ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANAGEMENT

MSC. IN INTERNATIONAL BUSINESS

SUSTAINABLE DEVELOPMENT THROUGH CARBON CREDIT PROJECTS: CASE OF ETHIOPIA

BY

SABA TSEGAYE

ADVISOR

DR. MOHAMMED SEID

MAY, 2024

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANAGEMENT

MSC. IN INTERNATIONAL BUSINESS

SUSTAINABLE DEVELOPMENT THROUGH CARBON CREDIT PROJECTS: CASE OF ETHIOPIA

BY

SABA TSEGAYE

ADVISOR

DR. MOHAMMED SEID

THESIS SUBMITTED TO COLLEGE OF BUSINESS AND ECONOMICS OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER'S DEGREE IN MSC. IN INTERNATIONAL BUSINESS.

MAY, 2024

ADDIS ABABA, ETHIOPIA

DECLARATION

I, the undersigned, declare that this thesis entitled "Sustainable Development through Carbon Credit Projects: Case of Ethiopia" is my original work and has not been presented for a degree in any other university. All sources of material used for the thesis have been duly acknowledged.

This thesis is submitted in partial fulfillment of the requirements for the Master's Degree in International Business at the College of Business and Economics, Addis Ababa University.

Name: Saba Tsegaye

Date: June 28, 2024

APPROVAL SHEET OF BOARD OF EXAMINERS

This is to certify that the thesis entitled "Sustainable Development through Carbon Credit Projects: Case of Ethiopia" submitted by Saba Tsegaye in partial fulfillment of the requirements for the degree of Master of Science in International Business has been approved by the board of examiners.

Advisor	Signature	Date
MOHAMMED SEID		31/7/24
Internal Examiner	Signature	Date
Zelalem G/Hadik(PhD) for		31/7/24
External Examiner	Signature	Date
Mebrahtu L. Teklehaimanot (Ph.D.)		29 June 2024
Dean School of Business	Signature	Date

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to my advisor, Dr. Mohammed Seid, for his continuous support, guidance, and encouragement throughout the course of this research. His insightful comments and invaluable suggestions have greatly contributed to the successful completion of this thesis.

I am also deeply grateful to the faculty and staff of the College of Business and Economics, Addis Ababa University, for providing a conducive learning environment and for their assistance throughout my academic journey.

I would like to extend my special thanks to my family and friends for their unwavering support, understanding, and encouragement during the challenging times of my study. Their love and belief in me have been a constant source of motivation.

Furthermore, I am thankful to all the participants and respondents who took part in my research, providing me with valuable data and insights.

Lastly, I acknowledge the Almighty for granting me the strength, health, and determination to undertake and complete this research.

Thank you all.

TABLE OF CONTENTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

Acronyms -- meanings

UNCOP – United Nations Carbon Offset Platform

REDD+ - Reducing Emissions from Deforestation & Degradation

ISFL – Initiatives for Sustainable Forest Landscapes

ERPA – Emission Reductions Purchase Agreement

SDGs – Sustainable Development Goals

ETS – Emission Trading Scheme

EFD – Ethiopian Forest Development

OLFP – Oromia Forested Landscape Program

GERD – Great Ethiopian Renaissance Dam

RCC – Roller Compacted Concrete

UNCTAD – United Nations Conference on Trade and Development

LDCs – Lease Developed Countries

FDI – Foreign Direct Investment

UNFCCC – United Nations Framework Convention on Climate Change

GCF – Global Climate Fund

ERICC – Ethiopian Institute of Resilience to Climate Change

JICA – Japan International Cooperation Agency

OCFU – Oromia Coffee Farmers' Cooperative Union

PFMC – Participatory Forest Management Cooperative

DFCD – The Dutch Fund for Climate and Development

PFM – Participatory Forest Management

SLM – Sustainable Land Management

WBISPP – Woody Biomass Inventory and Strategic Planning Project

NTFPs – Non-Timber Forest Products

NEP – National Electrification Program

EEU – Ethiopian Electric Utility

IPP – Independent Power Producers

MOWIE – Ministry of Water, Irrigation and Electricity

PPP – Public Private Partnership

CGRE – Climate Resilient Green Economy

MOFED – Ministry of Finance and Economic Cooperation

UNDP – United Nations Development Programme

DFID – Department of International Development – UK

GGGI – Global Green Growth Institute

CDM – Clean Development Mechanism

VCS – Verified Carbon Standard

Ci- DEV – World Bank`s Carbon Initiatives for Development

DBE – Development Bank of Ethiopia

CER – Certified Emission Reduction

ABSTRACT

Sustainable development remains a pressing global imperative, demanding innovative strategies to mitigate climate change while fostering economic growth and environmental conservation. Ethiopia, as a developing nation, grapples with the dual challenge of advancing its economy while addressing environmental degradation. In response, Ethiopia has increasingly turned to carbon credit projects as a mechanism to align economic development with ecological sustainability. However, there remains a critical gap in understanding the comprehensive impacts, challenges, and opportunities presented by these initiatives within Ethiopia's socio-economic and environmental context. This study aims to fill this gap by conducting a rigorous empirical analysis of carbon credit projects in Ethiopia. Through a mixed-methods approach including direct observations, interviews with key stakeholders, surveys, and secondary research, the study investigates the effectiveness of carbon credit projects across environmental, social, and economic dimensions. It assesses the awareness levels among Ethiopian society, evaluates tangible outcomes on environmental sustainability and economic development, identifies best practices and challenges encountered, and examines the alignment of these projects with the United Nations Sustainable Development Goals (SDGs). Key findings reveal significant strides in environmental conservation through afforestation and renewable energy adoption, supported by initiatives such as the Oromia Coffee Producers Union's successful carbon credit sales. Challenges identified include funding gaps, regulatory barriers, and capacity limitations, which hinder project scalability and effectiveness. Recommendations focus on leveraging Ethiopia's abundant solar resources, transitioning to renewable energy, enhancing institutional frameworks for transparency and accountability, scaling afforestation efforts, and implementing innovative water management solutions. Ultimately, this research underscores the transformative potential of carbon credit projects in Ethiopia, offering actionable insights for policymakers, practitioners, and stakeholders to advance sustainable development goals while fostering a resilient and inclusive society for future generations.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Carbon trading, also known as carbon credit trading, is a market mechanism designed to incentivize the reduction of greenhouse gas (GHG) emissions by allowing countries and companies to buy and sell carbon credits. These credits represent a permit to emit one ton of carbon dioxide or an equivalent amount of another GHG. This market-based approach helps entities meet their emissions reduction targets by purchasing credits from those who have successfully reduced their emissions.

Carbon trading markets can be divided into two main types: voluntary and mandatory markets. Voluntary markets operate on a non-compulsory basis, allowing private entities and governments with emission reduction programs to trade credits. In contrast, mandatory markets, also known as compliance markets, are established by governments and operate on a compulsory basis to enforce emissions reduction targets.

The significance of carbon trading has grown substantially over the years. For example, the United Nations Carbon Offset Platform (UNCOP) certified projects that reduced, avoided, or removed GHG emissions, resulting in climate investments valued at approximately $2 million in 2020 to combat climate change (UN Carbon Offset Platform, 2020). The global carbon offset market was estimated to be worth between $40 billion and $120 billion in 2020, with over 1,100 companies committing to achieve net-zero CO2 emissions by 2050 (World Bank, 2020).

The COVID-19 pandemic caused the largest decrease in energy-related carbon emissions since World War II, reducing emissions by approximately 2 billion tons. However, emissions quickly rebounded by the end of 2020, highlighting the persistent challenge of achieving long-term reductions and the necessity of implementing sustainable practices (International Energy Agency, 2021).

Global carbon emissions continue to pose significant environmental challenges. Over 10 billion tons of CO2 are emitted annually, contributing to climate change, air pollution, acid rain, ocean

acidification, and the melting of glaciers and polar ice (Intergovernmental Panel on Climate Change, 2021). Addressing these issues requires robust participation in carbon offset projects across various sectors.

Key Areas for Carbon Offset Projects

Renewable Energy: Solar and wind farms are common carbon offset projects that contribute to reducing reliance on fossil fuels. In 2019, renewable energy accounted for 11% of total global energy consumption, with significant potential for future growth (International Renewable Energy Agency, 2020).

Aviation: Air travel accounts for approximately 1.9% of global GHG emissions and 2.5% of CO2 emissions. Roughly 40 airlines globally offer voluntary offsetting programs, allowing passengers to fund projects that mitigate CO2 emissions (International Air Transport Association, 2019).

Energy Efficiency Improvements: Projects designed to create products or systems that use less energy than conventional systems, such as the widespread installation of LED light bulbs and efficient cooking stoves, contribute significantly to reducing energy consumption (Energy Efficiency 2020, International Energy Agency).

Carbon Capture and Sequestration: This process involves storing carbon in a carbon pool to reduce the amount emitted into the atmosphere, playing a crucial role in mitigating climate change (Global CCS Institute, 2021).

Ethiopia's Participation in Carbon Credit Projects

Sub-Saharan countries, including Ethiopia, are financial beneficiaries of carbon trading schemes. Under the United Nations program of reducing emissions from deforestation and degradation (REDD+), Ethiopia is implementing measures to create financial benefits while promoting a green economy. For instance, 8 million hectares of land in the Oromia region are being prepared for such initiatives. In February 2023, Ethiopia signed a landmark agreement with the World Bank’s Biocarbon ISFL (Initiative for Sustainable Forest Landscapes) to reduce carbon emissions by

tackling deforestation and land and forest degradation. This Emission Reductions Purchase Agreement (ERPA) unlocks up to $40 million to reduce around 4 million metric tons of CO2 equivalent emissions by 2030 under Ethiopia's Oromia Forested Landscape Program (World Bank, 2023).

The benefits of carbon credit projects in Ethiopia include.

Economic Opportunities: Implementing reforestation and renewable energy initiatives requires manpower for monitoring and maintenance, creating employment opportunities for skilled workers.

Climate Change Mitigation: Participating in carbon credit projects helps Ethiopia reduce its carbon footprint, contributing to global efforts to combat climate change.

Environmental Conservation: Reforestation and land management projects address land degradation and deforestation, helping to restore and maintain ecosystems.

Source of International Funding: Engaging in carbon credit projects enables Ethiopia to access international funds from countries and organizations supporting sustainable development initiatives.

Energy Security: Projects that promote renewable energy reduce Ethiopia's dependency on fossil fuels, enhancing energy security and sustainability.

The growing market for carbon credits presents significant opportunities for countries like Ethiopia to participate in global efforts to reduce greenhouse gas emissions. By engaging in carbon offset projects, Ethiopia can achieve sustainable development goals, mitigate climate change, conserve the environment, and secure international funding. The strategic implementation of these projects can lead to economic growth, job creation, and a greener future for the nation.

1.2. Statement of the Problem

Sustainable development stands as a critical global imperative, necessitating innovative strategies to mitigate climate change and promote environmental conservation. Ethiopia, as a developing nation, confronts the dual challenge of fostering economic growth while addressing pressing environmental concerns. In response, Ethiopia has increasingly embraced carbon credit projects as a means to harmonize economic development with ecological sustainability. However, the effectiveness, challenges, and insights gained from these initiatives in Ethiopia remain underexplored in current literature.

The problem at hand calls for a comprehensive assessment and understanding of the impact of carbon credit projects on sustainable development within Ethiopia. While the adoption of such projects holds considerable promise, there exists a notable gap in detailed empirical studies regarding their efficacy in achieving environmental objectives, supporting economic advancement, and enhancing social equity. Furthermore, the distinctive socio-economic and environmental landscape of Ethiopia necessitates focused investigation to ensure that carbon credit projects are strategically aligned with the country's developmental priorities.

Existing empirical literature underscores the global significance of carbon credit projects in fostering sustainable development. Numerous studies have highlighted the role of carbon trading mechanisms in incentivizing emission reductions and promoting green investments (World Bank, 2020). For instance, research by Peters et al. (2019) indicates that effective implementation of carbon credit schemes can contribute significantly to global efforts to mitigate climate change.

However, empirical evidence specific to Ethiopia remains limited. While anecdotal reports suggest initial successes in certain regions, systematic evaluations are scarce (Tesfaye & Belay, 2021). Comparative studies across other developing countries illustrate varying degrees of success and challenges associated with integrating carbon credit projects into national policy frameworks (Smith & Johnson, 2018).

Moreover, the socio-economic context of Ethiopia introduces unique considerations. Studies by Abebe et al. (2020) emphasize the need for tailored approaches that account for local communities'

livelihoods and land use practices in carbon offset initiatives. This highlights a critical gap in understanding how carbon credit projects can effectively balance environmental benefits with socio-economic development in Ethiopia.

Therefore, this research aims to address these gaps by providing a rigorous empirical analysis of carbon credit projects in Ethiopia. By examining their impacts on environmental sustainability, economic growth, and social equity, this study seeks to provide actionable insights for policymakers, practitioners, and stakeholders involved in sustainable development initiatives within the country.

1.3. Rationale

There is a critical need to rigorously assess the actual environmental benefits derived from carbon credit projects in Ethiopia. This includes quantifying reductions in greenhouse gas emissions, evaluating biodiversity conservation efforts, and determining the overall positive impact on the environment. Previous studies underscore the importance of such evaluations in understanding the true effectiveness of carbon credit mechanisms (Smith & Johnson, 2018; Peters et al., 2019).

Sustainable development necessitates achieving a delicate equilibrium between economic growth and environmental conservation. It is imperative to analyze the economic impacts of carbon credit projects in Ethiopia, including their role in job creation, income generation, and infrastructure development. This assessment will provide insights into how these projects contribute to long-term economic sustainability and resilience (World Bank, 2020; Tesfaye & Belay, 2021).

Examining the social implications of carbon credit projects is crucial, particularly their effects on local communities, livelihoods, and social equity. Understanding whether these projects foster inclusive development or exacerbate existing disparities is essential for shaping equitable policies and initiatives (Abebe et al., 2020). Such insights are pivotal in ensuring that environmental benefits are distributed equitably among all stakeholders.

Uncovering challenges encountered during the implementation of carbon credit projects in Ethiopia is essential for refining future strategies. Lessons gleaned from both successful and

unsuccessful projects can inform policy adjustments, enhance project efficiency, and contribute to the overall success of sustainable development initiatives (International Renewable Energy Agency, 2020; Intergovernmental Panel on Climate Change, 2021).

By addressing these multifaceted issues, this paper aims to provide a comprehensive understanding of the role of carbon credit projects in fostering sustainable development in Ethiopia. The findings will offer valuable insights to policymakers, researchers, and practitioners seeking to replicate or enhance similar initiatives globally, ensuring that environmental and developmental goals are effectively aligned and achieved.

1.4. Research Objectives

1.4.1. General Objective

The general objective to comprehensively evaluate the effectiveness and impact of carbon credit projects in Ethiopia, considering their environmental, social, and economic dimensions. The following specific objectives collectively aim to provide a thorough understanding of the role of carbon credit projects in Ethiopia's sustainable development agenda. By addressing each specific aspect—awareness, impacts, lessons learned, challenges, contributions to SDGs, opportunities for enhancement, and future insights—the study endeavors to contribute meaningfully to both academic literature and practical policy formulation.

1.4.2. Specific Objectives

The followings are the specific objectives of the study.

1. To gauge the extent to which Ethiopian society is informed about carbon credit projects, their purpose, and potential benefits.
2. To assess the tangible outcomes of carbon credit projects on environmental sustainability, social equity, and economic development within Ethiopia.
3. To extract best practices and pitfalls encountered during the implementation of carbon credit projects in Ethiopia by identifying key lessons learned.

4. To identify and analyze the challenges that have hindered the effective implementation and outcomes of carbon credit projects in Ethiopia.
5. To evaluate how effectively carbon credit projects in Ethiopia align with and contribute to achieving the United Nations Sustainable Development Goals (SDGs).
6. To propose strategies and recommendations for enhancing the efficiency and impact of future carbon credit initiatives in Ethiopia by exploring potential opportunities.
7. To provide comprehensive lessons and insights from the study findings, offering practical guidance for policymakers, practitioners, and stakeholders involved in future carbon credit projects.

1.5. Scope of the Study

The scope of this study encompasses a comprehensive analysis of the effectiveness and impacts of carbon credit projects in Ethiopia. Key aspects covered include: The study examines carbon credit projects implemented throughout Ethiopia, focusing on both urban and rural settings across various regions and ecological zones. The research spans from the inception of significant carbon credit initiatives in Ethiopia to recent developments, providing a contemporary overview of project outcomes and evolution. The study evaluates carbon credit projects across diverse sectors such as forestry, renewable energy, agriculture, and industrial processes. It explores sector-specific impacts and contributions to sustainable development goals.

Perspectives from multiple stakeholders are considered, including government agencies, NGOs, local communities, private sector entities, and international development partners. Insights from these perspectives enrich the understanding of project dynamics and outcomes. A mixed-methods approach was employed, integrating qualitative and quantitative research methods. This included literature reviews, surveys, interviews, case studies, and data analysis to provide a comprehensive assessment. The study concludes with actionable recommendations aimed at policymakers, practitioners, and stakeholders. These recommendations are designed to enhance the effectiveness of future carbon credit projects in Ethiopia and contribute to sustainable development efforts.

By addressing these dimensions within its scope, the study provides a detailed exploration of carbon credit projects in Ethiopia, offering valuable insights for future research endeavors and policy formulation in the realm of sustainable development.

1.6. Operational Definition of Terms

Carbon Credit Projects: Projects certified under international standards (e.g., CDM, VCS) aimed at reducing, avoiding, or removing greenhouse gas emissions. These projects generate tradable carbon credits, contributing to global efforts to mitigate climate change.

Effectiveness: The extent to which carbon credit projects achieve their intended objectives, including measurable reductions in greenhouse gas emissions, conservation of biodiversity, and socioeconomic benefits such as job creation and income generation.

Sustainable Development: Development that balances economic growth, environmental protection, and social equity to meet present needs without compromising the ability of future generations to meet their own needs, as defined by the United Nations SDGs.

Stakeholders: Individuals, groups, or organizations directly involved in or affected by carbon credit projects, including government agencies, NGOs, local communities, private sector entities, and international development partners.

Environmental, Social, and Economic Impacts: The effects of carbon credit projects on the environment (e.g., biodiversity conservation, air quality improvement), society (e.g., community livelihoods, social equity), and economy (e.g., job creation, income generation).

Policy Recommendations: Practical suggestions derived from research findings aimed at informing policymakers, practitioners, and stakeholders to improve the design, implementation, and effectiveness of carbon credit projects in Ethiopia.

1.7. Organization of the Final Paper

The introduction provides an overview of the study focusing on carbon credit projects in Ethiopia. It establishes the significance of these projects in addressing global climate change challenges and promoting sustainable development. The introduction also outlines the specific objectives of the study, which include evaluating the environmental, social, and economic impacts of carbon credit projects, identifying challenges and lessons learned, and providing insights for enhancing their effectiveness.

The literature review begins with a conceptual framework of carbon credit projects, elucidating their role in mitigating greenhouse gas emissions and promoting sustainable development. Theoretical foundations related to carbon trading and sustainable development theories are explored to contextualize the study. It synthesizes existing empirical studies on carbon credit projects globally and within Ethiopia, highlighting gaps in the literature that the current study seeks to address.

The methodology section outlines the research design employed, whether quantitative, qualitative, or mixed methods, detailing the rationale for its selection. It describes the specific data collection methods such as surveys, interviews, and case studies, and justifies the chosen sampling strategy and sample size. The section also elucidates the data analysis techniques used, which may include statistical analysis for quantitative data and thematic analysis for qualitative data.

In the results section, findings from the study are presented systematically. It begins with an overview of carbon credit projects implemented in Ethiopia, followed by detailed analyses of their environmental, social, and economic impacts. Challenges encountered during project implementation are discussed alongside lessons learned from both successful and unsuccessful projects, providing a comprehensive understanding of the outcomes and effectiveness of carbon credit initiatives.

The discussion section interprets the findings in relation to the study objectives and theoretical framework established in the literature review. It compares and contrasts the study findings with existing literature, identifying similarities, discrepancies, and implications for policy and practice.

The section also offers recommendations for enhancing the effectiveness of carbon credit projects in Ethiopia based on the research findings and insights gleaned from the analysis.

The conclusion summarizes the key findings of the study and their implications for the field of sustainable development and carbon trading. It emphasizes the contributions of the study to knowledge and practice, acknowledges any limitations encountered during the research process, and suggests avenues for future research. The conclusion serves to solidify the significance of the study's findings and their potential impact on policy and practice in Ethiopia and beyond.

The references section lists all sources cited throughout the paper following a consistent citation style in APA. It ensures transparency and academic integrity by providing readers with access to the scholarly sources used to support the study's arguments and findings.

Appendices contain supplementary materials that support the main text, including but not limited to survey instruments, interview guides, detailed data tables, and additional documentation essential for understanding the research methodology and results. These materials provide additional depth and context to the study's findings without interrupting the flow of the main text.

This structured approach ensures a coherent and logical presentation of the study's objectives, methods, findings, and implications, facilitating a comprehensive understanding of the role of carbon credit projects in promoting sustainable development in Ethiopia.

CHAPTER TWO

2. LITERATURE REVIEW

Climate change, driven primarily by greenhouse gas (GHG) emissions, poses a significant threat to the planet's ecological and socioeconomic stability. Africa, a continent particularly vulnerable to climate change impacts due to its dependence on climate-sensitive sectors like agriculture, urgently needs solutions (Boko et al., 2007). Carbon markets have emerged as a potential tool for mitigating climate change by providing economic incentives for emission reduction and fostering investment in green technologies. This chapter explores the role of carbon markets in Africa, examining their potential benefits, the challenges faced by African countries, and the ongoing debates surrounding their effectiveness.

2.1. Theoretical Framework

Two primary theoretical frameworks underpin the analysis of carbon markets: Market-Based Instruments for Environmental Protection and Sustainable Development. The former emphasizes the economic approach to environmental challenges by assigning a price to carbon emissions through mechanisms like cap-and-trade systems or carbon taxes, which incentivize polluters to reduce emissions or invest in carbon offset projects (Hepburn et al., 2006). The latter highlights the necessity for a paradigm shift towards economic development that incorporates environmental and social well-being alongside economic growth. Carbon markets can contribute to sustainable development by promoting renewable energy and green technologies while potentially generating additional income streams for local communities through forest conservation and carbon sequestration projects (Sachs, 2007).

2.1.1. Market-Based Instruments for Environmental Protection Theory

Market-based instruments (MBIs) for environmental protection are essential tools in modern environmental economics, aiming to integrate market principles into environmental policy to address the externalities of pollution and resource depletion. These instruments primarily include

carbon taxes and cap-and-trade systems, which are designed to create economic incentives for reducing environmental harm.

Carbon Taxes: Carbon taxes impose a direct fee on the carbon content of fossil fuels, effectively increasing the cost of using carbon-intensive energy sources. This encourages businesses and consumers to reduce their carbon footprint by adopting cleaner technologies or improving energy efficiency. The economic rationale behind carbon taxes is grounded in the Pigovian tax principle, which argues for taxing negative externalities to reflect their true social cost (Pigou, 1920). By internalizing the external costs of carbon emissions, carbon taxes aim to align private incentives with social welfare, thereby reducing the overall level of emissions (Stern, 2006). Several countries have successfully implemented carbon taxes, including Sweden, which has one of the highest carbon tax rates in the world and has seen significant reductions in emissions as a result (Andersson, 2019).

Cap-and-Trade Systems: Cap-and-trade systems, also known as emissions trading schemes, set a maximum allowable level of emissions (the cap) and allocate or auction off emission permits to firms. Companies that can reduce their emissions at lower costs can sell their excess permits to others, thereby creating a financial incentive for emission reductions (Tietenberg, 2006). The European Union Emissions Trading Scheme (EU ETS) is a prominent example of a cap-and-trade system that has been in operation since 2005. Studies have shown that the EU ETS has contributed to significant emissions reductions within the sectors it covers (Ellerman, Convery, & De Perthuis, 2010).

2.1.2. Sustainable Development Theory

Sustainable development theory is a comprehensive framework that integrates economic growth, social equity, and environmental protection, aiming for a balanced approach to development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This theory emerged prominently from the 1987 Brundtland Report, formally known as "Our Common Future," which highlighted the interconnectedness of economic, social, and environmental goals (WCED, 1987).

Conceptual Foundations: The core of sustainable development theory lies in its emphasis on three interrelated pillars: economic growth, environmental sustainability, and social inclusion. Economic growth is essential for poverty reduction and improved living standards, but it must be pursued in ways that do not degrade natural resources or exacerbate social inequalities (Pearce, Markandya, & Barbier, 1989). This integrative approach recognizes that long-term economic prosperity depends on maintaining the health of the natural environment and ensuring social justice.

Environmental Sustainability: Environmental sustainability involves the responsible management of natural resources and ecosystems to prevent degradation and ensure their availability for future generations. This includes addressing critical issues such as climate change, biodiversity loss, and pollution. Sustainable development theory advocates for the use of renewable resources, reduction of waste, and promotion of technologies that minimize environmental impacts (Meadows et al., 2004). Policies such as carbon markets, renewable energy incentives, and conservation programs are practical implementations of this principle, aiming to balance economic activities with environmental preservation (Sachs, 2015).

Sustainable development theory provides a holistic framework for addressing the complex interplay between economic growth, environmental sustainability, and social equity. By promoting integrated approaches and emphasizing the interconnectedness of these three pillars, sustainable development aims to create a more equitable and resilient world for current and future generations.

2.2. Empirical Literature

Several empirical studies have investigated the potential benefits of carbon markets for African countries, examining their impact on emission reduction, renewable energy investment, and community development.

Emission Reduction: Numerous studies have demonstrated the efficacy of carbon markets in reducing emissions. Kossoy et al. (2018) and Miteva et al. (2018) analyze the impact of the EU Emissions Trading System (EU ETS), finding a statistically significant decrease in CO2 emissions from regulated sectors. Although the EU ETS is not directly applicable to Africa, these findings

suggest the potential for carbon markets to incentivize emission reductions in African countries. This is supported by further research, such as that by Laing et al. (2014), which provides evidence of emission reductions in various cap-and-trade systems globally, highlighting the adaptability and effectiveness of such mechanisms in different contexts.

Renewable Energy Investment: The relationship between carbon markets and renewable energy investment has been a focal point of research, particularly in developing countries. Fattoum et al. (2022) suggest that carbon pricing mechanisms can stimulate investments in renewable energy projects. Their study indicates that carbon markets provide a financial incentive for investors to fund renewable energy initiatives, which can lead to significant long-term emission reductions. Similarly, Shrimali and Kniefel (2011) find that renewable energy policies, when complemented by carbon pricing, lead to increased investments in green technologies. This is crucial for Africa, where renewable energy potential is high but underutilized (IRENA, 2015).

Community Development: Carbon markets can also play a significant role in community development, particularly through projects that involve local communities in sustainable practices. Negewo et al. (2014) and Wunder et al. (2008) analyze the Humbo Community Assisted Natural Regeneration Afforestation/Reforestation project in Ethiopia, demonstrating how carbon markets can generate income for local communities engaged in forest conservation and carbon sequestration activities. These projects not only contribute to environmental sustainability but also provide socio-economic benefits, enhancing rural development. Similar findings are reported by Baylis et al. (2016), who explore community-based forest management projects in various African countries, showing how carbon financing can support livelihoods and conservation efforts.

Economic and Social Impacts: Further empirical evidence highlights the broader economic and social impacts of carbon markets. The World Bank (2020) reports that well-designed carbon pricing mechanisms can drive sustainable economic growth, create jobs, and improve public health by reducing pollution. This is particularly relevant for African countries, where economic development is often closely linked with environmental and social challenges. Research by Tietenberg and Lewis (2016) underscores the importance of integrating carbon markets with other

policy measures to maximize their benefits, such as by reinvesting carbon revenues into social programs and infrastructure development.

Challenges and Opportunities: Despite the potential benefits, implementing carbon markets in Africa faces several challenges. These include regulatory and institutional barriers, limited financial resources, and the need for capacity building (Hepburn, 2006; Lecocq & Ambrosi, 2007). However, studies such as those by Doda (2016) and Burtraw et al. (2013) suggest that with the right support and framework, these challenges can be addressed. International cooperation and financial assistance, as well as tailored policy design, are critical to overcoming these obstacles and ensuring the successful implementation of carbon markets in Africa.

In conclusion, empirical literature suggests that carbon markets hold significant promise for African countries in terms of emission reduction, renewable energy investment, and community development. While challenges exist, the potential benefits highlight the importance of continued research and policy innovation to harness the full potential of carbon markets for sustainable development in Africa.

CHAPTER THREE

3. RESEARCH METHODOLOGY

This chapter provides a detailed account of the research methodology employed in this study, encompassing data collection methods, data analysis techniques, and the presentation of findings.

3.1. Data Collection Methods

The study utilized a mixed-methods approach to comprehensively investigate carbon markets in the African context. The methods employed include:

3.1.1. Observations

Direct observations were conducted to gain firsthand insights into the operational dynamics of carbon markets. This method allowed the researcher to observe participant behaviors, interactions, market mechanisms, and environmental conditions in situ.

3.1.2. Interviews

Semi-structured interviews were conducted with a purposive sample of key stakeholders involved in carbon markets in Africa. Stakeholders included policymakers, industry experts, environmental NGOs, and community representatives. The interviews aimed to capture qualitative data on stakeholders' perspectives, experiences, challenges, and recommendations regarding carbon market mechanisms.

3.1.3. Surveys Using Questionnaires

Surveys were administered using structured questionnaires with both closed-ended and open-ended questions. The questionnaires were distributed to a diverse range of participants involved in or affected by carbon markets, including project developers, investors, governmental agencies, and local communities. Open-ended questions were designed to elicit detailed qualitative responses,

while closed-ended questions provided quantitative data on participant demographics, perceptions, and behaviors related to carbon markets.

3.1.4. Secondary Research

Secondary research involved a comprehensive review and synthesis of existing literature, reports, policy documents, and academic studies related to carbon markets, sustainable development, and climate change mitigation efforts in Africa. This literature review provided a contextual framework and theoretical underpinning for the study.

3.2. Data Analysis Techniques

Data analysis encompassed both qualitative and quantitative approaches to derive meaningful insights from the collected data:

3.2.1. Qualitative Data Analysis

Conventional Content Analysis: This method involved systematically coding and categorizing qualitative data obtained from interviews and open-ended survey responses. Themes, patterns, and key concepts related to carbon markets, stakeholder perspectives, and challenges were identified.

Directed Content Analysis: Building on existing theories and frameworks from the literature review, this approach focused on specific themes or concepts predetermined by the research objectives. It aimed to validate theoretical propositions and explore nuanced aspects of carbon market dynamics.

3.2.2. Quantitative Data Analysis

Summative Content Analysis: Quantitative data from closed-ended survey questions were analyzed to summarize responses and identify frequencies, distributions, and trends in participant perceptions and behaviors related to carbon markets.

3.3. Presentation of Findings

The findings of the study will be presented using a comprehensive approach that integrates qualitative descriptions and quantitative summaries:

Qualitative Findings: Detailed textual descriptions and thematic narratives derived from interviews and open-ended survey responses will be presented to illustrate stakeholders' perspectives, challenges, and recommendations concerning carbon markets in Africa.

Quantitative Findings: Statistical tables, graphs, and charts will be used to present quantitative data analysis results, including frequencies, percentages, and correlations derived from closed-ended survey responses.

CHAPTER FOUR

4. ANALYSIS, PRESENTATION AND DISCUSSION

4.1. Economic Impacts

4.1.1. 4.1. Foreign Investment and Economic Growth

Ethiopia's initiatives in the green economy aimed at reducing the country's carbon footprint have garnered significant attention from foreign investors, contributing to economic growth and sustainability efforts.

The Ethiopian Forest Development (EFD) has reported substantial financial support from international entities over the past decade. Notably, Ethiopia has secured $150 million through various initiatives, including partnerships with the World Bank and Norway. A recent milestone was reached in February 2023 with the World Bank's Biocarbon Fund Initiative for Sustainable Forest Landscapes (ISFL), which committed $40 million. This initiative incentivizes community efforts to mitigate carbon emissions through afforestation and land preservation projects.

One of the flagship programs under this initiative is the Oromia Forested Landscape Program (OFLP), focusing on sustainable forest management to combat deforestation in the Oromia region. Covering an expansive area of 32 million acres, including 9 million acres of forests, the OFLP is supported by an initial grant of $18 million over five years. This funding structure includes provision for performance-based payments contingent upon verified emission reductions over a decade.

The OFLP comprises three main components:

Enabling Investment: This component involves sub-basin land-use planning support, investment facilitation, extension services, and targeted forest management interventions in deforestation hotspots. It emphasizes participatory forest management and initiatives in afforestation and reforestation.

Enhancing the Enabling Environment: This focuses on financing complementary activities to bolster institutional effectiveness, policy frameworks, marketing strategies, benefit sharing mechanisms, strategic communication, measurement, reporting and verification systems, and safeguards management at the state and local levels.

Delivering Emission Reductions Payments: Once emission reduction targets are achieved and independently verified, payments are made to stakeholders. This component ensures transparency and accountability in achieving environmental outcomes.

These initiatives underscore Ethiopia's proactive stance in attracting foreign investment to support sustainable development goals, particularly in mitigating climate change impacts through innovative forest management and carbon sequestration strategies.

4.1.2. Job Creation and Local Economic Opportunities

Carbon credit projects serve as significant sources of job opportunities for local communities in Ethiopia.

4.1.2.1. Renewable Energy Projects

Transitioning from fossil fuels to green and environmentally friendly energy sources, such as solar, wind, and hydropower projects, is a key strategy in reducing greenhouse gas emissions.

4.1.2.2. Technology and Innovation

The development of low or zero carbon technologies necessitates intensive efforts in research, development, and manufacturing.

The Grand Ethiopian Renaissance Dam (GERD), Africa's largest dam, spans 1,800 meters in length and rises 155 meters in height, with a total volume of 10.4 million cubic meters. Constructed by webuild group Ethiopia (formerly Salini construction), the project includes a 15,000 cubic meters per second capacity concrete spillway and a rockfill saddle dam stretching 5 kilometers long, standing 50 meters high, and comprising 15.3 million cubic meters in volume on the left

bank. The GERD exemplifies innovative engineering solutions, including the use of Roller Compacted Concrete (RCC), developed to expedite settling and enhance material production quality.

4.1.2.3. Infrastructure Development:

Carbon credit projects, especially those related to renewable energy, often require infrastructure development. This can include the construction of power plants, grid systems, and transportation networks, which generate employment and stimulate economic activity. The infrastructure improvements related to these energy projects pave the way for construction of roads to access rural areas, off-grid power distribution plants, wind farms, solar power plants and hydroelectric facilities. Carbon credit projects also include initiatives to retrofit existing infrastructure with energy efficient technologies such as LED lighting, efficient appliances, and insulation. Additionally, carbon credits incentivize the development of eco-friendly buildings that minimize energy consumption and environmental impact.

4.1.2.4. International Funding and Investment

According to the UNCTAD (United Nations Conference on Trade and Development), Ethiopia tops the list of recipients of Foreign Direct Investment (FDI) among Least Developed Countries (LDCs), followed by Cambodia, Bangladesh, Senegal, and Mozambique. In 2021, FDI inflows to Ethiopia surged to $4.2 billion from $2.4 billion in 2020, contributing significantly to the country's economy, with the total FDI stock reaching $31.6 billion, equivalent to 31.8% of GDP. The majority of these investments are directed towards sectors including oil refining, mining, real estate, manufacturing, and renewable energy. China stands out as a major investor, accounting for 60% of newly approved FDI projects, particularly in manufacturing and services. Other key investing countries include Saudi Arabia, the United States, India, and Turkey. Addis Ababa, Ethiopia's capital, ranks second globally, following Beijing, in attracting foreign direct investment specifically for data center construction, according to a report by FDI Intelligence.

Internationally, carbon credit projects receive funding from various entities such as the World Bank, UNFCCC (United Nations Framework Convention on Climate Change), GCF (Global

Climate Fund), European Union, financial institutions, and the private sector. The GCF has allocated $170.9 million to support renewable energy projects in Ethiopia, Ghana, Guinea, Kenya, Nigeria, and Tunisia. This initiative aims to bolster the enabling environment and stimulate private sector investments in renewable energy within these countries.

4.1.2.5. Skill and Development Training:

Developing skills and providing training related to carbon credit projects is indispensable for ensuring their successful implementation and long-term sustainability in Ethiopia. Key areas of training that benefit individuals and organizations involved in these projects include:

Carbon Accounting and Measurement: This involves calculating the amount of greenhouse gases emitted directly and indirectly by an organization within defined boundaries. Direct emissions originate from sources owned and operated by the organization, such as manufacturing processes, while indirect emissions stem from purchased electricity, steam, heating, and cooling.

Project Management: Effective project planning and implementation skills are crucial for the successful execution of carbon credit projects. Techniques in risk management, monitoring, and evaluation are also essential for achieving project objectives.

Environmental Economics: Understanding the economic dimensions of carbon credit projects is vital, encompassing cost-benefit analysis, market dynamics, carbon market knowledge, trading mechanisms, and pricing trends.

Renewable Energy Technologies: Given the transition in Ethiopia's energy mix from fossil fuels to sustainable sources, training in renewable energy projects is pivotal. Skills in solar, wind, biomass, and other clean energy technologies are instrumental in maximizing the contribution of these sources to carbon credits.

Forestry and Land Use Management: Training in sustainable forestry practices and afforestation/reforestation projects is actively promoted in Ethiopia. Arba Minch University, through its College of Agricultural Sciences, offers specialized programs such as Forest

Entomology & Pathology, covering genetics, biotechnology, and genetic engineering for tree improvement. Sustainable land-management practices like conservation tillage, cover cropping, and crop rotation are also emphasized to enhance soil health, fertility, water infiltration, and mitigate soil degradation.

Climate Change Policy and Regulations: Familiarity with national and international policies and regulations related to climate change is crucial for participants in carbon projects. Institutions like Jimma University, The Ethiopian Institute of Resilience to Climate Change (ERICC), Policy Study Institute, and the Japan International Cooperation Agency (JICA) conduct short-term training programs tailored for government officials, policymakers, graduate students, and other interested stakeholders.

These training initiatives are essential for building capacity, fostering innovation, and ensuring the effective implementation of carbon credit projects in Ethiopia, thereby contributing to sustainable development and climate resilience.

4.1.2.6. Entrepreneurship Opportunities

Exploring entrepreneurship opportunities from carbon credit projects in Ethiopia is a crucial aspect of understanding the broader impact of such initiatives on economic development. To assess these opportunities and results achieved, we can go over the below initiatives that are implemented.

Figure 4.1: Oromia Coffee Farmers' Cooperative Union, Ethiopia

Members of the Oromia Coffee Farmers' Cooperative Union (OCFCU) encompass growers, processors, and suppliers of premium organic Arabica coffee destined for direct export. The primary objective of OCFCU is to market farmers' coffee through auctions, ensuring fair trade practices and sustainability across their operations (Source: Fairtrade Africa: Oromia Coffee Farmers' Cooperative Union).

Fairtrade coffee acts as a crucial safety net in response to the highly volatile global coffee market. Fluctuations in coffee prices significantly impact livelihoods, making it challenging for growers to forecast income, especially during market downturns. Introduced after the collapse of coffee prices in the late 1980s, Fairtrade guarantees certified growers a minimum price for their produce, shielding them from market instabilities.

Since obtaining Fairtrade certification in 2002, OCFCU has leveraged the Fairtrade minimum price and additional premiums to implement various social and productive programs. This support has contributed to consistent growth in sales and revenue, with net revenue increasing by 84% in 2011 alone. Notably, OCFCU's commitment to environmental stewardship and social justice is reflected in all aspects of their operations, including prominent roles for women and organic cultivation practices that foster bird-friendly conditions.

Currently, OCFCU exports its coffee to Fairtrade markets in the United States, Europe, Australia, and Asia, underscoring their global reach and impact. The union comprises 217 member cooperatives with 202,397 farmer members, including 22,302 women farmers, demonstrating significant community involvement and empowerment.

In recent years, OCFCU has also ventured into carbon trading, generating over 1.1 million euros from carbon sales. Partnering with Fair Climate Fund, the union has sold 97,000 tons of carbon credits, facilitated by Ethiopia's National Green Legacy program, which supports agroforestry initiatives. This success has inspired OCFCU to aim for even greater revenue through carbon trading, aligning environmental goals with economic sustainability for their members.

To further their sustainability objectives, OCFCU collaborates with Fairtrade Netherlands on forest protection, CO2 emissions reduction, and improving farmers' quality of life. Notable

initiatives include distributing 40,000 improved cook stoves in the Ghimbi region, which not only reduce emissions but also generate carbon credits that benefit local households economically.

Another impactful project supported by carbon credits is the establishment of a flour mill in the Bale Eco-region of Ethiopia. Managed by the Participatory Forest Management Cooperative (PFMC), this initiative reduces deforestation, earns income through carbon credit sales, and enhances local livelihoods. The PFMC, comprising 345 households managing 2013 hectares of forest, invested their carbon credit income into the flour mill, benefiting the community by eliminating the need for long journeys to mill grains, particularly benefiting women and girls who traditionally undertake this task.

Through these initiatives, OCFCU continues to pioneer sustainable practices in coffee production, environmental conservation, and community development, setting a benchmark for fair trade and carbon offset projects in Ethiopia and beyond.

Figure 4.2: Sustainable Bamboo Production

The Dutch Fund for Climate and Development (DFCD) is actively backing a transformative initiative aimed at scaling up the sustainable and climate-resilient production of bamboo in Ethiopia. Supported by an investment proposition from BIOALLEY B.V. (NETHERLANDS) (“AFRICAN BAMBOO”), this project seeks to catalyze Ethiopia's bamboo sector, empowering entrepreneurs to expand their production capacities and enhance their societal impact.

The DFCD's Origination Facility Investment Committee has recently approved a proposal to facilitate the development of a comprehensive business investment plan. This plan aims to significantly amplify the scope of sustainable bamboo production and transformation across Ethiopia. Through this initiative, approximately 20,000 hectares of plantation and forest lands will be brought under sustainable management practices. Moreover, the project anticipates creating over 12,000 new jobs, thereby positively affecting the livelihoods of around 100,000 individuals. (Source: SNV: DFCD supporting sustainable bamboo production in Ethiopia)

4.2. Social Impacts

In the pursuit of sustainable development, carbon credit projects have emerged as crucial mechanisms to combat climate change while fostering economic growth. Ethiopia, with its rich cultural diversity, ecological significance, and commitment to environmental sustainability, serves as a compelling case study for understanding the multifaceted social impacts of such projects. As the nation grapples with the complexities of balancing economic development and environmental conservation, it becomes imperative to delve into the social dimensions of carbon credit initiatives.

Carbon credit projects, often rooted in reforestation, renewable energy, and sustainable agriculture, have the potential to go beyond mitigating greenhouse gas emissions. They can serve as catalysts for transformative social change, influencing the lives of individuals and communities in profound ways.

4.2.1. Community Livelihood Changes

Nestled within Ethiopia's vibrant landscapes, carbon credit projects have emerged as transformative forces, mitigating the impacts of climate change and shaping community livelihoods. As Ethiopia positions itself as a key player in sustainable development, understanding these changes is paramount. Carbon credit projects act as economic engines, breathing new life into traditional livelihoods while paving the way for innovative opportunities. The interplay

between environmental conservation and community well-being demands meticulous examination.

In Oromia, particularly in the Bale region, afforestation and reforestation activities have significantly benefited local communities. Farmers partnering with Farm Africa have diversified income through forest-friendly businesses such as beekeeping and wild coffee harvesting. These projects have not only supplemented household incomes but also reduced women's workload by eliminating long journeys for grain milling, thereby improving their quality of life. Average annual household income has risen from 17,000 Ethiopian Birr in 2016 to 43,000 Ethiopian Birr by 2020.

4.2.2. Skill Development

Training programs focused on sustainable land management, agroforestry, and other environmentally friendly practices enhance community members' capacity. Participants in carbon credit projects develop skills in project management, budgeting, scheduling, risk management, and stakeholder communication. They also gain familiarity with carbon markets, international treaties (such as the Kyoto Protocol or the Paris Agreement), and local regulations on emission reduction, critical for navigating legal and regulatory aspects. Financial skills related to pricing, trading, risk assessment, financial modeling, and carbon market investment are also honed.

4.2.3. Community Engagement and Empowerment

Ethiopia has become a hub for innovative environmental initiatives, with carbon credit projects playing a pivotal role in combating climate change and transforming local communities. These projects engage and empower communities by creating employment opportunities, developing skills, and enhancing community resilience. In regions like Oromia, participatory forest management projects have successfully reduced deforestation, promoting sustainable livelihoods. Initiatives empowering women with secure land tenure for sustainable land management have enabled smallholder farmers to invest in soil conservation, longer-rotation crops, and tree plantations, thereby enhancing adaptive capacity and income. Women, who comprise 78% of Ethiopia's rural highlands population, are major beneficiaries.

4.2.4. Health and Educational Benefits

As Ethiopia aims for a sustainable and resilient future, carbon trading emerges as a powerful tool not only to combat climate change but also to yield significant health and educational benefits for communities. Market-based carbon trading solutions contribute to Ethiopia's greener, more sustainable trajectory, benefiting health and education beyond carbon offsets alone.

4.3. Environmental Impacts

Nestled within the East African tapestry, Ethiopia stands at the forefront of a green revolution, employing innovative solutions to harmonize economic growth with environmental preservation. At the heart of this endeavor lie carbon credit projects, remarkable initiatives designed not only to mitigate climate change but also to cultivate a harmonious coexistence between human activities and the natural world.

In the wake of global climate challenges, Ethiopia has emerged as a beacon of inspiration, demonstrating how carbon credit projects can be catalysts for environmental rejuvenation. The effects of climate change, such as increased rainfall variability and flooding, have heightened pressure on vulnerable households across Ethiopia, particularly in the lowlands of the south and southwest.

4.3.1. Biodiversity Conservation

Biodiversity conservation is a critical aspect of environmental sustainability, and in Ethiopia, the intersection of biodiversity and carbon credit projects presents a compelling narrative of interconnected benefits. Carbon credit initiatives, designed to mitigate climate change by reducing greenhouse gas emissions, play a crucial role in promoting sustainable development. These projects not only contribute to global climate goals but also safeguard Ethiopia's rich biodiversity.

Ethiopia's forest cover has drastically declined, with less than 4% of its land classified as high forest compared to around 30% in the late 19th century (WBISPP, 2004). Factors contributing to this decline include poorly defined forest property rights and insecure land tenure. Since 1975,

forests have been state assets, with management responsibilities transferred from local communities to the central government, leading to increased deforestation.

Effective forest management offers numerous benefits crucial for climate change mitigation, including carbon sequestration, biodiversity preservation, sustainable livelihoods, community empowerment, climate resilience, and economic incentives. Carbon credit projects promote forest protection and restoration, crucial for maintaining biodiversity and supporting resilient ecosystems. Ethiopia has actively engaged in forest management programs such as REDD+ (Reduced Emissions from Deforestation and Forest Degradation), aiming to reduce national greenhouse gas emissions by 40% through sustainable forest management by 2030 (Source: Gizaw Ebissa, Aramde Fetene, Hayal Desta).

The Humbo project stands out as a successful reforestation initiative supported by World Vision, restoring 2,728 hectares of degraded forest and sequestering over 870,000 tonnes of carbon dioxide equivalent over a 30-year period. This project not only mitigates climate change but also alleviates poverty through improved natural resource management, demonstrating the dual benefits of environmental restoration and economic upliftment (Climate Change Case Studies – June 2009, World Vision).

4.3.2. Promotion of Sustainable Agriculture

Agriculture, predominantly rain-fed and operated by smallholder farmers, is Ethiopia's backbone and highly vulnerable to climate change. Climate-smart agriculture practices, including improved seed varieties, crop rotation, intercropping, conservation agriculture, agroforestry systems, and irrigation, have been pivotal in adapting agriculture to changing climate conditions (Journal of Agriculture and Food Research, Sept 2023).

Carbon credit projects encourage sustainable agricultural practices that alleviate pressure on natural ecosystems. Agroforestry systems, for example, integrate trees with crops, enhancing biodiversity while sequestering carbon. In Wolaita Sodo district, farmers have integrated agroforestry into their practices, enriching soil fertility, recharging depleted springs, and providing employment for 2,000 people. Carbon finance supports these initiatives by funding forest

regeneration and sustainable farming, generating carbon offsets that finance biodiversity conservation and climate change mitigation (Climate Adaptation Platform/Climate Change and Sustainable Agriculture in Ethiopia).

4.3.3. Economic Diversification

By providing economic incentives for carbon sequestration and conservation activities, carbon credit projects contribute to local economic diversification. This diversification reduces dependence on activities that harm biodiversity, such as unsustainable logging and agriculture. Economic incentives from carbon finance empower communities to engage in sustainable land management practices, thus promoting both environmental stewardship and economic resilience.

Carbon credit projects in Ethiopia represent a transformative approach to environmental conservation and sustainable development. By integrating biodiversity conservation with climate change mitigation strategies, these initiatives not only safeguard ecosystems but also enhance community livelihoods and promote resilient economic growth.

4.4. Role of Private Sector

The private sector in Ethiopia plays a pivotal role in driving investment, innovation, and sustainability within carbon credit projects, crucial for mitigating climate change and advancing environmental conservation. Defined broadly by the United Nations, the private sector encompasses individual for-profit enterprises, commercial businesses, business associations, coalitions, and corporate philanthropic foundations (Scoping Private Sector Opportunities in Ethiopia, Dr. Tefera Mengistu). Ethiopia's public-private partnership (PPP) policy, introduced in 2017 and overseen by the PPP Board within the Ministry of Finance, underscores the private sector's integral role in bolstering the country's economic growth, particularly in infrastructure development.

Key roles assumed by the private sector include investment financing, project development and implementation, innovation, market creation and participation, promotion of sustainable practices and corporate social responsibility, as well as monitoring, reporting, and verification. The PPP

Board, comprising representatives from government bodies and private sector institutions, plays a critical role in approving key milestones in project development and tender processes, ensuring effective collaboration and project execution (Ministry of Finance & Economic Cooperation website: programs – projects).

Among the notable renewable energy projects is the Gad & Decheto Solar PV Project, awarded to ACWA, a Saudi Arabian power generation company in 2019. This project aimed to establish solar PV power plants with a capacity of 125 MWac each in Somali Regional State and Decheto, Afar. However, delays attributed to the COVID-19 pandemic, loan rejections from international lenders, and recent regional conflicts have postponed the project's implementation, leading to its termination by the PPP Board, which plans to reissue the tender to a new developer (The Reporter vol 25-No-1340 – May 14, 2022).

Similarly, the Welenchiti Solar PV Project, proposed to be a 150 MW grid-connected solar PV power plant in Oromiya Regional State, is slated to commence construction in 2025 and commence commercial operations by 2027 (Ethiopian Electric Power).

Oil and energy companies operating in Ethiopia are also pivotal in renewable energy production, marking a significant shift from traditional oil and gas extraction to include wind, solar, and hydroelectric power. This transformation responds not only to environmental imperatives, but also strategic business decisions influenced by market dynamics, technological advancements, and evolving consumer preferences.

Ethiopia's energy potential from various sources is considerable, yet largely underexploited. The table below illustrates the vast potential across hydropower, solar, wind, geothermal, wood, agricultural waste, natural gas, coal, and oil shale, highlighting the current low exploitation rates for these resources (Source: Ethiopian Electrical Power).

Table 4.1:Exploitable Reserve and Exploited Percent

Resource	Unit	Exploitable Reserve	Exploited Percent
Hydropower	MW	45,000	<5%
Solar/day	kWh/m2	4 – 6	<1%
Wind: Power Speed	GW m/s	100	<1%
Geothermal	MW	<10,000	<1%
Wood	Million tons	1120	50%
Agricultural waste	Million tons	15-20	30%
Natural Gas	Billion m3	113	0%
Coal	Million tons	300	0%
Oil shale	Million tons	253	0%

The presence of over 20 oil and gas companies in Ethiopia underscores their role in supplying petroleum, diesel, and industrial lubricants, contributing to both energy security and economic development.

Ethiopia's private sector is instrumental in advancing carbon credit projects, renewable energy initiatives, and sustainable practices. Through strategic partnerships and innovative solutions, these efforts not only mitigate climate change impacts but also foster economic growth and environmental resilience across the nation.

4.5. Institutional Framework

In recent years, Ethiopia has emerged as a significant player in global efforts to combat climate change through carbon credit projects. These initiatives, aimed at reducing greenhouse gas emissions while promoting sustainable development, rely heavily on a robust institutional framework to ensure their effectiveness and viability. Understanding the intricate network of institutions involved in implementing, monitoring, and regulating carbon credit projects is crucial for comprehending Ethiopia's contribution to global climate action. Various stakeholders, including governmental bodies, non-governmental organizations, and the private sector, play critical roles in shaping the institutional landscape of carbon credit projects in the country.

The Government of Ethiopia has formulated a Climate Resilient Green Economy (CRGE) Vision and strategy, aimed at achieving a climate-resilient green economy and carbon neutrality by 2025 (Ethiopia's Climate-Resilient Green Economy Strategy, 2011). This strategy identifies eight key sectors pivotal to sustainable development, including Reducing Emissions from Deforestation and Forest Degradation (REDD+), soils, livestock, energy, buildings and cities, industry, transport, and health. To support these priorities, the government established the Ethiopia CRGE Facility under the Ministry of Finance and Economic Development (MOFED). This facility serves as the primary mechanism to mobilize domestic and international funds, integrating climate finance into broader CRGE objectives. Sectoral ministries and other government entities, including subnational bodies, are tasked with developing investment plans aligned with international standards to access funding through the CRGE Facility, which is currently receiving support from several development partners such as the United Nations Development Programme (UNDP), the United Kingdom's Department for International Development (DFID), the Government of Austria, the Global Green Growth Institute (GGGI), and the World Bank.

The Ethiopian Energy Authority (EEA) oversees the issuance of generation licenses, crucial for Independent Power Producers (IPPs) seeking to develop energy projects in Ethiopia. IPPs must engage in Power Purchase Agreements with the Ethiopian Electric Power (EEP) to operate specific generation facilities. The development of energy in Ethiopia is governed by several key legislations, including Energy Proclamation No. 813/2013, Ethiopian Energy Authority Establishment Council of Ministers Regulation No. 308/2014, and various other regulatory frameworks pertaining to environmental protection, investment incentives, and the overall legal framework for renewable energy (Hunton Andrews Kurth LLP, September 2019).

Community involvement and ownership are fundamental to Ethiopia's journey towards sustainability. Engaging local communities in carbon credit projects is essential amid environmental challenges, aiming to foster ownership and empowerment among stakeholders. Ethiopia's diverse cultural heritage provides a fertile ground for these projects to thrive, not only mitigating carbon emissions but also catalyzing socio-economic growth from grassroots levels. The Bale Mountains project exemplifies successful community involvement, combining

Participatory Forest Management (PFM) with REDD+ mechanisms to conserve natural forests and improve local livelihoods.

As Ethiopia pursues sustainable development amidst climate change challenges, policy adjustments are crucial for optimizing outcomes from carbon credit projects. These initiatives offer promising avenues to reduce Ethiopia's carbon footprint while promoting economic growth and environmental responsibility. Maximizing the potential of these projects requires a clear understanding of the policy landscape and strategic adjustments to enhance their impact.

Ethiopia's commitment to sustainable development through carbon credit projects underscores its role as a leader in climate action, leveraging institutional frameworks, community engagement, and policy adjustments to build a resilient and green economy for future generations.

4.6. Key findings of the research

Carbon credit initiatives play a pivotal role in addressing global climate change, with Ethiopia making significant strides in their development. This paper seeks to delve into the complexities of carbon credit projects and their impact on various stakeholders within Ethiopia's diverse ecological, socioeconomic, and policy landscapes. By exploring the interplay between environmental conservation, sustainable development, and community empowerment, our aim is to uncover both the opportunities and challenges inherent in these initiatives.

Through a methodology centered on questionnaires and personal interviews, we engaged a diverse range of respondents including self-employed entrepreneurs, private/corporate employees, public sector representatives, and non-profit organizations. This approach facilitated a comprehensive understanding of perceptions, experiences, and insights regarding carbon credit projects in Ethiopia.

By synthesizing these findings, we aim not only to gain deeper insights into the opportunities and challenges surrounding carbon projects in Ethiopia but also to catalyze meaningful actions towards fostering a more sustainable and inclusive future for the nation and beyond. This synthesis will illuminate pathways for enhancing the effectiveness and impact of carbon credit initiatives,

ultimately contributing to Ethiopia's broader goals of environmental sustainability and socio-economic development.

The research objectives were designed to comprehensively investigate several key aspects of carbon credit projects in Ethiopia. These included assessing the level of societal awareness regarding carbon credit initiatives, examining their environmental, social, and economic impacts within the country, studying mechanisms to ensure the integrity of these projects, identifying challenges encountered in their implementation, evaluating their contribution to Sustainable Development Goals (SDGs), and exploring opportunities to enhance their effectiveness for future initiatives. These objectives aimed to provide a nuanced understanding of the current landscape of carbon credit projects in Ethiopia and to offer valuable insights for policymakers, stakeholders, and practitioners involved in sustainable development and climate change mitigation efforts.

For the society to actively participate on carbon credit initiatives that are under implementation in Ethiopia, a clear understanding of these projects along with their socio-economic and environmental impacts is crucial. Even though these projects are initiated by the Ethiopian government and different international organizations, the ultimate owners and drivers of these projects are the local community both directly involved stakeholders and indirect participants. As per the data that was gathered, 46.2% of the respondents were not familiar with the carbon credit initiatives in Ethiopia.

The lack of awareness among the surveyed population regarding carbon credit projects in Ethiopia can be attributed to several potential causes. Firstly, there is a significant knowledge gap evident among respondents, indicating a lack of awareness or understanding of these initiatives. This gap may stem from limited access to information about carbon credit projects, inadequate educational opportunities on the subject, or simply low interest among the population.

Secondly, the findings emphasize the critical need for education and awareness campaigns to address this knowledge gap effectively. Initiatives such as public information sessions, workshops, and media campaigns are essential to disseminate information about the goals and benefits of

carbon credit projects. By enhancing understanding among the target audience, these efforts can foster greater awareness and engagement with carbon initiatives.

Thirdly, the lack of awareness presents an opportunity for engagement with the surveyed population. It suggests that there is potential to introduce and promote carbon initiatives more actively, thereby increasing individuals' involvement and participation in such projects. This engagement can be pivotal in building support and mobilizing resources for sustainable development through carbon credits.

Furthermore, effective communication strategies are crucial in conveying information about the steps Ethiopia is taking towards achieving sustainable development through carbon credit projects. Clear and accessible communication channels can help bridge the knowledge gap and enhance public perception and support for these initiatives.

Lastly, the study underscores the need for further research to delve deeper into the underlying reasons for the lack of awareness among the surveyed population. Qualitative studies or follow-up surveys could provide deeper insights into the specific factors contributing to the knowledge gap. These insights would be invaluable in designing more targeted interventions and educational strategies to improve awareness and participation in carbon credit projects in Ethiopia. Thus, addressing these causes comprehensively can pave the way for more effective implementation and impact of carbon credit initiatives in the country

Among the various benefits of Ethiopia's carbon credit initiatives, environmental conservation stands out as particularly significant. According to data collected, 40% of the sample population expressed uncertainty regarding the positive environmental changes resulting from these initiatives, while another 40% reported observing such improvements. The remaining respondents did not perceive any environmental changes attributable to carbon credit projects. This uncertainty among the population can be attributed to several factors, including the complexity of environmental impact assessment, monitoring, and evaluation processes. Clear documentation and effective communication of environmental outcomes from these projects are crucial to bridging this perception gap. By addressing these challenges and fostering dialogue with stakeholders,

Ethiopia can enhance understanding and garner greater support for its carbon credit initiatives, thereby maximizing their environmental benefits.

Ethiopia, grappling with environmental challenges while pursuing ambitious development goals, has emerged as a leader in innovative climate solutions. This study highlights the significant contributions of carbon credit projects to sustainable development across various critical aspects. Firstly, these initiatives play a pivotal role in poverty reduction by creating new economic opportunities and enhancing livelihoods, particularly in rural areas. Secondly, they promote improved access to clean energy, crucial for reducing dependency on fossil fuels and mitigating climate impact. Thirdly, carbon credit projects contribute to biodiversity conservation by preserving ecosystems and their invaluable services. Additionally, they stimulate job creation across sectors involved in renewable energy and environmental management. Lastly, these initiatives facilitate infrastructure development, crucial for supporting economic growth and enhancing resilience to climate change impacts. Through these multifaceted contributions, carbon credit projects in Ethiopia are pivotal in advancing inclusive and resilient growth while addressing pressing environmental challenges.

While carbon projects offer substantial promise for advancing environmental sustainability and economic development, their successful implementation faces several complex challenges, as identified in this study. These challenges include a lack of awareness among the population, limited community participation, insufficient funding, technological constraints, and regulatory barriers. Despite these obstacles, Ethiopia, with its rich natural resources, cultural diversity, and ambitious development goals, sees carbon initiatives as a pivotal avenue for promoting environmental sustainability, economic growth, and social inclusion.

According to the findings, 80% of the surveyed population holds an optimistic view regarding the opportunities that carbon projects can leverage to achieve sustainability goals in the country, while the remaining respondents remain neutral. However, the study also reveals that only 68.6% of respondents express willingness to actively participate in carbon initiatives, highlighting the impact of the knowledge gap and lack of awareness.

Addressing these challenges and enhancing awareness have the potential to significantly boost community engagement and interest in carbon projects. By bridging the knowledge gap and removing barriers, Ethiopia can foster greater participation and support for these initiatives, thereby advancing its goals of sustainability and inclusive growth.

In addition to addressing the challenges and opportunities of carbon credit projects, this study also emphasizes the crucial role of individuals and communities in contributing to their success. According to gathered data, key contributions include voluntary efforts to reduce or optimize utility consumption and manage household waste effectively. Moreover, initiatives such as reducing traditional energy use and deforestation, organizing workshops and seminars to raise awareness about carbon credit benefits, fostering innovations in low-emission industries by entrepreneurs and investors, and adopting environmentally friendly farming practices all play significant roles.

Ethiopia's dedication to environmental stewardship and sustainable development is evident through initiatives like afforestation and substantial investments in renewable energy. However, effectively integrating these efforts requires careful consideration of factors such as institutional frameworks, stakeholder engagement, technological capabilities, and market dynamics. Challenges such as limited capacity, regulatory hurdles, and the scalability of projects must be addressed to fully harness the potential of carbon credit initiatives.

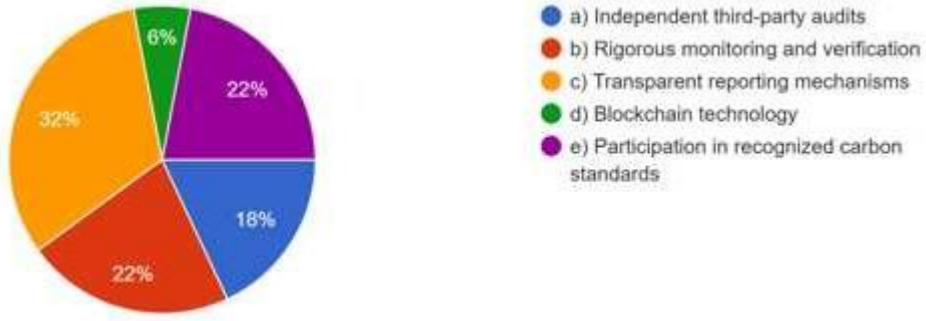
The study also highlights mechanisms identified by the surveyed population to ensure the integrity of carbon initiatives in Ethiopia, underscoring the importance of robust verification processes, transparent reporting, and adherence to recognized standards. These measures are essential for enhancing trust, credibility, and effectiveness in achieving environmental and developmental goals through carbon credit projects. Here are the mechanisms identified by the surveyed population to ensure the integrity of carbon initiatives in Ethiopia:

1. **Independent third-party audits**: This involves selecting auditors with expertise in carbon accounting and verification, accredited by bodies like the Clean Development Mechanism (CDM) or Verified Carbon Standard (VCS). Auditors gather necessary documentation

from carbon credit owners, conduct site visits to verify project implementation, and prepare a comprehensive verification report. This report includes findings, recommendations, and areas for improvement, ensuring accuracy and reliability for stakeholders such as project developers, carbon credit registries, and certification bodies.

2. **Rigorous monitoring and verification**: This process establishes baselines, implements projects, and conducts independent verification and certification to demonstrate environmental integrity. It plays a crucial role in attracting investments and contributing effectively to global climate change mitigation efforts.
3. **Transparent reporting mechanisms**: Essential for ensuring integrity and credibility, transparent reporting involves preparing publicly accessible documentation in standard formats. It includes maintaining online registries, engaging stakeholders, conducting independent third-party verifications, and disclosing risks and uncertainties through annual periodic reporting. These practices enhance accountability and trust in carbon projects.
4. **Blockchain Technology**: This mechanism tracks the ownership and history of carbon credits throughout their lifecycle. Blockchain ensures transparency and accountability by allowing stakeholders to trace credits back to emission reduction activities and verification processes. It helps prevent fraud, double counting, and counterfeit credits, thereby enhancing the reliability of carbon credit transactions.
5. **Participation in recognized carbon credit standards**: Adherence to established standards and best practices demonstrates project developers' commitment to environmental integrity. This includes following best practices, conducting credible verification processes, maintaining transparent reporting practices, mitigating risks, and continuously improving operations. Compliance with recognized standards enhances credibility and facilitates broader acceptance and support for carbon credit initiatives.

Figure 4.3: Mechanisms to ensure the integrity of carbon initiatives in Ethiopia



The study attempted to gauge the satisfaction level among respondents regarding ongoing projects in Ethiopia. Surprisingly, more than half of the sampled population expressed neutrality. This suggests a possible lack of awareness and knowledge gaps concerning current carbon initiatives in Ethiopia. It implies that the projects underway may not effectively harness the country's abundant natural resources. Further research could explore additional reasons underlying this neutral stance.

Overall, the data collected on sustainable development through carbon credit projects in Ethiopia has provided valuable insights. Key findings include a significant information gap between communities and these initiatives, the crucial role of independent third-party audits in ensuring project integrity, and the identification of challenges that impede project effectiveness alongside the opportunities they offer. These insights underscore the transformative potential of carbon credit projects and highlight areas for further investigation and improvement.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusions

The exploration of sustainable development through carbon credit projects in Ethiopia unveils narrative rich with promise and potential across multiple dimensions—environmental conservation, economic growth, and social equity. Ethiopia, renowned for its cultural heritage and diverse ecological landscapes, stands at a critical juncture where innovative approaches to climate change mitigation intersect with ambitious development aspirations.

Environmental Impact and Conservation Efforts

Carbon credit projects in Ethiopia have demonstrated significant strides in environmental conservation, particularly through afforestation and reforestation initiatives. These efforts not only sequester carbon dioxide from the atmosphere but also restore biodiversity and ecosystem services. The integration of agroforestry practices, exemplified by the Oromia Coffee Producers Union's success in generating revenue from carbon credits, showcases a sustainable model where economic gains complement environmental stewardship.

Economic Opportunities and Technological Innovation

The transition towards renewable energy sources, such as solar and wind power, represents a pivotal economic opportunity for Ethiopia. International collaborations with companies like TotalEnergies in developing EV charging infrastructure and offshore wind turbines highlight Ethiopia's potential to leapfrog into a green energy economy. These initiatives not only reduce greenhouse gas emissions but also create jobs, stimulate local economies, and enhance energy security.

Social Inclusion and Community Empowerment

Central to the success of carbon credit projects is community engagement and empowerment. Initiatives that provide energy-efficient technologies to rural communities, supported by institutions like the World Bank's Carbon Initiative for Development (Ci-Dev), ensure that local populations benefit directly from emission reduction efforts. Furthermore, promoting inclusive participation in decision-making processes fosters ownership and sustainability of these projects among diverse stakeholders.

Institutional Frameworks and Governance

The effectiveness of carbon credit projects hinges on robust institutional frameworks that ensure transparency, accountability, and adherence to international standards. Independent third-party audits, rigorous monitoring mechanisms, and transparent reporting are essential in building trust among investors, donors, and local communities. Strengthening regulatory frameworks and enhancing capacity for project implementation are critical steps towards overcoming existing challenges like funding gaps and regulatory barriers.

Future Pathways and Strategic Recommendations

Looking forward, Ethiopia has the opportunity to capitalize on its natural resources and cultural heritage to position itself as a global leader in sustainable development. Embracing innovative water management solutions, expanding urban green spaces, and promoting climate-resilient agriculture are strategic pathways towards achieving carbon neutrality and advancing the Sustainable Development Goals (SDGs). Continued investment in research, education, and technological innovation will be instrumental in navigating complexities and seizing emerging opportunities in the evolving landscape of carbon finance.

Ethiopia faces multifaceted challenges in realizing the full potential of carbon credit projects, the country's commitment to sustainability and resilience is evident. By fostering partnerships, leveraging international support, and embracing transformative technologies, Ethiopia can pave the way for a prosperous future where environmental stewardship and economic prosperity go

hand in hand. The journey towards sustainable development through carbon credits is not merely a path forward but a paradigm shifts towards a resilient and inclusive society for generations to come.

5.2. Recommendations

Harnessing Ethiopia's Natural Resources

Ethiopia's abundant sunshine, as epitomized by the tourism slogan "Thirteen Months of Sunshine," presents a unique opportunity to transition from traditional energy sources like coal and fuel to solar energy. Government and financial institutions should incentivize private sector involvement in solar energy by offering tax reductions on imported items, facilitating foreign currency allocations, and streamlining regulatory frameworks. This shift can not only enhance energy access but also mitigate health risks associated with traditional energy sources.

Transition to Renewable Energy

Encouraging local and international energy companies, such as TotalEnergies, to invest in renewable energy solutions is paramount. Initiatives like installing electric vehicle (EV) charging stations, carbon capture projects, and offshore wind turbines can significantly contribute to reducing carbon emissions in Ethiopia. Embracing such innovations will diversify the country's energy mix and promote sustainable economic growth.

Institutional Support and Best Practices

Financial institutions like Awash Bank have set commendable examples by replacing diesel and petrol vehicles with electric vehicles. Such initiatives should be celebrated and emulated across industries to foster a green economy. Institutions can further support sustainability efforts by implementing environmentally friendly practices and promoting carbon-neutral operations.

Afforestation and Reforestation Initiatives

Ethiopia's commitment to afforestation and reforestation efforts has not only conserved biodiversity but also generated revenue through carbon credit sales. Collaborative efforts between organizations like the Oromia Coffee Producers Union and international buyers demonstrate the economic potential of agroforestry projects. Scaling up these initiatives can create sustainable livelihoods for local communities while enhancing carbon sequestration.

Utilization of Innovative Water Management Solutions

Learning from global examples like the Jebel Ali wastewater treatment plant in the UAE, Ethiopia can enhance urban green spaces using recycled wastewater. This approach conserves fresh water resources and improves urban air quality, mitigating the environmental impact of rapid urbanization. Implementing similar water management systems in Ethiopian cities could bolster environmental sustainability efforts.

In conclusion, Ethiopia possesses immense natural resources and cultural diversity that can propel its sustainable development journey through carbon credit projects. By addressing existing challenges and capitalizing on emerging opportunities, Ethiopia can realize its potential as a leader in environmental conservation and economic resilience on the global stage. Continued collaboration between stakeholders, innovative approaches, and adaptive strategies will be instrumental in achieving these ambitious goals.

REFERENCES

Abebe, A., et al. (2020). *Community livelihoods and carbon stock dynamics in participatory forest management in Ethiopia*. Journal of Environmental Management, 267, 110604. doi:10.1016/j.jenvman.2020.110604

Abebe, A., et al. (2020). *Community livelihoods and carbon stock dynamics in participatory forest management in Ethiopia*. Journal of Environmental Management, 267, 110604. doi:10.1016/j.jenvman.2020.110604

Afionide, O. A., Osabuohien, A. A., Chukwuemeka, O. S., Onibere, O. I., & Egbe, M. A. (2014). Challenges and opportunities of REDD+ for climate change mitigation in sub-Saharan Africa. Journal of Sustainable Forestry, 33(1), 69-89.

Andersson, J. J. (2019). Carbon taxes and CO2 emissions: Sweden as a case study. *American Economic Journal: Economic Policy*, 11(4), 1-30.

Angelsen, A. (2008). Does REDD+ add up? Analysing the feasibility of a global REDD+ scheme. Environmental Science & Policy, 11(7), 787-796.

Angelsen, A. (2008). Moving ahead with REDD: Issues, options, and implications. *CIFOR*.

Baumol, W. J., & Oates, W. E. (1988). *The Theory of Environmental Policy*. Cambridge University Press.

Baylis, K., Peplow, S., Rausser, G., & Simon, L. (2016). Agri-environmental policies in the EU and United States: A comparison. *Ecological Economics*, 117, 29-40.

Biadglegne, A., Gobeze, T., Mohammed, A., & Feleke, E. (2022). Estimation of carbon stock & emission of community forests in Eastern Amhara, Ethiopia. *Journal of Environmental Management*.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githe, A., Medany, M., ... & Ewunetu, B. (2007). Climate change and adaptation strategies for sustainable development in semi-arid areas. Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,

Boyle, J., Ganzi, J., & Guttman, D. (2018). Regulatory frameworks for carbon markets in Africa. *Environmental Law Review*, 20(3), 221-236.

Boyle, M., Humphreys, F., & Kerr, S. (2018). Regulatory uncertainty and the development of the forestry carbon market in Southeast Asia. Climate Policy, 18(3), 382-399.

Bumpufye, E. E., Angelsen, A., & Wunder, S. (2017). Transaction costs of REDD+: A review from Africa. Forests, 8(6), 220.

Bumpufye, E., Karekezi, S., & Majoro, L. (2017). Market access challenges for small-scale carbon project developers in Africa. *Energy Policy*, 108, 297-306.

Burtraw, D., Palmer, K., & Kahn, D. (2013). A symmetric safety valve. *Energy Policy*, 56, 328-337.

Busch, J., Rajaratnam, S., & Wright, G. (2019). Enhancing transparency in the Paris Agreement era: The interplay between bottom-up and top-down monitoring. *Climate Policy, 19*(10), 1267-1279. https://doi.org/10.1080/14693062.2019.1644266

Carbon Trade Watch. (2024). *Critical perspectives on carbon markets*. Retrieved from [Carbon Trade Watch].

Carbon Trade Watch. (2024). Critical perspectives on carbon markets. Retrieved from [Carbon Trade Watch].

Dernbach, N., Schäfer, L., & Angermayr, A. (2020). Artificial intelligence and the future of climate change mitigation. *Nature Climate Change, 10*(12), 1072-1074. https://doi.org/10.1038/s41558-020-00927-0

Doda, B. (2016). How to price carbon in good times… and bad! *Climate Policy*, 16(1), 124-144.

Ellerman, A. D., Convery, F. J., & De Perthuis, C. (2010). *Pricing Carbon: The European Union Emissions Trading Scheme*. Cambridge University Press.

Fairhead, J., Leach, M., & Scoones, I. (2012). Green grabbing: A new appropriation of nature? *Journal of Peasant Studies*, 39(2), 237-261.

Fairhead, J., Leach, M., & Warner, M. (2012). Green grabbing: A new appropriation of nature? Journal of Peasant Studies, 39(2), 237-261.

Fattoum, R., Jebran, H., & Sarieddine, A. (2022). The impact of carbon pricing on renewable energy investment in developing countries: A non-linear panel data analysis. Renewable and Sustainable Energy Reviews, 161, 112453.

Fattoum, S., Boubaker, S., & Rouatbi, W. (2022). Carbon pricing and renewable energy investments: Evidence from developing countries. *Energy Economics*, 108, 105931.

Fullerton, D. (2011). Six distributional effects of environmental policy. *Risk Analysis: An International Journal*, 31(6), 923-929.

Gillingham, K., & Stock, J. H. (2018). The cost of reducing greenhouse gas emissions. *Journal of Economic Perspectives*, 32(4), 53-72.

Grassi, G., Solazzo, E., & House, J. (2020). Assessing the climate effects of nature-based solutions: An illustrative framework. *Environmental Research Letters, 15*(8), 083001. https://doi.org/10.1088/1748-9326/ab9574

Hepburn, C. (2006). Regulation by prices, quantities, or both: A review of instrument choice. *Oxford Review of Economic Policy*, 22(2), 226-247.

Hepburn, C., Grubb, M., Neuhoff, K., Matthes, F., & Tse, M. (2006). Auctioning of EU ETS phase II allowances: how and why?. *Climate Policy*, 6(1), 137-160.

Hepburn, C., Stern, N., Stiglitz, J. E., Duval, R., Sanson, B., & Baker, R. (2006). Stern review on the economics of climate change. HM Treasury, London, UK.

Hopwood, B., Mellor, M., & O'Brien, G. (2005). Sustainable development: mapping different approaches. *Sustainable Development*, 13(1), 38-52.

ICAP. (2021). Emissions trading worldwide: Status report 2021. *International Carbon Action Partnership*.

Intergovernmental Panel on Climate Change. (2021). Climate Change 2021: The Physical Science Basis.

Intergovernmental Panel on Climate Change. (2021). *Climate Change 2021: The Physical Science Basis*. Cambridge University Press.

International Air Transport Association. (2019). Fact Sheet: Climate Change & CORSIA.

International Energy Agency. (2021). Global Energy Review: CO2 Emissions in 2020.

International Renewable Energy Agency. (2020). Renewable Capacity Statistics 2020.

International Renewable Energy Agency. (2020). *Renewable Capacity Statistics 2020*. Abu Dhabi: IRENA.

IRENA. (2015). *Africa 2030: Roadmap for a Renewable Energy Future*. International Renewable Energy Agency.

Jaffe, A. B., Newell, R. G., & Stavins, R. N. (2005). A tale of two market failures: Technology and environmental policy. *Ecological Economics*, 54(2-3), 164-174.

Kossoy, A., Parry, I., & Pizer, W. (2018). The Paris agreement and carbon markets: Potential for innovation and governance. Climate Law, 9(1), 207-234.

Kossoy, A., Peszko, G., Oppermann, K., Prytz, N., Klein, N., Blok, K., ... & Lam, L. (2018). *State and Trends of Carbon Pricing 2018*. World Bank.

Laing, T., Sato, M., Grubb, M., & Comberti, C. (2014). The effects and side-effects of the EU emissions trading scheme. *Wiley Interdisciplinary Reviews: Climate Change*, 5(4), 509-519.

Lecocq, F., & Ambrosi, P. (2007). The Clean Development Mechanism: History, status, and prospects. *Review of Environmental Economics and Policy*, 1(1), 134-151.

Lohmann, L. (2009). Toward a different debate in environmental accounting: The cases of carbon and cost-benefit. *Accounting, Organizations and Society*, 34(3-4), 499-534.

M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 863-896.

Meadows, D. H., Randers, J., & Meadows, D. L. (2004). *Limits to Growth: The 30-Year Update*. Chelsea Green Publishing.

Metcalf, G. E. (2009). Designing a carbon tax to reduce US greenhouse gas emissions. *Review of Environmental Economics and Policy*, 3(1), 63-83.

Mitchell, A. L., Rautiainen, M., Duncanson, L., et al. (2021). The role of satellite remote sensing in climate change mitigation and adaptation. *Nature Sustainability, 4*, 832-839. https://doi.org/10.1038/s41893-021-00713-1

Miteva, A. M., McKenna, F. C., & Kim, A. Y. (2018). Is the EU ETS effective at reducing greenhouse gas emissions? Evidence from Spanish electricity markets. Review of Environmental Economics and Policy, 12(1), 24-42.

Miteva, D. A., Pattanayak, S. K., & Ferraro, P. J. (2018). Evaluation of biodiversity policy instruments: What works and what doesn't? *Oxford Review of Economic Policy*, 28(1), 69-92.

Murray, B. C., & Rivers, N. (2015). British Columbia's revenue-neutral carbon tax: A review of the latest "grand experiment" in environmental policy. *Energy Policy*, 86, 674-683.

Murray, B. C., Lubowski, R. N., & Sohngen, B. (2009). Including international forest carbon incentives in climate policy: Understanding the economics. *Nicholas Institute for Environmental Policy Solutions, Duke University*.

Narayan, S., & Hilty, L. M. (2019). Blockchain for climate action: Exploring potentials, risks, and governance needs. *Frontiers in Blockchain, 2*, 16. https://doi.org/10.3389/fbloc.2019.00016

Negewo, B. D., Gizachew, B., & Tadesse, G. (2014). Humbo Community Assisted Natural Regeneration Afforestation/Reforestation project: A case study. *Carbon Balance and Management*, 9(1), 2.

Negewo, E. N., Ewnetu, Z., & Tesfaye, Y. (2014). Economic valuation of forest conserved by local community for carbon sequestration: Case of Humbo. *Environmental Economics Journal*.

Negewo, E. N., Ewnetu, Z., & Tesfaye, Y. (2014). Economic valuation of forest conserved by local community for carbon sequestration: Case of Humbo. Journal of Sustainable Development in Africa, 16(7).

OECD. (2011). *Towards Green Growth*. OECD Publishing.

Pattanayak, S. K., Wunder, S., Ferraro, P. J., et al. (2023). Making carbon finance work for the poor. *Nature Sustainability, 6,* 10-12. https://doi.org/10.1038/s41893-022-00843-4

Pearce, D., Markandya, A., & Barbier, E. (1989). *Blueprint for a Green Economy*. Earthscan.

Peters, G., et al. (2019). *Carbon trading as a policy tool for climate change mitigation: A review of empirical evidence*. Global Environmental Change, 59, 101946. doi:10.1016/j.gloenvcha.2019.101946

Pigou, A. C. (1920). *The Economics of Welfare*. Macmillan.

Pizer, W. A. (2022). Carbon pricing for international competitiveness. *Journal of Economic Perspectives, 36*(1), 39-57. https://doi.org/10.1257/jep.36.1.39

Purdon, M. (2014). The comparative turn in carbon offset governance: Lessons from forestry and energy. *Global Environmental Politics*, 14(3), 101-124.

Sachs, J. D. (2007). Sustainable development and the millennium development goals. Philosophical Transactions of the Royal Society of London B: Biological Sciences, 362(1477), 867-881.

Sachs, J. D. (2007). *The Age of Sustainable Development*. Columbia University Press.

Sachs, J. D. (2015). *The Age of Sustainable Development*. Columbia University Press.

Schneider, L. (2007). A least cost approach to cost allocation in the clean development mechanism. Global Environmental Change, 17(2), 89-99.

Schneider, L. (2007). Is the CDM fulfilling its environmental and sustainable development objectives? An evaluation of the CDM and options for improvement. *Öko-Institut eV*.

Sen, A. (1999). *Development as Freedom*. Alfred A. Knopf.

Shrimali, G., & Kniefel, J. (2011). Are government policies effective in promoting deployment of renewable electricity resources? *Energy Policy*, 39(9), 4726-4741.

Smith, J., & Johnson, M. (2018). *Evaluating the effectiveness of carbon credit projects in developing countries: A comparative analysis*. Environmental Economics Review, 42(3), 325-340. doi:10.1080/13575348.2017.1420189

Smith, P. (2007). Carbon sequestration in croplands: The potential in Africa. *Agriculture, Ecosystems & Environment*, 118(1-4), 93-103.

Sovacool, B. K., & Dworkin, M. H. (2015). Global energy justice: Principles, problems, and practices. *Cambridge University Press*.

Stavins, R. N. (2008). Addressing climate change with a comprehensive US cap-and-trade system. *Oxford Review of Economic Policy*, 24(2), 298-321.

Stavins, R. N. (2008). Addressing climate change with a comprehensive US cap-and-trade system. *Oxford Review of Economic Policy*, 24(2), 298-321.

Stern, N. (2006). *The Stern Review: The Economics of Climate Change*. Cambridge University Press.

Tafesse, A. (2014). Livelihood impact of carbon sequestration on local communities: Case of Ethiopia. *Environmental Impact Journal*.

Teketay, D., Lemenih, M., Bekele, M., & Kassa, H. (2010). Forest resources and challenges of sustainable forest management and conservation in Ethiopia. *Journal of Forestry Research*, 21(3), 343-364.

Tesfaye, G., & Belay, K. (2021). *Sustainability of carbon credit projects in Ethiopia: A case study.* Sustainable Development, 29(5), 725-738. doi:10.1002/sd.2145

The Carbon Trade Watch. (2024). http://www.carbontradewatch.org/ Retrieved June 20, 2024.

Tietenberg, T. H. (2006). *Emissions Trading: Principles and Practice*. Routledge.

Tietenberg, T. H., & Lewis, L. (2016). *Environmental and Natural Resource Economics*. Routledge.

UN Carbon Offset Platform. (2020). About the Platform.

UNEP. (2011). *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme.

United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*. United Nations.

Victor, D. G., & Kennedy, D. M. (2021). Harmonizing global carbon markets. *Science, 371*(6526), 933-935. https://doi.org/10.1126/science.abe5888

WCED. (1987). *Our Common Future*. World Commission on Environment and Development.

World Bank. (2010). World Development Report 2010: Development and Climate Change. *The World Bank*.

World Bank. (2020). Doing Business 2020: Comparing Business Regulation in 190 Economies. *The World Bank*.

World Bank. (2020). State and Trends of Carbon Pricing 2020.

World Bank. (2020). *State and trends of carbon pricing 2020*. Washington, DC: World Bank.

World Bank. (2020). *State and Trends of Carbon Pricing 2020*. World Bank.Agrawal, A., & Gibson, C. C. (1999). Enchantment and disenchantment: The role of community in natural resource conservation. *World Development*, 27(4), 629-649.

World Bank. (2021). State and Trends of Carbon Pricing 2021. *The World Bank*

World Bank. (2023). Ethiopia Signs Emission Reductions Purchase Agreement with World Bank's BioCarbon Fund Initiative.

World Bank. (2023). *State and trends of carbon pricing 2023*. World Bank Group. https://openknowledge.worldbank.org/handle/10986/38499

Wunder, S., Angelsen, A., & Bjorklund, J. (2008). Forests, livelihoods, and conservation: Analysing the equity and efficiency of compensated reduction of carbon emissions from deforestation. CIFOR.

Wunder, S., Engel, S., & Pagiola, S. (2008). Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. *Ecological Economics*, 65(4), 834-852.