sustainability.

The distribution of benefits among beneficiaries is fair and equitable. A total of 74.2% respondents agreed and 25.2% respondents strongly agreed that FOLUR benefits are fairly distributed. Only 0.6% respondents were neutral. No respondents disagreed with the statement. Approximately 99.4% of respondents perceive the program as equitable, showing a strong sense of fairness and transparency in benefit allocation. This is essential to prevent elite capture and ensure community cohesion.

The mean score of fair distribution of benefits (Mean = 4.25) expressed a very high level of agreement that benefits from FOLUR interventions are fairly distributed. This finding suggests that the program has effective mechanisms for equitable benefit sharing, minimizing perceptions of bias or unequal allocation among beneficiaries.

Similarly, the majority, 78.0% respondents agreed, and 20.3% respondents strongly agreed that FOLUR positively contributes to sustainable natural resource and environmental management. About 1.7% respondents were neutral. Around 98.3% of respondents recognized the environmental benefits of FOLUR interventions, indicating that community members perceive tangible contributions to forest and land management.

The mean score of environmental contribution (Mean = 4.19) fall within the high agreement category, suggesting that participation and environmental benefits are well recognized by beneficiaries. This mean score indicates high agreement that FOLUR interventions positively contribute to sustainable environmental and natural resource management. Beneficiaries perceive tangible environmental improvements, suggesting that conservation and sustainability components of the program are visible and impactful at the community level

Coffee Revitalization Practices (Replanting, Stumping, Soil Fertility, shade Management) positively benefited the community. For coffee revitalization, 85.5% of respondents perceived positive impacts (Agree: 69.0%, strongly Agree: 16.5%). 10.4% of respondents disagreed (Disagree: 7.5%, strongly Disagree: 2.9%), and 4.1% were neutral. This suggests that respondents perceive positive impacts of coffee revitalization practices. The 10.4% disagreement suggests that some beneficiaries are not yet experiencing the benefits, possibly due to variability in adoption rates, farm conditions, or time-lagged productivity gains.

The lowest mean score was observed for coffee revitalization benefit (Mean = 3.89). This suggests comparatively moderate perceptions regarding improvements in coffee productivity and quality. The lower mean may reflect variability in adoption rates, time lag in agricultural outcomes, or contextual production challenges affecting some beneficiaries.

Adoption and Regular Use of Efficient Cook stoves positively contributed to fuel wood consumption reduction and improving household energy efficiency. The majority respondents 72.5% respondents agreed and 26.1% respondents strongly agreed that FOLUR interventions encouraged adoption of efficient cook stoves. Only (0.3%) respondent disagreed and 1.2% respondents were neutral. Approximately 98.6% of respondents confirm adoption, indicating

highly successful uptake of cook stoves, which is critical for reducing fuel wood consumption and improving household energy efficiency.

The mean score for adoption of efficient cook stoves (Mean = 4.24) also falls within the very high agreement range, demonstrating successful uptake of promoted technologies. This mean score reflects a *very high level of agreement* that FOLUR interventions have encouraged the adoption and regular use of efficient cook stoves.

The impact of cook stoves on reducing fuel wood consumption and forest pressure was strongly recognized, with 99.5% positive responses (Agree: 72.8%, Strongly Agree: 26.7%). Only 0.6% of respondents were neutral, and none disagreed. This suggests that respondents observed reduced fuel wood consumption, demonstrating clear environmental impact. This reinforces the success of clean energy interventions in alleviating pressure on forest resources.

Similarly, high mean scores were observed for reduced fuel wood and forest pressure (Mean = 4.26). This suggests that efficient cook stove use has reduced fuel wood consumption and pressure on forest resources. This suggests that environmental benefits are not only theoretical but are directly experienced by households. The high level of perceived reduction in fuel wood use underscores stakeholders' confidence that cook stoves deliver environmental benefits at both household and landscape levels.

Overall Satisfaction with FOLUR Activities reflects perceived relevance, fairness, environmental improvement, and livelihood benefits. The majority, 73.3% respondents agreed, and 26.1% respondents strongly agreed that they were satisfied with FOLUR implementation and outcomes. Only 0.3% respondent disagreed and 0.3% respondent was neutral. About 99.4% of respondents are satisfied with the program, reflecting overall approval of FOLUR activities and perceived effectiveness. High satisfaction suggests strong legitimacy and potential sustainability of interventions.

Similarly, high mean scores were observed for overall satisfaction (Mean = 4.25). These results indicate strong confidence in the program's overall effectiveness across all dimensions. This broad satisfaction likely reflects the combined perceptions of relevance, participation, fairness, environmental impact, and quality of life improvements documented in FOLUR's field implementation in Oromia and other regions.

In general, beneficiaries immensely recognize the relevance, participation, equity, environmental benefits, and effectiveness of FOLUR interventions. Coffee revitalization is the

only area with significant variation, suggesting the need for follow-up technical support to ensure consistent impact.

Table 18: Perceptions on Community participation and Environmental Sustainability

Statement	SD N (%)	DA N (%)	NR N (%)	AR N (%)	SA N (%)	Mean
Address priority needs	0 (0.0)	2 (0.6)	6 (1.7)	272 (78.8)	65 (18.8)	4.36
Community involvement	0 (0.0)	1 (0.3)	11 (3.2)	263 (76.2)	70 (20.3)	4.17
Fair benefit distribution	0 (0.0)	0 (0.0)	2 (0.6)	256 (74.2)	87 (25.2)	4.25
Environmental contribution	0 (0.0)	0 (0.0)	6 (1.7)	269 (78.0)	70 (20.3)	4.19
Coffee revitalization impact	10 (2.9)	26 (7.5)	14 (4.1)	238 (69.0)	57 (16.5)	3.89
Adoption of cook stoves	0 (0.0)	1 (0.3)	4 (1.2)	250 (72.5)	90 (26.1)	4.24
Reduced fuel wood pressure	0 (0.0)	0 (0.0)	2 (0.6)	251 (72.8)	92 (26.7)	4.26
Overall satisfaction	0 (0.0)	1 (0.3)	1 (0.3)	253 (73.3)	90 (26.1)	4.25

Source: Fields Survey, 2026

4.8. Determinants of Adoption of Improved Cook Stove and Coffee Rejuvenation

4.7.1. Determinants of adoption of improved cook stove

Despite improved stove having multiple economic, social, environmental, and health benefits; the improved stove dissemination programs failed to capture worldwide recognition. In this study a binary logistic regression was conducted to examine the factors influencing improved cook stove adoption as the users' choice and preference of improved cook stove system. Before running the data into the model, its fitness was checked.

All the hypothesized explanatory variables were checked for the existence of multicollinearity problem. Variance Inflation Factor (VIF) was used to test multicollinearity problem. If the VIF of a variable exceeds 10 (this will happen if R_i^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995). The results indicated that all VIF values were 4.2, which is below the threshold value of 10, suggesting that multicollinearity was not a serious problem in the model.

The likelihood ratio test shows that the predictors jointly influence adoption decisions (LR $\chi^2(11) = 154.73$, $p < .001$). The pseudo coefficient of determination indicates that approximately 68.2% of the variation in improved cook stove adoption is explained by the model ($R^2 = 0.682$). This suggests that the variation in the adoption of improved cook stove by household or variation independent variable is explained by independent variables used in the model predicting power and it is free from heteroskedasticity and multicollinearity. Empirical evidence indicates that rejuvenated coffee trees can significantly increase productivity after the recovery period, although farmers may initially hesitate to adopt the practice due to temporary income losses during regrowth stages (Abate et al., 2021).

Table 19 presents the results of a binary logistic regression model estimating determinants of household adoption of improved cook stoves. The model includes socio-demographic, economic, and environmental variables. The analysis revealed that age, income level, fuel wood usage before project intervention, fuel wood usage during project intervention, and time spent on collecting fuel wood and cooking and forest conservation status were statistically significant**.** Those variables have a strong positive relationship with dependent variable with 95% confidence level by comparing the population means**.** On the contrary, education level, farm land size and Indoor air quality have no strong interaction with the dependent variable.

Table 19:The logistic regression model output

Variables	B	S.E.	Wald	Sig.	Exp(B)
Sex	-.421	.452	.870	.351	.656
Age	.043	.025	2.914	.088	1.044
Educational level	-1.650	1.268	1.694	.293	.192
Household size	-.106	.081	1.699	.192	.900
Income level	.020	.000	3.544	.060	1.030
Farm land size	-.185	1.231	.023	.880	.831

Fuel wood usage before intervention	-.080	.027	9.053	.003	.923
Fuel wood usage during intervention	.162	.053	9.439	.002	1.176
Time spent for collecting fuel and cooking	3.682	1.445	6.491	.011	39.719
Indoor air quality	1.309	1.351	.938	.333	3.703
Forest conservation status	2.953	1.678	3.098	.078	19.156
Constant	-4.552	1.956	5.418	.020	.011
N = 345, R^2= 0.682, LR chi2(11) = 154.73, P-value= 0.000					

Source: Fields Survey, 2026

Logistic regression analysis identified five statistically significant predictors of adoption of improved cook stove practices: Age, Income level, fuel wood consumption before project intervention, fuel wood consumption during project intervention, reduced time spent collecting/cooking fuel and forest conservation status.

As indicated in the above Table 19, the age of the household head had significant effect on the decision of adoption of improved stove positively at 10% level of significance. The odds ratio indicates that a one-year increase in age increases the likelihood of adopting improved cook stoves by about 4.4%. This suggests that older household heads may have greater awareness of health and environmental consequences of traditional cooking methods. Empirical studies such as Beyene and Koch (2013) similarly found that older farmers tend to adopt energy technologies due to accumulated experience and risk perception.

In this study, household income level was found to be positively significant in determining the probability of improved cook stove adoption at 10% level of significance. The odds ratio indicates that higher income household had a positive effect, indicating that households with higher income level were likely to adopt sustainable practices. This finding was inconsistent with an assessment conducted by (Levine et al., 2013) which indicated that the cook stove's price was a decisive factor that affects the decision for adoption.

Fuel wood consumption before FOLUR project intervention negatively affects adoption of improved cook stove. Fuel wood consumption before the intervention had a negative effect at 1% level of significance, indicating that households with higher baseline fuel wood usage were slightly less likely to adopt sustainable practices. Households with higher fuel wood consumption before the intervention were slightly less likely to adopt sustainable practices.

The odds ratio indicates that higher previous fuel wood consumption reduces the likelihood of adopting improved cook stoves. This may reflect entrenched behavioral patterns and resistance to switching technologies.

In contrast, fuel wood usage during the intervention period has a positive and highly significant effect at 1% level of significance, suggesting that households actively managing fuel use during the intervention were more likely to adopt improved cook stoves or alternative fuels. The odds ratio suggests that households experiencing higher fuel wood use during the intervention were 17.6% more likely to adopt improved stoves. This result indicates that increased awareness of fuel scarcity and energy demand may encourage households to adopt more efficient cooking technologies.

These findings correspond with empirical evidence from Beyene and Koch (2013) and Gebreegziabher et al. (2012) which show that households with higher fuel consumption are more motivated to adopt fuel-efficient stoves to reduce fuel costs and labor burden. Time spent on collecting fuel wood and cooking is the dominant factor influencing adoption of sustainable practices. Time spent decreased statistically significant at 5% level of significance. The reduction in time spent collecting fuel and cooking emerged as the strongest predictor of adoption. The odds ratio indicates that households spending more time collecting fuel and cooking are nearly 40 times more likely to adopt improved cook stoves. This suggests that time burden is a major driver of technology adoption. Improved cook stoves reduce both fuel collection time and cooking duration, making them particularly attractive to households facing labor constraints.

Similar findings have been reported by Puzzolo et al. (2016) who emphasize that time savings are a critical incentive for adopting improved cooking technologies, especially for rural women responsible for fuel collection and meal preparation. Thus, interventions that reduce household labor, particularly for women and children who typically collect fuel, have the highest potential to drive adoption.

Forest conservation status shows a positive relationship with adoption and is significant at the 10% level. The odds ratio suggests that households concerned with forest conservation are substantially more likely to adopt improved cook stoves. Each unit increase in current fuel wood use increases the odds of adopting forest conservation practices by approximately 19.20%**.** This indicates that environmental awareness may play an important role in promoting sustainable energy technologies. Empirical studies such as Gebreegziabher et al. (2012) have

also demonstrated that concerns about deforestation and fuel scarcity significantly motivate adoption of improved biomass stoves in rural communities.

In general, the results indicate that the most important determinants of improved cook stove adoption include fuel wood usage before the intervention, fuel wood usage during the intervention, time spent collecting fuel and cooking, income level (marginal significance) and forest conservation awareness (marginal significance). Among these, time spent collecting fuel and cooking emerged as the strongest predictor, suggesting that labor and time savings are major drivers of improved cook stove adoption.

4.7.2. Econometric analysis on determinants of adoption of coffee rejuvenation

A binary logistic regression model was used to examine the determinants influencing farmers' decisions to practice stumping of old coffee trees. The model was estimated using data from 345 coffee-producing households. The Variance Inflation Factor (VIF) was used to test the presence of multicollinearity among explanatory variables. The results indicated that the VIF values were 2.05, which are well below the critical value of 10. Therefore, multicollinearity was not considered a serious problem in the logistic regression model.

The likelihood ratio test indicates that the model is statistically significant **(**LR $\chi^2(13) = 165.03$, $p < 0.001$**),** suggesting that the explanatory variables jointly explain the variation in the adoption of stumping practices. The pseudo R^2 value of 0.562 indicates that approximately 56.2% of the variation in farmers' decisions to stump old coffee trees is explained by the variables included in the model**,** which suggests relatively strong explanatory power for adoption behavior models.

Empirical evidence indicates that rejuvenated coffee trees can significantly increase productivity after the recovery period, although farmers may initially hesitate to adopt the practice due to temporary income losses during regrowth stages (Abate et al., 2021).

The results suggest that the adoption of stumping is influenced mainly by economic capacity, farm resources, and agronomic factors**.** Variables such as household education level, household income, total farm size, coffee farm size, and age of coffee trees significantly increase the likelihood of adoption. Conversely, management practices like pruning and shade management reduce the need for stumping by maintaining tree productivity.

Table 20: The logistic regression model output

Variables	B	S.E.	Wald	Sig.	Exp(B)

Sex	-.656	.440	2.225	.136	.519
Age	.023	.023	1.009	.315	1.023
Education level	2.452	1.287	3.627	.057	11.610
Household family size	.046	.076	.370	.543	1.048
Household income	.000	.000	4.209	.040	1.020
Total Farm size	.612	.323	3.589	.058	1.844
Coffee farm size	1.914	.557	11.814	.001	.147
Age of coffee trees	.103	.023	20.678	.000	.902
Average coffee yield	.000	.000	.001	.973	1.030
Replanting of coffee trees	.571	.455	1.572	.210	.565
Pruning and removing suckers	-2.872	.572	25.242	.000	.057
Soil fertility management	.563	.468	1.449	.229	1.756
Shade management	-1.006	.475	4.475	.034	.366
Constant	1.414	1.422	.990	.320	4.114

Source: Fields Survey, 2026

Table 20 presents education level has a positive coefficient (B = 2.452) and is marginally significant at the 10% level **(**p = 0.057**).** The odds ratio (Exp(B) = 11.610) indicates that farmers with formal education are significantly more likely to adopt stumping practices compared with less educated farmers.

Education enhances farmers' ability to acquire, interpret, and apply agricultural information. Educated farmers are more likely to understand extension advice and evaluate the long-term benefits of rejuvenation practices. Similarly, adoption studies in Ethiopian coffee production systems have shown that education significantly increases the likelihood of adopting improved management practices such as pruning, shade management, and rejuvenation techniques (Abate et al., 2021).

With regard to economic factors**,** household income has a positive and statistically significant effect on the adoption of stumping (p = 0.040). The odds ratio (Exp(B) = 1.020) suggests that farmers with higher income are more likely to practice stumping of old coffee trees.

This finding is consistent with the theory that financial capacity plays an important role in the adoption of agricultural innovations. Stumping requires farmers to cut down old trees, which leads to temporary production losses while the trees regenerate. Farmers with higher income levels are better able to absorb this temporary income reduction.

Empirical studies have shown that financial incentives significantly increase the adoption of coffee rejuvenation practices among smallholder farmers. Programs that provide financial support or compensation for temporary yield loss can substantially increase adoption rates (Abate et al., 2021).

With regard to coffee production characteristics, average age of coffee trees has a positive and highly significant effect adoption of stumping practices. The average age of coffee trees has a positive and highly significant effect ($p < 0.01$). This implies that farmers are more likely to adopt stumping as their coffee trees become older. This result is expected because stumping is primarily used to rejuvenate aging coffee trees whose productivity declines over time. Empirical studies have shown that rejuvenation practices such as stumping are essential for restoring productivity and extending the productive lifespan of coffee trees (Mezigeb, K., et al. 2019). As coffee trees age, farmers are more likely to consider rejuvenation practices to maintain long-term productivity.

With regard to farm resource characteristics, total farm size and Coffee farm size are more likely to adopt stumping practices. Total farm size has a positive coefficient ($B = 0.612$) and is marginally significant at the 10% significance level ($p = 0.058$). The odds ratio ($Exp(B) = 1.844$) indicates that farmers with larger farms are approximately 1.8 times more likely to adopt stumping practices.

Farm size is widely recognized as an important determinant of technology adoption. Larger farms provide farmers with greater flexibility to allocate land for experimental or rehabilitation practices without significantly affecting total farm output. Empirical evidence from agricultural adoption studies consistently shows that larger farms are more likely to adopt new technologies due to economies of scale and greater resource availability (Feder et al., 1985).

Coffee farm size has a highly significant effect ($p = 0.01$) on the adoption of stumping practices. Farmers with larger coffee plantations are more likely to invest in rejuvenation practices to maintain productivity. Larger coffee farms are typically more commercially oriented and therefore have stronger incentives to adopt productivity-enhancing practices. Studies

conducted by the International Coffee Organization indicate that farm size is an important determinant of investment in coffee plantation management and rehabilitation practices.

With regard to coffee farm management practices pruning and removing suckers and Shade management are significantly less likely to adopt stumping practices. Pruning and removing suckers has a negative and highly significant effect ($p < 0.01$)**.** This implies that farmers who regularly practice pruning are significantly less likely to adopt stumping practices.

Pruning improves plant health, promotes better air circulation, and enhances nutrient allocation, thereby sustaining productivity and delaying the need for rejuvenation practices. According to the Food and Agriculture Organization, effective pruning management can extend the productive life of coffee trees and reduce the need for drastic rejuvenation methods.

Shade management has also a negative and statistically significant effect ($p = 0.034$). Farmers practicing shade management are less likely to adopt stumping. Shade trees help regulate microclimatic conditions, improve soil moisture retention, and enhance soil fertility. Empirical studies have shown that shade-grown coffee systems improve long-term productivity and sustainability in coffee agroforestry systems, which may reduce the need for drastic rejuvenation practices (Perfecto et al., 1996). Similar studies on Ethiopian coffee systems show that shade management improves sustainability and productivity in coffee-based agroforestry systems, thereby reducing the need for drastic rejuvenation practices (Abate et al., 2021).

In general, in many smallholder farming systems, differences in technology adoption are largely mediated by farm management and economic factors which play an important role in determining adoption decisions. These findings imply that policies aimed at improving coffee productivity should focus on strengthening agricultural extension services, improving farmers' financial capacity, promoting integrated coffee management practices and providing training on coffee rejuvenation techniques. Such interventions can significantly improve the adoption of coffee rehabilitation practices and enhance the sustainability of coffee production systems.

4.9. Household Livelihood Improvements

4.9.1 Improved household income

Case study evidence illustrated the impact of these interventions: Rabiya Sultan, a 23-year-old participant in choora district, explained, "Before FOLUR, household income was unstable due to reduced forest yields. Now, coffee seedlings and livestock rearing provide regular income." Similarly, in Abaya District, Mrs. Netsanet Tallo highlighted increased household income from

cattle fattening, particularly during high-demand periods such as religious holidays. Focus group discussions in Bunnata and Hafursa Bangasa revealed that start-up capital ranging from 380,000 to 384,800 ETB enabled organized income-generating activities. The findings in general suggest that FOLUR interventions have contributed positively to improving livelihoods, particularly in enhancing income and participatory decision-making.

Focus group discussions were also held with selected beneficiaries and community representatives of Omo Beko and Omo Funxule Kebele of Gomma district. Accordingly, women cooperative union established in Omo Beko operates on a government coffee farm and focus on honey production as a livelihood activity engagement in the project area. Members of the cooperative union received seed money totally ETB 60,000 to support income-generating activities. Individual financial support of ETB 3,200 provided to them helped them to initiate or strengthen income-generating activities and support household livelihoods.

Women participants in the FGD in the study area confirmed that they have got training on women's economic empowerment focusing on awareness, purpose, and practical application of the activities supported by the FOLUR project. Participants described that the training provided was relevant, empowering, and confidence-building, and contributing to increased participation of women in economic activities.

> *In similar manner, Mr. Birkisa Aba mecha, from Omo Bako Kebele mentioned that the training, awareness creation, and financial support enabled women previously excluded from economic activities to generate income, save money, and participate in cooperative leadership that facilitates ground for women's Economic Empowerment that Creates Lasting Change on their livelihood in the project areas.*

The data gathered from Omo Funtule Ganda in same study area using FGD and researchers field observation revealed that women beneficiaries of FOLUR project have been participating in different income generating activities. Among others, women mainly engaged in activities such as sheep fattening, fuel-efficient stove production, coffee rejuvenation and land management practices, including compost production, use of NORA following awareness creation and coffee seedling production to improve their livelihoods in the project kebeles.

Participants of FGD in Omo Funtule confirmed that they were benefited from FOLUR project intervention by engaging in economic activities such as sheep fattening. For instance, the participants mentioned that beneficiaries purchased sheep for 6,000 birr and sold them for 18,000 birr, resulting in a threefold increase in income in Omo Funtule kebele. Sheep

Producing Cooperative Union established in Omo Funtule began with an initial capital of 48000 birr and has grown to 99,000 birr. The growth was achieved through regular savings of 100 birr per week per member and the sale of well-fattened sheep at prices ranging from 18,000 to 24,000 birr.

In similar kebele Women's cooperative union of fuel-efficient stove production that consists of 18 (eighteen) women members who have started producing and selling fuel-efficient stoves, also generating income and promoting energy-efficient technologies in the District. As a result, women's participation in income-generating activities is improved, saving culture and financial discipline among members increased, fuel-wood consumption reduced through the use of fuel-efficient stoves. Women's economic empowerment programs providing seed capital and training have been shown to increase women's participation in income-generating activities and improve household welfare (UN Women, 2018)

Members of the Tokuma Enterprise in Yayyo district obtained formalized land for nurseries and livestock operations, with field observations revealing terraced coffee plots, livestock enclosures, and integrated soil and water conservation (SWC) structures. In terms of financial capital, women's groups shifted from subsistence to market-oriented activities; a women's primary cooperatives in Omo funtule, purchased 18 sheep for 91,000 ETB, sold them for 198,000 ETB (netting a profit of 107,000 ETB), and reinvested 228,000 ETB in wheat cultivation.

According to the district cooperative officer, across the project, 27 women's savings groups comprising approximately 650 members were established, each receiving initial capital (3,000 ETB), monthly contributions (400 ETB per member), and project funds (115,000 ETB), bringing total capital to around 297,000 ETB. Observations confirmed that 63,000 ETB had been deposited in formal banks, indicating a focus on long-term financial planning. These show that participation in savings groups and cooperatives enhances financial inclusion, enabling households to accumulate assets and invest in income-generating activities (Ksoll et al., 2016).

4.9.2 Income Diversification and Coping Strategies

Households in the FOLUR project areas diversified their income sources by engaging in multiple activities, including coffee rejuvenation, livestock fattening, agroforestry, vermicomposting, and small-scale savings schemes, such as biweekly contributions of 20 ETB. To cope with temporary reductions in coffee yields during stumping, beneficiaries relied on alternative income sources like livestock fattening and group savings mechanisms. Case study

participants and focus group discussions consistently reflected optimism regarding future harvests and the sustainability of these diversified livelihood strategies. Households engaged in multiple income sources experience lower poverty rates and greater resilience to climate variability compared to those relying on a single crop (Barrett et al., 2001).

Indicators of improved resilience among the beneficiaries included increased savings and asset accumulation, enhanced women's participation in economic decision-making, and the adoption of market-oriented as well as environmentally sustainable practices. Improved savings, asset accumulation, and women's participation in decision-making are key indicators of resilience (Béné et al., 2016). Despite these positive developments, limitations in financial capital and the incomplete implementation of project activities suggest that resilience is still evolving and has not yet been fully consolidated. Therefore, integrated livelihood based intervention strengthen these indicators, although long-term sustainability requires continued support from the program.



Figure 8: Income Diversification by women and youth cooperative enterprise in Yayo district sheep fatting and in Cora district beekeeping and fruit and vegetable seedling and marketing

4.9.3 Skills Development and Awareness

Training and knowledge transfer played a critical role in promoting forest-friendly livelihood practices among FOLUR project beneficiaries. Skills training emerged as the strongest perceived benefit, with a remarkable 92.5% of respondents agreeing or strongly agreeing that they received skills training for income diversification, and only 1.4% disagreeing. This suggests the programme's training component is its most visible and well-received intervention. Similarly, household income increase garnered strong endorsement, with 90.4% of respondents agreeing that income had risen due to FOLUR activities, and only 2.3% disagree as notably decisive outcome (Figure 9)



Figure 9: Omo Funtule kebele Women cooperative union training on Fuel efficient stove production and marketing

FGD participants received capacity-building sessions covering coffee rejuvenation, livestock management, beekeeping, land restoration, watershed management, organic input production, and value-chain enhancement. Study showed that, agricultural training and extension services significantly influence adoption of sustainable practices. Farmers trained in land restoration, watershed management, and improved production techniques are more likely to adopt environmentally friendly practices and improve yields (Davis et al., 2012). The effect of these trainings was evident in the adoption of improved techniques that reduced environmental pressure, such as the use of energy-efficient cook stoves and sustainable coffee management practices. Researchers' field observations confirmed that beneficiaries actively applied the skills they had learned in on going community initiatives.

Moreover, Beneficiaries also received technical assets such as coffee cutting machines, coffee hole diggers, fuel-efficient cook stoves, and irrigation tools; however, FGDs highlighted limitations in the quantity and capacity of these tools, suggesting the need for scaling up to

meet demand. Access to land, credit, and agricultural tools is strongly associated with improved productivity. Studies indicate that farmers receiving improved inputs and irrigation support achieve productivity gains of up to 50% (World Bank, 2019).

4.10 Institutional Collaboration and FOLUR Implementation

Institutional collaboration is paramount important in enhancing project effectiveness and sustainability. Integrated landscape programs that align with local government priorities and involve multi-level coordination achieve stronger outcomes in natural resource management and livelihood improvement (GEF, 2021). The study identified that institutional collaboration played a crucial role in facilitating the implementation and sustainability of FOLUR interventions in Gomma District. The project's activities were closely aligned with district and national development priorities, particularly in natural resource management and women's economic empowerment. Similarly, the regional coordinator, stated that the project objective align with the national and regional forest and land-use policies by promoting sustainable forest management, integrated land use planning, and climate-resilient development. It supports key frameworks such as forest conservation strategies, REDD+, and the CRGE strategy, while strengthening institutional capacity and implementing practical, landscape-level interventions in Oromia. Overall, the project translates policy objectives into concrete actions that enhance forest restoration, sustainable land management, and improved livelihoods. Forest restoration on communal lands reflected compliance with policy directives, while systematic land-use planning and documentation of best practices supported efforts to scale up successful interventions (primary data via KII, FGD, Field observation, and 2026)

According to Key informant from Agricultural office of Gomma district Coordination and oversight were reinforced through direct supervision by the Deputy District Head, demonstrating high-level government commitment, alongside committees operating at district, zonal, and kebele levels that facilitated joint planning, monitoring, and implementation. Institutional impacts included strengthened women's economic engagement, the promotion of agroforestry, soil and water conservation, and tree planting, as well as the development of an integrated model addressing economic development, peace building, and women's empowerment particularly for women who have historically been excluded from economic, social, and political/administrative participation. At the community level, improved coordination among government offices and project staff enhanced the efficiency, ownership,

and sustainability of FOLUR interventions, ensuring that activities were implemented in line with both economic and environmental objectives.

4.11. Success Stories and Lessons for Scaling Up and Replication

Beneficiary interest in scaling up the intervention was driven by visible improvements in household welfare and environmental protections in the study area. According to the KIIs from Gomma District agriculture and cooperative officer, the FOLUR project operates in five kebele within Gomma District; however, substantial community demand exists to expand coverage to 36 of the district's 41 kebeles. Beneficiaries and local officials (KII), widely perceived the initiative as "their project," reflecting a high level of community ownership and buy-in. Furthermore, the intervention has contributed to women's economic empowerment, as cooperative unions engaged in stove production, livestock management, and seedling cultivation has created income generating opportunities and leadership roles. These activities have, in turn, encouraged broader participation and facilitated social learning among non-beneficiary community members reinforcing sustainability and long-term adoption (Bailis et al., 2015; Global Alliance for Clean Cook stoves, 2019).

4.11.1. Evidence-Based Success Stories

Prior to the implementation of the FOLUR project, rural households across the coffee-forest landscapes of the study districts faced persistent livelihood insecurity, low agricultural productivity, and increasing environmental degradation. Coffee production constituted the dominant livelihood activity; however, declining yields from aging coffee trees, reduced soil fertility, and limited access to improved agricultural technologies constrained income generation.

Evidence from Focus Group Discussions with members of the Tokuma Cooperative Enterprise in Yaayyoo District indicated that households relied heavily on petty trade, seasonal wage labor, or temporary migration to supplement declining coffee income. Similarly, a household case study from Witatee kebele revealed that families were increasingly dependent on forest coffee harvesting and small-scale trading, both of which were becoming less reliable due to on-going forest degradation. These findings are consistent with previous empirical studies conducted in the Jimma and Illubabor zones, which demonstrate that forest coffee-dependent households often experience high income variability and limited economic resilience due to aging plantations, declining soil productivity, and weak market linkages (Schmitt et al., 2019).

Gender inequalities further compounded these challenges. Women had limited access to productive resources, extension services, and decision-making authority within households and community institutions. As one of the case study participant in the study explained:

"Women had very limited decision-making power in coffee production and forest resource management before the project."

Field observations conducted during the study confirmed these accounts. Coffee farms were characterized by senescent coffee trees, degraded soils, and poorly managed shade systems, indicating both declining productivity and increasing ecological stress. Collectively, these conditions illustrate the structural livelihood vulnerabilities that existed prior to the introduction of FOLUR interventions.

4.11.2 Gender and Decision-Making

The FOLUR project significantly enhanced women's active involvement in natural resource management and livelihood activities. Focus group discussions revealed that women participated in nursery management, livestock rearing, and forest restoration, collectively raising approximately 25,000 coffee seedlings, avocado trees, and other species are associated with livelihoods and income diversification and food security. Evidence shows that women's participation in forestry, agriculture, and conservation initiatives improves both environmental outcomes and household welfare (Agarwal, 2009). Training opportunities further strengthened women's technical skills and leadership capacity, enabling them to effectively adopt improved practices and decision makings as per the project objectives. Case study evidence indicating enhanced household-level empowerment (Figure 3) aligns with research showing that women's control over productive resources leads to improved household nutrition, education, and wellbeing (World Bank, 2019).

Rabiya Sultan from Coora noted, her success history in her mother language that

> *"Duratti dubartootiin angoon murtii kennuu qabeenya dhaabbataa akka bunaa fi qabeenya lafaa irratti musteesuun dhibaa turee. Fakenyaaf buna kunuunsuu, gamashuu fi buna jaare buqisanii dhaabuu akkasumas hojii eegumsa bosonaa, biyyoo fi bishaanii irratti ofii murteesinee oftitti amanamummaan hojjechuun rakkisaa ture garuu amma hubannoon dadamaqinaa gama Projektii kanaan waan arganneef of taanee waan hojjennu irratti murteessa jirra''*

Literary when translated it mean that "Previously, we women had limited decision-making power over assets such as coffee and land, but now we actively manage and make decisions

ourselves." Accordingly, she believes everything is changed positively after her participation in FOLUR Program significantly. Women's increased decision-making power over land and coffee resources reflects broader evidence that empowerment interventions reduce gender disparities in agricultural productivity (Aguilar et al., 2015; UN Women, 2018).

4.11.3 Transforming Livelihoods through Women's and Youth Empowerment

The FOLUR project introduced a range of integrated livelihood and landscape restoration interventions, including coffee rejuvenation, agroforestry, livestock fattening, beekeeping, compost production, and fuel-efficient stove technologies. These interventions significantly improved both household economic resilience and environmental sustainability. Women strategically combined sheep husbandry, grain trading, and coffee-related activities to diversify household livelihoods in climate-smart and seasonally adaptive ways, enhancing both economic resilience and resource efficiency. Livelihood diversification is widely recognized as a strategy for reducing vulnerability to climate and market shocks (Ellis, 2000).

A case study in Jimma zone, Gomma district case study in Omo Funtule kebele in illustrates the economic impact of these interventions. Women organized in cooperative groups engaged in sheep fattening, stove production, coffee rejuvenation, and organic fertilizer production. For example, sheep purchased for 6,000 ETB were sold for approximately 18,000 ETB, representing a threefold return on investment.





Figure 10: sample integrated framings in Gomma District (Omo Funtule, integrated farming's)
Source: researchers field observations, 2026

Similarly, fuel-efficient stove cooperatives not only generated income for participating women but also contributed to reduced firewood consumption and decreased pressure on surrounding forest ecosystems. Integrated farming systems combining poultry production, coffee seedlings, composting, and beekeeping further strengthened household livelihood diversification.

These findings support existing literature demonstrating that diversified livelihood strategies significantly enhance resilience to climate and market shocks among smallholder farmers (Barrett et al., 2001). In addition, fuel-efficient stove initiatives contribute to both environmental conservation and improved household health outcomes by reducing indoor air pollution (FAO, 2017).

Similar success history of Mrs. Netsanet Talla, a young farmer from Abaya District, provides a compelling case study of the transformative potential of the FOLUR intervention model. Mrs. Netsanet has been actively involved in FOLUR activities for approximately 12 months. Before joining the FOLUR Project, her family struggled with low farm productivity and inadequate tools for coffee plantation, making their livelihood difficult. Women, including Mrs. Netsanet, also had little role in household decision-making. Challenges were prevalent, ranging from inadequate tools for digging coffee plantation holes to deep-seated social norms where women were excluded from household decision-making processes. The family struggled to excavate holes large enough for proper coffee plantation, and domestic matters were solely managed without her input, limiting the household's overall capacity to improve their livelihood collaboratively. After 12 months in the FOLUR initiative, her family adopted improved farming practices and strengthened their coffee production. Equally important, she now actively participates in family decisions and discussions. Mrs. Netsanet says the program helped women recognize their vital role in improving household livelihoods and well-being.

Her story highlights how FOLUR support has enhanced both economic resilience and women's empowerment at the family level.

Through the FOLUR initiative, Mrs. Netsanet received comprehensive support including skill development training, awareness-raising sessions, community mobilization, and materials for a fuel-efficient cooking stove. This intervention catalyzed significant changes in her agricultural practices, particularly regarding coffee rejuvenation. She successfully uprooted and replanted half a hectare of her coffee land last year, which is now flourishing and showing promising growth. Building on this success, she has completed land preparation to uproot and replant the remaining half of her coffee land. Her perception of old-aged coffee trees has shifted, and she now believes strongly in the potential for high production from these rejuvenated plants. The motivation derived from the visible success of the new plants has even encouraged her to discuss coffee protection strategies with her husband, marking a significant shift in collaborative farm management.

Within one year, she successfully rejuvenated half a hectare of coffee plantation, which is now demonstrating improved growth and productivity. Encouraged by these results, she has prepared the remaining half hectare of land for rejuvenation. In addition to improving coffee production, Mrs. Netsanet diversified her household livelihood by engaging in ox fattening, allowing her family to sell livestock during peak holiday markets when prices are highest. She is also preparing to introduce vermin compost production, further strengthening sustainable soil fertility management.



Figure 11: Flourishing rejuvenated coffee plantation and land preparation for the second phase

Beyond coffee production, Mrs. Netsanet has diversified her livelihood activities to enhance economic resilience. She is currently fattening an ox to sell during holy days at higher prices, a strategy that has noticeably increased her household income. This additional revenue plays a significant role in improving household welfare through better food security and asset accumulation. Furthermore, she is expanding her sustainable agriculture practices by preparing to establish vermin compost production, having ready the necessary instruments for this initiative. These diversified income streams reduce vulnerability and demonstrate her commitment to adopting integrated landscape management practices that go beyond traditional farming.

Equally significant are the changes observed in household decision-making dynamics. Mrs. Netsanet reported that she now participates actively in discussions regarding agricultural investments, financial planning, and family livelihood strategies. According to her account, her husband now recognizes her role as a partner in household economic management rather than excluding her from decision-making.

Her experience illustrates how integrated landscape management programs can simultaneously promote economic empowerment, gender equality, and sustainable natural resource management.

The project has also driven profound social transformations within her household, specifically regarding women's empowerment. Mrs. Netsanet reports that her role in family decision-making has fundamentally changed since engaging with FOLUR. She and her husband now discuss family matters together to work towards improving their livelihood, and she notes that her husband supports her participation rather than mistreating her for it. She has gained new insights into women's empowerment and actively collaborates with other women to change household livelihoods, a dynamic that did not exist before the project intervention. This shift has empowered her to advocate for her role in family life and agricultural decisions, fostering a more equitable household environment.

Environmentally, Mrs. Netsanet's family is adopting sustainable land use practices such as tree plantation, agroforestry, and reduced forest pressure. Although she received a fuel-efficient cook stove designed to decrease reliance on forest products, she admits to inconsistent usage, suggesting that further understanding of the stove's functionality could enhance full adoption. Looking toward the future, Mrs. Netsanet is satisfied with the intervention but suggests that grouping women for dairy cow projects might be more beneficial than fattening groups alone. Despite this feedback, she remains confident in the sustainability of the project's impact, reporting that the women's groups formed to improve livelihoods will continue to work together even after the project lifecycle ends, driven by their newfound understanding of the importance of collaboration.

4.11.4. Ecological and Livelihood Impacts of Forest Restoration Interventions

Forest restoration interventions implemented under the FOLUR project have generated multiple ecological and socio-economic benefits, demonstrating the potential of integrated landscape management approaches to simultaneously enhance ecosystem services and rural livelihoods. Evidence from field observations, Focus Group Discussions and Key Informant Interviews indicates that restoration activities have contributed to improvements in vegetation cover, soil conservation, biodiversity protection, and community awareness of sustainable resource management.

Field observations across restoration sites in Gomma, Adaba, and Cooraa districts indicate visible improvements in forest regeneration and vegetation density, particularly in areas where

degraded lands were protected through area closures and enrichment planting. The introduction of indigenous species such as *Hagenia abyssinica* and other multipurpose trees has supported ecological recovery by improving canopy cover, stabilizing soils, and enhancing habitat conditions for biodiversity.

The FLOUR Ethiopia M& E officer noted that through the project support, a total of 15,584 hectares of natural forest, including 2,666-hectare coffee biospheres reserves, have been brought under PFM system. In parallel, 2,276 hectares of degraded communal lands and forests have been brought under restoration. Forest restoration initiatives have shown positive progress, particularly where communities are engaged through participatory forest management systems. Restoration of degraded coffee forest landscapes and improved management practices are contributing to ecosystem recovery and biodiversity conservation.

Community members participating in FGDs reported that restoration efforts have reduced land degradation and improved the condition of surrounding landscapes. In particular, restored areas have contributed to improved soil moisture retention, reduced erosion, and enhanced microclimatic conditions within coffee forest landscapes. These ecological improvements are consistent with findings from previous studies demonstrating that participatory forest restoration contributes to improved ecosystem functioning and biodiversity conservation in Ethiopia (Ameha et al., 2014; FAO, 2020).

Furthermore, the integration of agroforestry practices within coffee farming systems has enhanced the ecological sustainability of agricultural landscapes. Shade tree management and the introduction of multipurpose species have strengthened ecosystem resilience by supporting soil fertility, regulating microclimates, and improving long-term coffee productivity. Such agroforestry systems are widely recognized as climate-smart agricultural practices that promote both environmental sustainability and livelihood resilience (IPCC, 2022).

Beyond ecological benefits, forest restoration interventions have also generated tangible livelihood improvements for participating household**s**. Community members reported that improved forest management practices have increased the availability of forest-related products, including fuel wood, fodder, honey, and non-timber forest products, which contribute to household subsistence and income diversification.

Participatory Forest Management arrangements have further strengthened community access to forest resources through regulated and sustainable use mechanisms. Beneficiaries noted that organized community groups are now able to collectively manage forest areas while benefiting

from controlled harvesting, seedling production, and conservation-based livelihood activities. In several communities, restoration initiatives have also created employment and income opportunities through activities such as tree nursery development, seedling production, and restoration site management. Women and youth groups have been particularly involved in these activities, contributing to improved household income and strengthening community participation in environmental conservation.

Additionally, the restoration of degraded forest areas has reinforced other livelihood interventions promoted under the FOLUR project, including beekeeping, coffee rejuvenation, and agroforestry. Healthy forest ecosystems provide essential ecological services that support agricultural productivity, including pollination, soil fertility improvement, and water regulation. As a result, restoration efforts have contributed indirectly to improved agricultural performance and livelihood stability.

4.11.5 Community Perceptions and Sustainability

Evidence from FGDs and KIIs suggests that community perceptions of forest restoration interventions are highly positive. Participants emphasized that restored forest areas not only provide ecological benefits but also strengthen long-term livelihood security. Community members expressed a growing sense of responsibility toward protecting restored areas and maintaining sustainable resource management practices.

This increased community ownership reflects the participatory nature of the FOLUR intervention model. Local engagement in restoration planning, implementation, and monitoring has strengthened trust between communities and implementing institutions, thereby enhancing the sustainability of restoration outcomes.

4.11.6 Implications for Landscape Restoration and Climate Resilience

The combined ecological and livelihood benefits observed in the study areas demonstrate the importance of integrating forest restoration with livelihood development strategies. By linking environmental conservation with income-generating activities, the FOLUR project has created incentives for communities to actively participate in sustainable land management practices. The FOLUR Project is closely aligned with Ethiopia's national priorities on sustainable land management, forest restoration, and climate-resilient green economy. It supports the implementation of integrated land-use planning, participatory forest management (PFM), and sustainable coffee value chains, which are key elements of national policies such as the Forest Development, Conservation and Utilization Policy and the Climate Resilient Green Economy strategy. More specifically, it supports the implementation of National Forest Sector

Development Program through coordination on monitoring and incentives for Participatory Forest Management of indigenous forest

Such integrated approaches are increasingly recognized as essential for addressing the interconnected challenges of climate change**,** biodiversity loss, and rural poverty. The experiences documented in the study districts highlight the potential for scaling up participatory forest restoration initiatives across other coffee forest landscapes in Ethiopia.

However, sustaining and expanding these impacts will require continued support for community-based forest governance, improved post-planting management practices, and strengthened technical and institutional capacity at the local level.

4.12. Lessons Learned for Scaling-Up and Replication

The findings from the study districts provide several important lessons for scaling up integrated rural development and forest landscape restoration initiatives. FOLUR has made important progress in promoting sustainable land-use practices through integrated land-use planning, agroforestry promotion, crop land restoration, degraded communal land/forest restoration activities, and strengthened community-based forest management systems. To date, through these integrated efforts a total of 63,567 hectares has been brought under improved land use practices. These interventions are gradually improving land productivity while contributing to forest conservation.

Integrated Livelihood and Environmental Interventions: Combining economic empowerment with sustainable land-use and forest restoration generates synergistic socio-economic and ecological benefits. Activities such as coffee rejuvenation, honeybee production, and fuel-efficient stove adoption simultaneously enhance household income, reduce pressure on forests, and improve overall well-being.

Women's economic empowerment creates lasting change: Targeted training, awareness-raising, and financial support enabled previously marginalized women to participate in income-generating activities, establish savings practices, and assume leadership roles within cooperative unions. Strengthening women-led cooperatives is therefore crucial for sustaining economic gains and social empowerment.

Adequate Inputs Determine Project Success: Insufficient inputs such as honeybee boxes and coffee stumping machines limit productivity and the scaling of interventions. Ensuring timely

and sufficient access to essential materials is critical for improving adoption rates and achieving long-term project impact.

Livelihood diversification enhances household resilience: The adoption of multiple income-generating activities reduces vulnerability to climate variability and market fluctuations.

Transitional Financial Support is Critical: Temporary reductions in household income during transitional activities, such as coffee rejuvenation, necessitate proportional financial support to maintain beneficiary engagement and uptake of recommended practices.

Community organizations strengthen sustainability and social cohesion**:** Women's cooperatives and youth groups facilitated knowledge exchange, collective savings, and informal social protection mechanisms for vulnerable households. Economic groups provided targeted assistance to vulnerable households for instance, allocating 5,000 ETB to widows during periods of shock thereby reinforcing social cohesion and enhancing community resilience (Devereux & Sabates-Wheeler, 2004).

Community-led innovation: Initiatives such as the development of a community grinding mill and other value-addition enterprises exemplify endogenous, locally driven solutions that address economic needs while fostering community ownership. Local innovation enhances sustainability by aligning interventions with community priorities (Chambers, 1994).

Fuel-Efficient Stoves Deliver Multiple Benefits**:** The adoption of fuel-efficient stoves led to reduced firewood consumption, lower indoor smoke exposure, and significant time savings. Scaling up stoves and establishing community-based distribution mechanisms can maximize environmental, health, and economic benefits. Fuel-efficient cook stoves have reduced fuel wood consumption and labor burden for women while contributing to forest conservation. Coffee rejuvenation and improved management practices are helping farmers restore productivity in degraded coffee farms and expected to improve yield by 100% and beyond, and have significant long-term income potential.

Demonstration effects stimulate wider adoption of innovations: Successful early adopters motivated neighbouring households to replicate improved practices, indicating strong potential for community-driven scaling.

Integration of Women's Enterprises with Participatory Forest Management (PFM): Linking income-generating activities to forest restoration facilitated conservation-compatible

livelihoods, simultaneously promoting ecological sustainability and economic well-being (FAO, 2017).

Technical support and follow-up are critical for sustained adoption**:** Continuous training, extension services, and monitoring significantly influence the long-term success of livelihood and restoration interventions.

Cooperative formation strengthens sustainability**:** Cooperative structures enhance savings, knowledge sharing, social cohesion, and collective bargaining, reinforcing both livelihood and conservation objectives. Continued capacity building and market linkage support are essential to sustain cooperative activities.

Community ownership encourages expansion**:** Perceiving FOLUR as "our project" increased community participation, care for assets, and willingness to adopt recommended practices. Early engagement of local communities and government institutions foster a sense of ownership and contributes to long-term sustainability. Participatory forest management approaches, community-based restoration activities, capacity-building for local committees, and integrated livelihood support initiatives (which includes training, on-going technical support, input provision, grant, etc) such as women income diversification support, engaging women and youths in agroforestry business, and coffee productivity improvement have been effective in strengthening community ownership.

Strong demand signals readiness for scale-up: Communities beyond the initial project areas expressed interest in joining after observing tangible benefits. Lessons learned from pilot kebeles can guide scaling to additional sites, supported by improved resource allocation and coordination.

Continuous follow-up improves impact: The project is implemented through government structures and coordinated with sector offices responsible for forestry, land use, and agriculture. This institutional integration helps align FOLUR interventions with on-going government programs on land restoration, sustainable agriculture, and livelihood development. Regular refresher training, technical support, and monitoring reinforce correct practices and build beneficiary confidence, ensuring sustained behavioral change and long-term effectiveness of interventions.

4.13 Implications for Scaling-Up

The evidence generated through this study indicates that the FOLUR intervention model holds strong potential for replication and scaling across other coffee-forest landscapes in Ethiopia. Expanding the program could generate substantial benefits for rural livelihoods, forest restoration, and climate resilience.

However, successful scaling will require increased financial support for livelihood transition periods, improved access to agricultural inputs and equipment, strengthened extension services and technical training, expansion of women-led cooperatives and community institutions, stronger coordination between local government and development partners

By addressing these factors, the FOLUR model can serve as an effective framework for promoting sustainable rural development, gender empowerment, and landscape restoration in Ethiopia's coffee-producing regions.

4.14: Challenges/Barriers to the effective implementation of the FOLUR project

Financial constraints**:** Insufficient financial resources emerged as one of the most frequently cited barriers to the effective implementation of the FOLUR project, constraining both the sustainability and scalability of its interventions. Evidence from KIIs indicates that limited seed funding for beneficiaries reduces their capacity to offset temporary income losses associated with transitional practices, such as coffee stumping, which can suppress yields for up to one year. Findings from FGDs further revealed that inadequate access to inputs hindered the expansion of livelihood activities, including honey production; for instance, in Hawi Gudina, 15 beehive boxes were distributed among 20 women, a level of support insufficient to generate meaningful income.

Such financial constraints are widely recognized as major barriers to the adoption of sustainable land management practices among smallholder farmers (Food and Agriculture Organization [FAO], 2017; World Bank, 2020).Researchers, field observations verified these accounts, showing that financial limitations delayed the timely procurement of essential inputs and slowed the implementation of activities such as coffee seedling production, compost application, and landscape restoration. These findings imply that enhanced and appropriately timed financial support is critical to sustaining adoption, maintaining beneficiary engagement, and maximizing the overall effectiveness of project interventions.

Technical and material limitations**:** Several technical expertise and shortages of essential materials were reported, constraining implementation efficiency, productivity, and the sustained adoption of promoted practices. In coffee rejuvenation activities, the allocation of only two coffee stumping machines per Kebele was inadequate to support large-scale implementation, resulting in delays and reduced operational efficiency. Similarly, insufficient provision of beehive boxes limited the income-generating potential of women's cooperatives engaged in honey production. Limited access to appropriate technologies and agricultural inputs is a commonly documented constraint in rural development programs (FAO, 2017).

For fuel-efficient cook stoves, design limitations particularly issues related to flue tube length negatively affected indoor air quality and cooking performance, thereby reducing consistent utilization. In addition, only partial adherence to recommended agroforestry practices within coffee plantations posed risks to long-term ecological sustainability. Field observations substantiated these findings, revealing gaps in the availability of machinery, tools, and effective agroforestry integration, which collectively undermined implementation fidelity.

Infrastructure and accessibility challenges further constrained participation and access to project services. Evidence from FGDs in Omo Beko Kebele of Gomma district indicated that the Kebele's administrative office is located more than one hour away on foot, creating difficulties for beneficiaries in collecting fuel-efficient stoves and accessing extension support. Poor rural infrastructure is widely recognized as a major barrier to service delivery and technology adoption (World Bank, 2020).To address these barriers, participants recommended the establishment of decentralized distribution points and improved local access mechanisms to reduce transportation burdens and enhance inclusive participation in project activities.

Environmental and contextual stressors**:** Climatic and ecological conditions were found to significantly influence the outcomes of FOLUR interventions. Seedling survival was particularly affected by prolonged dry seasons, livestock encroachment, and rugged terrain, which collectively threatened the establishment of restored forest and coffee seedlings. Similarly, the transportation of compost in remote or steep areas constrained the consistent application of soil fertility practices, limiting the full realization of benefits from improved soil management. Climate variability and environmental stressors are known to undermine restoration initiatives and agricultural productivity, particularly in drought-prone regions (Intergovernmental Panel on Climate Change [IPCC], 2022). These findings underscore the necessity for context-sensitive adaptations that account for local environmental conditions and

logistical constraints to enhance the effectiveness and sustainability of project interventions (FAO, 2017).

Cultural and social barriers**:** Cultural norms and prevailing local practices were identified as key factors constraining the adoption of new technologies within FOLUR interventions. Certain fuel-efficient cook stove designs were incompatible with the preparation of local staples such as *enset* (qooccoo), resulting in partial or inconsistent utilization. Additionally, some farmers exhibited initial reluctance to engage in restoration and coffee rejuvenation activities due to perceived risks or limited familiarity with modern agricultural techniques Adoption of innovations in rural communities is strongly influenced by cultural compatibility, perceived risks, and social acceptance (Rogers, 2003). Researchers Field observations while most farmers actively participated in project activities, a minority continued to rely on traditional practices, highlighting the influence of cultural and experiential factors on adoption behavior (Rogers, 2003).

Institutional and capacity constraints: The effectiveness of FOLUR project implementation is strongly influenced by human and institutional resource capacity. In particular, inadequate numbers of extension staff and limited technical expertise hinder timely follow-up, supervision, and monitoring of project activities. Weak institutional capacity is a common constraint affecting the sustainability of development interventions (IFAD, 2019). The FOLUR Ethiopia M&E Officer revealed Key challenges such institutional coordination gaps across sectors, limited technical capacity at local levels, delays in implementation processes, and the need for stronger community awareness in some areas. Although monitoring and evaluation (M&E) mechanisms are established, participants recommended their strengthening to support adaptive management and enhance long-term accountability. These observations indicate that bolstering staff capacity, improving coordination, and providing targeted technical support are essential for sustaining project effectiveness and ensuring the successful delivery of intended ecological and socio-economic outcomes (World Bank, 2020).

Participants across FGDs, KIIs, and case studies offered several recommendations to enhance the effectiveness and sustainability of FOLUR interventions. Key suggestions included increasing financial support and providing seed capital to facilitate transitional activities, expanding access to essential tools, machinery, and agricultural inputs, and adapting technologies such as fuel-efficient cook stoves to align with local cultural and dietary practices. Participants also emphasized the need to strengthen monitoring, evaluation, and follow-up

systems, field supervision, and evidence-based reporting. A restoration tracking tool (RTT) developed through kobo toolbox platform deployed to track restoration activities. Field staff track each restoration activity using ODK collect on their smartphone.

Community-based monitoring mechanisms: strengthening digital data collection, improving restoration tracking systems, and integrating community monitoring data with national reporting systems would further improve effectiveness, improve accessibility through decentralized service points and logistical support, and promote the full integration of agroforestry and soil fertility management practices to maximize ecological and livelihood benefits. Such integrated and participatory approaches are widely recommended for sustainable rural development and natural resource management (FAO, 2017; IFAD, 2019).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

This study assessed household livelihoods, sustainable land use, forest restoration, improved cookstove adoption, and coffee rejuvenation practices in FOLUR intervention areas in Oromia, Ethiopia, drawing on data from 345 surveyed households and complementary qualitative evidence. The findings paint a coherent picture of meaningful progress alongside persistent structural challenges that must be addressed to secure long-term sustainability.

Before the FOLUR project, smallholder households in the study area lived with fragile and highly vulnerable livelihoods, almost entirely dependent on coffee farming and characterized by low productivity, limited diversification, aging coffee trees, degraded soils, and weak resilience to environmental and market shocks. Gender disparities further compounded household vulnerability, with women's participation in production and land management decisions remaining marginal. Following the intervention, however, meaningful livelihood improvements were recorded across the project areas. Households diversified income through livestock fattening, beekeeping, coffee seedling production, and agroforestry-related enterprises. Women and youth reported greater participation in income-related decision-making, and coordinated project support combining startup capital, training, and resource access enabled beneficiaries to establish or strengthen income-generating activities and adopt more sustainable farming practices.

Regarding coffee farm management, the study found considerable but uneven adoption of rejuvenation practices. Stumping of old coffee trees was the most widely practiced technique (64.6%), followed by replanting (63.2%), shade management (58.6%), and soil fertility management (57.7%), while pruning and sucker removal remained the least adopted practices at 34.3%. Despite these adoption gains, a critical implementation gap persisted: the majority of farmers applied these practices only occasionally rather than systematically. Pruning exhibited the weakest consistency, with only 1% of adopters applying it regularly, and about 73% of soil fertility management practitioners reported irregular application. Shade management emerged as the most consistently practiced activity. Mean score analysis confirmed moderate intensity of practice across all rejuvenation activities, indicating that although adoption has begun, sustainable integration into routine farm management has not yet been achieved. Logistical constraints, labor shortages, limited technical knowledge, and insufficient extension follow-up were identified as the principal barriers to consistent practice.

In the area of forest conservation and land restoration, FOLUR interventions demonstrably strengthened household knowledge, promoted widespread adoption of soil and water conservation measures, and supported active participation in tree planting and ecosystem

restoration. The vast majority of respondents perceived positive ecological changes, including improved tree growth, increased biodiversity, and greater vegetation cover. Integrated land management practices, including agroforestry and on-farm tree planting, contributed to reduced land degradation and more stable production environments, confirming that the project meaningfully advanced landscape-level conservation goals.

The adoption of improved cookstoves was one of the project's most notable achievements, with 88.4% of surveyed households adopting the technology. This high uptake translated into substantial co-benefits: 97.1% of respondents reported reduced firewood consumption, 96.8% experienced savings in time spent collecting fuel and cooking, 92.7% acknowledged improved indoor air quality, and 94.8% perceived reduced pressure on forest resources. Women and children, who bear the primary burden of fuel collection and cooking, benefited most from these time and health gains. Nevertheless, persistent barriers continued to constrain wider and more consistent use, including cultural incompatibility with certain traditional foods, limited access to maintenance and spare parts, inadequate local supply chains, and continued dependence on firewood for heating and lighting in areas lacking electricity.

Finally, the econometric analysis of adoption determinants revealed that household income, educational attainment, farm size, labor burden, and environmental awareness were the most consistent predictors of technology and practice adoption across both cookstoves and coffee rejuvenation. These findings underscore that adoption is not merely a matter of awareness or willingness but is deeply conditioned by economic capacity and access to knowledge and resources. Overall, the FOLUR project demonstrated that integrated, multi-dimensional interventions combining skills training, financial support, market linkage, and extension services can produce meaningful and measurable improvements in household livelihoods, land management, and forest conservation in smallholder coffee landscapes. Sustaining and deepening these gains will require continued investment in the enabling conditions that make consistent adoption possible.

5.2. Recommendations

The study recommends strengthening the long-term effectiveness and sustainability of the FOLUR project by addressing the financial, technical, institutional, and social barriers that continue to limit the full realization of project benefits. While the project has achieved significant success in improving livelihoods, promoting environmental restoration, expanding

clean energy adoption, and strengthening community participation, deeper structural support is required to sustain and scale these achievements.

Enhance Financial and Material Support

The study recommends strengthening financial and material support mechanisms to improve the sustainability of project interventions and reduce the economic burden faced by beneficiary households. Since coffee production remains the primary livelihood source for most households in the study areas, farmers require sufficient seed capital and timely financial assistance to cope with the temporary income losses associated with coffee rejuvenation practices, particularly during stumping and rehabilitation periods. Expanding access to essential agricultural tools, machinery, and production inputs such as coffee stumping machines, beehive boxes, composting equipment, and agroforestry materials would further increase the adoption and effectiveness of sustainable coffee management practices.

In addition, expanding microcredit schemes, revolving funds, and women's saving groups would strengthen the financial capacity of women's cooperatives and youth groups engaged in income-generating activities, enabling them to sustain and expand their businesses over time.

Strengthen Technical Assistance and Capacity Building

The findings indicate the need to strengthen technical assistance and capacity-building interventions to ensure the consistent adoption of promoted practices. Training programs on sustainable coffee management, agroforestry, soil fertility improvement, vermicomposting, and forest restoration should be expanded and delivered continuously to improve long-term impact. Refresher and advanced training opportunities should also be provided for women and youth in collaboration with regional and local institutions to enhance technical competence, leadership skills, and financial literacy. Furthermore, extension services should be strengthened through the recruitment of additional extension workers and increased field-level supervision so that more kebeles can be reached and farmers can receive regular follow-up support and guidance.

Promote Women's Economic Empowerment and Gender Inclusion

The study highlights the importance of strengthening women's economic empowerment and gender inclusion within project activities. Women-focused cooperative development should be expanded across all project districts by linking women's livelihood activities with forest restoration and sustainable land management initiatives.

Women's participation in household and community decision-making processes should also be encouraged through leadership development programs and public speaking training. Gender awareness programs targeting households and communities should also be strengthened to address persistent cultural barriers limiting women's economic and leadership roles.

Strengthen Sustainable Land-Use and Environmental Practices

The study recommends expanding sustainable land-use and environmental restoration practices across degraded landscapes in the project areas. Greater emphasis should be placed on promoting soil and water conservation measures, agroforestry systems, and participatory forest management approaches in order to strengthen ecological restoration and reduce land degradation.

Adaptive management strategies should also be introduced to improve seedling survival rates, including supplementary irrigation, mulching practices, and the use of drought-tolerant indigenous tree species. Furthermore, integrating livelihood activities with forest restoration through agroforestry-linked income-generating opportunities would encourage long-term community commitment to environmental conservation and ecological stewardship.

Improve Adoption of Fuel-Efficient Technologies

Although adoption of improved cook stoves was high, the study recommends strengthening efforts to improve sustained utilization and accessibility of fuel-efficient technologies. Improved cook stove designs should be adapted to local cooking practices and cultural preferences in order to increase household acceptance and consistent use. Establishing decentralized production and distribution centers would improve accessibility and facilitate the expansion of stove adoption in remote kebeles. Moreover, stove dissemination programs should be integrated with awareness campaigns and practical training that demonstrate the health, environmental, economic, and labor-saving benefits of energy-efficient technologies.

Institutionalize and Scale the Integrated Landscape Approach

The study findings show strong community demand for expansion of the FOLUR model into additional kebeles and districts. However, long-term sustainability cannot rely solely on continued project-based implementation. Instead, the integrated landscape approach should be institutionalized within existing government systems and local governance structures.

This requires integrating FOLUR methodologies including coffee management practices, participatory forest management approaches, cooperative development systems, and integrated

landscape planning tools into the formal programs of regional agricultural bureaus, forestry institutions, and cooperative promotion offices. Development agents trained under the project should be supported to serve as trainers within government systems to facilitate wider scaling at lower cost. In addition, district and kebele level coordination mechanisms established through the project should be formalized as permanent local landscape governance platforms with clear mandates and institutional support.

Recommendations for Scale-Up and Replication

The project should document and package its most effective approaches—especially the integrated package of skills training, startup capital, and market linkage support—into a replicable model that can be scaled to other coffee-forest landscapes in Ethiopia and the wider region. Future targeting should prioritize the most vulnerable households, including female-headed households, land-poor farmers, and youth without land rights, to strengthen equity and maximize development impact. To better understand long-term effectiveness, follow-up assessments should be conducted every two to three years to evaluate the sustainability of adoption behavior, the evolution of livelihood outcomes, and the extent of forest recovery beyond the project's implementation period. Finally, the project should disseminate its findings with the broader FOLUR global program and relevant Ethiopian government ministries to support evidence-based national policy on sustainable land management, household energy, and smallholder coffee development.

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