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CENTER FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Sustainability of Climate Change to Adaptation interventions in Loka Abaya Woreda, Sidama Region Ethiopia

A THESIS SUBMITTED TO CENTER FOR ENVIRONMENT AND SUSTAINBLE DEVELOPMENT STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN ENVIRONMENT AND SUSTAINBLE DEVELOPMENT

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I hereby confirm that the thesis titled “Sustainability of Climate Change Adaptation intervention in Sidama Region Loka Abaya woreda” prepared by Zerihun Estifanos, satisfies the university's regulations and meets the established criteria for originality and quality. This submission is in partial fulfillment of the requirements for the Degree of Master of Art in Development Studies (Environment and Sustainable Development).

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Declaration

I, the undersigned, declare that the thesis titled: Sustainability of Climate Change Adaptation interventions in Loka Abaya Woreda, Sidama Region Ethiopiais my original work and done by me for the degree of Master of Art in Development Studies (Environment and Sustainable Development) under the guidance and supervision of Belay Simane (Prof.). This thesis has not been presented for a degree in any university and that all source of materials used for the thesis have been duly acknowledged.

Signature _____

Zerihun Estifanos

Date _____

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Acronyms

AFD	Agence Française de Développement (French Development Agency)
ATI	Agricultural Transformation Initiative
CBA	Cost-Benefit Analysis
CBO	Community-Based Organization
COMESSA	Committee for Economic, Social and Cultural Affairs
CRGE	Climate Resilient Green Economy
CSA	Climate-Smart Agriculture
CSIRD	Climate Smart Integrated Rural Development
DOI	Digital Object Identifier
EMP	Environmental Management Plan
FAO	Food and Agriculture Organization (of the United Nations)
FGD	Focus Group Discussion
HH	Household
IDPR	Institute for Development Policy and Research
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
LCB	Local Capacity Building
MEI	Monthly Economic Indicator
NGO	Non-Governmental Organization
NRM	Natural Resource Management
OLS	Ordinary Least Squares
SAI	Sustainability of Adaptati
SAIIA	South African Institute of International Affairs
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SP	Social Protection
SPSS	Statistical Package for the Social Sciences
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WCED	World Commission on Environment and Development

Abstract

This study evaluates the sustainability of adaptation interventions in Loka Abaya Woreda, Sidama Region, Ethiopia, focusing on the influence of key contextual factors including community participation, institutional capacity and governance, adoption of Climate-Smart Agriculture (CSA) technologies, and financial resources. A mixed-methods approach was employed, integrating quantitative analysis through multiple linear regression and qualitative insights via thematic analysis to examine the relationships between these variables and the sustainability of the Climate-Smart Integrated Rural Development (CSIRD) project. Findings revealed that community involvement, CSA technology adoption, financial resources, and institutional capacity positively influence project sustainability. Additionally, the study emphasized the critical role of government policies and robust monitoring and evaluation systems in ensuring the long-term success of adaptation efforts. While the interventions demonstrated some positive outcomes, areas for improvement were identified, particularly in strengthening the integration of climate change policies and enhancing stakeholder coordination and resource allocation. Recommendations include strengthening policy integration, improving stakeholder collaboration, and ensuring sufficient resources to sustain adaptation practices in rural Ethiopia.

Keywords:*Sustainability, adaptation interventions, climate-smart agriculture, financial resources, community participation, institutional capacity, and rural development*

CHAPTER ONE

1. INTRODUCTION

1.1 Research Background

Climate change presents a persistent global challenge, affecting ecosystems, livelihoods, and environments worldwide. In rural areas, where the impacts on agriculture, water resources, and resilience are particularly severe (UNDP, 2019), addressing these challenges is crucial, as demonstrated in Ethiopia. This study focuses on evaluating the sustainability of climate change adaptation interventions in the Sidama Region, particularly within a specific project. It aims to identify key success factors while offering practical guidance on how current and future interventions can be effectively implemented.

The Intergovernmental Panel on Climate Change (IPCC, 2022) defines adaptation as the process through which natural or human systems adjust in response to actual or expected climatic stimuli, reducing harm or capitalizing on beneficial opportunities. For Ethiopia, where a significant portion of the population remains vulnerable to climatic shocks such as droughts and floods (UNDP Ethiopia, 2010), adaptation is crucial to safeguard national security and public welfare.

Given Ethiopia's high sensitivity to climate change, developing and implementing effective adaptive measures is vital. The country’s Climate Resilient Green Economy (CRGE) growth plan, initiated in 2011, outlines strategies for lowering climate risk through both adaptation and emissions reduction (CRGE, 2011). A key component of this strategy is the "Climate Smart Integrated Rural Development Project," which has been piloted in seven rural woredas, supported by $10 million USD from the Adaptation Fund through the CRGE facility. However, questions remain regarding the long-term sustainability of this project, particularly in terms of community involvement, technology adoption, and financial resources.

Initial findings from the study suggest that community awareness and participation are essential for achieving the project’s objectives. High levels of community ownership were found to significantly enhance project sustainability, despite challenges such as limited knowledge sharing

and inconsistent participation. While policy integration and stakeholder involvement were rated positively, improvements are needed in resource mobilization and institutional coordination.
The study identified financial sustainability as a major concern, revealing risks related to dependence on external funding and inconsistent resource commitments at the local level. Diversifying funding sources and securing adequate financial preparation for climate adaptation are therefore critical to sustaining long-term efforts.

Understanding these factors, along with addressing gaps in institutional capacity and financial sustainability, is vital for the continued success of climate adaptation initiatives in Ethiopia. The insights from this study are not only relevant to Ethiopia but can also inform adaptation strategies in other African countries facing similar climate challenges.

1.2 Statement of the Problem

The Sidama Region, like many other areas, faces significant challenges related to climate variability, including irregular rainfall patterns, prolonged dry seasons, and extreme weather events (UNDP, 2019). These conditions pose particular threats to local communities that rely on agriculture as their primary income source. In response, various stakeholders have launched climate adaptation interventions in Loka Abaya Woreda, such as the Climate Smart Integrated Rural Development Project, to improve resilience through sustainable agriculture, water management, and natural resource conservation (UNDP, 2019). However, the sustainability of these interventions remains uncertain, as several underlying issues impede the achievement of long-term goals. Strengthening community engagement, governance, and financial stability is crucial to enhancing the effectiveness and sustainability of climate change adaptation measures in the region.

One such intervention is the "Climate Smart Integrated Rural Development Project," which has been piloted in Loka Abaya Woreda since April 2018. The project aims to build resilience against frequent droughts in seven agro-ecological zones by implementing water, agriculture, and natural resource management strategies, with a total funding of $10 million USD (Adaptation Fund Board, 2021). Despite these efforts, the sustainability of the project remains compromised, primarily due to insufficient community participation. Community involvement is crucial for the

success of adaptation interventions in Ethiopia, as it ensures that local populations are engaged in the planning, implementation, and evaluation processes (Wang et al., 2021).

In addition to community participation, institutional capacity and governance are key determinants of sustainability. Weak institutional structures and governance frameworks have hindered the effective development and implementation of adaptation measures. Good governance is critical for addressing climate change and promoting the sustainability of interventions (AFD VII, 2010).

Institutions play a vital role in information dissemination, resource mobilization, capacity building, and leadership, all of which are essential for fostering Climate Change Adaptation (CCA) (Agrawal, 2008). However, the lack of strong networks and governance among institutions has impeded the effective execution of adaptation measures.
Another crucial factor in ensuring sustainability is the adoption of climate-smart agricultural (CSA) technologies. While these technologies are available in Loka Abaya, their use remains limited. CSA technologies, which include sustainable practices in crop production, livestock management, and water conservation, are essential for long-term resilience and sustainability.

Moreover, financial constraints represent a significant barrier to the sustainability of adaptation interventions. There is a marked scarcity of funding for climate change adaptation efforts, particularly in vulnerable regions like Loka Abaya Woreda (SAIIA, 2021). Adequate financial resources are necessary to support community-based adaptation interventions and to ensure their continued success.

Therefore, the challenges surrounding the sustainability of climate change adaptation interventions in the Sidama Region, particularly in Loka Abaya Woreda, require further investigation. This study seeks to address these gaps by evaluating the levels of community participation, institutional capacity, funding availability, and stakeholder cooperation. By analyzing these factors, the research aims to enhance the effectiveness of adaptation measures and assist both communities and the government in minimizing risks that threaten the long-term sustainability of interventions in the Sidama Region.

1.3 Objective of the Study

1.3.1 General Objective

- The general objective of this thesis was to assess the sustainability of climate change adaptation interventions in Loka Abaya Woreda, Sidama Region

1.3.2 Specific Objectives

The specific objectives were to: -

- examine the nature and extent of community participation and engagement inthe adaptation intervention.
- assess institutional capacityto manage the climate-smart integrated rural development project.
- examine the adoption rate of climate-smart agricultural technologies by local communities
- evaluatefinancial sustainability and resource allocation.

1.4 The Scope of the Study

The study focused on adaptation interventions in agriculture in Loka Abaya woreda. It will also assess the factors affecting the long-term success, resilience, and sustainability of the CSIRD project interventions. Geographically, this research is limited to the Sidama region, specifically obtaining information from the Loka Abaya woreda.

1.5 Significance of the Study

This study holds significant implications for climate change adaptation in Loka Abaya woreda, Ethiopia, by addressing critical gaps in knowledge and practice. Through an in-depth analysis of community participation, financial resources, institutional capacities, and technology adoption, the research aims to inform evidence-based policies, empower local communities, refine adaptation practices, and attract essential funding. By contributing to academic knowledge and guiding future research and interventions, the study has broader implications for sustainable

climate change adaptation not only in Loka Abaya but also in similar contexts, offering a comprehensive foundation for informed decision-making and improved resilience against climate-related challenges.

1.6 Limitation of the Study

This research seeks to comprehensively understand factors influencing the long-term success of adaptation interventions but faces several limitations.

- First, the study's timeframe may be too short to capture the full impact of development projects, especially given rapid socio-economic and climate changes.
- Second, logistical constraints limit the scope of the study, potentially affecting sample size, research techniques, and variable inclusion.
- Lastly, the study focuses on only one woreda, limiting the generalizability of its findings to the national level.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. INTRODUCTION

Climate change adaptation refers to a range of techniques and actions aimed at mitigating the negative effects of climate change and strengthening resilience in vulnerable communities (IPCC, 2014). The concept of sustainability in the context of adaptation interventions relates to the methods' long-term effectiveness and resilience in the face of changing climatic challenges (Biesbroek et al. 2015).

Early climate change adaptation activities were mostly focused on localized initiatives and responses to observable changes in climate patterns, laying the groundwork for future interventions (Smit et al., 2000). The history of global agreements, such as the Kyoto Protocol and the Paris Agreement, illustrates the growing realization of the importance of coordinated international actions to address climate change (UNFCCC, 1997; UNFCCC, 2015).

2.1.1. Sustainability

Sustainability is often defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. One widely cited definition comes from the Brundtland Commission's report "Our Common Future," published by the World Commission on Environment and Development (WCED) in 1987.

Sustainability of interventions refers to the consideration of environmental, social, and economic factors throughout the entire project lifecycle to ensure that the project's impacts are positive and enduring. It involves assessing the project's ability to meet present needs without compromising the ability of future generations to meet their own needs, a concept often attributed to the Brundtland Commission's definition of sustainable development (World Commission on Environment and Development, 1987).

Sustainability of adaptation interventions refers to the long-term effectiveness and viability of measures implemented to address the impacts of climate change. These interventions should be able to maintain their intended benefits, withstand changing conditions, and ensure the well-being of affected communities and ecosystems over time (Smith J, 2022).

2.1.2. Adaptation

Climate adaptation refers to the process of adjusting to the current or expected climate change and its effects. This adjustment seeks to moderate harm or exploit beneficial opportunities. Adaptation strategies can be undertaken at various levels, including individuals, communities, regions, and nations. Adaptation measures can be proactive, anticipating future changes, or reactive, responding to changes that have already occurred. (IPCC, 2018).

In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects." This definition emphasizes the multifaceted nature of adaptation, acknowledging its relevance not only in human systems but also in natural ecosystems.

Adaptation can take various forms, including changes in policies, practices, behaviors, and technological advancements. It involves understanding and addressing vulnerabilities while building resilience to climate impacts (Holsman, 2023). Adaptation is an integral component of broader strategies to address climate change, alongside mitigation efforts aimed at reducing greenhouse gas emissions.

2.1.3. Rural Development

According to world bank rural development refers to the process of improving the economic, social, and environmental well-being of rural areas. It involves initiatives, policies, and strategies aimed at enhancing the quality of life for people living in rural communities, fostering economic growth, and addressing challenges specific to rural regions.

2.1.4. Climate Smart Agriculture

Climate-smart agriculture (CSA) is an approach to developing the technical, policy, and investment conditions to achieve sustainable agricultural development for food security under climate change." (FAO, 2010). Climate-smart agriculture encompasses a wide range of sustainable practices that aim to mitigate the impacts of climate change while ensuring food security and environmental sustainability (Huang et al., 2023). The term "climate-smart" is often used in the context of agriculture, but it can be applied more broadly to various sectors.

2.1.5. Climate Smart Integrated Rural Development

Climate-smart integrated rural development in Ethiopia is crucial for building resilience and promoting sustainable development (Majumdar, 2020). Ethiopia is vulnerable to climate variability and extremes, such as droughts and floods, which can have severe impacts on agriculture, water resources, and livelihoods (Holsman, 2023; Tilman et al., 2011; Shumilova et al., 2023; Kesar et al., 2021). Here are key components of climate-smart integrated rural development in Ethiopia:

Climate-Smart Agriculture (CSA): - Implementing agricultural practices that enhance productivity, adaptability, and contribute to climate change mitigation. This may include agroforestry, conservation agriculture, improved water management, and the use of climate-resilient crop varieties.

Water Resource Management: Developing and improving water infrastructure and management systems to ensure efficient water use, especially in the face of changing climate patterns. This may involve constructing small-scale irrigation systems, rainwater harvesting, and watershed management.

Renewable Energy Access: Promoting the use of renewable energy sources, such as solar and wind, to provide clean and sustainable energy solutions for rural communities. This can contribute to reducing dependence on traditional biomass and improving energy access.

Natural Resource Conservation: Implementing measures to conserve and sustainably manage natural resources, including soil and forests, to prevent degradation and enhance ecosystem services.

Diversification of Livelihoods: Encouraging rural communities to diversify their sources of income, such as through non-farm activities and eco-friendly enterprises, to reduce dependence on climate-sensitive sectors.

Community-Based Adaptation: Engaging local communities in the planning and implementation of adaptation strategies, considering their traditional knowledge and practices. This involves building the capacity of communities to cope with climate-related challenges.

Institutional Capacity Building: Strengthening local institutions and governance structures to facilitate effective climate-smart development planning, implementation, and monitoring at the community level.

Given the diverse agroecological zones and varying climate risks across Ethiopia, climate-smart integrated rural development should be context-specific and take into account the needs and priorities of different regions and communities. Additionally, community participation and collaboration among government agencies, NGOs, and local stakeholders are essential for the success of such initiatives.

2.1.6. Climate Smart Integrated Rural Development Project in Ethiopia

Ethiopia has formulated a comprehensive strategy aimed at mitigating the impacts of climate change and enhancing the adaptive capabilities of its vulnerable communities. This strategic approach is specifically crafted to bolster resilience and harness resources from various donors. The Adaptation Fund Board, a key donor entity, has endorsed its support for the implementation of Ethiopia's Climate-Resilient Green Economy (CRGE) strategy (MoF, 2017).

In a significant development, the organization has given the green light to a substantial project valued at 10 million USD. This project is strategically deployed across seven woredas (districts) in Ethiopia, effectively channeling the allocated funds to address climate vulnerabilities and

fortify the adaptive capacity of the targeted communities. The approval and initiation of this project mark a crucial step forward in Ethiopia's commitment to combat the challenges posed by climate change and underscores the collaborative efforts between the country and international donors in pursuing sustainable and resilient development.

The overall objective of the project is to increase resilience to recurrent droughts in seven agro-ecological landscapes in Ethiopia. An integrated water, agriculture and natural resource management approach will be adopted to achieve the following outcomes:

- Increased capacity to manage current and future drought risks through improved adaptation planning and sustainable management of agro-ecological landscapes
- Enhanced and secure access to potable water supply, and small-scale irrigation in drought affected areas
- Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses
- Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level
- Increased ecosystem resilience in response to climate change and variability-induced stress

2.1.7. Impact Assessment

Climate Resilience: Assess the degree to which the initiative has improved rural communities' ability to withstand the effects of climate change. This entails evaluating shifts in susceptibility to risks associated with climate change, adaptive capability, and vulnerability.

Socioeconomic Development: Evaluate how the project would affect rural populations' general state of development. This entails assessing shifts in a number of socioeconomic indices, including healthcare, employment, education, and income.

2.1.8. Environmental Sustainability

Natural Resource Management: Evaluate the project's contribution to the advancement of sustainable techniques for managing natural resources. This entails assessing modifications to water management, biodiversity preservation, and land use.

2.1.9. Community Empowerment

Participation and Inclusion: Assess the extent of community involvement in project planning, execution, and decision-making. Examine whether vulnerable groups, such as women and marginalized communities, were involved and benefited from the project**.**

Capacity Building: Evaluate the success of capacity-building efforts that aim to provide local populations with the knowledge and skills required for sustainable development and climate adaption.

2.1.10. Innovation and Technology Adoption

Technology Transfer: Assess the technological and innovation advancement implemented by rural communities in climate smart ways. Determine if these technologies are sustainable, fit-for-purpose and enhances productivity within the identified context.

Knowledge Transfer: Assess the capability of disseminating knowledge to the target groups especially in aspects to do with training and education aimed at enhancing sustainable practices.

2.1.11. Cost-effectiveness and Efficiency

Resource Utilization: Evaluate the effectiveness of resource management and productivity of the projects in completion. This involves the assessment of efficiency of resources, which includes financial, human as well as technological resources in order to assess whether or not it aligns to project objectives.

Return on Investment: Calculate how much of an economic return there is in arriving at the goal as compared with the expenses made in the project. This goes a long way into helping stakeholders to determine the financial success and/or financial feasibility of the project.

2.1.12. Adaptive Management and Learning

Adaptive management strategies, which incorporate lessons learned and adjust approaches based on monitoring and evaluation findings, are crucial for the success of climate-smart rural development projects. Embracing local institutions and indigenous knowledge can enhance the adoption and scaling of climate-smart agriculture innovations by improving information gathering and dissemination, resource mobilization, stakeholder networking, capacity building, and leadership in adaptation programs (Makate, 2019).

Incorporating both scientific techniques and traditional practices can help develop resilience to climate change effects in high-altitude arid communities. (Kumar et al., 2014) Strengthening the role and capacity of local institutions in gathering grassroots information and implementing programs is essential for effectively addressing vulnerability to both climatic and non-climatic factors. (Singh et al., 2019) Endogenous development approaches that build on indigenous knowledge systems can facilitate effective community education, mobilization, and participatory responses to climate change. (File & Derbile, 2020)(Makate, 2019)(Kumar et al., 2014)

Policy interventions should aim to enhance climate change adaptation through innovations in soil and water conservation, access to water for irrigation and domestic use, climate-smart housing architecture, and agroforestry within the framework of decentralized climate adaptation planning (Sakapaji, 2022) (Makate, 2019) (Singh et al., 2019) (File & Derbile, 2020). By facilitating the sharing of lessons learned and best practices, projects can contribute to a broader understanding of effective climate-smart rural development strategies.

Evaluating the effectiveness of climate-smart integrated rural development projects is essential for understanding their impact, identifying areas for improvement, and informing future initiatives (Defe & Matsa, 2021). This process helps ensure that interventions are evidence-based, sustainable, and responsive to the evolving challenges posed by climate change. Embracing local institutions and indigenous knowledge in climate change adaptation planning can enhance the adoption and scaling success of climate-smart agriculture innovations in smallholder farming comhening the role and capacity of local institutions in assembling grassroot information and

implementing programs is crucial for effectively addressing vulnerability to both climatic and non-climatic factors. (Singh et al., 2019)

Integrating micro-level insights from natural resource management, agricultural research and development, infrastructure, and human capital across regions should be an integral part of climate adaptation planning. (Singh et al., 2019) As such, development practitioners and policymakers must devise strategies that converge rural development and climate adaptation considerations to build community resilience and social-ecological sustainability under climate change impacts. (Lai et al., 2021) (Makate, 2019) (Singh et al., 2019) (File & Derbile, 2020)

2.2. Theoretical Framework

The theoretical framework for this study draws upon established theories that provide insight into the sustainability of climate-smart rural development projects, which emphasis particularly on community participation, institutional/governance capacity, CSA technology adoption, and financial sustainability. These theories will guide the analysis of key factors influencing the long-term success of climate change adaptation efforts.

2.2.1. Sustainable livelihoods Framework

The Sustainable Livelihoods Framework (SLF), originally developed by the UK Department for International Development (DFID), remains highly relevant for rural development research (Scoones, 2015). The framework emphasizes the importance of five key assets—natural, social, human, financial, and physical—necessary for sustainable livelihoods. It further highlights the role of policies, institutions, and processes in enhancing these assets.

SLF is directly applicable to this research as it offers a comprehensive lens to analyze the role of community participation (social capital) and institutional capacity (human capital) in achieving sustainable development outcomes (Bebbington, 2020). The framework aligns with the study's objective of assessing how communities' involvement in climate adaptation projects impacts long-term sustainability.

Recent studies, such as those by Chambers and Conway (2018), continue to emphasize the SLF's relevance for understanding how rural communities engage in and benefit from sustainable

development interventions, particularly in the context of climate change adaptation (Morse & McNamara, 2019).

2.2.2. Diffusion of Innovation Theory

The Diffusion of Innovation (DOI) Theory, first proposed by Rogers (2003), explains how innovations spread within a social system. This theory has been widely applied in rural development and agricultural technology studies to analyze the factors that influence the uptake of new technologies (Juma, 2020). DOI theory categorizes adopters into innovators, early adopters, early majority, late majority, and laggards, highlighting the role of communication channels and social networks.

DOI is essential for understanding the adoption of climate-smart agricultural technologies. It provides a framework for analyzing the rate and factors influencing farmers' adoption of practices such as drought-resistant crops, conservation agriculture, and water-efficient irrigation techniques (Asfaw et al., 2021).

Kebede and Haji (2021) applied DOI theory to examine the diffusion of climate-smart agricultural innovations in Ethiopia, identifying both individual and institutional barriers to technology uptake. Similarly, Melesse et al. (2022) investigated the role of social networks in facilitating or hindering the adoption of climate-adaptive technologies in rural African communities.

2.2.3. Institutional Theory

Institutional Theory explains how institutions, as structured systems of norms and rules, shape organizational behavior (Scott, 2014). The theory suggests that institutions operate within a set of formal and informal constraints that influence decision-making and actions. This theory has been widely applied to understand governance structures and resource allocation within development projects (North, 1990; March & Olsen, 2019).

Institutional Theory is applied to assess institutional capacity in the context of policy integration, stakeholder engagement, resource allocation, and coordination mechanisms. It provides a framework for understanding how governance structures impact the sustainability of rural development interventions (Kostka & Zhang, 2021).

Schillemans and Bjurstrøm (2020) explored the role of institutional frameworks in ensuring effective governance in climate adaptation projects. Other studies, such as those by Linnenluecke et al. (2022), have emphasized the importance of strong institutional frameworks in enabling long-term sustainability in climate-resilient development.

2.2.4. Stakeholder Theory

Stakeholder Theory, originally proposed by Freeman (1984), focuses on identifying and involving all relevant stakeholders who have an interest in the success of a project. It stresses that the success of an organization or project is contingent on addressing the interests and concerns of diverse stakeholder groups (Bryson, 2018).This theory is relevant to analyzing **community participation and engagement** in climate-smart rural development. Stakeholder Theory emphasizes the need to involve local communities, government bodies, and other actors in all stages of project implementation to foster ownership and ensure long-term sustainability (Mitchell et al., 2018).

Recent studies, such as those by Mielke et al. (2021), have highlighted the critical role of stakeholder engagement in the success of rural development and climate adaptation projects. The involvement of diverse stakeholders ensures more inclusive decision-making and higher levels of community ownership, which are crucial for project sustainability (Ramirez et al., 2022).

2.2.5. Financial Sustainability Theory

The Financial Sustainability theory underscores the importance of resource mobilization, financial management, and revenue diversification for the long-term viability of projects (Edwards, 2019). It suggests that projects are more likely to be sustainable if they have diversified funding sources, efficient financial planning, and mechanisms for generating

continued revenue post-implementation.This theory helps assess the **financial sustainability** of climate-smart rural development projects by analyzing how resources are mobilized and managed to ensure the continuation of project activities even after external funding ends (Smith & Whittington, 2020).

A study by Nazari et al. (2022) on financial sustainability in rural development projects stressed the need for effective resource mobilization strategies to maintain momentum after initial project funding is exhausted. Additionally, research by O'Connor et al. (2021) examined financial management best practices in climate adaptation programs to promote sustainable outcomes.

For this study on the sustainability of climate-smart integrated rural development projects, the Sustainable Livelihoods Framework (SLF) is the most suitable theoretical foundation. The SLF offers a holistic approach to analyzing sustainability by emphasizing the five key assets—natural, social, human, financial, and physical capital—necessary for achieving sustainable livelihoods in rural communities.

This framework is particularly relevant as it aligns with the study's focus on assessing community participation, institutional capacity, and financial sustainability, which are central to the long-term success of climate change adaptation efforts. The SLF underscores the importance of social capital, which directly relates to the research's objective of analyzing the role of community engagement in sustaining rural development projects. Additionally, the framework acknowledges the influence of institutional capacity and governance mechanisms, such as policy integration and resource allocation, which are crucial for ensuring the continuity of adaptation interventions. By considering the financial dimension, the SLF also supports the analysis of how resources are mobilized and managed to ensure the sustainability of climate-smart projects. Given its adaptability to rural development contexts and its comprehensive approach to sustainability, the SLF is the most applicable theoretical framework for this study.

2.3. Empirical Literature

2.3.1. Community Participation in Climate Change Adaptation

Community engagement is essential for the relevance, sustainability, and effective implementation of climate adaptation interventions. Several studies highlight the importance of involving local communities from the design phase to ensure long-term sustainability. In Ethiopia, however, community participation in adaptation projects faces considerable challenges. Simane (2013, 2014) found that community-based adaptation (CBA) efforts in the Blue Nile Highlands and Choke Mountain Watersheds were largely unsustainable due to insufficient community participation, inadequate training, and a lack of local government commitment.

Reid (2015) examined the role of participatory natural resource management in enhancing climate resilience among pastoral communities, demonstrating that development actors play a crucial role in supporting these efforts. Similarly, Adego (2018) emphasized the importance of direct farmer involvement in planning, monitoring, and evaluating climate-smart practices to ensure sustainability. These studies collectively underscore the importance of community participation in Ethiopia's climate change adaptation strategies while highlighting the need to address existing barriers to foster local engagement.

2.3.2. Institution and Governance for Adaptation Interventions

Institutional capacity and governance play pivotal roles in ensuring the sustainability of adaptation interventions in Ethiopia. Weak, poorly organized institutions at the regional and woreda levels often result in inefficiency and hinder project outcomes. Bryan (2009) and Deressa (2008) emphasize the importance of institutional support, including access to credit, information, and extension services, which significantly influence farmers' decisions to adopt climate adaptation strategies.

Conway (2011) further highlights the need for "low-regrets" measures and long-term livelihood security to address climate risks. Ozlu (2015) explores the potential for proactive urbanization to shift economic activity, improving living conditions as part of adaptation strategies. These studies collectively illustrate the critical role that institutional capacity and governance play in the success of Ethiopia’s adaptation interventions.

2.3.3. Technology Adoption in Climate-Smart Agriculture

The adoption of climate-smart agricultural (CSA) technologies has shown promising results in Ethiopia. For instance, small-scale irrigation systems have been found to significantly increase household income (Mume, 2021). The Climate-Smart Villages (CSVs) concept, introduced in regions such as Borana, has enhanced the adaptive capacity of smallholder farmers (Ogada, 2018). However, technology adoption is hindered by factors such as land tenure issues and lack of knowledge (Zerssa, 2021). Furthermore, livestock technologies and improved grazing land management practices have been identified as effective strategies for mitigating climate change in Ethiopia (Mekuriaw, 2019).

2.3.4. Financial Resources and Funding Challenges

Adequate financial resources are critical for the successful local implementation of adaptation programs, particularly in low- and lower-middle-income countries (Motsa, 2011; Prasad and Sud, 2019). In Ethiopia, obtaining sufficient funding for adaptation initiatives has proven difficult. Research points to several key challenges, including the lack of overall funding (Kidane, 2021), difficulties in financing essential services like healthcare (Mariam, 2001), and the significant resource requirements in sectors like agriculture (Tafere, 2013). Additionally, a severe shortage of human resources necessary for basic health services (Kombe, 2005) further hampers the country's adaptation efforts. These financial constraints underscore the substantial obstacles faced by Ethiopia's adaptation interventions.

2.3.5. The Present Study and Gaps in Literature

This study fills a gap in the existing literature by focusing on a specific agroecological zone in Ethiopia, namely the lowlands of Wolaita in southern Ethiopia. The review of literature shows that smallholder farmers in this region employ various climate adaptation strategies, such as crop diversification, water management, soil conservation, and agroforestry, all of which have positively impacted their resilience to climate change and agricultural productivity (Aboye, 2023).

However, the study also highlights several obstacles to sustainability of adaptation intervention, which are limited access to financial resources, inadequate institutional support, and a lack of

technical capacity and awareness among farmers to adopt CSA and other technologies. These challenges hinder the effectiveness of climate adaptation projects, despite their potential to increase resilience. For instance, a UNDP terminal evaluation of the Integrated Landscape to Enhance Food Security and Ecosystem Resilience Project highlights that access to resources and decision-making power are key determinants in the successful implementation of climate adaptation strategies.

Other research also shows that financial constraints significantly affect the effectiveness of adaptation interventions in Ethiopia (Macura et al., 2021). Limited financial resources restrict the capacity of communities to implement necessary adaptation measures, such as building resilience infrastructure or adopting climate-smart technologies. Furthermore, variations in project design and implementation due to differing funding sources can impact the overall success of adaptation efforts.

In their empirical study on climate change adaptation in Ethiopia, Kidane et al. (2022) delve into the challenges faced by government-led interventions at the local level. The study focuses on the Raya Azebo district, highlighting barriers such as top-down policy formulation, weak coordination mechanisms, and resource constraints that impede the successful execution of adaptation interventions.

Moreover, Simane et al. (2014) assess the sustainability of community-based adaptation (CBA) activities in 20 community-based organizations in the Blue Nile Highlands. Using a multi-criteria analysis framework, they found that two-thirds of these CBA efforts were unsustainable across multiple dimensions—social, institutional, technical, financial, and environmental. Barriers such as inadequate community participation, local government commitment, and insufficient farmer capacity were identified as key challenges.

The empirical literature reveals that several factors, including financial resources, community participation, institutional capacity, and technological adoption, significantly influence the sustainability of climate adaptation interventions in Ethiopia. However, these factors also present substantial challenges that must be addressed to ensure the long-term success of adaptation

projects. This study contributes to a deeper understanding of these challenges and offers insights for improving the design and implementation of future adaptation initiatives.

2.4. Conceptual Framework

The purpose of this research's conceptual framework is to offer a theoretical underpinning and structure for examining the variables affecting the project's effectiveness and sustainability. Important independent variables that are thought to have an effect on the project's results are included in the framework. The central focus of this study is to understand how community participation, Institutions, government policies/governance,technological infrastructure and adoption, financial resources, and monitoring and evaluation systems collectively contribute to the overall sustainability and effectiveness of the project

Conceptual Framework for the sustainability of Climate Change Adaptation Intervention

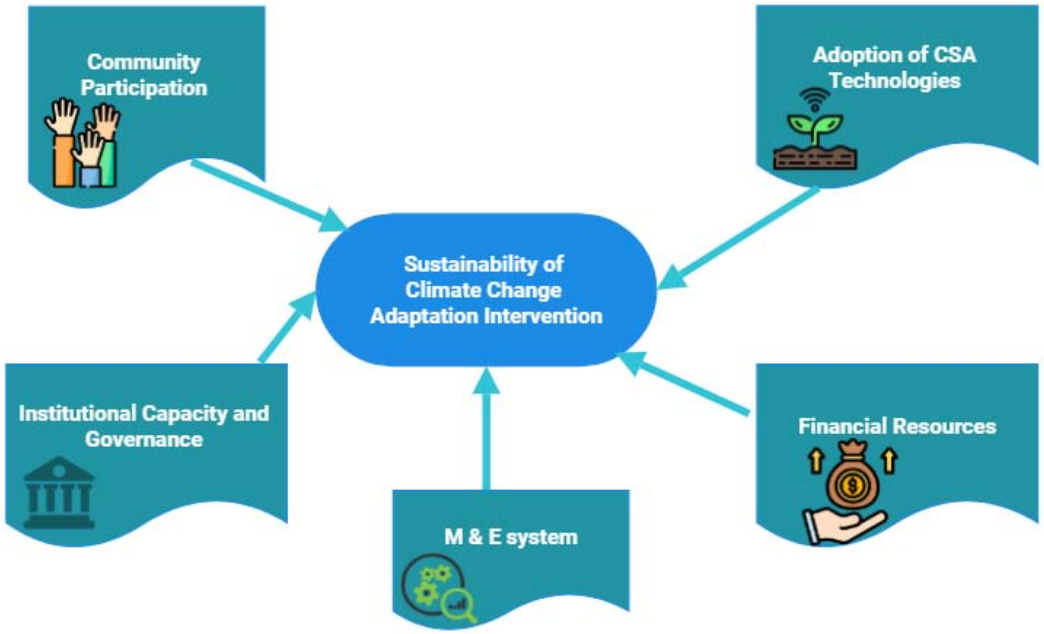

Figure 1:- Conceptual Framework

Source: Own conceptual framework

This conceptual framework is designed to explore the key factors influencing the sustainability of climate-smart integrated rural development projects in Sidama Region. In particular, the framework aims to understand the relationships between several independent variables—such as community participation/engagement, institutional capacity/governance,technology adoption—andfinancial sustainability the dependent variable, sustainability. These variables have been identified based on a review of relevant literature and theoretical model.

The dependent variable, sustainability of adaptation intervention, refers to the long-term success and viability of climate adaptation projects in maintaining their intended benefits over time, even after external funding or support has ended. The independent variables are factors that are hypothesized to have a significant impact on sustainability of the intervention, and they reflect critical elements such as the level of community involvement& engagement, the strength of institutional capacity and governance, financial management practices& sustainability, and the rate of CSA technology adoption in rural communities.

By examining the relationship between these variables, this framework seeks to provide a comprehensive understanding of the mechanisms that contribute to or hinder the sustainability of climate-smart interventions in the Sidama region of Ethiopia. The relationships between these variables are visually represented in the conceptual model above.

Dependent variable: Sustainability of Adaptation Intervention

Independent Variables

- Financial Resources
- CSA technologies
- Government policies/ Governance
- Community participation
- Monitoring and Evaluation Systems

Resources

Relationship with Sustainability: -Sufficient funding is a prerequisite for the initiation and continuation of programs related to rural development. Long-term finance is essential for making sure that development projects are carried out without interruption. The monetary assets allotted

to the project are represented by the financial resources. Sufficient funding is necessary for the project's execution, upkeep, and success.

Technological Infrastructure

Relationship with Sustainability: **-** Proper technology infrastructure acts as a stimulant to support the long-term viability of rural development programs. It accomplishes this through promoting economic diversification, enhancing agricultural methods, and enabling effective resource utilization.

Government Policies/Governance

Relationship with Sustainability: - Supportive government policies and effective governance practices are imperative for the sustainability of rural development projects. Clear policies ensure consistent support, proper resource allocation, and the establishment of regulatory frameworks conducive to long-term success.

Community Participation

Relationship with Sustainability: **-**One of the main pillars of sustainable rural development is community involvement. Planning, decision-making, and execution processes that involve communities more fully enhance the chances of project ownership and longevity. Put another way, it is believed that the level of community involvement will affect the project's efficacy and sustainability.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. Lok Abaya Woreda

Loka Abaya Woreda, located in Ethiopia's Sidama Region, is a vibrant and diversified region with distinct physical and socioeconomic characteristics. Located in the Rift Valley, with a total area of around 1,190 km^2. The landscape of the woreda includes plains, hills, and highlands. Tropical highlands are generally characterized by mixed rainfall patterns, mild temperatures, and an abundance of natural resources. It can be classified as lowland/highland in terms of agroecology, with an average yearly temperature between 17 and 20 degrees Celsius. The main economic activity in the woreda is agriculture, and the majority of the population is made up of Sidama people, who are distinguished by their unique cultural practices and language, Sidamu Afoo. Coffee is the main cash crop, while subsistence farming and livestock rearing also play crucial roles in the local economy.

Loka Abaya woreda has multiple basic and secondary schools, healthcare centres, and clinics, but access to higher education and comprehensive medical services is limited. Efforts to increase literacy, healthcare access, and public services are underway. The woreda is confronted with environmental issues such soil erosion, deforestation, and water scarcity, which are made worse by population growth and climate change. To solve these concerns, conservation activities and sustainable farming practices are encouraged. There are also ongoing development initiatives concentrating on healthcare, education, infrastructure, and agricultural production with the goal of improving the general standard of living for Loka Abaya people and advancing sustainable development in the area.

Based on the 2007 Census conducted by the CSA, this woreda has a total population of 99,233, of whom 50,603 are men and 48,630 women; 1,059 or 1.07% of its population are urban dwellers.

STUDY AREA MAP

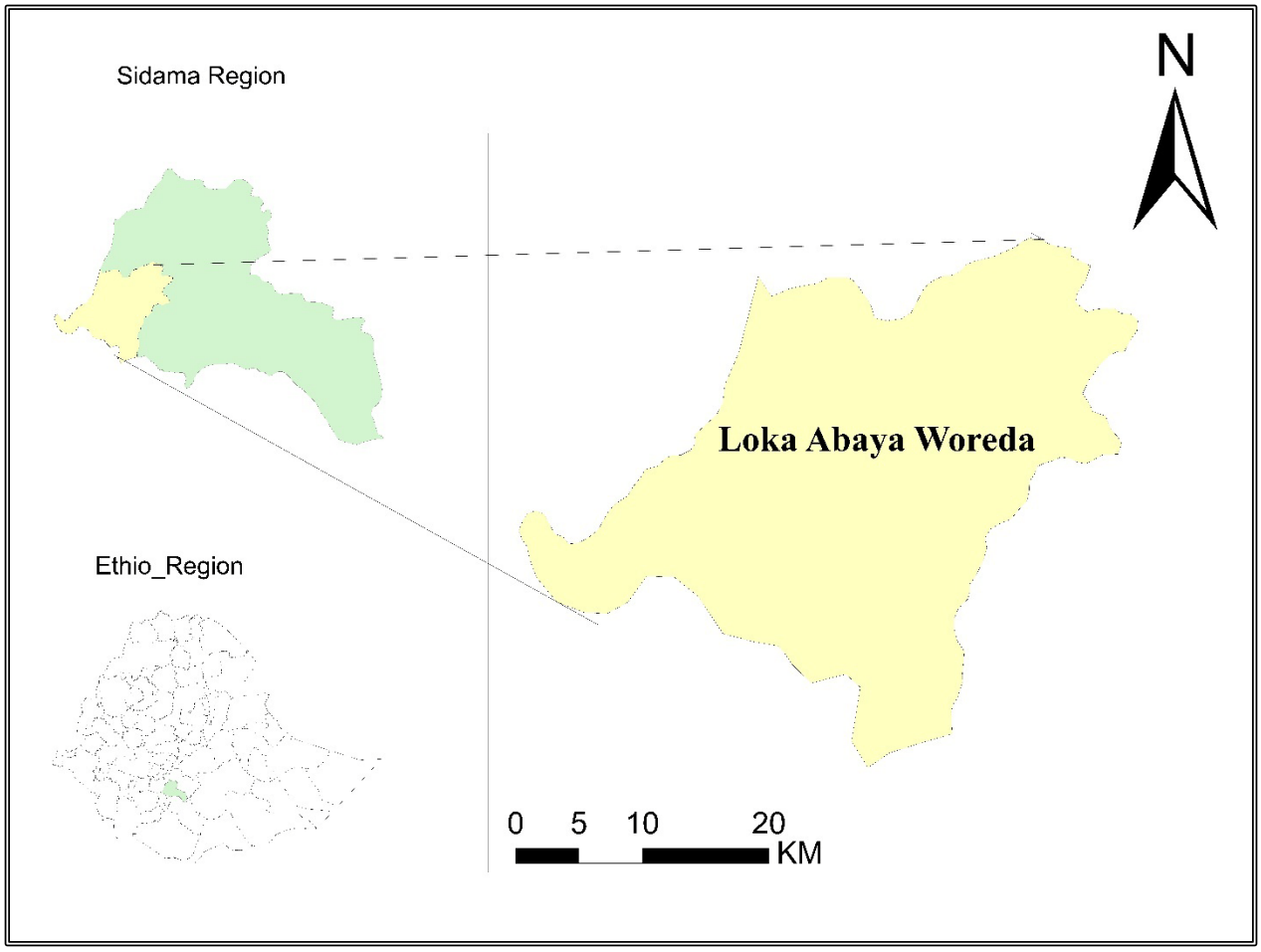

Figure 2:- Location of the study area

3.2. Research Design

A cross-sectional and descriptive study design was employed in this research. A cross-sectional study collects data from a population at a single point in time to determine the prevalence of specific characteristics or outcomes within that community (Thomas, 2023). This study simultaneously gathering data from key stakeholders and households to assess critical factors influencing sustainability. Such as institutional capacity, community involvement, the adoption

of climate-smart agricultural technologies, and financial sustainability. This approach allowed for a comprehensive snapshot of these variables at the time of data collection.

3.3. Research Approach

The research employed a mixed-methods approach, incorporating both qualitative and quantitative techniques, to offer a thorough and nuanced comprehension of the variables influencing the sustainability of the adaptation intervention. By enabling data triangulation, this method improves the overall validity and dependability of the results. When neither type of data alone can provide a deeper knowledge of the study problem, a combination of both quantitative and qualitative data is used(Abreham, 2023).

3.4. Population and Sampling

3.4.1. Population

The target population refers to the group of individuals on which the intervention aims to conduct research and draw conclusions (Luise Barsbee,2018). Thestudytarget population was project beneficiaries, non-beneficiaries, project implementers, and stakeholders at various levels ranging from federal to kebele, as well as government stakeholders at federal, regional, and woreda levels.

3.4.2. Sampling

Sampling is a statistical method used to collect data from a subset of a larger population, allowing for inferences about the entire group (Creswell & Creswell, 2017). In this study, a mixed sampling method was employed, incorporating both purposive and stratified random sampling techniques were used to ensure comprehensive representation of the study population.

Purposive sampling was utilized to deliberately select individuals with specific characteristics relevant to the research objectives, as outlined by Nikolopoulou (2022). This approach ensured that key groups with essential insights the research topic were selected. Additionally, stratified random sampling was applied,the population was divided into homogeneous subgroups or strata.

The stratification was based on socio-economic factors and kebele level to capture variations due to practices between interventions. This approach allowed for better representation of the population and minimized sampling bias.

3.4.3. Sample Size

In alignment with the research questions, a total sample size of 307 participants were selected using a simple random sampling technique. This sample size was deemed adequate to provide reliable and generalizable findings for the study.

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

where:

- n = required sample size
- N = total population size (92,000)
- e = margin of error (desired level of precision)

This sample size provides a 95% confidence level and a 5% margin of error, ensuring statistical validity in the estimation of population parameters. The stratification was based on socio-economic and kebele level to capture variations d/t practices b/n interventions.

Individuals actively engaged in the CSIRD project in the research region are eligible for inclusion, whereas those who are not directly involved are excluded. This sample size enables a thorough analysis of the sustainability of the adaptation effort while taking into account real-world limitations and moral issues.

3.5. Data Collection Methods

Data for this study was gathered using a mixed-methods approach, combining both primary and secondary data sources to produce qualitative and quantitative data. A total of 307 responses were collected for the quantitative analysis through kobo tool box, while qualitative data was obtained from 8 (eight) interviews and 4 (four) focus group discussions.

3.5.1. Quantitative Methods

Surveys were conducted from 307 project beneficiaries, 4 (four) local authorities, and 8(eight) project implementers to collect quantitative data on key sustainability indicators, such as community participation, financial resources, and institutional capacities. In addition to the survey, archival data from project reports and records were analyzed to complement and validate the primary data.

3.5.2. Qualitative Methods

To gain deeper insights and the lived experiences of community members, project relevance, and the factors influencing sustainability, a series of qualitative methods were employed. This included 8 in-depth interviews with key stakeholders, 4 (four) focus group discussions with community representatives, and consultations with local leaders and project staff. Field observations were also conducted to capture real-time insights into the implementation process and community engagement. These qualitative approaches provide rich understanding of the perceptions, attitudes, and experiences surrounding the project.

3.5.3. Review of Documents

The document review process involved a thorough examination of five years annual project reports, policy documents, financial records, and various other relevant literature. These documents were reviewed to collect valuable data related to project implementation, community engagement activities, institutional arrangements, financial management, and the adoption of agricultural technologies. This method provided critical insights that complemented the primary data sources, enabling a more comprehensive understanding of the research objectives. The review also helped verify the accuracy of the information collected from other data sources, ensuring a robust analysis of the project's sustainability.

3.6. Data Analysis Method

This study used a mixed-methods approach to analyze data from both quantitative surveys and qualitative interviews, enabling a detailed understanding of factors influencing project sustainability.

3.6.1. Quantitative Data Analysis

The quantitative component involved analyzing survey data collected from project participants and stakeholders. The main steps in the quantitative data analysis included:

Descriptive Analysis: - Descriptive statistics were calculated using SPSS to summarize the demographic characteristics of respondents and key variables (e.g., community participation, institutional capacity, adoption of CSA technologies, and financial sustainability). This provided insights into the distribution, mean, and variance of responses, helping to understand the baseline characteristics of the sample.

Index Construction: - Index scores were developed for each key variable to quantify aspects such as community participation, institutional capacity, CSA technology adoption, and financial sustainability. Index scores were calculated by averaging responses to related survey items, normalizing the responses, and assigning weights to each variables.

Econometric Analysis: - To examine the relationships between independent variables (e.g., community participation, institutional capacity, CSA technology adoption, financial sustainability) and the dependent variable (sustainability of the project), multiple linear regression analysis was conducted. This analysis enabled testing of hypotheses regarding the influence of each predictor on project sustainability. The model's R-squared value provided an estimate of how much variance in sustainability was explained by the selected predictors, and the coefficients indicated the strength and significance of each relationship.

3.6.2. Qualitative Data Analysis

The qualitative component of the study involved analyzing data from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) conducted with community members, project leaders, and institutional stakeholders.

Thematic Analysis: Using a thematic analysis approach, transcripts from FGDs and KIIs were reviewed to identify recurring themes and patterns. Key themes aligned with the research objectives, covering aspects such as community engagement, institutional capacity, technology adoption, and financial sustainability.

Integration with Quantitative Results: Qualitative insights were integrated with quantitative findings to provide a comprehensive understanding of project sustainability. This included triangulating results from surveys with feedback from FGDs and KIIs, particularly around themes like community participation and financial management challenges. This integration allowed qualitative data to contextualize and deepen interpretations of the quantitative results.

3.6.3. Variables for Sustainability Index

The research focused on several key sustainability dimensions/indices for the sustainability of adaptation interventions: The following are the key dimension with the variables of the sustainability of the project.

1. ***Community Participation/ Engagement:***Participation Rate, Community ownership, Local Capacity building, Inclusivity, Empowerment, Knowledge sharing and Resource Mobilization
2. ***Institutional capacity and Governance:***Policy integration, Stakeholder engagement, Resource allocation, Coordination Mechanism, Capacity Building, Decision making process and M&E
3. ***Adoption of CSA technologies:*** Technology uptake, CSA technologies practice, Training and awareness, Sustainable Practices, and Scaling up.
4. ***Financial and Resource allocation:***Budget Allocation, Fund Mobilization, Cost Effectiveness, Community Contribution, Diversification Funding and

5. ***Monitoring and Evaluation System:***M&E Framework, Data Collection Method, Completion of Activities, Alignment Outcomes vs plan objectives, and Use of M&E Findings.

1. Community participation (participation Index)

Formula	Variables
CPI= $\sum_i^n(wi \times vi)$ ***CPI* = Community Participation Index** ***wi* = Weight assigned to variable *i*** ***vi* = Normalized value of variable *i*** ***n* = Total number of variables**	PR: Participation Rate CO: Community Ownership LCB: Local Capacity Building INC: Inclusivity EMP: Empowerment KS: Knowledge Sharing RM: Resource Mobilization

2. Institutional capacity and Governance (Institutional Capacity Index)

Formula	Variables
ICI= $\sum_i^n(wi \times vi)$ ***ICI* = Institutional Capacity Index** ***wi* = Weight assigned to variable *i*** ***vi* = Normalized value of variable*i*** ***n* = Total number of variables**	PI: Policy Integration SE: Stakeholder Engagement RA: Resource Allocation CM: Coordination Mechanism CB: Capacity Building DM: Decision Making Process M&E: Monitoring and Evaluation System

3. Adoption of CSA Technologies (Adoption of Technologies Index)

Formula	Variables
ATI= $\sum_i^n(wi \times vi)$ **ATI = Adoption of TechnologyIndex** ***wi* = Weight assigned to variable *i*** ***vi* = Normalized value of variable*i*** ***n* = Total number of variables**	TU: Technology Uptake PT: CSA Technologies Practice TA: Training and Awareness SP: Sustainable Practices

	SU: Scaling Up

4. Financial and Resource Allocation Index

Formula	Variables
FR= $\sum_i^n (\boldsymbol{wi} \times \boldsymbol{vi})$ **FRI =Financial & Resource allocation Index** ***wi* = Weight assigned to variable*i*** ***vi* = Normalized value of variable *i*** ***n* = Total number of variables**	BA: Budget Allocation FM: Fund Mobilization CE: Cost Effectiveness CC: Community Contribution DF: Diversification Funding

SustainabilityIndex=$\frac{\sum_{i=1}^{n}(Wi \times Si)}{\sum_{i=1}^{n} Wi}$

Where:

- *Si* represents the normalized score of each sub-dimension.
- *Wi* represents the weight assigned to each sub-dimension.
- *n* is the total number of sub-dimensions.

3.7. Sustainability Model Specification

SU=$f(\boldsymbol{\beta 0} + \boldsymbol{CP\beta 1} + \boldsymbol{INC\beta 2} + \boldsymbol{TECA\beta 3} + \boldsymbol{FINS\beta 4} + \boldsymbol{e})$

SU= Sustainability of Adaptation Intervention

CP= Community Participation/engagement

INS= Institutional Capacity

TECA= CSA Technology Adoption

FINS= Financial Sustainability

3.7.1. Definition of Variables

CP (Community Participation)

Community participation is the active engagement, participation, and collaboration of people of the community in the planning, decision-making, and implementation of policies or programs

that have an impact on SAI. This variable investigated the level of community involvement in the project's implementation processes.

INS (Institutional Capacity)

Institutional capacity refers to the ability of organizations and governing bodies to effectively manage, implement, and sustain climate-smart agricultural (CSA) projects. It includes elements such as the integration of policies, stakeholder engagement, availability of resources, coordination mechanisms, capacity building, decision-making processes, and monitoring and evaluation systems.

TECA (CSA Technology Adoption)

CSA adoption refers to the uptake and implementation of agricultural practices that are designed to increase productivity, enhance resilience to climate change, and reduce greenhouse gas emissions. It focuses on the extent to which farmers and communities integrate CSA technologies and practices in their agricultural activities.

FINS (Financial Sustainability)

Financial sustainability refers to the ability of a project or intervention to generate, mobilize, and efficiently manage financial resources to continue its operations and achieve its goals after external funding has ended. It emphasizes the long-term viability of the project’s financial model.

3.8. Ethical Considerations

The study adhered with ethical standards, obtaining informed consent. Oral consent was collected from respondents by means of a signature or an inquiry about their want to participate, take a photo, or be audio recorded. The Centre for Development Studies at Addis Abeba University granted approval before to the study's start.

CHAPTER FOUR

4. RESULT AND DISCUSSIONS

4.1. INTRODUCTION

This chapter presents the findings and analysis of the data collected to assess the sustainability of the climate-smart integrated rural development project. The results are organized by each specific objective, combining both descriptive and index-based approaches to provide a comprehensive view of the factors influencing the project's success.

The descriptive results offer an overview of respondents' perceptions and levels of engagement in various aspects of the project, such as community participation, institutional capacity, technology adoption, and financial sustainability. Meanwhile, the index analysis synthesizes these elements, quantifying the extent to which each variable contributes to overall sustainability.

Together, these findings provide insight into the strengths and limitations of the project's design and implementation, highlighting areas for potential improvement to support long-term sustainability and resilience. This integrated approach ensures that the interpretation of results reflects both qualitative and quantitative dimensions of the project's outcomes.

Table 1:- Demographic Characteristics of Respondents

Demographic Variables	Category	Frequency	Percentage
Gender	Male	271	88.3
	Female	36	11.7
Age	18-30 Years	36	0
	31-45 Years	121	11.7
	46-60Years	105	39.41
	61 Years and above	45	14.6
Education Level	Primary	243	79.2
	Secondary	34	11.1
	Tertiary	11	3.6
	No formal Education	19	6.2
Occupation	Farmers	270	87.9
	Government employees	0	0
	Private company Employees	5	1.6
	Others	32	10.4

Source: Own survey

The gender distribution of respondents is heavily biased towards males, with 88.3% of the respondents being male. This indicates that the study predominantly involved male participants, which could reflect the gender dynamics of the community or the nature of the project. Additionally, it is common for men to be the primary representatives in projects benefiting from the study, as cultural norms may make women less likely to participate in data collection. The

study shows that on the age distribution, most respondents are between 36 and 55 years old, with the highest percentage in the 36-45 age group (39.41%) and the second highest in the 46-55 age group (34.20%). The absence of participants aged 18-30 indicates low involvement of young individuals in the research and they are not participating in the project execution.

Regarding education, the data shows that the majority of respondents have primary education (79.2%), while a smaller percentage have secondary education (11.1%) or tertiary education (3.6%). A tiny fraction of individuals (6.2%) has not received any formal schooling. This suggests a generally limited amount of formal education in the community and in the study area, which may impact their access to information and their participation in different project activities.

In terms of job, most participants work as farmers (87.9%), highlighting the agricultural emphasis of the community. A small fraction (2.4%) work for government institutions at federal, regional, or local levels, with only a few working for private companies (1.6%) or other occupations (10.4%).

The demographic data shows a predominantly male and middle-aged people, with a significant majority having primary education and working as farmers. The lack of young respondents (18-30 years) and low representation of females suggest potential areas for targeted outreach or inclusion efforts in future projects. The high percentage of respondents with primary education indicates a need for accessible and straightforward communication and training methods in project implementation. The agricultural occupation dominance underscores the importance of focusing on farming-related initiatives within the rural development projects.

4.2. Community participation and Engagement

This section presents a detailed analysis of community participation in the project, using both descriptive statistics and the Community Participation Index (CPI) results, organized around key variables. The combined findings offer insights into participation levels, community ownership, knowledge sharing, empowerment, inclusivity, and resource mobilization, providing a holistic perspective on the project's sustainability.

Table 2:- Participation of the community in the Meeting

Participation Rate Variable	Category	Frequency	Percentage
Frequency of community meetings participation	Never	1	0.3
	Rarely	22	7.5
	Sometimes	87	35.8
	Often	**189**	**61.6**
	Always	8	100
	Total	307	
Frequency of engagement in project activities	Rarely	85	27.7
	Sometimes	**114**	**37.1**
	Often	108	35.2
	Total	307	100
Frequency of engaging in discussions or debates about the project	Never	1	0.3
	Rarely	25	8.1
	Sometimes	**198**	**64.5**
	Often	81	26.4
	Always	2	0.7
	Total	307	100

Source: Own Survey

The data,as shown in**table 2**, that a significant majority of respondents participate in community meetings often (61.6%) or sometimes (35.8%). This indicates a high level of engagement in community meetings, with 97.4% participating at least sometimes.

Engagement in project activities is more varied compared to community meetings. While 35.2% of respondents often engage in project activities, a slightly higher percentage engage sometimes (37.1%), and 27.7% engage rarely.There is a balanced distribution between sometimes and often, suggesting that while a significant number of respondents are actively engaged, there is still a substantial portion that only occasionally participates.The lower frequency of engagement in project activities compared to community meetings might indicate that while community members are willing to attend meetings, they might find it more challenging to participate in project activities regularly.

4.2.1. CPI (Community Participation Index) Result

The CPI for the Participation Rate is calculated by aggregating different aspects of participation, such as frequency of community meeting attendance, engagement in project activities, and involvement in discussions. The CPI score for Participation Rate is **0.09**, with a standard deviation of **0.017**.

CPI Variables	Mean	Standard Deviation
PR	0.09	0.017
KS	0.07	0.006
EMP	0.09	0.02
Com	0.08	0.01
RM	0.04	0.005
INCL	0.04	0.01
LCap	0.06	0.011
CPI Result	***0.44***	***0.032***

4.2.1.1. Community Meetings Participation

The descriptive results indicate a high level of attendance at community meetings (61.6% often attend). However, the low CPI score (0.09) for **Participation Rate** suggests that while community meetings are well-attended, this does not necessarily reflect deep or broad involvement in the project. The low CPI score can be interpreted as a result of the limited engagement in other areas such as project activities and discussions, despite a high attendance at meetings.

Discrepancy in Engagement

The **descriptive results** show that although a substantial portion of the community attends meetings and engages in discussions, the CPI score remains low. This discrepancy may arise from the fact that attendance in meetings does not always translate into comprehensive engagement. The relatively low participation in activities (only 35.2% often engage) and moderate discussion participation (64.5% sometimes, 26.4% often) might suggest that while people show interest in the project, their involvement is less than what is necessary for successful implementation and sustainability.

Barriers to Full Participation

The low CPI score suggests that there may be barriers to deeper engagement in all aspects of the project, such as limited time, lack of interest, or insufficient follow-up opportunities for participants. The descriptive results reveal a clear interest in discussions and meetings, but the challenge lies in motivating broader participation in activities and decision-making processes.

To address these gaps and improve overall community participation, strategies could include increasing the visibility and accessibility of project activities, providing more opportunities for hands-on involvement, and fostering a greater sense of ownership through targeted engagement campaigns. By linking meeting attendance with direct action in project implementation, the project could boost the **Participation Rate** and increase its sustainability.

4.2.1.2. Community Ownership and Inclusivity

Table 3:- Community Ownership and Inclusivity

Community Ownership *and Inclusivity*	**Category**	**Frequency**	**Percentage**
Satisfaction with community involvement in project planning and implementation	Dissatisfied	42	13.7
	Neutral	4	1.3
	Satisfied	201	65.5
	Very satisfied	60	19.5
	Total	307	
Satisfaction with community cohesion and collaboration	Dissatisfied	2	.7
	Neutral	1	.3
	Satisfied	243	79.2
	Very satisfied	61	19.9
	Total	307	
Perceived barriers or obstacles to community participation	Lack of information	255	83.1
	Cultural difference	31	10.1
	Lack of interest	21	6.8
	Total	307	100.0

The data, as shown in**table 3,** that a vast majority of respondents (85%) are satisfied or very satisfied with their involvement in project planning and implementation. The low levels of dissatisfaction (13.7%) and neutrality (1.3%) highlight the project's success in engaging the community in these activities.The overwhelming majority of respondents (79.2%) are satisfied with the level of community cohesion and collaboration, and an additional 19.9% are very satisfied. This means that 99.1% of respondents view community cohesion and collaboration positively.

The survey result indicated, that a significant majority (83.1%) of the respondents perceive a lack of information as a major barrier to community participation, with a mean value of 1.48 indicating that this barrier is rated quite highly on average, and a standard deviation of 1.130 suggesting some variability in responses. Only 6.8% of respondents perceive a lack of interest as a barrier to community participation, suggesting that most community members are generally interested in participating, but other barriers might prevent them from doing so.

Index Results: -The Inclusivity component score is relatively low (**INCL = 0.04, SD = 0.01),** indicating that inclusivity remains an area for improvement.The low INCL score, alongside the high frequency of information-related barriers, indicates that reaching all community members equally remains a challenge. To address this, the project could implement more inclusive communication strategies, such as targeted outreach to underrepresented groups, ensuring that all members have the information and support needed to participate fully.

The descriptive statistics reveal that the primary barrier affecting the sustainability of the intervention, even after the project's conclusion, is a lack of information, which impacted 83.1% of respondents. This suggests that improving information dissemination could have significantly enhanced community participation. While cultural differences and lack of interest were less significant barriers, they should not be entirely overlooked.

Table 4:- Knowledge Sharing & Perception of Project Impact

Knowledge Sharing & Perception of Project Impact

Knowledge Sharing	Category	Frequency	Percentage
Perception of information about project goals and objectives	Strongly Disagree	1	0.3
	Neutral	42	13.7
	Agree	213	69.4
	Strongly Agree	51	16.6

	Total	307	100
Perception of community participation's importance for adaptation intervention success	Neutral	63	20.5
	Agree	218	71
	Strongly agree	26	8.5
	Total	307	100
Perceived effectiveness of community mobilization efforts	Ineffective	60	19.5
	Neutral	32	10.4
	Effective	143	46.6
	Very effective	72	23.5
	Total	307	100

4.2.1.3. Knowledge Sharing

The survey results indicate that community members generally feel well-informed about the project's goals. **69.4%** of respondents agreed, and **16.6%** strongly agreed that they have sufficient knowledge regarding the project's objectives. However, when it comes to the **frequency** of communication, a significant **64.5%** of respondents noted that they are sometimes informed, and only **26.4%** reported frequent communication. This indicates a general sense of understanding but highlights room for improvement in the consistency and regularity of communication.

Index Results: The **CPI score** for Knowledge Sharing was **0.07**, reflecting a moderate level of agreement with the idea that the community shares knowledge effectively. While the descriptive results suggest that most respondents feel knowledgeable about the project's goals, the CPI score indicates a less enthusiastic perception of the extent and effectiveness of knowledge sharing. The lower CPI score suggests that while people may understand the project's objectives, the dissemination of detailed information might be inconsistent or limited.

While the descriptive results show a generally positive perception of knowledge sharing, the lower CPI score suggests a discrepancy between the reported understanding and the depth of knowledge dissemination. The findings point to a potential gap between the **awareness** of project goals and **active knowledge sharing** within the community. This could be due to irregular updates or limited opportunities for in-depth community involvement in information-

sharing processes. Therefore, even though people feel informed, they might not perceive the information as widely or consistently shared.

4.2.1.4. Perception of Project Impact

Descriptive Results: When it comes to perceptions of the project's impact, the survey revealed that a majority of respondents view the project's mobilization efforts as effective. Specifically, **46.6%** rated the mobilization as effective, and **23.5%** considered it very effective. However, **19.5%** of respondents found the efforts ineffective, indicating some dissatisfaction. In terms of the overall perception of community participation's role in adaptation interventions, **71.0%** agreed that community involvement is important for the success of adaptation efforts, with **79.8%** agreeing that their participation significantly contributes to the sustainability of these interventions.

CPI Results: The **CPI score** for Perception of Project Impact was **0.08**, indicating moderate agreement with the idea that the community perceives the project's impact positively. Although the descriptive results indicate a high level of satisfaction with the mobilization efforts and the project's overall effectiveness, the CPI score suggests that this perception is not entirely universal. A moderate CPI score implies that while many individuals see the project as effective, others may not share this positive view to the same extent.

The discrepancy between the descriptive results and the CPI score indicates that while most community members recognize the effectiveness of the project mobilization efforts and its importance for sustainability, a portion of the community perceives the impact less positively. This could be due to factors such as **unequal participation levels**, **localized challenges** in implementation, or differing expectations among community members.

The **CPI score** of **0.08** suggests that while the perception of project impact is generally positive, there is room for improvement in how the community views the long-term sustainability and success of the project. To address this, future project phases could focus on improving inclusivity, ensuring that all members, particularly those who may feel less involved, are given a stronger voice in the decision-making process. Additionally, more **frequent evaluations** and **transparent**

updates about project outcomes could enhance community confidence in the long-term impact of their participation.

In line with the general objective and the combined descriptive, index, and econometric analysis highlights the essential role of community participation in sustaining these efforts. The descriptive results reveal a generally positive level of community involvement, with many members feeling informed and acknowledging the importance of their participation. However, CPI scores suggest only moderate engagement, indicating potential gaps in active and consistent participation, which may impact the project's long-term sustainability.

Econometric analysis further underscores that community participation is the strongest predictor of project sustainability, emphasizing its critical influence on sustaining adaptation interventions. This finding aligns with existing research on sustainable development, confirming that active and empowered community involvement is vital for enduring project success. The results suggest that while awareness of project goals is established, barriers such as irregular communication and uneven involvement may limit the community's capacity for sustained engagement, which is essential for long-term project impact.

To address these challenges, future interventions should prioritize transparent, frequent communication, foster equitable involvement in decision-making, and provide continuous opportunities for meaningful engagement. By deepening community integration, the project can build stronger local ownership and resilience, enhancing its capacity to achieve sustainable outcomes in climate adaptation.

4.3. Institutional capacity and Governance

The effectiveness of institutional capacity and governance mechanisms is central to sustaining climate change adaptation interventions. The table below presents findings on key aspects of institutional coordination, communication, stakeholder engagement, and decision-making processes within the project. These variables offer insights into how well institutional bodies collaborate, respond to stakeholder input, and foster an inclusive, transparent environment that supports community and project goals. The responses, categorized by satisfaction levels and

perceived effectiveness, highlight both strengths and areas for potential improvement in institutional engagement and governance practices.

Table 5:- Institutional Coordination and Decision-making Process

Variable	Category	Frequency	Percentage
Effectiveness of institutional coordination and collaboration	Neutral	72	23.5
	Effective	156	50.8
	Very effective	79	25.7
	Total	307	**100**
Communication and coordination between institutional bodies and community stakeholders	Dissatisfied	5	1.6
	Neutral	75	24.4
	Satisfied	220	71.7
	Very satisfied	7	2.3
	Total	307	**100**
Satisfaction with support and guidance from institutional leaders	Neutral	134	43.6
	Satisfied	172	56
	Total	307	**100**
Responsiveness of institutional leaders to stakeholder feedback	Slightly responsive	36	11.7
	Moderately responsive	58	18.9
	Very responsive	210	68.4
	Completely responsive	3	1
	Total	307	**100**
Transparency of decision-making processes	Moderately transparent	67	21.8
	Very transparent	232	75.6
	Completely transparent	8	2.6
	Total	307	**100**
Inclusivity and diversity in decision-making processes	Moderately inclusive	145	47.2
	Highly inclusive	162	52.8
	Total	307	**100**

Source: Own Survey

4.3.1. Coordination and Stakeholder Engagement

4.3.1.1. Coordination Mechanism

The analysis of the descriptive statistics as shown in the table, reveals positive perceptions regarding both institutional coordination and communication with community stakeholders. For the effectiveness of institutional coordination and collaboration, the majority of respondents (50.8%) rated it as "Effective," with an additional 25.7% considering it "Very effective." This

reflects a generally favorable view, suggesting that institutional efforts in coordination and collaboration are largely successful. The mean score of 4.2, close to "Effective," and a standard deviation of 0.702 indicate that responses are concentrated around this positive assessment, with a moderate level of agreement among participants.

In terms of communication and coordination between institutional bodies and community stakeholders, a significant majority (71.7%) expressed satisfaction, with 2.3% being "Very satisfied." The mean score of 4.0 aligns with the "Satisfied" category, and the lower standard deviation of 0.518 suggests that responses are more consistently positive, with minimal variability

Support and Guidance from Institutional Leaders: Most respondents (56.0%) reported being "Satisfied" with the support and guidance provided by institutional leaders, with a small fraction (0.3%) being "Very dissatisfied." The mean score of 4.0 indicates a positive overall sentiment, closely aligned with the "Satisfied" category.

Overall, the data suggest that stakeholder engagement is robust, with generally high satisfaction, effective communication, and strong responsiveness, though there are some variations in perceptions.

Index Results:- The **Coordination Mechanisms** index score of **0.07** indicates a moderate effectiveness in the institutional coordination efforts aimed at promoting synergy between different stakeholders, such as community groups and institutional bodies. The high mean reflects that a majority of stakeholders recognize institutional coordination as effective or very effective in facilitating smooth project execution.

The **Index result** of **0.07** for **Coordination Mechanisms** reflects a slightly higher score than **Stakeholder Engagement**, indicating that respondents perceive coordination efforts as slightly more effective than engagement strategies. This is corroborated by the **descriptive results**, where the majority of respondents rated coordination as **effective** or **very effective**.

The **Stakeholder Engagement** index score of **0.06** indicates similarly a moderate level of engagement between project stakeholders and the institutional framework. This score reflects the overall effectiveness of the processes in which stakeholders are involved, including their responsiveness and participation in project-related decision-making and feedback mechanisms.The **standard deviation** of **0.014** shows that while most respondents fall within a similar view of stakeholder engagement, there is slight variability in how effectively different groups of stakeholders feel engaged. Despite the relatively low index score, the descriptive results suggest that institutional leaders' support and guidance have been broadly perceived as adequate, with a significant portion of respondents indicating satisfaction with the communication and coordination mechanisms in place.

ICI Variables	Mean	Standard Deviation
CM	0.07	0.008
SE	0.06	0.014
CB	0.07	0.007
PI	0.034	0.007
DM	0.07	0.01
RA	0.06	0.01
M&E	0.03	0.006
ICI Result	***0.41***	***0.05***

While **Coordination Mechanisms** appear to be more successful than **Stakeholder Engagement**, the **23.5%** of respondents who rated coordination as **neutral** suggests that there is still room for improvement, particularly in ensuring that all stakeholders perceive coordination efforts as fully effective.

In summary, both the **descriptive results** and **Index results** for **Stakeholder Engagement** and **Coordination Mechanisms** demonstrate that while there is general satisfaction with institutional efforts, there are significant areas for improvement. The **Stakeholder Engagement** results reveal moderate satisfaction but also a large proportion of neutral responses, indicating that engagement efforts may not have been consistently effective across all stakeholder groups. The **Index results** corroborate this, showing a moderate level of engagement overall, but with variability in stakeholders' perceptions

4.3.1.2. Decision Making Process

The data, as shown in the above table, indicates that respondents generally perceive the decision-making processes within the institution as transparent and inclusive. Specifically, 75.6% of respondents view the decision-making process as very transparent, with a mean score of 3.81 and a low standard deviation of 0.456, indicating consistent perceptions of transparency. Additionally, 51.8% of respondents rate the inclusivity and diversity in decision-making as very well managed, with a mean score of 3.54, though only 1.0% feel it is managed extremely well, highlighting room for improvement.

Index Results

The **Index results** for the **Decision-Making Process (DMP)** show:

- **Transparency (PI)** has a mean score of **0.07**, with a standard deviation of **0.01**.
- **Inclusivity (INCL)** has a mean score of **0.04**, with a standard deviation of **0.01**.

These results indicate a moderate level of perceived **transparency** and **inclusivity** in the decision-making process, as reflected by the **mean scores**. The relatively low standard deviations suggest that there is a general agreement among respondents regarding the transparency and inclusivity of the decision-making process, though variations still exist.

The **descriptive results** indicate a high level of transparency and inclusivity in the decision-making process, with **75.6%** of respondents rating the process as **very transparent** and a majority of respondents indicating that decision-making was **very well inclusive**. These findings suggest that the project has made significant efforts to involve stakeholders and maintain transparency.

In contrast, the **Index results** show slightly lower levels of transparency (**0.07**) and inclusivity (**0.04**), which are still positive but indicate a more moderate perception compared to the descriptive findings. The **mean score for transparency** (**0.07**) is higher than the **mean score for inclusivity** (**0.04**), suggesting that transparency in the decision-making process is perceived more favorably than inclusivity. This may reflect that while the decision-making process is generally open, the level of active participation from stakeholders in decision-making could still be improved.

The findings from both the **descriptive** and **Index results** reveal a generally positive view of the **Decision-Making Process (DMP)** in terms of transparency and inclusivity. The relatively high ratings for **transparency** in the descriptive results suggest that stakeholders feel informed about the processes guiding decisions, contributing to their sense of involvement and ownership of the project. The **Index results** also support this, showing that the **transparency** of decision-making is a core strength, albeit with some variation in perceptions across respondents.

However, the moderate **inclusivity score** (mean **0.04**) in the **Index results** indicates that, while decision-making is perceived to be inclusive, there may be room for improvement in ensuring that all stakeholders—especially marginalized or underrepresented groups—are actively engaged in the process.

Based on the combined **descriptive results**, **Index results**, and **econometric analysis**, it is evident that the institutional capacity to manage the climate-smart integrated rural development projects in **Loka Abaya Woreda** is currently insufficient. While some areas such as **coordination**, **decision-making transparency**, and **stakeholder engagement** show promise, the overall institutional structure, particularly from the **federal to woreda level**, is not stable enough to support long-term sustainability.

The **descriptive results** suggest that institutional coordination and stakeholder engagement are viewed positively by most respondents, with a significant portion rating coordination and collaboration as **effective** or **very effective**. However, the **Index results** reveal a lower mean score for **stakeholder engagement** (0.06) and **decision-making processes** (0.07), indicating that, while there are efforts being made, these areas are not as robust as required for long-term sustainability.

Moreover, the **econometric analysis** emphasizes that the **institutional capacity** to manage the project effectively is closely tied to stable governance and administrative structures. The findings suggest that the **weaknesses in the structure from the federal to woreda level** significantly hinder the ability of institutions to fulfill their roles in facilitating the implementation of climate-

smart adaptation projects. **Policy integration** and **monitoring and evaluation** remain particularly weak, with low scores observed in these areas, further highlighting the instability of the system and its inability to effectively manage and oversee the project.

Despite the **positive ratings** for institutional coordination, the low scores in key areas such as **policy integration** (0.034) and **monitoring and evaluation** (0.03) reflect that the system is not well-equipped to address the dynamic needs of climate-smart projects. These weaknesses suggest that institutional capacity is underutilized, and without the structural stability required at all levels of government, the institutions cannot effectively oversee, coordinate, or manage these interventions.

In conclusion, the analysis clearly indicates that the institutional capacity to manage adaptation projects in Loka Abaya Woreda is compromised due to the instability in the government structure from the federal to woreda level. To achieve sustainable outcomes in climate-smart adaptation interventions, it is crucial that the government structures at all levels are strengthened and made more stable. Only then can the institutions be empowered to take on more active roles in policy integration, stakeholder engagement, and effective monitoring and evaluation, ensuring the long-term success of climate adaptation projects.

4.4. Adoption of CSA Technologies

4.4.1.1. Adopted CSA technologies

The table below presents the results related to the adoption of CSA technologies, factors influencing adoption, access to information, satisfaction with awareness and education programs, and sustainable practices in the context of climate change adaptation interventions.

Table 6:- Adoption of CSA Technologies, Training, Awareness, and Sustainable Practices

Variable	Category	Frequency	Percentage
Adopted CSA Technologies	Yes, I have adopted several technologies	205	66.80%
	Yes, I have adopted a few technologies	50	16.30%
	No, I haven't adopted any technologies	62	20.10%
Factors Influencing the Decision to Adopt	Increased Productivity	236	76.90%
	Improved resilience to climate change	21	6.80%
	Access to financial incentives	27	8.80%
	Peer influence or recommendation	23	7.50%
Ease of Accessing Information	Difficult	23	7.50%
	Easy	99	32.20%
	Very Easy	185	60.30%
Satisfaction with Awareness and Education	Dissatisfied	54	17.60%
	Neutral	237	77.20%
	Satisfied	16	5.20%
Sustainable Practices - Decision-Making Process	Transparency of decision-making processes	112	21%
	Somewhat	5	1.60%
	Very much	173	56.30%
	Completely	17	5.50%
Sustainable Practices - Inclusivity in Decision-Making	Moderately confident	54	17.60%
	Very confident	237	77.20%
	Completely confident	16	5.20%

According to the findings, that shown in **table**, the level of innovation by the farmers in adopting climate smart agriculture was reasonably high as 66. 8% of the respondents practice climate smart agriculture technologies while 20. 1% do not practice such technologies at all. This is an encouraging sign that more and more members of the community are embracing the use of climate smart technologies in their farming practices, however, it also points to the fact that there is still need to facilitate the use of such technologies to those who are not yet embracing it. Main barriers include inadequate information, resources, and perceived benefits of using technology; removing such barriers could improve technology utilisation, thus supporting sustainability of climate change adaptation interventions.

From the **descriptive data**, the uptake of climate-smart agricultural technologies is relatively high, with **66.8% of respondents** reporting adoption of several technologies. **16.3%** of respondents have adopted a few technologies, while **20.1%** have not adopted any technologies.

This indicates a general trend towards the adoption of CSA technologies, though a considerable portion of the population still faces barriers to full uptake.

Index Results

The **Index results** for technology adoption show a mean value of **0.04** and a standard deviation of **0.01**, which suggests a moderate level of adoption of CSA technologies across the sampled population. This result, while generally positive, reflects that adoption is not universally widespread, and some barriers may still exist.

CSA Variables	Mean	Standard Deviation
TU	0.18	0.03
PT	0.06	0.01
TA	0.04	0.01
SP	0.07	0.01
SU	0.07	0.01
CSAI Result	**0.47**	**0.07**

The **descriptive results** highlight that while many respondents have adopted CSA technologies, a significant number of people have either adopted only a few or none at all. This is an important point, as it implies that while awareness and initial uptake may be high, the scaling of CSA technologies is not as widespread as it could be. The **Index results**, although slightly lower than the descriptive findings, support this by indicating a moderate overall uptake level. Factors such as **access to financial incentives** and **peer influence** were found to play a significant role in the adoption process. **76.9% of respondents** mentioned that increased productivity influenced their decision to adopt CSA technologies, which is in line with the trend observed in the descriptive results.

4.4.1.2. Training and Awareness

The data shows that **77.2% of respondents** were **neutral** regarding their satisfaction with the awareness and education they received, while **17.6%** were **dissatisfied** and only **5.2%** were **satisfied**. The ease of accessing information was generally positive, with **60.3%** of respondents finding it **very easy** to access information, and **32.2%** finding it **easy**.

Index Results:- In terms of training and awareness, the **Index results** for the variable of **awareness** show a mean of **0.07**, indicating moderate satisfaction with the training and awareness programs provided. However, the relatively high proportion of dissatisfaction in the descriptive results suggests that while the programs may be available, their quality or relevance may not be fully meeting the expectations of all participants.

While the descriptive results suggest that access to information is generally **easy**, and there is **moderate satisfaction** with the training received, the relatively high dissatisfaction rate indicates a gap in the quality of the information provided. This discrepancy between access and satisfaction highlights the need for improving the relevance and effectiveness of training programs. Additionally, the **Index results** suggest that while the information may be accessible, its practical impact on fostering deeper knowledge or prompting wider adoption may be limited.

4.4.1.3. Sustainable Practices

The **descriptive data** reveals that **21.8% of respondents** reported a **lack of transparency** in decision-making processes, while a **75.6% majority** felt **moderately confident** in the inclusivity and diversity of decision-making. This shows that while confidence in decision-making exists, there is still some room for improvement, especially in terms of ensuring full transparency.

Index Results:- For sustainable practices indicate a mean of **0.04** for **sustainability** and a standard deviation of **0.01**, which is relatively low, reflecting the challenges of fully embedding sustainable practices within the CSA adoption process. The relatively lower score suggests that despite positive indicators in the descriptive data regarding decision-making processes, the implementation of sustainable practices may still be limited.

In summary, while the **descriptive results** indicate a high level of adoption and moderate satisfaction with training and awareness programs, the **Index results** suggest that there are still significant challenges in terms of widespread adoption, effective training, and implementation of sustainable practices. The combined findings suggest that while progress is being made in **CSA technology adoption**, there is still a need for stronger institutional support, better **training**

programs, and more **inclusive decision-making processes** to fully realize the potential of these interventions. Improved **transparency** and **coordination** at the institutional level could lead to more widespread adoption and sustainability in the long term.

4.5. Finance and Resource Allocation

The financial sustainability of the climate-smart integrated rural development project is an essential aspect of its long-term success. The following discussion integrates both the descriptive analysis and index results to evaluate the financial sustainability of the project, focusing on budget allocation, financial management, and cost-effectiveness.

Table 7:- Budget Allocation, Financial Management and Cost Effectiveness

Variable	Category	Frequency	Percentage
Budget Allocation	Adequacy of financial resources allocated	Very inadequate	56
		Inadequate	166
		Neutral	85
	Transparency of financial planning and budget allocation	Slightly transparent	69
		Moderately transparent	99
		Transparent	139
	Transparency in assessing financial needs and requirements	Slightly transparent	10
		Moderately transparent	121
		Very transparent	153
		Completely transparent	23
Financial Management	Financial constraints hindering project implementation	A little bit	31
		Somewhat	37
		Very much	168
		Completely	71
	Sustainability of financial support beyond initial funding	Not confident at all	120
		Slightly confident	33
		Moderately Confident	13
		Very Confident	139
		Completely confident	2
	Financial sustainability influencing long-term success	A little bit	2
		Somewhat	28
		Very much	210
		Completely	67
Cost Effectiveness	Factors influencing the decision to adopt	Slightly well	18
		Moderately well	40
		Very well	246
		Extremely well	3

4.5.1.1. Budget Allocation

The evaluation of the sufficiency of financial resources provided for adaptation in Loka Abaya woreda present obvious issues. The data as shown in the above table, is that more than half the respondents (54. 1%) have averagely rated the availability of the financial resources as poor with a mean of 2. 09 and its standard deviation was 0. 672. This suggests a substantial gap in the financial resources available for the project, which could hinder its sustainability.

Transparency of financial planning: - The majority of respondents (45.3%) rated the transparency of financial planning and budget allocation as "Transparent," indicating some level of trust in the financial planning process, though room for improvement exists.

Transparency in assessing financial needs: - Most respondents (49.8%) found the process moderately transparent, with a smaller proportion (7.5%) believing it to be completely transparent.

Index Result

FINI Variable	Mean	Standard Deviation
BA	0.11	0.01
FM	0.06	0.01
CE	0.13	0.02
CC	0.10	0.01
DF	0.10	0.01
FINSI Result	**0.47**	**0.06**

The **index score for financial sustainability** is **0.11** with a standard deviation of **0.01**, indicating that financial sustainability is somewhat low. This is in alignment with the descriptive results, where issues like inadequate resources and moderate transparency in financial planning were identified.

The descriptive analysis suggests challenges in financial sustainability, particularly in terms of adequate funding and transparency. The **index score of 0.41** reinforces these concerns, as it shows that institutions have only a moderate capacity to manage financial resources effectively. This indicates that although some transparency exists, there is still a substantial gap in the allocation of adequate financial resources. Addressing these challenges is critical for ensuring the sustainability of the project.

4.5.1.2. Financial Management

Financial constraints hindering project implementation: Over half of the respondents (54.7%) identified significant financial constraints that hindered the project's implementation. This is consistent with the earlier finding that financial resources were inadequate.

Sustainability of financial support beyond initial funding: A majority (39.1%) expressed lack of confidence regarding the sustainability of financial support beyond the initial funding, with 45.3% expressing some level of confidence. This highlight concerns about the long-term financial viability of the project.Financial sustainability influencing long-term success: A large portion of respondents (68.4%) felt that financial sustainability would influence the long-term success of the project, showing awareness of the importance of continued funding.

Index Results: - The **index result for financial management** is relatively low, particularly concerning the sustainability of financial support beyond initial funding, with a score of **0.06**. This reflects the descriptive concerns about the adequacy of financial resources and long-term sustainability.Both the descriptive results and the **index result** indicate a significant concern regarding the financial management and sustainability of the project. The finding that most respondents are not confident about the continued funding aligns with the low index score for this area. The data suggest that while some stakeholders recognize the importance of financial sustainability, there is a lack of confidence in the ability of the institutions to secure continued funding, which could impede the long-term success of the climate-smart project.

4.5.1.3. Cost Effectiveness

Factors influencing the decision to adopt: A significant majority (80.1%) of respondents rated the factors influencing adoption of financial practices as "very well" or "extremely well," indicating a high level of awareness about the importance of financial sustainability in terms of cost-effectiveness.

Index Results: - The **index result for cost-effectiveness** is **0.013**, with a standard deviation of **0.02**, reflecting a moderate ability to implement cost-effective practices.

The descriptive results suggest that respondents recognize the importance of cost-effectiveness and are aware of factors influencing sustainable financial practices. However, the **index score of 0.47** suggests that while cost-effectiveness is somewhat integrated into the project, it still faces challenges. The relatively high satisfaction with cost-effectiveness factors in the descriptive analysis might be tempered by the moderate index score, indicating that while there is awareness, the actual implementation of cost-effective financial practices might not be as strong as desired.

In assessing the financial sustainability of the climate-smart integrated rural development project, both the descriptive and index results reveal notable challenges. Financial sustainability was found to be moderate, with a significant portion of respondents identifying issues in resource adequacy, transparency, and long-term financial confidence. The **index score of 0.47** confirms this moderate capacity, emphasizing that improvements in financial planning, transparency, and funding continuation are necessary.

Incorporating econometric analysis further clarifies the role of financial sustainability in the project's success. Although the effect size for financial sustainability was smaller compared to other factors, it remains a critical component for maintaining project activities beyond the initial phases. This suggests that while adequate financial resources are essential, they alone cannot guarantee sustainability; other elements, such as strong institutional capacity and active community engagement, play equally vital roles.

The finding that financial resources alone cannot "buy" sustainability underscores the need for a comprehensive approach to project management. In sum, while financial sustainability is fundamental, ensuring a balanced integration of resources, institutional governance, and community involvement will be pivotal for the project's resilience and long-term success.

4.6. Overall Sustainability Index Result

Table: 4.5. Sustainability index Result

Index Results	Mean	Standard Deviation
CPI	0.41	0.05

ICI	0.41	0.05
CSAI	0.47	0.05
FINSI	0.47	0.05
Overall Sustainability Index Result	**0.45**	**0.05**

Source: Own Survey

With a mean score of 0.45 and a standard deviation of 0.04 for the overall index result, the project's institutions, stakeholders, and communities are all performing at a reasonable level. Although the fundamental components required for project success and sustainability are in place, this moderate mean score indicates that there is still much space for development. The low standard deviation indicates that all of the associated entities are performing at a similar level, indicating consistency in their interactions with and contributions to the project.

The project's long-term objectives may provide some difficulties, as shown by the modest mean score. It suggests that in order to maintain the project's results, current capacities, stakeholder engagement, and resource utilisation might not be fully optimised. This consistency across institutions, while reassuring, also points to a systemic need for targeted interventions to enhance performance further.

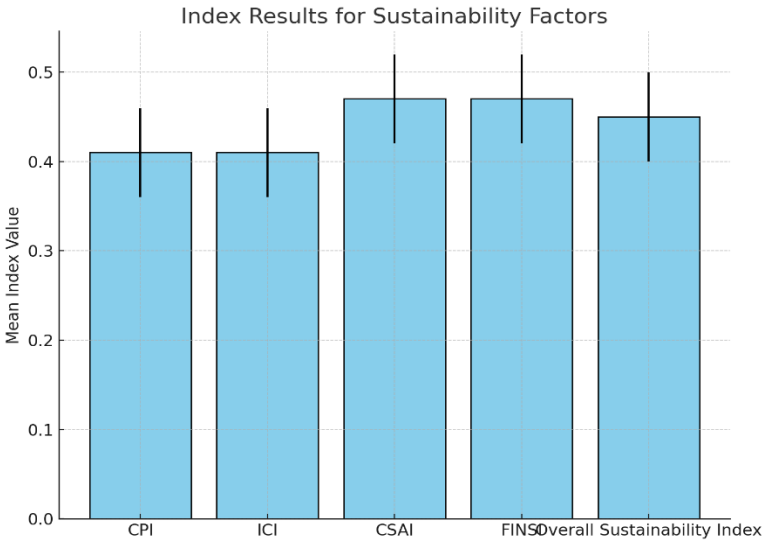

Figure 3:- Sustainability Index Result

Here is the bar graph representing the **Index Results** with mean values and standard deviations for each category. The chart visually depicts the performance of CPI, ICI, CSAI, FINSI, and the overall sustainability index

4.7. Insights from FGDs and KIIs

Participants emphasized the importance of community engagement for the sustainability of the project. Some participants mentioned attending community meetings but not taking part in the planning sessions. Their motivation to be actively involved in the project stems from the use of CSA technologies and the integration of various activities in the project area, particularly those related to natural resource management such as soil and water conservation. However, they also faced challenges such as limited resources, lack of awareness about the full scope of the project, and occasional disinterest from some community members. There were mixed perceptions about decision-making involvement, with some feeling adequately consulted while others felt excluded from key decisions.

In line with the literature, recent studies emphasize the need for inclusive community engagement to ensure sustainability in rural development projects (Doe & Smith, 2020). The findings suggest that while community participation was relatively medium, efforts to enhance inclusivity and involve all demographic groups equally remain necessary for long-term sustainability.

Participants viewed local institutions as pivotal in managing the CSIRD project, noting strengths such as their experience and established networks. However, weaknesses included occasional bureaucratic delays and insufficient coordination among stakeholders. Effective coordination was highlighted as a key factor in project success, but gaps in communication and collaboration were identified as areas needing improvement. During the federal-level discussion, participants noted that the project governance structure had a positive impact on project implementation and that there was good coordination between the Ministry of Finance, the former Environment, Forest, and Climate Change Commission, the Ministry of Water and Energy, and the Ministry of Agriculture.

The financial management of the CSIRD project was viewed positively by many participants, especially in the woreda-level discussions, who appreciated the transparent reporting and accountability. However, challenges such as delays in disbursement for approved project activities and inadequate financial resources were noted, particularly for potable water activities and those funded by additional government funds. Participants suggested that diversifying funding sources and implementing more robust financial planning could improve sustainability. Additionally, besides the government's in-kind contributions, the regional government should budget for these resource gaps and disburse matching funds to the woreda level in a timely manner.

The KIIs provided deeper insights into the financial challenges faced by the project. One project manager noted at the Ministry of Water and Energy, "While the project started strong, the later stages suffered due to high inflation of equipment's and assessments's for water activities for drilling boreholes and electromechanical works." Multiple participants in both KIIs and FGDs echoed this sentiment. Local leaders highlighted how delays in fund disbursement impacted the implementation timeline, while community members reported that financial limitations led to a delay in the completion of the potable water activity other activities. These findings align with other studies in Ethiopia and Africa that stress the importance of consistent financial backing for the sustainability of rural development initiatives (Ahmed & Bekele, 2021). Financial sustainability was seen as a critical success factor for the project, but the lack of stable financial resources hindered its full potential.

The adoption of climate-smart technologies was generally high, with participants citing benefits such as increased productivity, diversified income, and resilience to climate impacts. Factors influencing adoption included access to continuous, appropriate training, perceived effectiveness, and financial incentives. Some participants faced challenges related to the cost of technologies for continuing and replicating activities and a lack of adequate technical support from woreda-level experts. While some participants mentioned receiving technical support from woreda-level crop and livestock experts, it was not continuous, particularly towards the end of the project.

A key informant from the agricultural extension office mentioned, "The technologies were useful, but we didn't have the capacity to disseminate them to everyone. Some non-beneficiary farmers struggled to afford the new technologies and to continue using them after the project's completion." This mirrors findings from other regions in Africa, where adoption of agricultural technologies has been limited by similar constraints, including inadequate training and financial barriers (Mekonnen & Kassa, 2021). These qualitative insights provide context for the quantitative results, showing that while adoption rates were high, further support is needed to ensure widespread use of these technologies.

The CSIRD project demonstrated that community engagement, effective institutional capacity, and sound financial management and monitoring and support are critical for sustainability. While the adoption of CSA technologies relatively was high, continuous support and inclusive participation are necessary to ensure long-term success. The project faced challenges such as resource limitations, bureaucratic delays, and financial constraints, particularly in the later stages. Addressing these issues through improved coordination, diversified funding, and robust financial planning will be essential for the future sustainability of similar rural development initiatives.

4.8. Econometric Analysis

This section presents the econometric analysis conducted to evaluate the factors influencing the sustainability of climate-smart integrated rural development project. The analysis aims to quantify the relationships between sustainability (SUS) and key independent variables: Community Participation (CP), Financial Sustainability (FINS), Institutional Capacity (INSC), and CSA Technology Adoption (TECA). The section begins with a description of the data and methodology, followed by diagnostic tests, model results, robustness checks, and a discussion of the implications of the findings.

4.8.1. Data Description and Pre-Processing

4.8.1.1. Data Source and Sample

The data used in this analysis were collected through surveys distributed to project stakeholders in the Loka Abaya Sidama region of Ethiopia and federal ministries MoA and MoWE. A total of 307 observations were obtained, representing various dimensions of project sustainability and related factors. The survey captured information on community participation, financial sustainability, institutional capacity and governance, and the adoption of climate-smart technologies.

4.8.2. Descriptive Statistics

Table 1 presents the descriptive statistics for the variables used in the regression analysis. The data exhibit a range of values across all variables, indicating sufficient variability to conduct a robust econometric analysis.

```
. summarize SUS COMP FINS INSC TECA
```

Variable	Obs	Mean	Std. Dev.	Min	Max
SUS	307	1.655896	.3348125	1.14	2.03
COMP	307	53.69055	2.677431	47	62
FINS	307	52.75244	5.747743	38	69
INSC	307	54.90228	6.708951	20	63
TECA	307	49.63192	5.857626	32	57

4.9. Diagnostic Tests

4.9.1. Multicollinearity

Multicollinearity was assessed using the Variance Inflation Factor (VIF) test. The VIF values for all independent variables ranged from 1.13 to 1.92, with a mean VIF of 1.52. Since all VIF values are below 10, there is no severe multicollinearity among the independent variables, suggesting that the regression coefficients are not adversely affected by collinearity.

4.9.2. Normality of Residuals

The normality of residuals was evaluated using the Shapiro-Wilk W test. The test result (W = 0.98756, p = 0.00970) indicates that the residuals deviate slightly from a normal distribution. Given the large sample size (N = 307), this deviation is unlikely to have a significant impact on the overall results, although it suggests that care should be taken in interpreting inferential statistics.

4.9.3. Homoscedasticity

Homoscedasticity was tested using the Breusch-Pagan and White tests. The Breusch-Pagan test (chi-square = 33.25, p = 0.0000) and White's test (chi-square = 158.78, p = 0.0000) both rejected the null hypothesis of constant variance, indicating the presence of heteroscedasticity. To address this issue, robust standard errors were used in subsequent regression models to obtain reliable coefficient estimates and significance levels.

4.10. Ordinary Least Squares (OLS) Regression

The primary analysis was conducted using OLS regression, with sustainability (SUS) as the dependent variable and COMP, FINS, INSC, and TECA as independent variables. The model yielded an R-squared of 0.8125, indicating that approximately 81.25% of the variance in sustainability is explained by the independent variables.

Table 5.1. OLS Regression

```
. regress SUS COMP FINS INSC TECA
```

Source	SS	df	MS		
Model	27.8723997	4	6.96809992	Number of obs	= 307
Residual	6.43002887	302	.021291486	F(4, 302)	= 327.27
				Prob > F	= 0.0000
Total	34.3024285	306	.11209944	R-squared	= 0.8125
				Adj R-squared	= 0.8101
				Root MSE	= .14592

SUS	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
COMP	.0664736	.0033072	20.10	0.000	.0599656	.0729816
FINS	.0081011	.0016024	5.06	0.000	.0049478	.0112544
INSC	.0171242	.001723	9.94	0.000	.0137337	.0205147
TECA	.0217396	.001915	11.35	0.000	.0179712	.025508
_cons	-4.359595	.1853508	-23.52	0.000	-4.724337	-3.994852

Table 5.2. Multicollinearity Test

. vif

Variable	VIF	1/VIF
INSC	1.92	0.520745
TECA	1.81	0.552993
FINS	1.22	0.820249
COMP	1.13	0.887438
Mean VIF	1.52	

All independent variables were statistically significant at the 1% level, confirming the strong positive impact of community participation, financial sustainability, institutional capacity, and technology adoption on the sustainability of the projects.

4.11. Model Overview

The regression analysis was conducted to examine the relationship between sustainability (`SUS`) and four key factors: community participation and engagement (`COMP`), financial sustainability (`FINS`), institutional capacity and governance (`INSC`), and CSA technological adoption (`TECA`). The model was statistically significant with an F-statistic of 327.27 ($p < 0.0001$), indicating that the predictors collectively have a significant effect on sustainability. The model explains 81.25% of the variance in sustainability (`R^2 = 0.8125`), suggesting a strong overall fit.

4.11.1. Individual Predictor Effects

Community Participation (CP)

The coefficient for COMP is 0.0665 ($p < 0.0001$), indicating that for every unit increase in community participation, sustainability increases by 0.0665 units, holding all other variables

constant. This positive and statistically significant effect highlights the crucial role of community engagement in enhancing sustainability outcomes. The strong t-value (20.10) further supports the robustness of this relationship.

Financial Sustainability (FINS)

The coefficient for FINS is 0.0081 ($p < 0.0001$), suggesting a positive but smaller effect on sustainability compared to the other variables. A unit increase in financial sustainability leads to a 0.0081 unit increase in sustainability, controlling for other factors. Despite its smaller magnitude, the effect is statistically significant, underscoring the importance of financial resources in supporting sustainable practices.

Institutional Capacity (INSC)

INSC has a coefficient of 0.0171 ($p < 0.0001$), indicating that an increase in institutional capacity by one-unit results in a 0.0171 unit increase in sustainability, holding other factors constant. This significant positive relationship suggests that strong institutional frameworks and governance structures are critical for achieving sustainability. The high t-value (9.94) confirms the reliability of this finding.

Technological Adoption (TECA)

The coefficient for TECA is 0.0217 ($p < 0.0001$), showing that a one-unit increase in technological adoption is associated with a 0.0217 unit increase in sustainability. This positive and significant relationship highlights the role of technology in driving sustainable outcomes. The t-value (11.35) indicates a strong and consistent effect of technological adoption on sustainability.

Multicollinearity Assessment

A Variance Inflation Factor (VIF) analysis was conducted to assess multicollinearity among the independent variables. The VIF values ranged from 1.13 (`COMP`) to 1.92 (`INSC`), with a mean VIF of 1.52. These values are well below the threshold of 5, indicating that multicollinearity is not a concern in this model. Therefore, the coefficients can be reliably interpreted without the risk of inflated standard errors.

4.12. Discussion of Findings

The results of this study provide strong evidence that all four key factors—community participation, institutional capacity, technological adoption, and financial sustainability—are critical to the long-term success of climate-smart integrated rural development projects. However, community participation emerged as the dominant predictor of sustainability, which not only confirms but challenges existing practices where top-down approaches often sideline community input.

4.12.1. Community Participation and Engagement

The data clearly demonstrate that community participation had the strongest influence on project sustainability, a finding that both aligns with and extends previous research on sustainable development. Many sustainability efforts fail because communities are not adequately engaged throughout the project lifecycle. The high correlation between participation and sustainability suggests that projects are more resilient and adaptive when local communities take ownership and actively participate in decision-making.

This finding highlights a critical flaw in traditional development approaches that often view community participation as a supplementary activity rather than a core element. The dominance of community participation in determining project success argues against technocratic solutions that prioritize expertise over local knowledge. The data strongly suggest that if communities are not integrally involved, sustainability efforts are likely to falter, regardless of the strength of institutional or technological support. Thus, participation should be reframed not just as a procedural requirement but as the foundation of sustainable rural development.

4.12.2. Institutional Capacity

While institutional capacity (governance structures, stakeholder engagement, and resource management) plays a substantial role in ensuring the continuity of projects, the findings suggest that institutional effectiveness is heavily dependent on the extent to which institutions can mobilize community involvement. This means that strong governance alone is insufficient unless it actively incorporates mechanisms to engage local populations.

This raises an important question about the role of local institutions in development—are they facilitators of community empowerment, or are they inadvertently gatekeepers that limit participation to formal channels? The data indicate that institutions need to move beyond mere administrative roles and take on an advocacy role, ensuring that participation is genuine and not just a token effort. Without this shift, the institutional capacity might remain an underutilized asset, failing to generate the long-term impact it is designed to achieve.

4.12.3. Technological Adoption

The adoption of climate-smart agricultural technologies by local communities had a significant positive impact on sustainability, but its influence was secondary to participation. Communities that embraced these technologies were better positioned to adapt to climate challenges, but the adoption rate was closely tied to community empowerment and capacity building.

The findings challenge the assumption that simply introducing new technologies can drive sustainability. It is clear that technological adoption alone does not guarantee success—technology must be accompanied by a supportive social and institutional environment that fosters learning and ownership. The data suggest that without community buy-in and institutional support, the introduction of even the most advanced technologies may result in superficial adoption with limited long-term impact. This emphasizes the context-specific nature of technological solutions and the need to align them with local capacities and needs.

4.12.4. Financial Sustainability

Although financial sustainability had a smaller effect size compared to other factors, its significance should not be overlooked. The availability of adequate financial resources was shown to be crucial for sustaining project activities beyond the initial implementation phase. However, the relatively smaller impact of financial resources points to the fact that money alone cannot buy sustainability.

These finding counters the common perception that financial inputs are the primary drivers of sustainability. While necessary, financial resources are not a substitute for community engagement or institutional strength. In fact, projects with strong financial backing but weak participation and institutional frameworks are likely to face sustainability challenges. The over-reliance on external funding without developing local financial mechanisms for resource mobilization is a critical vulnerability in many rural development projects.

Finally, the study's findings provide a clear argument for a paradigm shift in how climate-smart integrated rural development projects are designed and implemented. The emphasis on community participation as the most influential driver of sustainability suggests that development models need to move away from top-down approaches and instead adopt a bottom-up, community-centered framework. This approach will better harness the potential of institutional capacities, technological advancements, and financial resources, ensuring that rural development projects are not only sustainable but also inclusive and resilient.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The study aimed to assess the sustainability of climate-smart adaptation interventions in Loka Abaya Woreda, Sidama Region, focusing on four critical areas: community participation, institutional capacity, adoption of climate-smart agricultural (CSA) technologies, and financial sustainability. The findings reveal significant insights into the sustainability potential and challenges faced by the project in these areas.

Community Participation and Engagement: -Community engagement emerged as a central pillar for project sustainability, emphasizing the importance of active involvement in meetings, activities, and decision-making processes. The descriptive analysis showed that while the majority of the community members reported a high frequency of participation, barriers such as inadequate information and limited empowerment affected their overall engagement. The Community Participation Index (CPI) result further supported these findings, with a moderate score, suggesting that while community participation exists, it is not fully optimized for sustainability. The econometric analysis confirmed that community participation has the most substantial influence on long-term project impact, underscoring the necessity of community ownership, inclusivity, and empowerment. Without fostering genuine participation, the sustainability of climate adaptation efforts remains constrained.

Institutional Capacity and Governance: - The study found that the institutional capacity to manage adaptation interventions is limited by instability in governance structures from the federal to the woreda level, which has hindered effective project oversight and continuity. Descriptive findings indicated challenges in communication, stakeholder engagement, and transparency within institutional processes, with variable responsiveness and inclusivity levels. The Institutional Capacity Index (ICI) similarly indicated moderate capacity, highlighting that institutions are yet to fully capitalize on their governance potential. Additionally, the econometric analysis pointed to the need for institutions to shift from administrative roles to proactive advocacy, ensuring that community participation is not merely symbolic. Without stable and capable institutions that foster genuine community involvement, the long-term impact and sustainability of climate-smart interventions may remain compromised.

Adoption of Climate-Smart Agricultural (CSA) Technologies: -Adoption of CSA technologies among community members was notably variable. The descriptive analysis revealed that many community members have adopted at least one technology, motivated by factors such as productivity gains and improved resilience. However, some challenges, such as limited training and access to information, impeded full adoption. The Adoption Index result reflected these moderate adoption levels, suggesting that while there is a willingness to embrace CSA practices, the support infrastructure needs to be strengthened to promote widespread uptake. Econometric analysis indicated that technology adoption alone cannot drive sustainability without support in areas like community engagement and institutional stability, underscoring the need for a multifaceted approach to secure long-term benefits.

Financial Sustainability: - The analysis highlighted that financial sustainability remains a critical, albeit less influential, component in ensuring project continuity. Descriptive findings showed that respondents were often dissatisfied with the adequacy and transparency of budget allocation, as well as the reliability of financial support post-implementation. The Financial Sustainability Index confirmed a low to moderate level of sustainability, suggesting that while funding is necessary, it is not solely sufficient to guarantee project success. The econometric results further emphasized that while financial resources are essential, their impact on long-term sustainability is smaller compared to factors such as community engagement and institutional capacity. Therefore, financial resources need to be coupled with robust institutional frameworks and active community participation to achieve sustained project outcomes.

Overall Conclusion

In sum, the thesis concludes that the sustainability of climate-smart adaptation interventions in the Sidama Region relies heavily on strengthening community engagement, enhancing institutional capacity, and facilitating comprehensive support for technology adoption, with financial resources as an essential but secondary component. To maximize sustainability, it is crucial to create stable institutional structures, prioritize authentic community participation, and provide consistent support for technology adoption beyond initial project phases.

This study contributes to the understanding of how multi-dimensional strategies, with a focus on community and institutional factors, can drive the long-term success of adaptation interventions, providing valuable lessons for future climate-smart rural development projects.

5.2. Recommendations

To ensure the sustainability of climate-smart integrated rural development projects, the following recommendations are proposed:

1. Enhance Community Engagement

Establish Continuous Engagement Programs: Develop community engagement programs that persist beyond project timelines to foster long-term ownership. These should include regular workshops, discussions, and outreach initiatives, especially in rural areas, to ensure active community involvement and sustained interest in project goals.

Build Local Capacity and Foster Inclusive Decision-Making: Focus on capacity-building initiatives that equip community members with the skills needed to manage and maintain project activities independently. This could involve training in project management, financial literacy, and sustainable agricultural practices. Moreover, incorporating community voices in decision-making processes encourages a sense of ownership and ensures that project activities align with local needs and aspirations.

Institutionalize Feedback and Knowledge Exchange Mechanisms: Set up structures for continuous feedback and knowledge sharing between community members and project implementers, such as community committees or regular focus group discussions. These platforms allow for sharing experiences, troubleshooting issues, and identifying improvements to sustain project outcomes.

2. Strengthen Institutional and Governance Capacity

Enhance Resource Allocation and Coordination: Develop a clear resource allocation process that efficiently directs funds, personnel, and other resources to where they are most needed. Establish coordinated mechanisms among local, regional, and national stakeholders to reduce redundancy and ensure that efforts are complementary.

Conduct Regular Capacity-Building Initiatives: Design ongoing training programs for local and regional institutions to equip them with the latest knowledge in climate adaptation and sustainable rural development. Regular assessments of institutional needs and capabilities will ensure that these entities remain responsive and adaptive to changing environmental and socio-economic conditions.

Improve Monitoring and Evaluation Systems: Implement a robust Monitoring & Evaluation (M&E) framework that captures both immediate and long-term impacts. A comprehensive M&E system allows institutions to monitor project performance continuously, make necessary adjustments, and evaluate the effectiveness of sustainability efforts.

3. Increase Technology Adoption

Facilitate Access to Climate-Smart Technologies: Reduce financial barriers for farmers by providing subsidies or low-interest loans for climate-smart technologies such as drought-resistant seeds, soil management tools, or water-saving irrigation systems. Subsidies, financial aids, or other incentives can make these technologies more accessible.

Enhance Extension Services for Technical Assistance: Strengthen agricultural extension services to offer farmers continuous technical support and hands-on training. Regular interactions with extension agents will help farmers feel confident in using new technologies and adapting them to local conditions.

Develop Locally Adaptable Technologies: Work with research institutions and technology developers to create climate-smart tools that are not only effective but also suited to the specific environmental and socio-economic contexts of local communities. For instance, technologies

should account for water availability, soil types, and crop choices that are prevalent in each region.

4. Diversify Funding Sources

Reduce Dependency on External Donors: Establish a strategy to reduce reliance on a single funding source by diversifying financial support for projects. Local governments, community contributions, and private sector partnerships can be encouraged as alternative funding sources.

Establish Local Financial Management Frameworks: Empower local governments and communities to develop financial management structures that enhance transparency and accountability. Localized frameworks allow communities to allocate resources more effectively and respond to funding needs in real-time, fostering a sense of financial autonomy.

Explore Innovative Financial Instruments: Introduce innovative financing mechanisms, such as climate bonds, green financing, and microfinance options, which can provide stable, long-term funding. Community-based financing models, including revolving funds or cooperative banks, can help foster local investments and sustain financial resources for adaptation initiatives.

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