



PAN-AFRICAN UNIVERSITY

INSTITUTE OF WATER AND ENERGY SCIENCES (including
CLIMATE CHANGE)

CLIMATE CHANGE TRACK

MASTER DISSERTATION

**INVESTIGATING THE POTENTIAL OF CARBON MARKET FINANCE TO
SUPPORT GREEN INNOVATION AND ENTREPRENEURSHIP IN WEST
AFRICA: CASE STUDY OF BENIN REPUBLIC**

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ACADEMIC YEAR 2023-2024

DECLARATION

CERTIFICATION

ACKNOWLEDGEMENT

LIST OF ACRONYMS AND ABBREVIATIONS

- **ACMI** - African Carbon Market Initiative
- **AFOLU** - Agriculture, Forestry, and Other Land Use
- **ARR** - Afforestation, Reforestation, and Revegetation
- **AU** - African Union
- **AENOR** - Asociación Española de Normalización y Certificación
- **BOAD** - West African Development Bank
- **CAGR** - Compound Annual Growth Rate
- **CCB** - Climate, Community & Biodiversity
- **CDM** - Clean Development Mechanism
- **CCS** - Climate Change Adaptation
- **CDM** - Clean Development Mechanism
- **CO₂** - Carbon Dioxide
- **CO_{2e}** - Carbon dioxide equivalent
- **CSA** - Climate-Smart Agriculture
- **COP** - Conference of the Parties
- **CERs** - Certified Emission Reductions
- **DGEC** - Direction Générale de l'Énergie et du Climat (General Directorate of Energy and Climate)
- **DNA** - Designated National Authority
- **EIAs** - Environmental Impact Assessments
- **EPA** - Environmental Protection Agency
- **EMD** - Empirical Mode Decomposition
- **ETS** - Emissions Trading Systems
- **EU** - European Union
- **EVT** - Extreme Value Theory
- **FCFA** - West African CFA franc (Franc de la Communauté Financière d'Afrique)
- **FSC** - Forest Stewardship Council

- **GDP** - Gross Domestic Product
- **GHG** - Greenhouse Gas
- **ICCVCM** - Integrity Council for the Voluntary Carbon Market
- **INStAD** - National Institute of Statistics and Economic Analysis of Benin
- **IPCC** - Intergovernmental Panel on Climate Change
- **IOSCO** - International Organization of Securities Commissions
- **JI** - Joint Implementation
- **kWh/m²/day** - Kilowatt-hours per square meter per day
- **LULUCF** - Land Use, Land-Use Change, and Forestry
- **LoA** - Letter of Approval
- **MCVDD** - Ministère du Cadre de Vie et du Développement Durable (Ministry of Environment and Sustainable Development)
- **MCVT** - Ministère du Cadre de Vie et du Développement Territorial (Ministry of Living Environment and Territorial Development)
- **MtCO₂e** - Million tonnes of carbon dioxide equivalent
- **Ms.** - Master of Science
- **NDA** - National Designated Authority
- **NGOs** - Non-Governmental Organizations
- **NASPP** - Niger Acacia Senegal Plantation Project
- **NDCs** - Nationally Determined Contributions
- **OECD** - Organisation for Economic Co-operation and Development
- **PDD** - Project Design Document
- **PD** - Project Description
- **PIN** - Project Idea Note
- **PNUD** - Programme des Nations Unies pour le Développement (United Nations Development Programme)
- **PONADER** - National Policy for the Development of Renewable Energies
- **PNP** - Pendjari National Park
- **PNW** - W National Park

- **PNP** - Pendjari National Park
- **PV** - Photovoltaic
- **RCC** - Regional Collaboration Centre
- **REC** - Regional Economic Community
- **SBEE** - Société Beninoise d'Energie Electrique
- **SD VISTa** - Sustainable Development Verified Impact Standard
- **SDGs** - Sustainable Development Goals
- **UN** - United Nations
- **UNFCCC** - United Nations Framework Convention on Climate Change
- **USAID** - United States Agency for International Development
- **USD** - United States Dollar
- **US** - United States
- **UNFCCC** - United Nations Framework Convention on Climate Change
- **UN** - United Nations
- **US** - United States
- **VCU** - Verified Carbon Unit
- **VCS** - Verified Carbon Standard
- **VCM** - Voluntary Carbon Market
- **VERRA** - Previously known as Verified Carbon Standard
- **WPS** - Water Purification System
- **WAP** - W-Arly-Pendjari
- **WWF** - World Wildlife Fund
- **YTD** - Year-to-Date

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ABSTRACT

The increasing interest in harnessing carbon market finance to foster green innovation and entrepreneurship mirrors the worldwide dedication to addressing climate change and attaining sustainable development goals. In West Africa, notably in Benin Republic, the distinctive challenges and opportunities faced, including the promotion of sustainable practices across sectors such as agriculture, forestry, renewable energy, and waste management, emphasize the importance of delving into carbon finance as a catalyst for environmental initiatives and economic advancement. This highlights the imperative to explore how carbon market mechanisms can bolster green projects and empower youth innovators and entrepreneurs not only in Benin but also in neighboring countries.

This master's Dissertation delves into exploring carbon market finance as a catalyst for sustainable development initiatives in Benin Republic, West Africa. The study investigates the potential impact of leveraging carbon credits in key sectors such as forestry, renewable energy, agriculture, and waste disposal to mitigate greenhouse gas emissions and promote eco-friendly practices. Through a comprehensive analysis of implementing carbon credit projects, including project conceptualization, design, monitoring, and market integration, valuable insights are gained into the opportunities and challenges of utilizing carbon finance in the region. By examining the current state of the carbon market in West Africa, with a specific focus on Benin, this research contributes to the existing body of knowledge on climate change mitigation strategies and sustainable development practices. The study underscores the importance of collaboration among policymakers, investors, entrepreneurs, and stakeholders to drive innovation and knowledge sharing in green finance.

Key recommendations are provided for policymakers to enact supportive regulations, investors to fund sustainable projects, entrepreneurs to engage in green initiatives, and stakeholders to foster collaboration and knowledge exchange. The findings of this research highlight the significant role of carbon market finance in advancing sustainable development goals and addressing environmental challenges in the region. Through a multidisciplinary approach that combines environmental science, economics, and policy analysis, this study offers valuable insights for academia, policymakers, industry practitioners, and environmental advocates seeking to promote sustainable development through carbon finance mechanisms in West Africa.

Keywords: Carbon market finance, Sustainable development, Green finance, Climate change mitigation, West Africa, Benin Republic.

RESUME

L'intérêt croissant pour exploiter le financement du marché du carbone pour favoriser l'innovation verte et l'entrepreneuriat reflète l'engagement mondial à lutter contre le changement climatique et à atteindre les objectifs de développement durable. En Afrique de l'Ouest, notamment au Bénin, les défis et opportunités distinctifs auxquels sont confrontés, y compris la promotion de pratiques durables dans des secteurs tels que l'agriculture, la foresterie, l'énergie renouvelable et la gestion des déchets, soulignent l'importance d'explorer le financement du carbone comme catalyseur pour les initiatives environnementales et le développement économique. Cela souligne l'impératif d'explorer comment les mécanismes du marché du carbone peuvent soutenir les projets verts et autonomiser les jeunes innovateurs et entrepreneurs non seulement au Bénin, mais aussi dans les pays voisins.

Cette thèse de master explore le financement du marché du carbone en tant que catalyseur pour les initiatives de développement durable au Bénin, en Afrique de l'Ouest. L'étude examine l'impact potentiel de l'utilisation des crédits carbone dans des secteurs clés tels que la foresterie, l'énergie renouvelable, l'agriculture et l'élimination des déchets pour atténuer les émissions de gaz à effet de serre et promouvoir des pratiques respectueuses de l'environnement. À travers une analyse complète de la mise en œuvre des projets de crédit carbone, y compris la conceptualisation du projet, la conception, le suivi et l'intégration sur le marché, des informations précieuses sont obtenues sur les opportunités et les défis de l'utilisation du financement du carbone dans la région. En examinant l'état actuel du marché du carbone en Afrique de l'Ouest, avec un accent particulier sur le Bénin, cette recherche contribue au corpus existant de connaissances sur les stratégies d'atténuation du changement climatique et les pratiques de développement durable. L'étude souligne l'importance de la collaboration entre les décideurs politiques, les investisseurs, les entrepreneurs et les parties prenantes pour stimuler l'innovation et le partage des connaissances dans la finance verte.

Des recommandations clés sont fournies aux décideurs politiques pour promulguer des réglementations de soutien, aux investisseurs pour financer des projets durables, aux entrepreneurs pour s'engager dans des initiatives vertes, et aux parties prenantes pour favoriser la collaboration et l'échange de connaissances. Les conclusions de cette recherche mettent en évidence le rôle significatif du financement du marché du carbone dans la promotion des objectifs de développement durable et la résolution des défis environnementaux dans la région. À travers une approche multidisciplinaire combinant les sciences de l'environnement, l'économie et l'analyse des politiques, cette étude offre des informations précieuses pour le monde universitaire, les décideurs politiques, les praticiens de l'industrie et les défenseurs de l'environnement qui cherchent à promouvoir le développement durable grâce aux mécanismes de financement du carbone en Afrique de l'Ouest.

Mots-clés : Financement du marché du carbone, Développement durable, Finance verte, Atténuation du changement climatique, Afrique de l'Ouest, Bénin.

CHAPTER ONE

1 INTRODUCTION

1.1 Background

Climate change stands as one of the most significant threats of our era, jeopardizing both human society and natural systems with the potential for irreversible harm if not promptly addressed (Nima 2022; Naveed *et al.*, 2022; Samuel *et al.*, 2023; John *et al.*, 2023). The surge in greenhouse gas (GHG) concentrations in the atmosphere is a result of extensive burning of fossil fuels and alterations in land use since the Industrial Revolution, with net GHG emissions witnessing a substantial rise of over 50% since 1990, reaching 59 gigatons of carbon dioxide equivalent (GtCO₂e) in 2019 (IPCC, 2022). Addressing the impact of elevated levels of human-generated greenhouse gas (GHG) emissions, leading to climate change, is widely recognized as one of the most urgent and critical global challenges at present (Gavurova *et al.*, 2021; Society, 2021; Reavis *et al.*, 2022). Climate scientists emphasize that to achieve a 50% probability of restricting the increase in global temperature to a mere 2 degrees compared to pre-industrial levels (1850–1900), a substantial reduction of 40%–70% in carbon dioxide equivalent (CO₂e) emissions are required globally by 2050, relative to the levels recorded in 2010 (Allen *et al.*, 2009; IPCC, 2014). Both private entities and governmental actors on a global scale are progressively establishing ambitious goals for reducing emissions, aiming to achieve net-zero emissions and restrict global warming to 1.5 degrees by the year 2050 (COP26, 2021). Net zero targets signify achieving equilibrium between carbon sources and sinks, eliminating net total annual CO₂ emissions from all human-induced sources, which has gained significant importance (Van *et al.*, 2021).

Instruments based on market mechanisms form a crucial component of the all-encompassing strategy to attain a global net zero by the middle of the century, offering incentives and means for entities contributing to pollution to decrease or potentially eliminate detrimental environmental impacts (Goers *et al.*, 2010). The latter is based on the principle that an entity mitigates its Greenhouse Gas (GHG) emissions, either by reduction or elimination, through compensatory measures such as funding emissions abatement projects in different locations (Lovell & Liverman, 2010; IIF, 2021). Market-based tools encompass emissions trading, taxes on emissions, hybrid mechanisms, and carbon offset markets. Presently, over 60 compliance carbon markets operate across various geographic scales, permitting the acquisition of carbon offsets as a means to adhere to compulsory regional limits on the overall annual Greenhouse Gas (GHG) emissions (Stankevich, 2022).

Originating in the 1980s, the Kyoto Protocol introduced three market-based flexible mechanisms to help parties achieve targets cost-effectively, fostering private sector investments and facilitating technology transfer, capacity building, and sustainable development in developing countries (Richard *et al.*, 2012). Collectively, the Clean Development Mechanism (CDM), Joint Implementation (JI), and Emissions Trading (ET) initiatives have witnessed substantial engagement, with the CDM alone recording over 7,800 project activities, issuing more than two billion tonnes of Certified Emissions Reductions (CERs), and mobilizing more than \$400 billion in investments from both private and public sources (UNFCCC, 2022a). Simultaneously, concerns have been voiced regarding the Clean

Development Mechanism (CDM), suggesting that it created counterproductive motivations for climate mitigation with lower ambitions, redistributed responsibilities unevenly among nations, compromised environmental integrity, neglected human rights considerations, and resulted in a net increase in global emissions (Cames et al., 2016; La Hoz Theuer et al., 2017). Nevertheless, the theoretical foundations for international carbon markets endured, and with the adoption of the Paris Agreement in 2015, parties embraced it with several new pathways for cooperative implementation under Article 6, encompassing a framework for bilateral cooperation under Article 6.2, the establishment of a new centralized carbon market mechanism under Article 6.4, and the inclusion of various non-market approaches under Article 6.8. (Fondén, 2022). While the overarching provisions for these novel mechanisms were incorporated into the Paris Agreement, it required nearly six years of negotiations for parties to finalize the comprehensive rules and modalities for Article 6, which occurred at the 26th Conference of the Parties (COP26) in Glasgow in November 2021 (UNFCCC, 2022b).

The carbon market plays a crucial role in driving emissions reductions, promoting sustainable development, and facilitating the transition to a low-carbon economy. It facilitates the more cost-effective achievement of emissions targets, thereby reducing political resistance to ambitious goals and enabling swifter and deeper emission cuts over time (Pedro et al., 2023). Additionally, it functions as a valuable tool aligned with the Paris Agreement's aspirations for carbon dioxide removal to limit global warming (Sanggetha et al., 2023). Furthermore, empirical evidence indicates that the carbon market significantly enhances energy and environmental performance, leading to reduced energy intensity and improved carbon emission efficiency (Anhua et al., 2022). Moreover, its close association with the electricity market underscores its profound influence on the evolution of the power industry (Axel et al., 2023).

1.2 Problem Statement

The West Africa region contributes 2.03% of the world's greenhouse gas emissions (0.05% contribution for Benin Republic), despite having 5.26% of the global population, with per capita emissions at approximately 1.08 metric tons of carbon dioxide-equivalent (tCO₂e), around six times lower than the global average (USAID, 2019). Underemployment represents a notable concern in Benin, especially among the youth demographic, with the World Bank reporting a 90.1% rate of informal employment and 72% underemployment in 2019. It's crucial to note that Africa currently produces only a tiny percentage of its carbon credit potential (ACMI, 2022), while financing development continues to be a major challenge for the large majority of African governments, Regional Economic Communities (RECs), and continental bodies such as the AU and its organs (AU Agenda, 2063). As a component of Benin's 2021-2026 action program (PAG 2), the government expressed its commitment to utilizing carbon financing as a means of mobilizing resources to foster the development of its eco-friendly economy, support its shift towards renewable energy, and monetize its natural resources (Benin Energy Plus, 2023). The implementation of efficient carbon credit initiatives not only has the potential to reduce emissions and remove CO₂e from the atmosphere, contributing to significant climate impacts, but also serves as a pathway for achieving development goals such as improving energy accessibility, promoting cleaner cooking practices for better health, and fostering employment opportunities (ACMI, 2022).

The state of the scientific discussion on the potential of carbon emission market finance to support green innovation and entrepreneurship in West Africa, particularly in Benin Republic, is still evolving. While there is a growing body of research on the mechanisms and scope of global carbon markets (Pollitt, 2019; Promethium Carbon & IETA, 2016; Dawes et al., 2023), the specific application of these mechanisms to foster green innovation and entrepreneurship in West Africa is less explored. The financial potential of carbon markets for green projects has been recognized (Hodes, 2011; Takada, 2017; Asian Development Bank, 2022) but the extent to which this potential can be harnessed to support green innovation and entrepreneurship in West Africa is not well-documented. There is a need for more empirical studies examining the financial performance and impact of carbon market finance on green projects in the region. The identification of key sectors for carbon credit generation in West Africa has been initiated (Fall et al., 2020), but a comprehensive analysis of how youth innovators and entrepreneurs can design business cases to tap into this potential is lacking. The process of implementing a carbon credit project in Africa has been discussed in some studies. There is a focus on meticulous accounting procedures to convert social and ecological life into marketable carbon credits, which involves the politics of these calculations in small-scale interactions (Heather, 2016). Technical support and capacity building are needed to foster carbon project development in Africa (Jules et al., 2016). Slow and carbon project development remains difficult, particularly for projects involving small-scale farmers (Jules et al., 2016). However, a simple model guide to support youth innovators/entrepreneurs to navigate these processes is yet to be developed.

1.3 Research Objectives

1.3.1 Main Objective

The overall objective of this research is to investigate the potential of carbon market finance as a catalyst for supporting green innovation and entrepreneurship in West Africa with the focus in Benin Republic.

1.3.2 Specific Objectives

The specific research objectives are to:

a. Examine the Mechanisms and Scope of Global Carbon Markets

Investigate the key mechanisms and features of global carbon markets to understand how they operate and influence the flow of financial resources.

b. Assess the financial potential of carbon markets for green innovation and entrepreneurship.

Assess the capacity of carbon markets from a financial perspective and how it can support green innovation, projects, and entrepreneurs in Benin, including the available investment pool, grants, and funding opportunities.

c. Identify key sectors for carbon credit generation and how youths' innovators and entrepreneurs could design business cases to tap on it.

Identify specific sectors within West Africa (Benin Republic) that offer the greatest potential for generating carbon credits, highlighting their unique characteristics and attractiveness for carbon credit initiatives.

- d. Analyse the process of implementing a carbon credit project and propose simple model guide to support youth innovators/entrepreneurs to navigate in these processes.

Analyse the step-by-step process of initiating, developing, and sustaining a carbon credit project, and develop practical business case that demonstrates the effective integration of carbon markets as a financial model to provide funding and provides a comprehensive guide for young West African (Beninese) green entrepreneurs and innovators.

1.4 Research Questions

Based on the stated objectives, the following questions have been used to guide the research process and finally answered from the findings of the study:

- a. What are the key mechanisms that govern how global carbon markets operate and influence financial flows?
- b. How substantial is the financial capacity of carbon markets to fund green innovation and entrepreneurship in Benin?
- c. Which sectors in Benin have the strongest potential to generate reliable and cost-effective carbon credits?
- d. What steps are required to successfully develop, validate, and sell carbon credits from a project in Benin?

1.5 Relevance of the Study

This research study titled "INVESTIGATING THE POTENTIAL OF CARBON MARKET FINANCE TO SUPPORT GREEN INNOVATION AND ENTREPRENEURSHIP IN WEST AFRICA: CASE STUDY OF BENIN REPUBLIC" presents a timely and compelling analysis, highlighting the role of leveraging carbon market finance in combating climate change, and fostering sustainable development in West Africa, particularly in Republic of Benin. In terms of the added value of this research, it will provide new insights into the potential of carbon market finance as a catalyst for green innovation and entrepreneurship in West Africa. It will also contribute to the development of practical tools and strategies to help youth innovators and entrepreneurs tap into this potential. Furthermore, the research will enhance our understanding of the process of implementing a carbon credit project in Africa and provide a model guide for youth innovators/entrepreneurs. This research could therefore play a crucial role in promoting green innovation and entrepreneurship in West Africa, thereby contributing to the region's sustainable development goals.

1.6 Thesis Outline

The outline of this thesis report is composed of five chapters and is as follows:

- The first chapter provides the introduction of this study: it includes the background, the problem statement, the objectives of the study, the research questions, the research hypothesis, and justification of the study (relevance of the study).
- The second chapter offers a comprehensive literature review examining the current landscape of carbon market finance, its contributions to climate change mitigation, and its potential for fostering youth opportunities, green innovation, and entrepreneurship in West Africa, specifically Benin Republic, by exploring existing studies and strategies in this domain.
- The third chapter presents the description of the study area.
- The fourth chapter provides research methodology, the data used for this study with discussion on their pre-processing.
- The fifth chapter presents the results and discussion.
- The sixth chapter provides a conclusion and few recommendations.

CHAPTER TWO

2 LITERATURE REVIEW

3 STUDY AREA

3.1 West African Region

West Africa is a subregion within the continent of Africa, as classified by the United Nations Geoscheme. It is bounded to the west and south by the Atlantic Ocean, to the north by North Africa, and to the east by Middle Africa. Comprising 16 countries and one dependency, West Africa also includes two island territories: the independent nation of Cabo Verde and the British dependency of St. Helena. The northern segment of West Africa is characterized by the Sahel region, a semi-arid zone that serves as a buffer between the Sahara Desert in the north and the southern savannas. Approximately half of the West African countries are situated in the Sahel, while the remaining half is positioned in the savanna region, near the Atlantic Ocean. Notably, three countries in West Africa -Mali, Burkina Faso, and Niger- are landlocked.

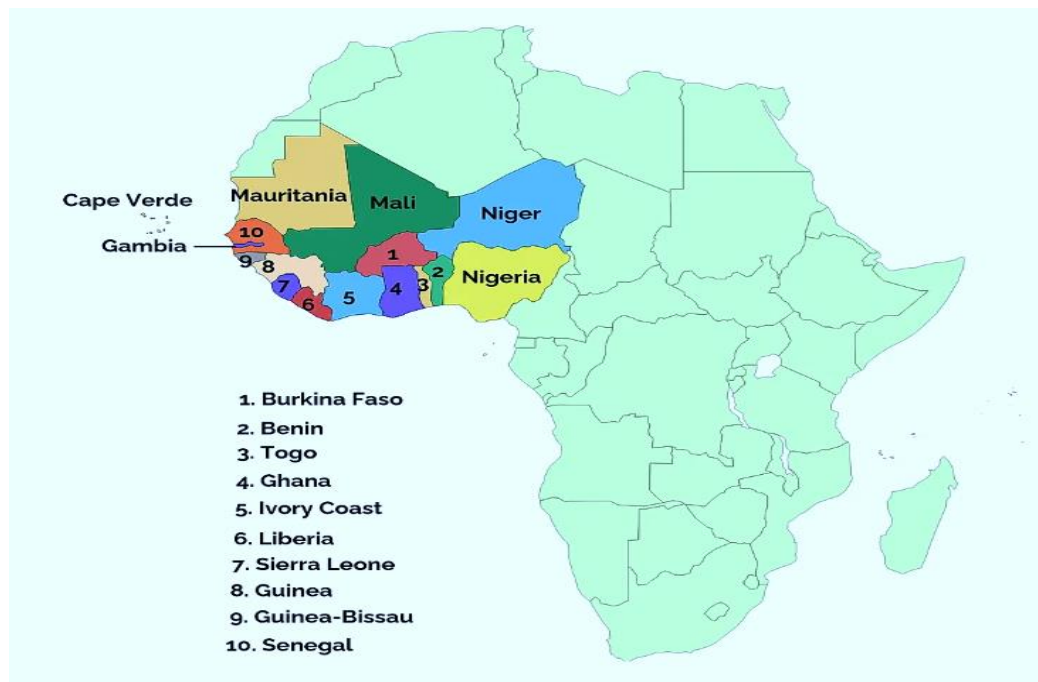


Figure 2: Map of the 16 countries of West Africa

Source: Adapted from Word Atlas

3.1.1 Regional Climate Summary of the Region

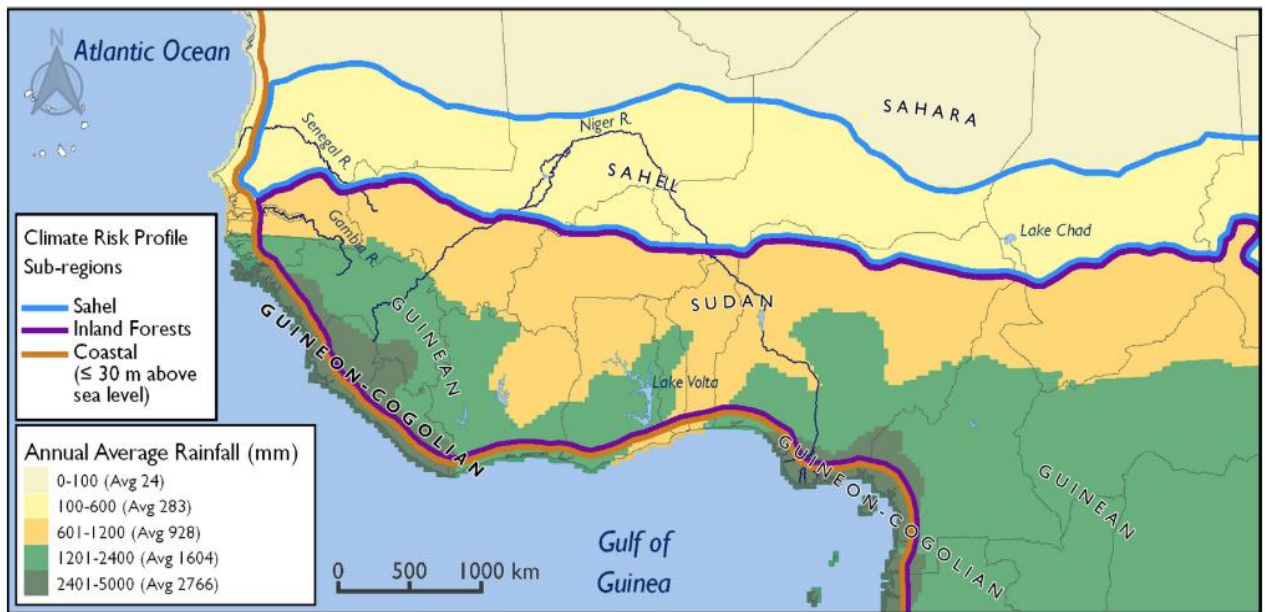
Encompassing around 25% of the continent, West Africa features a variety of bioclimatic zones, including rainforests, coastal plains, lowland plateaus, deserts, and distinct highlands like the Guinea Highlands, Jos Plateau, Air Mountains, and Cameroon Highlands (USAID, 2018).

West Africa can be categorized into four main bioclimatic zones from north to south (see Figure...): the Sahel, Sudan, Guinean, and Guineo-Congolian. These zones exhibit a latitudinal gradient in rainfall, with the Sahel experiencing the lowest precipitation (as minimal as 100 mm annually) and progressively higher rainfall towards the south, reaching its peak along the southern coast (up to 5,000 mm annually). This profile examines subregions aligned with bioclimatic zones but organizes them into three distinct categories: the Sahel, the Inland Forests, covering a significant portion of the Sudan zone and the inland regions of the Guinean and Guineo-Congolian zones, and the Coastal subregion, which includes coastal areas spanning different bioclimatic zones (USAID, 2013).

During the summer months (May–October), West Africa experiences substantial rainfall due to moist southwest winds originating from the Atlantic Ocean. The amount, onset, and duration of rainfall in West Africa exhibit considerable variability, especially in drier zones. Coastal areas typically have a 10 to 20 percent annual variability, while the Sahel and Sahara regions may exceed 40 percent. The dry season (November–March) is characterized by dusty Harmattan trade winds from the north, leading to reduced humidity and the potential for severe dust and sandstorms. Average annual temperatures range from 22 to 28°C, with maximum temperatures exceeding 40°C in the Sahel during the summer months (April–September) (USAID, 2018).

Figure 3: Bioclimatic zones and subregions of West Africa

Source: Adapted from USAID 2018



3.2 Republic of Benin

3.2.1 Geographic Location

The Republic of Benin is situated in the intertropical zone, between the parallels $6^{\circ}30'$ and $12^{\circ}30'$ latitude North, and the meridians 1° and $3^{\circ}40'$ longitude East. It has a total area of 114,763 km² and is bordered to the north by Niger and Burkina Faso, to the south by the Atlantic Ocean, to the west by Togo, and to the east by Nigeria. It comprises four administrative units (12 departments, 77 municipalities, 546 arrondissements, and 5290 villages) (MCVDD, 2022).

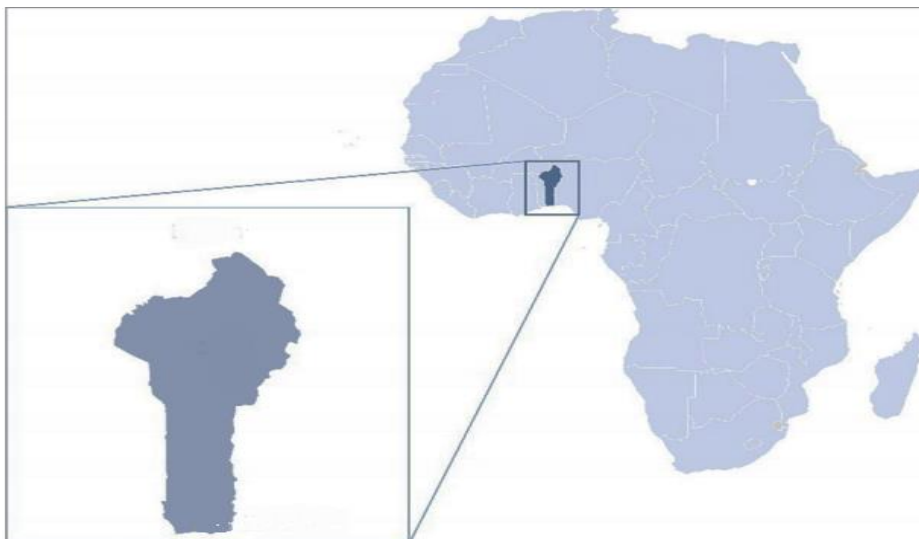


Figure 4: Benin's position within West Africa

Source: Adapted from Ombelet et al., 2022

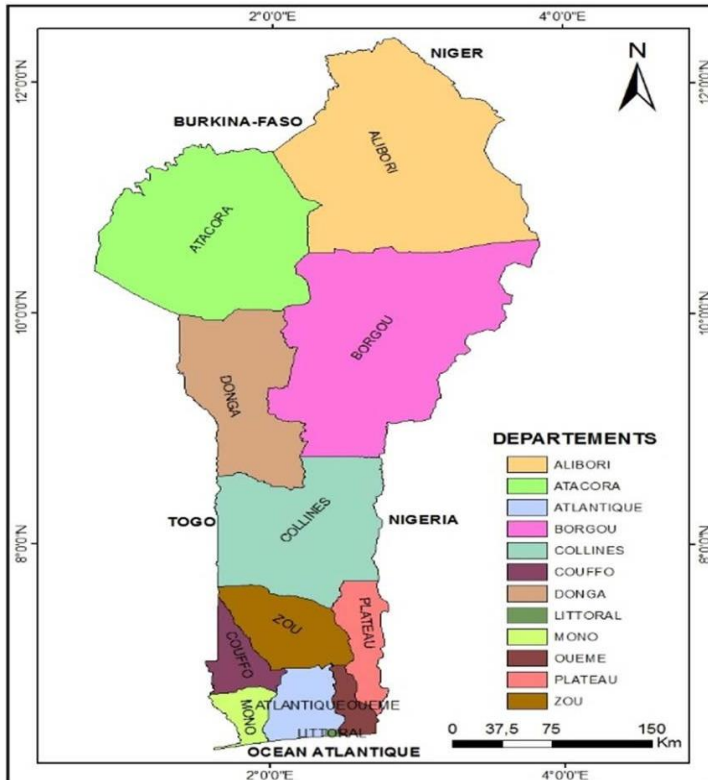


Figure 5: Geographical location of Benin

Source: Météo-Bénin, 2022

3.2.2 Climatic Characteristics

Benin experiences two (2) distinct climate types: the southern region features an equatorial climate marked by high humidity and alternating dry periods (from November to March and from mid-July to mid-September) and rainy seasons (from April to mid-July and from mid-September to October). In the central and northern parts, a tropical climate prevails with a dry season spanning from November to April and a rainy season from June to September. This amalgamation of seasons results in the delineation of three climatic zones from south to north, namely a Guinean zone, a Sudano-Guinean zone, and a Sudanese zone (Figure....) (MCVDD, 2022).

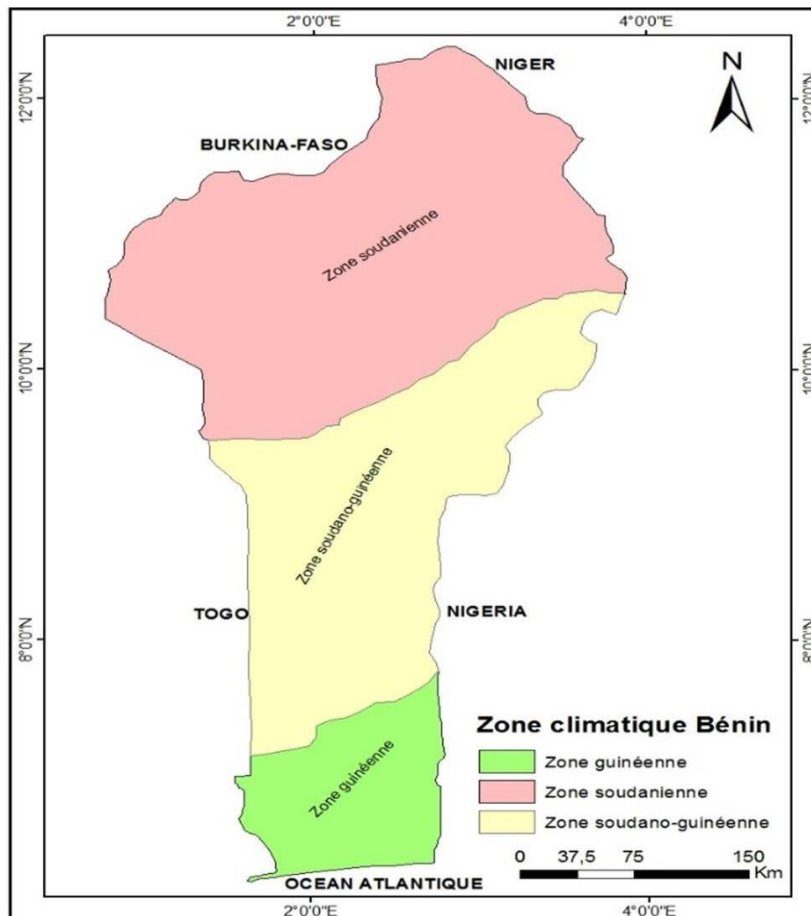


Figure 6: Benin's Climatic Zones

Source: Météo-Bénin, 2022

The Guineo-Congolian zone experiences four seasons with an average annual rainfall of 1217.1 mm spread over approximately 87 days on average. Precipitation varies by 260.6 mm between the driest and wettest months. The average annual temperature is 27.4 °C, with a temperature range of 3.7 °C throughout the year. The major rainy season occurs from April to July, and the minor one from September to mid-November. These rainy periods are interspersed with two dry seasons: a major one from mid-November to mid-March and a minor one from August to September. The average daily temperature during these dry seasons ranges from 25° to 29 °C, with air humidity fluctuating between 69% and 97%.

The Sudano-Guinean zone follows a rainfall pattern between bimodal and unimodal. The average annual rainfall ranges from 900 mm to 1110 mm, typically spread over 75 days on average. Relative humidity in this zone varies from 31% to 98%, while temperatures range between 25 °C and 29 °C. In the Sudanese zone, the annual rainfall ranges from 900 to 1100 mm, distributed over an average of 71 days. Air humidity varies from 18% during the harmattan season (December to February) to 99% in August during the rainy season. The average monthly temperature in this zone ranges from 24 °C to 31 °C.

3.2.3 Socio-economic and environmental context

As of the end of 2020, the population of Benin is approximately 12.2 million, with women comprising 51%. The fertility rate is 5.7 children per woman, and life expectancy is 61.8 years. About 45% of the population is under the age of 15, placing a significant burden on the working-age population responsible for meeting the basic needs of children and youth in terms of health and education (PNUD, 2022).

The country's economy is primarily based on agriculture and the processing industries of agricultural products, with a significant focus on two export products: cotton and cashews, and trade. The primary sector accounts for 28.1% of the GDP, while the secondary sector represents 14.6%, including 6% for agri-food industries and 4.4% for the construction and public works sector. The tertiary sector constitutes 48.8% of the GDP, with 13% attributed to commerce and 9% to transportation. Exports, valued at 498 billion FCFA in 2019, are heavily concentrated on three product categories: cotton fiber (53% of the country's exports), cashew nuts (9% of exports), and oilseeds (4.7% of exports) (MCVDD, 2022).

The Guineo-Congolian zone encompasses various ecosystems, including well-drained soil formations like sandy ridges (ancient or recent), wetland formations (lagoons and mudflats), and the original plateau formation composed of semi-deciduous humid dense forests, with remnants observed in the form of patches (Pobè botanical reserve, sacred forests, or relic forests). Key plant species in this zone include *Ceiba pentandra*, *Azelia africana*, *Diospyros mespiliformis*, *Anogeissus leiocarpus*, *Antiaris toxicaria*, *Milicia excelsa*, *Mimusops andongensis*, *Milicia excelsa*, *Triplochyton scleroxylon*, *Piptadeniastrum africanum*, and *Terminalia superba*. The southern part of this coastal zone is predominantly influenced by hydromorphic entities shaped by specific hydroclimatic and pedological conditions bordering estuarine systems. The vegetation in the Western estuary is a mangrove forest reflecting high soil salinity. The climax formation associated with the Eastern system is a swampy forest consisting of *Symphonia globulifera*, *Mitragyna ciliata*, *Alstonia congensis*, and *Ficus congensis*. The transition zone between Sudanese and Guineo-Congolian zones displays Guinean affinities. It features mosaic patterns of light forests, occasionally dense dry forests, interspersed with wooded and shrubby savannas, and crossed by forest galleries. Plant species in this zone include *Daniellia oliveri*, *Parkia biglobosa*, and *Terminalia glaucescens* on well-drained soils, *Anogeissus leiocarpus*, *Acacia campylacantha*, and *Terminalia macroptera* on hydromorphic soils, and *Isoberlinia doka* and *Detarium microcarpum* on hardened soils or shallow rocks. The Sudanese zone comprises savannas and forest galleries with trees sparsely covering the ground. In the southern part of this zone, the vegetation is similar to the transition zone, featuring populations of *Isoberlinia doka* and *I. tomentosa*, followed by species like *Adansonia digitata*, *Pterocarpus erinaceus*, *Azelia africana*, *Erythrophleum guineense*, *Amblygonocarpus andongensis*, and *Swartzia madagascariensis* (MCVDD, 2022).

CHAPTER FOUR

4 METHODOLOGY

In developing a robust methodology for this study, careful consideration was given to the selection of effective strategies for data collection and analysis, ensuring a comprehensive and reliable exploration of the intricate facets of global carbon markets.

4.1 Methodological approach

With the aim of investigating the potential of carbon market finance as a catalyst for supporting green innovation and entrepreneurship in West Africa with the focus on Benin Republic, this research mainly employs a qualitative approach in order to examine the mechanisms and scope of global carbon markets, identify key sectors for carbon credit generation and how youths' innovators and entrepreneurs could design business cases to tap on it, propose business cases building carbon market as financial model to finance innovations respectively startups of youth entrepreneurs in Africa, and analyse the process of implementing a carbon credit project and propose simple model guide to support youth innovators/entrepreneurs to navigate in these processes. Qualitative analysis involves examining textual, visual, or audio data, ranging from confirming existing hypotheses to exploring new insights, and can be guided either by a predefined conceptual framework, indicating a deductive approach, or by the data itself, indicating an inductive approach (Mihas, 2019). Both primary and secondary data have been collected. Primary data include data obtained from our survey on knowledge and exploration of the carbon market in Benin addressed to different actors including professionals and students from several sectors mainly environmental and agricultural sectors coupled with discussion had with professional from DGEC (MCVT). Secondary data have been collected from sources such as books, articles, websites, policy briefs, organisation/government publications, and other research studies concerning carbon market and particularly aspects that we want to develop because carbon market is a quite huge domain.

The choice of the qualitative approach is driven by the need for a comprehensive understanding of the carbon market in Benin Republic, acknowledging the multifaceted nature of the research question. The qualitative method is a strategic choice to capture both the broader trends and the nuanced details essential for providing actionable insights to support green innovation and entrepreneurship in West Africa. In the examination of carbon markets, qualitative research methods like deductive qualitative techniques, including bibliographic and documentary analysis, alongside structured interviews with professionals in the carbon market industry, have been employed (Birchall et al., 2016; Xiao et al., 2020). Qualitative scenario analysis has been utilized to evaluate policy feasibility and comprehend the intricate, uncertain, and non-economic elements associated with achieving deep decarbonization in the energy sector (Franziska et al., 2021). These qualitative research methodologies offer valuable insights into various aspects of the carbon market, encompassing the creation and exchange of carbon credits, as well as the evolution of carbon finance and regulatory frameworks concerning carbon emissions (Anjenette, 2023).

4.2 Data collection

The data collection approach is a thoughtful combination of **primary** and **secondary** data sources, which allows for a comprehensive exploration of the **carbon market** in Benin Republic.

4.2.1 Primary Data Collection (Survey):

We employed a survey using a Google Form to collect primary data. This survey was distributed to various actors, including professionals and students from environmental and agricultural sectors in Benin. The Google Form survey allowed for collection of both closed-ended and open-ended responses. It likely included multiple choice, rating scale, and open text questions. This mixed question format permitted quantification of responses as well as collection of detailed explanations and ideas. Distributing the survey via an online form provided ease of access and response for participants. It enabled gathering input from a wider range of people across sectors and locations compared to only conducting in-person interviews. The structured digital format also facilitated organization and analysis of the collected quantitative and qualitative primary data. The survey aimed to assess knowledge and exploration of the carbon market. It likely covered topics such as participants' understanding of carbon credits, market mechanisms, and potential applications. Discussions with professionals from DGEC (MCVT) further enriched your primary data. These conversations likely provided insights into practical experiences and challenges related to carbon market activities.

4.2.2 Secondary Data Collection (Documentary Research):

Secondary data were gathered from a variety of sources:

- **Books:** Relevant literature on carbon markets, environmental economics, and related topics.
- **Articles:** Academic articles, research papers, and reports discussing carbon market trends, policies, and case studies.
- **Websites:** Online platforms providing information on carbon credits, market mechanisms, and global initiatives (carbon market platform (OECD); ecosystem marketplace; world economic forum; etc.).
- **Policy Briefs:** Concise documents summarizing policy implications and recommendations.
- **Organizational/Government Publications:** Reports from institutions, government agencies, or international bodies.
- **Other Research Studies:** Existing studies that shed light on carbon market dynamics, challenges, and opportunities.

4.3 Data Analysis Method

Our data analysis utilized well-established qualitative research methods, including evidence synthesis, content analysis, and thematic analysis.

4.3.1 Content Analysis

Content analysis is a research method that allows for replicable and valid interpretations of texts to be made within their usage contexts, employing specialized procedures that can be learned and applied independently of the researcher's authority, thereby offering new insights, enhancing comprehension of specific phenomena, and guiding practical actions as a scientific tool (Kim et al., 1985). Content analysis finds application across diverse fields such as finance and blockchain, where it assesses scoring methodologies of decentralized autonomous organizations (DAOs) (Christiane, 2023), political science for studying networks and statehood formation (Victor, 2022), archival research like newspapers and speeches (Scott, 2023), sustainability reporting to evaluate compliance with reporting principles (Chyntia et al., 2022), and textbook analysis against curriculum standards (Abd & Ellina, 2022). Sampathkumar et al. (2020) employed the content analysis method to investigate biomass fuel production from various waste residues, while Yu et al. (2024) utilized it to analyze the synergy between carbon emissions trading and green financial instruments.

4.3.2 Thematic Analysis

Thematic analysis is a qualitative research technique employed by researchers to methodically categorize and scrutinize intricate data sets in search of overarching themes that encapsulate the narratives contained within the data (Dawadi, 2020). Thematic analysis entails identifying themes by thoroughly reviewing transcribed data (King, 2004), with a rigorous approach to this method capable of yielding insightful and reliable findings (Nowell et al., 2017).

Recent studies have increasingly employed thematic analysis methods in examining various aspects of the carbon market. Feng et al. (2012) utilized extreme value theory (EVT) to estimate risk exposure in carbon pricing within the EU ETS, emphasizing the need for thorough risk analysis among market participants. Similarly, Zhu et al. (2015) applied empirical mode decomposition (EMD) to understand carbon price fluctuations in the European Union Emissions Trading Scheme, underlining the importance of grasping the underlying characteristics of price changes for effective policymaking and risk management. In contrast, Luo et al. (2014) investigated the effects of a proposed carbon tax on the financial market returns of Australian firms using the event-study method, shedding light on the regulatory impact on market performance. Additionally, Huang et al. (2020) proposed a combinatorial optimization prediction method based on unstructured data for forecasting carbon prices, aiming to enhance prediction accuracy and reliability in the evolving carbon emission trading market. Tang et al. (2020) analyzed urban carbon emission intensity under an emission trading system in Chinese cities, emphasizing the role of market-based instruments in addressing local carbon emissions. Lastly, Qi et al. (2021) explored the influence of a pilot carbon trading policy on low-carbon innovation among enterprises in China, highlighting the significance of allocation methods in incentivizing emission reduction innovation.

4.3.2.1 Evidence Synthesis

Synthesizing research evidence entails gathering and analysing existing information through clear and defined methods to compile, summarize, and understand a collection of literature, often employing a systematic review methodology (Sucharew & Macaluso, 2019). It helps protect against the impact of individual studies and guarantees the inclusion of essential viewpoints (Andrew, 2017). Qualitative evidence syntheses conducted across multiple contexts offer a holistic view of similarities and distinctions among countries, whereas those conducted within a single context consider particular contextual elements (Andrew et al., 2019). Evidence synthesis is recognized as playing a crucial role in tackling inquiries concerning intervention or system intricacy and in the development of guidelines (Kate et al., 2019).

Carlson et al. (2016) employed a qualitative meta-synthesis method to examine the benefits of eco-labeling in developing nations, finding that despite challenges, producers gain various advantages from certification. Munn et al. (2014) introduced the ConQual approach to establish confidence in qualitative research synthesis, offering a systematic means to assess confidence in synthesized qualitative findings. Moreover, Yao et al. (2021) stressed the significance of integrating non-market environmental values like carbon sequestration into decision-making for sustainable forest management, underscoring the importance of considering these values alongside market values. In a separate context, Bello et al. (2022) utilized a qualitative approach to evaluate the impact of capital market performance on economic growth in developing nations, highlighting the use of descriptive synthesis to evaluate empirical evidence. Additionally, Draanen et al. (2023) conducted a qualitative narrative synthesis to explore the connections between socioeconomic marginalization and overdose, revealing reciprocal links between the two through institutional pathways with reinforcing mechanisms. The application of qualitative evidence synthesis methods across various domains, including consumer trust, environmental management, and economic growth, underscores the value of synthesizing qualitative data to enhance decision-making processes.

CHAPTER FIVE

5 RESULTS AND DISCUSSION

This chapter details the outcomes related to the specific objectives of the study.

5.1 Mechanism and Scope of the Global Carbon Markets

To comprehend the evolution and significance of carbon markets, it is essential to initially grasp the workings of carbon pricing mechanisms, which involve understanding how reductions in emissions are transferred between individuals, countries, or companies.

Carbon pricing is a strategy that seeks to account for the external expenses associated with carbon emissions, enabling the mitigation of carbon output and requiring emitters to bear the financial burden of this environmental pollution (Bardalai & Quinauco, 2023). This method serves as a financial motivator for polluters, providing them with the choice to either transform their practices to reduce emissions or persist in emitting while compensating for the environmental impact (World Bank, 2023).

There are two primary categories of carbon pricing instruments: direct and indirect. **Direct instruments** establish a price directly correlated to carbon emissions, typically expressed as the value per tonne of carbon dioxide equivalent (MtCO₂e), ensuring consistent and cost-effective incentives. **Indirect instruments**, on the other hand, alter the price of products or services related to carbon emissions in a manner not directly proportional to pollution levels. This category includes fuel and commodity taxes, as well as fuel subsidies impacting energy consumers, which may inadvertently encourage higher fuel consumption and, consequently, increased CO₂ emissions. These indirect instruments often align with socioeconomic objectives beyond the explicit aim of reducing carbon emissions. The table 4 below offers comprehensive details on indirect carbon pricing instruments, covering their descriptions, and providing examples for better comprehension.

Table 4: Indirect Carbon Pricing Instruments

Carbon Pricing Instruments	Description	Examples
Carbon Emissions Taxes	Levies imposed by governments on polluting industries based on greenhouse gas emissions. Intended to incentivize emission reduction by allowing companies to avoid tax liability. Concerns include potential encouragement of pollution if taxes are paid and difficulties in accurately measuring the external cost of emissions. Revenue can be allocated to environmental projects or broader tax reforms.	Carbon taxes in countries like Sweden, Norway, and Canada.
Emissions Trading Systems (ETS)	Cap-and-trade systems where a government sets a maximum emission level (cap) for industries, issuing permits accordingly. Permits are distributed through auctions or free allocation, allowing trading. Stricter caps over time aim for total emission reduction. ETS advantages include certainty	European Union Emissions Trading System (EU ETS), California Cap-and-Trade

	about environmental impact, low abatement costs, and promotion of low-carbon technology. Challenges involve issues like over-allocation, weak caps, windfall profits, and volatility.	Program, Regional Greenhouse Gas Initiative (RGGI) in the United States.
Crediting Mechanisms	Carbon credits certified by governments or independent bodies, representing avoidance, reduction, or removal of GHG emissions. Types include avoidance, reduction, and removal credits. Can be traded to regulated companies for compliance or entities with voluntary mitigation commitments. Creates a monetary incentive for emission reduction. Concerns include the potential for companies to continue polluting by purchasing credits and doubts about the validity of GHG reductions. Market participants are taking steps to address concerns, such as using new technology and setting standards.	Clean Development Mechanism (CDM), Verified Carbon Standard (VCS), Gold Standard.

While dealing with carbon markets, it is crucial to mention its core principles for establishing trust, ensuring fairness, promoting efficiency, and facilitating international cooperation within the global carbon market. This, in turn, contributes to a more effective and impactful market in achieving global climate goals.

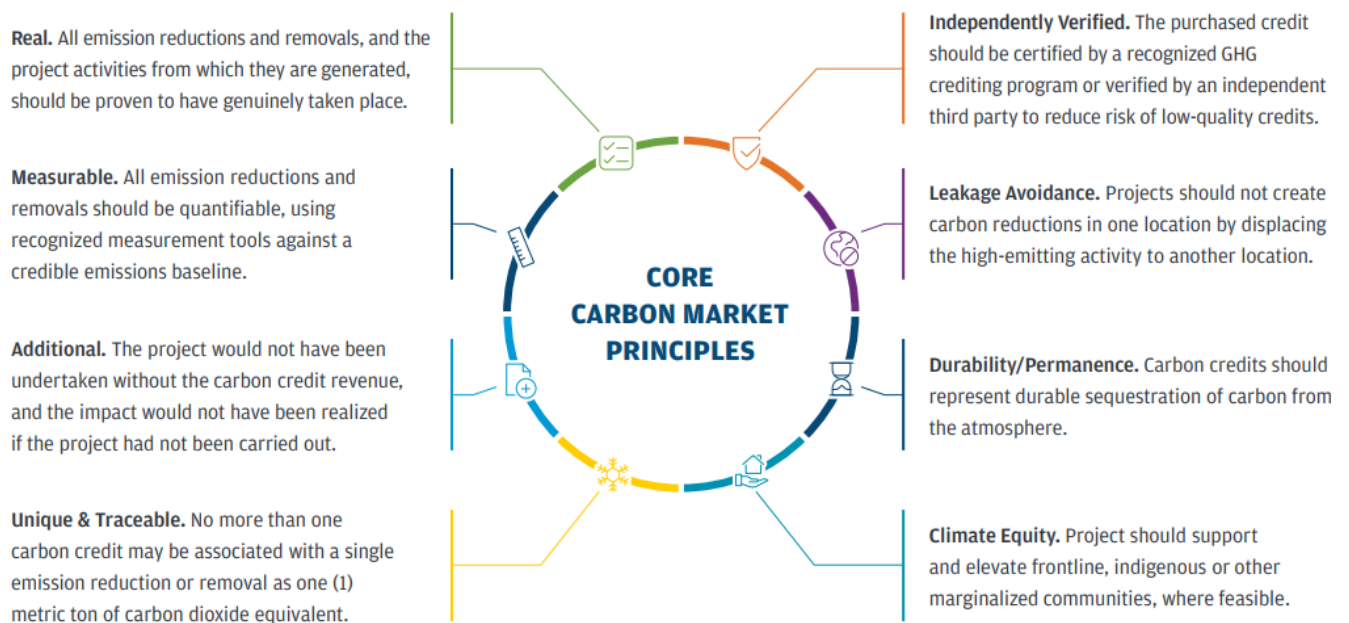


Figure 7: Core Carbon Market Principles

Source: Integrity Council for the Voluntary Carbon Market (ICVCM)

The figure 7 depicts Core Carbon Principles (CCPs) developed by the Integrity Council for the Voluntary Carbon Market (ICVCM). These principles serve as a framework for ensuring the integrity of carbon credits issued in the voluntary carbon market.

The principles governing carbon credits encompass crucial elements to ensure their effectiveness and integrity in contributing to genuine climate action. These principles include the requirement for carbon credits to represent actual, measurable, and additional emission reductions or removals, thereby avoiding double counting. Permanence is emphasized to ensure the lasting impact of reductions or removals over a defined timeframe, mitigating the risk of future reversals. Leakage avoidance is crucial to prevent increased emissions elsewhere due to the credited projects.

Furthermore, the concept of additionality is fundamental, stipulating that emission reductions should go beyond what would naturally occur without the project. Transparency is emphasized, necessitating the availability of comprehensive information about projects and methodologies to assess credibility. Rigorous monitoring, reporting, and verification procedures are essential for independent verification of claimed climate benefits. Governance principles stress the importance of robust and accountable institutions overseeing carbon crediting programs.

Risk management measures are deemed necessary to identify, assess, and mitigate potential project risks, ensuring environmental integrity and preventing fraud. Stakeholder engagement is a key principle, requiring meaningful involvement of relevant parties, including local communities and Indigenous Peoples. Finally, a sustainable development focus encourages carbon credit projects to contribute to broader objectives such as poverty reduction, biodiversity conservation, and improved livelihoods, extending benefits beyond climate change mitigation.

5.1.1 Transitioning from carbon pricing to carbon markets

Carbon markets arose in reaction to extensive environmental deterioration and the pressing need for a gradual reduction in greenhouse gas emissions. These markets function as trading systems, enabling entities to buy and sell greenhouse gas emission units as commodities, with the overarching goal of limiting global carbon emissions and curbing the long-term rise in global temperatures (Bardalai & Quinaucho, 2023). By facilitating a smooth transition towards lower carbon emissions, these markets mobilize resources and lower production costs for companies and nations, exemplified by the Kyoto Protocol, the inaugural agreement in 1997 that obligated developed economies to cut emissions by an average of 5% from 1990 levels during 2008-2012 (UN, 2020). Nevertheless, the specialized market gained increased significance with the 2015 Paris Agreement setting commitments to achieve net-zero carbon emissions by 2050. This underscored the imperative to focus efforts not only on reducing emissions but also on enhancing the transparency of the impact of these reductions (UN, 2021). Two major categories of carbon markets are the regulatory compliance market and the voluntary carbon market. The table 5 below provides a concise comparison between them.

Table 5: Comparative Overview of Voluntary and Compliance Carbon Markets

	Voluntary Carbon Market	Compliance Carbon Market
Regulation	Not legally mandated; decentralized regime	Supported and regulated by national, international, or regional authority under cap-and-trade system
Participant Choice	Companies/industries choose to compensate for emissions	Government establishes which industries or companies must participate; participation is compulsory
Credit Usage	Companies can buy credits for voluntary use	Credits used to fulfill mandatory emission reduction requirements
Credit Generation	Generated by companies with operations reducing emissions	Originates from companies participating in cap-and-trade programs, adhering to set emission reduction targets
Motivation for Participation	Motivated by industry climate risks, sustainability goals, ethics, reputation	Compelled by legal requirements; focus on meeting mandatory emission reduction targets
Market Size (2021)	Total traded value almost US\$2bn	Estimated value around US\$850bn (Refinitiv) or potentially higher (ICE)
Transaction Types	Mostly over-the-counter trades; some spot OTC marketplaces (e.g., Xpansiv, AirCarbon Exchange); futures exchanges (e.g., CME, EEX, ICE) also offer carbon credit futures	Primarily over-the-counter trades with growing interoperability between compliance markets and carbon credits, blurring the distinction
Interoperability (2022 IOSCO)	Growing interoperability between compliance markets and carbon credits	Distinction between mandatory and voluntary markets becoming increasingly unclear; certain compliance markets accepting high-quality carbon credits issued by voluntary GHG crediting programs

The figure 8 below showcases more the difference between both markets.

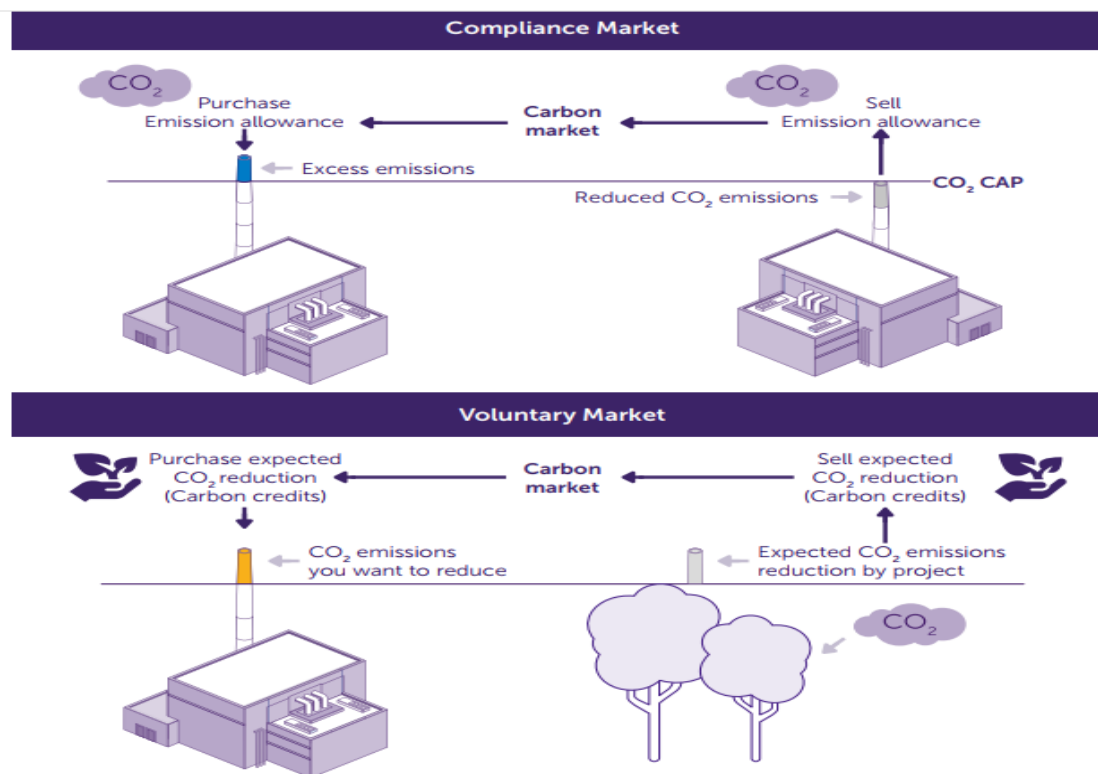


Figure 8: Compliance versus Voluntary carbon markets

Source: TFSVCM, 2021

From this figure, in compliance markets, participants, typically companies, actively engage to secure emission allowances, and those exceeding their allocations can trade surplus emissions. The primary goal is to reduce CO₂ emissions in adherence to a predetermined emissions cap regulated by authorities. On the other hand, voluntary markets offer entities the flexibility to purchase anticipated CO₂ reductions, known as carbon credits, for offsetting their emissions. Additionally, entities implementing projects aimed at emission reductions have the opportunity to sell these reductions in the market. While compliance markets operate under stringent regulatory oversight and adhere to set emissions caps, voluntary markets thrive on the independent choices of participating entities, showcasing a distinct contrast in their operational dynamics.

In essence, both markets share the common goal of mitigating climate change by reducing CO₂ emissions. The differentiating factor lies in the obligatory nature of compliance markets, usually governed by governmental or international regulations, in contrast to the voluntary nature characterizing voluntary markets.

5.1.1.1 Other International carbon markets

We want to mention here about REDD+. REDD+ is not classified as a carbon market, but certain standards have utilized it to generate carbon offsets from forestry initiatives. It operates as a system for compensating ecosystem services, involving payments for emission reductions linked to avoiding deforestation and preventing land degradation. However, the practice of issuing carbon offsets from forestry projects, especially REDD+, has faced significant criticism for lacking environmental

integrity and sufficient safeguards against adverse impacts on the environment and local communities. Critiques focus on the challenges of accurately predicting outcomes in the absence of projects, the potential for indirect impacts leading to increased deforestation elsewhere, and the requirement for long-term deforestation avoidance when issuing credits, posing logistical and feasibility challenges over extended periods.

5.1.2 Carbon markets worldwide

This section furnishes essential information regarding global carbon markets.

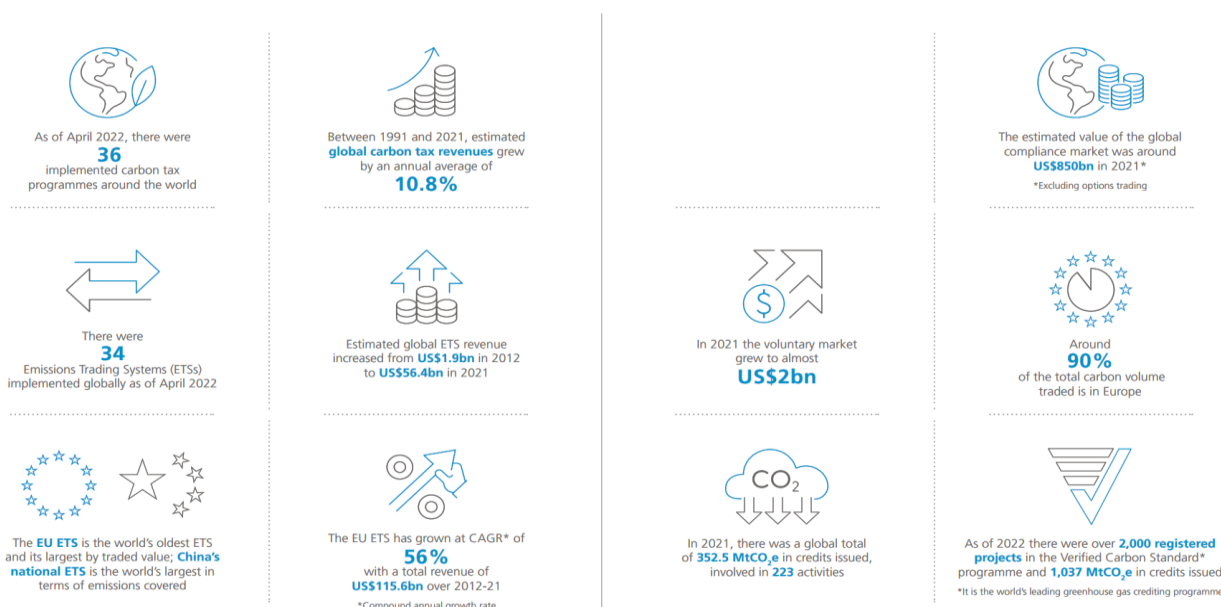


Figure 9: Global Trends and Development in Carbon Trading and Taxation

Source: Bardalai & Quinaucho, 2023.

As of April 2022, carbon pricing initiatives globally reflect a growing commitment to address climate change. With 36 implemented carbon tax programmes worldwide, businesses face increasing incentives to curb carbon emissions, as evidenced by a 10.8% annual growth in estimated global carbon tax revenues from 1991 to 2021. Concurrently, 34 Emissions Trading Systems (ETSs) globally underscore the adoption of market-based strategies, with the total ETS revenue surging from US\$1.9bn in 2012 to US\$56.4bn in 2021. The voluntary market, where companies proactively offset carbon emissions, demonstrated substantial growth, reaching almost US\$2bn in 2021, highlighting a heightened corporate commitment to environmental sustainability. Regionally, Europe dominates carbon trading, accounting for around 90% of the total carbon volume traded. The EU ETS, the world's oldest and largest ETS, has experienced remarkable growth, achieving a Compound Annual Growth Rate (CAGR) of 56% and accumulating a total revenue of US\$115.6bn over the period 2012-2021. Moreover, the Verified Carbon Standard (VCS) program, a leading greenhouse gas crediting initiative, boasts over 2,000 registered projects and has issued 1,037 MtCO₂e in credits as of 2022, emphasizing its global significance in emissions reduction efforts.

5.2 Financial Potential of Carbon Markets for Green Innovation and Projects in West Africa (Benin Republic)

Within this section, we present the findings about the financial capacity of carbon markets to support green innovation and projects, including the available investment pool.

5.2.1 Market size and Growth

It is expected that a large quantity of carbon removal will be required for the world to reach net-zero emissions by 2050 as shown by the figure 10 below.

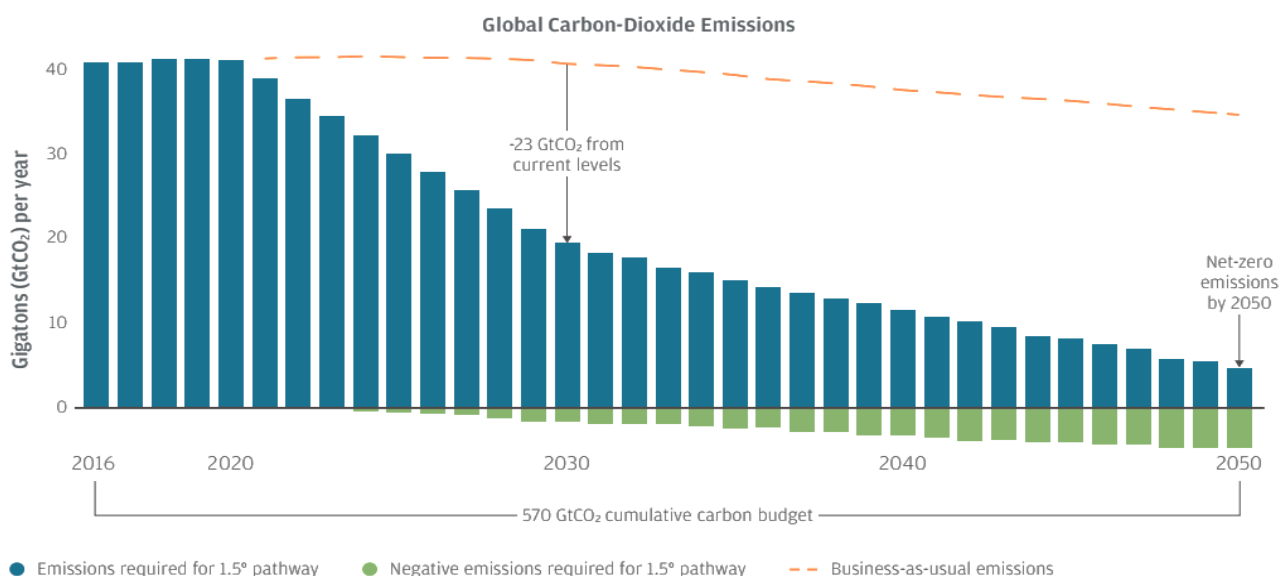


Figure 10: Global Carbon-Dioxide Emissions

Source: IPCC, 2018

The figure 10 illustrates the significant gap between the "business-as-usual" scenario and the 1.5°C pathway highlights the urgency of reducing emissions globally. Attaining net-zero emissions by 2050 necessitates a swift shift to clean energy sources and substantial investments in carbon removal technologies. Carbon markets can play a pivotal role in financing this transition by establishing financial value for carbon credits. Companies reducing emissions or extracting carbon from the atmosphere can earn credits, tradable to companies needing emission offsets. The revenue from these credits can then fund renewable energy, reforestation, and other green projects, aiding emission reduction and carbon removal. The global carbon market is anticipated to experience substantial growth in the upcoming decades, offering countries like Benin a notable financial opportunity to engage in the carbon market and generate revenue for green initiatives.

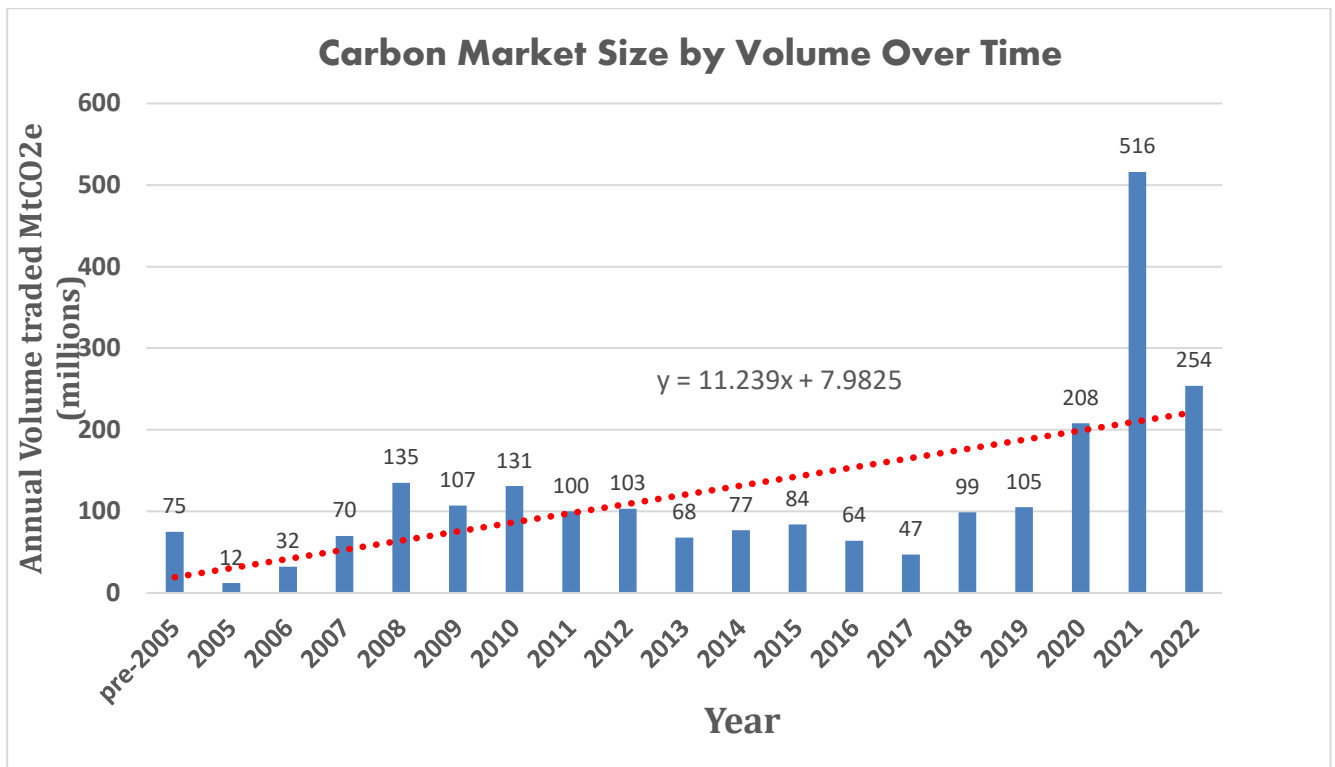


Figure 11: Volume of Traded Carbon Credits in the Voluntary Carbon Market: Pre-2005 to 2022

According to the figure 11, the carbon market volume was about 75 MtCO₂e in 2005 and increased to 516 MtCO₂e in 2022. This represents a compound annual growth rate (CAGR) of about 11.2%. The graph also shows that the carbon market has experienced some volatility in recent years. For example, the market volume declined in 2009 due to the global financial crisis. However, the market has since rebounded and has continued to grow in recent years. The future of the carbon market is uncertain, but it is expected to continue to grow in the coming years. This is due to the increasing focus on climate change and the need to reduce greenhouse gas emissions.

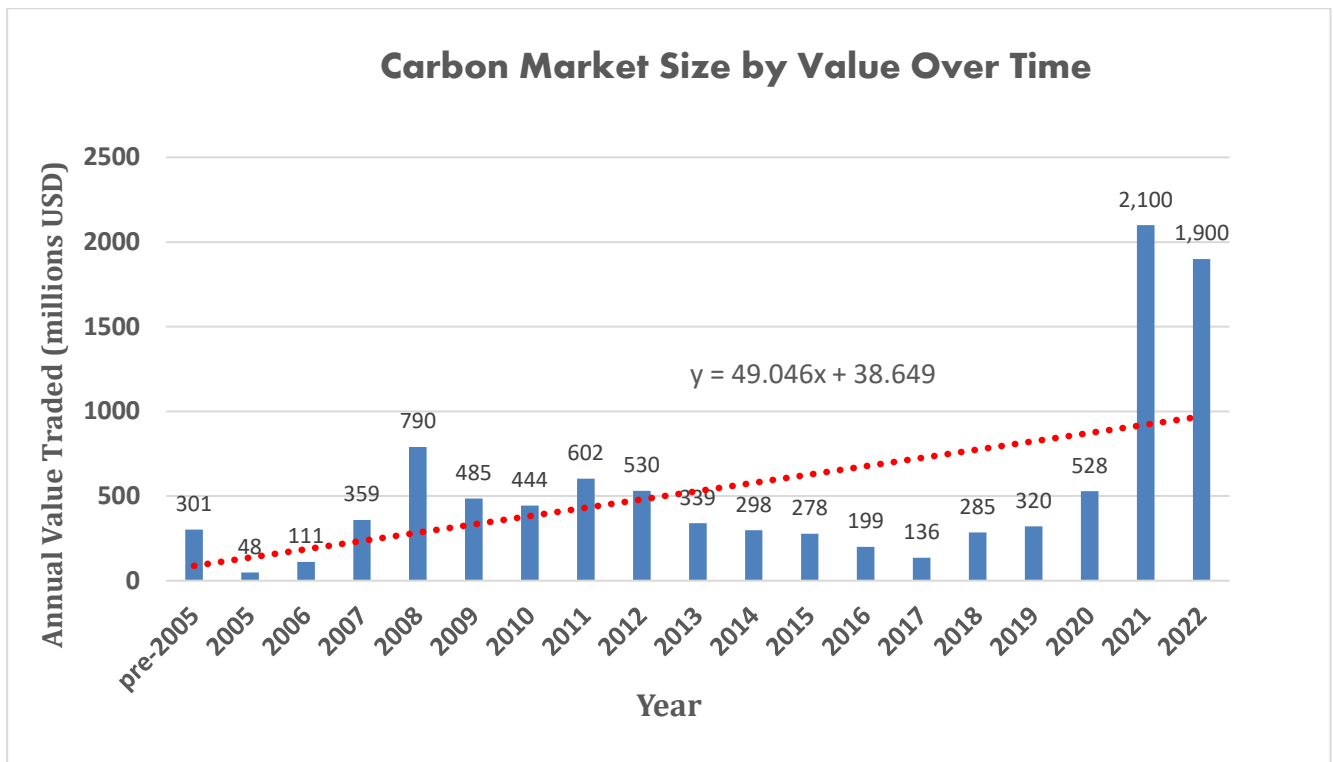


Figure 12: Value of Traded Carbon Credits in the Voluntary Carbon Market: Pre-2005 to 2022

As shown in figure 12, the blue line represents the impressive growth of the carbon market's value over time. Starting at a modest 301 million USD in 2005, it has surged to a remarkable 2,100 million USD by 2022, with an impressive 49% annual growth rate. This isn't just a statistic; it reflects the increasing awareness of the climate crisis and the rising demand for carbon offsets.

So, what does this mean for green projects? The expanding carbon market indicates a growing pool of funds dedicated to environmentally friendly ventures. Picture it as a treasure chest full of potential financing for renewable energy project, sustainable forestry initiative, or energy-efficient innovation. This isn't just a theoretical idea. The upward trend on the graph suggests a shift towards investment, with a steeper slope compared to a scenario based solely on grants. While grants are important, the data indicates that investors are increasingly recognizing the value of green projects, acknowledging their potential for both environmental impact and financial returns. And here's the exciting part – this isn't a temporary trend. The continuous upward trajectory signals an expanding opportunity for project developers. Envision a future where securing funding for green project is not a challenge but a readily available support. That's the promise of the carbon market.

It's not just a financial opportunity; it's a chance to make a real impact. By tapping into the potential of the carbon market, we can turn green aspirations into concrete realities, creating a future where environmental sustainability and economic prosperity go hand in hand. The carbon market is more than just a market; it's a driver for positive change.

5.2.2 Carbon market related initiatives and available investment pool in Africa

Africa holds substantial technical potential for carbon credits, estimated at around 2,400 MtCO₂e by 2030, with a potential value exceeding \$50 billion if all credits are sold (McKinsey, 2020). Harnessing even a portion of this overall potential could redirect substantial climate financing into Africa, bolstering employment, livelihoods, and contributing to advancements in energy access, biodiversity, and health (ACMI, 2022).

5.2.2.1 African Carbon Markets Initiative (ACMI)

Launched during the COP27 Egypt in November 2022, African Carbon Markets Initiative (ACMI) aims to maximize Africa's potential in carbon markets by tackling obstacles to the expansion of the voluntary carbon market and establishing the groundwork for a robust voluntary carbon market ecosystem in Africa by 2030. ACMI's aspirations encompass four key goals. First, to increase African credit retirements to approximately 300 MtCO₂e by 2030, marking a substantial 19-fold rise from the 16 MtCO₂e retired in 2020. This objective aligns with Africa's potential global share and its current growth trajectory, considering the estimated 15x growth of global markets from 2020 to 2030, with Africa capturing a growing market share due to its unrealized potential. Second, to generate or support around 30 million jobs by 2030, spanning various aspects of the value chain in carbon project development, execution, certification, and monitoring. Third, to enhance the quality and integrity of African credits, raising prices from approximately \$5 per tonne in 2021 to around \$20 per tonne, mobilizing up to \$6 billion in capital from carbon credits by 2030. Lastly, to ensure fair and transparent distribution of carbon credit revenue, with a significant portion directed to local communities. ACMI aims to collaborate with leading organizations to establish standards for transparency and benefits-sharing, ensuring a balanced and effective market expansion.

ACMI's overarching, long-term vision extends beyond 2030, aiming to expand Africa's carbon market to a range of 1.5-2.5 GtCO₂e and mobilize over \$100 billion annually by 2050. This ambitious goal is coupled with a commitment to ensuring fair and transparent distribution of carbon credit revenue, with a significant portion directed towards African communities. The envisioned outcomes include tangible benefits such as cleaner air, increased adoption of renewable energy sources in urban areas, healthier cooking practices in households, advancements in farming and forestry practices, and the creation of job opportunities for the growing population.

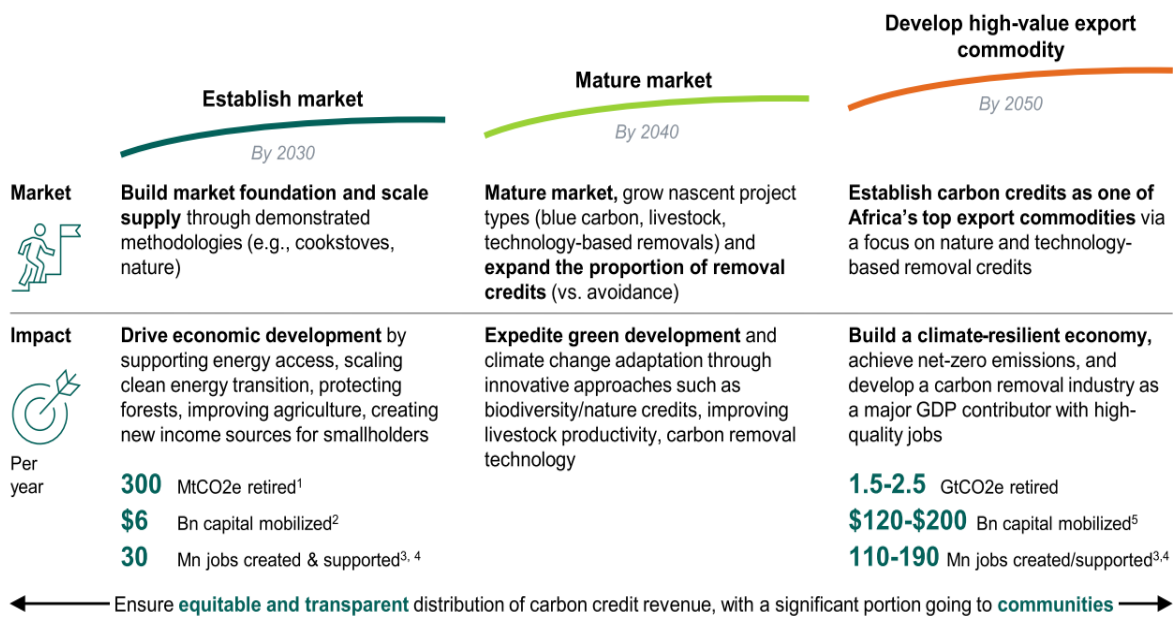


Figure 13: ACMI's Ambition

Source: ACMI, 2022

5.2.2.2 Regional Collaboration Centre for West and Central Africa (RCC Lomé)

UN Climate Change, in collaboration with six key partners, is driving action at the local level through regional collaboration centres that integrate climate change expertise with detailed local insights in Bangkok, Dubai, Kampala, Lome, St. George's-Grenada, and Panama. Originally established to disseminate the benefits of the Clean Development Mechanism under the Kyoto Protocol, these Regional Collaboration Centres (RCCs) have expanded their role since the adoption of the Paris Agreement. They now play a crucial role in facilitating the implementation of countries' Nationally Determined Contributions, offering support in capacity-building, technical assistance, and strategic networking. This involves mobilizing expertise and resources to advance sustainable development. Additionally, the RCCs contribute to the organization of annual Regional Climate Weeks in various regions worldwide, including Asia-Pacific, Africa, Latin America and the Caribbean, and the Middle East and North Africa (UNFCCC, 2024).

RCC Lomé, established in 2013, resulted from a partnership between the United Nations Climate Change (UNFCCC) secretariat and the West African Development Bank (BOAD) ((UNFCCC, 2024). Its primary objective is to disseminate the advantages and opportunities of the Clean Development Mechanism (CDM) in Western and Francophone Africa. Since 2015, RCC Lomé, in alignment with other Regional Collaboration Centres (RCCs) globally, has expanded its role to function as a regional representative of the UNFCCC (RCC-Lomé, 2020). It works towards achieving the goals of the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement. In collaboration with regional partners, RCC Lomé is committed to aiding national and regional climate action through activities such as capacity-building, technical assistance, strategic

networking, and accessing expertise and resources to drive climate action and sustainable development. The centre aims to support the implementation of Countries' Nationally Determined Contributions (NDCs), the 2030 Agenda for Sustainable Development, and other pertinent policies in the region, while also facilitating the redirection of resources and climate finance towards climate action (RCC-Lomé, 2020).

From 2013 to the present, the Centre has supported over 300 projects eligible for the Clean Development Mechanism (CDM), providing direct assistance to over a hundred organizations and project stakeholders (BOAD, 2024). Currently, it is assisting countries in transitioning from CDM projects to Article 6.4 of the Paris Agreement. Additionally, the Centre has spearheaded several initiatives to support states in their endeavours to meet commitments made under the Paris Agreement, particularly in the field of carbon markets namely the West African Alliance on Carbon Markets and Climate Finance. The Alliance focuses on updating its country members on negotiation issues, connecting these concerns to their domestic situations, and orchestrating a robust advocacy coalition.

The West African Alliance on Carbon Markets and Climate Finance is based in Dakar, Senegal and strives to strengthen the standing of West African countries, enabling their active participation in global carbon markets, facilitating technology transfer, and securing result-based climate finance for effective NDC implementation. Specifically, the Alliance aims to:

- Encourage the active engagement of West African delegates in UNFCCC negotiations concerning market mechanisms, transparency, and climate finance.
- Advocate for increased access to market mechanisms and climate finance opportunities at both national and sub-regional levels.
- Initiate the transition of capacities and activities related to the Clean Development Mechanism (CDM) to align with the Paris Agreement context.
- Facilitate and support Article 6 pilot initiatives within the sub-region, fostering the exchange of implementation knowledge between pilot experiences and negotiations.

Source: West African Alliance on Carbon Markets and Climate Finance, 2024.

The West African Alliance on Carbon Markets and Climate Finance was conceived at COP 22 in Marrakech in 2016. However, the official establishment of the Alliance was formalized through a resolution during the inaugural meeting of founding members held on June 30, 2017, in Cotonou, coinciding with the Africa Carbon Forum.

5.2.2.3 Carbon Project Registration Authority in the Republic of Benin

As per Article 1 of Decree No. 2022-699 dated December 7, 2022, in the Republic of Benin, the Carbon Project Registration Authority, hereinafter referred to as the 'Registration Authority,' is established. The Registration Authority is an interministerial body under the dual supervision of the Ministry of Finance and the Ministry of Sustainable Development (Government of Benin, 2022).

In Article 2 (missions and attributions), the Carbon Project Registration Authority has the mission to promote carbon projects in the Republic of Benin, in line with the strategic orientations of the Beninese Council for Sustainable Development. In this regard, its responsibilities include:

- Promoting a high-quality carbon market in Benin.
- Ensuring project implementation in accordance with national legislation, the country's sustainable development goals, and its nationally determined contribution.
- Protecting the interests of the Republic of Benin, local communities, and populations by ensuring their benefit from international financing.
- Promoting the fulfilment of national and international voluntary efforts in climate change within its nationally determined contribution framework.
- Establishing the national registry, where all developed, past, present, or future carbon projects on Beninese territory must be registered.
- Registering carbon projects on Beninese territory according to a determined mechanism.
- Managing the national carbon project registry.
- Acting as the state's representative to entities and project promoters of greenhouse gas mitigation projects and adaptation projects with co-benefits, except in cases where the National Designated Authority Council of the Green Climate Fund is competent.
- Acting on behalf of the Beninese state with international carbon certification standards.
- Addressing project proponents' doubts regarding registration in the national registry.
- Monitoring the evolution of rules and procedures of international carbon certification standards.
- Publishing approved carbon projects in the national registry.
- Compiling initial and periodic reports to submit to the international community.
- Deciding Benin's participation in approaches and mechanisms provided for by Article 6 of the Paris Agreement, in collaboration with the Beninese Council for Sustainable Development.

Source: DECREE No. 2022-699 OF DECEMBER 7, 2022, establishing the creation, powers, organization, and functioning of the Carbon Project Registration Authority in the Republic of Benin.

5.3 Key Sectors for Carbon Credit Generation in West Africa (Benin Republic)

This section outlines our discoveries concerning the specific sectors within West Africa, particularly the Benin Republic, that exhibit significant potential for carbon credit generation. It underscores the distinctive characteristics and appeal of these sectors for carbon credit initiatives.

Carbon credit programs present an opportunity for countries to finance low-carbon development initiatives through the voluntary carbon market. By identifying sectors that have significant emissions reduction potential, carbon credits can be generated and sold to offset corporate emissions in countries looking to achieve carbon neutrality goals. For developing nations like the Benin Republic, carbon

markets provide a means to attract climate finance investments that support national priorities such as access to clean energy, sustainable agriculture practices, and conservation of natural resources. Before diving into the specific high-impact sectors, it's important to understand the context of Benin's economic activities and climate change vulnerabilities.

In 2022, the economic growth rate in Benin Republic is estimated at 6.3%, following 7.2% and 3.8% in 2021 and 2020, respectively. This growth is driven by the primary sector, represented by agriculture, with a value that increased by 4.8% in 2022 after 5.2% the previous year. The secondary sector recorded a growth of 7.9% in its value added in 2022, down from 9.1% the previous year. Finally, the tertiary sector continues to support the activities of the other two sectors, with its value added increasing by 6.0% in 2022, compared to 6.6% the previous year (INStAD, 2023). The assessment of vulnerability to climate change in economic sectors has revealed significant sectoral risks, including the disruption of the agricultural calendar, decreases in agricultural yields, crop losses, disruptions in fishing and aquaculture activities, scarcity of pastures, and intensification of transhumance. In addition to these sectoral risks, there is a high mortality rate in livestock, proliferation of waterborne diseases, and degradation of socio-economic infrastructure, with substantial economic repercussions on the lives of affected populations (poverty, food insecurity, low income, population migration, etc.) (MCVDD, 2022). Regarding socio-economic vulnerability, across the country, socio-professional groups such as emerging farmers, fishermen, small-scale livestock breeders, agro-industrial processors, and small-scale farmers appear to be less vulnerable in terms of access to basic resources (cultivable land, water bodies, reservoirs, ecosystems, housing, roads, markets, etc.). As for access to social services (health, education, domestic energy, etc.), almost all of these actors appear to be among the least vulnerable groups, especially in the northern and southern regions of the country (MCVDD, 2022).

Creating an enabling policy environment and developing local expertise are necessary to effectively engage carbon markets. With the right project types and community involvement, carbon credits can generate climate and social benefits by supporting livelihoods through low-emissions development.

5.3.1 Strategic Sectors for Carbon Credit Generation

Before delving into the key sectors for carbon credit generation within the context of West Africa, with the focus on Benin Republic, it's important to go through the issuances potentials of carbon credit generation categories or sectors worldwide from previous carbon credit project registration by category.

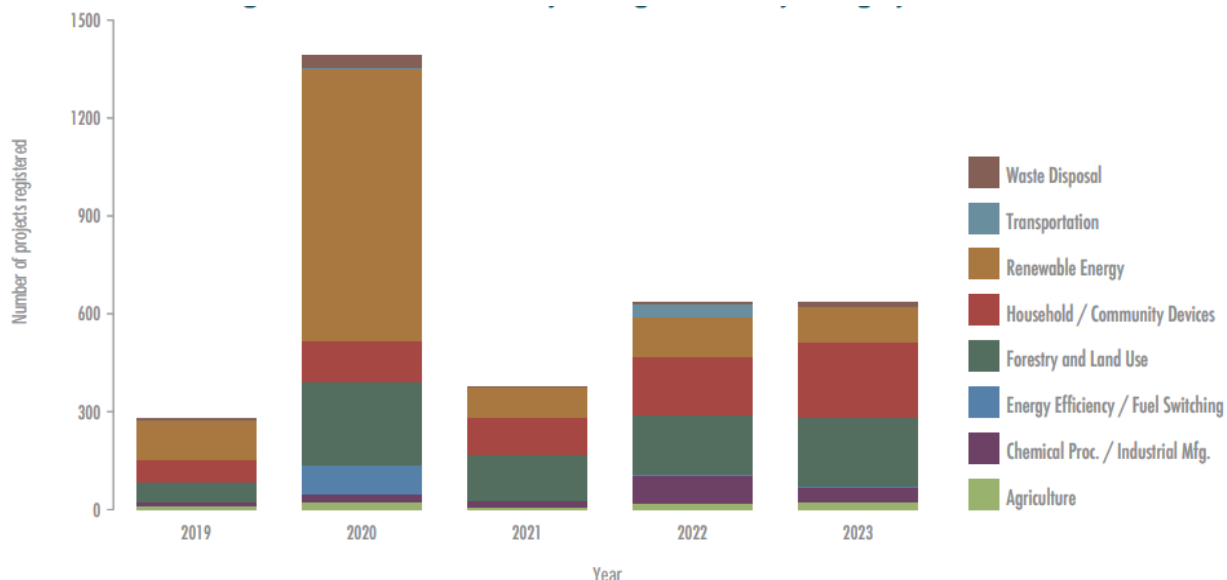


Figure 14: Registrations of Projects for Carbon Credits by Category, 2020-2023

Source: Ecosystem Marketplace, 2023.

Different project categories exhibit distinct potentials for issuances linked to their overall supply potential. From the figure... Forestry and Land Use, Household/Community Devices, and Renewable Energy persist as dominant categories for new projects in 2022, with indications suggesting this trend will continue in the future. Agriculture projects demonstrated a notable presence in both 2022 and 2023, with anticipated ongoing growth in this sector as market participants explore climate solutions within Agriculture, Forestry, and Other Land Use (AFOLU). This exploration encompasses areas that were previously underexplored or have become viable due to market price increases. The considerable rise in new project registrations within the Transportation category in 2022 is also noteworthy, with almost all these projects registered with ACR. The table 6 below presents the voluntary Carbon Market (VCM) transaction volumes, values, and prices categorized by projects, spanning from 2021 to year-to-date 2023.

Table 6: Voluntary Carbon Market (VCM) transaction from 2021 to year-to-date 2023.

CATEGORY	2021			2022			2021-2022 PERCENT CHANGE			2023 (YTD)
	VOLUME (MtCO ₂ e)	VALUE (USD)	PRICE (USD)	VOLUME (MtCO ₂ e)	VALUE (USD)	PRICE (USD)	VOLUME	VALUE	PRICE	PRICE (USD)
FORESTRY & LAND USE	242,339,151	\$1,401,461,426	\$5.78	113,253,651	\$1,148,848,783	\$10.14	-53%	-18%	+75%	\$11.21
RENEWABLE ENERGY	214,508,581	\$463,950,451	\$2.16	92,477,042	\$386,054,729	\$4.16	-57%	-17%	+93%	\$3.97
CHEMICAL PROCESSING & INDUSTRIAL MANUFACTURING	17,253,275	\$53,877,016	\$3.12	13,338,781	\$68,531,895	\$5.14	-23%	+27%	+65%	\$4.69
HOUSEHOLD / COMMUNITY DEVICES	8,687,821	\$46,606,814	\$5.36	9,070,331	\$77,590,244	\$8.55	+4%	+66%	+60%	\$7.33
ENERGY EFFICIENCY / FUEL SWITCHING	10,936,656	\$23,583,132	\$2.16	6,601,354	\$35,577,952	\$5.39	-40%	+51%	+150%	\$3.69
WASTE DISPOSAL	11,647,530	\$42,292,142	\$3.63	6,207,615	\$44,870,139	\$7.23	-47%	+6%	+99%	\$9.00
AGRICULTURE	987,026	\$9,525,119	\$9.65	3,783,393	\$41,700,362	\$11.02	+283%	+338%	+14%	\$6.43
TRANSPORTATION	5,405,466	\$6,257,391	\$1.16	176,338	\$770,485	\$4.37	-97%	-88%	+277%	-

Source: Ecosystem Marketplace, 2023.

This table provides insights into sectors with notable transaction volumes and evolving prices in the Voluntary Carbon Market (VCM) from 2021 to the year-to-date (YTD) 2023, shedding light on transaction volumes and evolving prices.

5.3.2 Sectors with Higher Transaction Volumes

Forestry and Land Use emerges as a standout sector, consistently demonstrating high transaction volumes, indicative of robust activity and substantial potential for carbon credit generation. This underscores the market's recognition of the pivotal role played by afforestation, reforestation, and sustainable forest management projects in environmental conservation. Renewable Energy, while experiencing a decline in volume, remains a key player with significant potential. This aligns with the global emphasis on transitioning to clean energy sources, and technological advancements could further enhance its viability in the carbon market. At the third position, Chemical Processing and Industrial Manufacturing come into focus, presenting a dynamic landscape for emissions reduction. Initiatives in these sectors, ranging from cleaner production processes to the utilization of eco-friendly materials, showcase a growing commitment towards sustainable industrial practices.

5.3.3 Sectors with Increasing Prices

Examining sectors with increasing prices, Forestry and Land Use again takes the spotlight. The sector's steady rise in price per ton suggests a growing acknowledgment of the value inherent in forest carbon sequestration. Agriculture, despite a comparatively lower volume, stands out due to a notable

price increase, indicating a rising interest in carbon reduction projects within this sector. Further considerations bring attention to sectors like Waste Disposal and Energy Efficiency. While these sectors currently display lower volumes and prices compared to others, they hold promise for future growth. As waste management and energy efficiency become increasingly crucial for climate action, these sectors may witness a surge in activity.

It's important to note that the Year-to-Date (YTD) data for 2023 is incomplete, and final figures may deviate from current observed trends. Overall, the table provides a comprehensive overview of sectors with significant potential for successful implementation in the carbon market, emphasizing ongoing developments needed to unlock the full potential of Renewable Energy, Agriculture, and Waste Disposal and Energy Efficiency in the Voluntary Carbon Market (VCM).

5.3.4 Opportunities to generate carbon credits in Benin Republic by sector

5.3.4.1 Forestry and Land use

Benin has a variety of forest and plant ecosystems that can sequester carbon and generate credits. Benin boasts over 11 million hectares of forest, representing approximately 27% of its land area. National parks cover 1.26 million hectares, approximately 11% of the national territory. The Pendjari National Park (PNP) and the W National Park (PNW) constitute 40% of a contiguous transboundary protected area network known as the "W-Arly-Pendjari" (WAP), spanning 3.39 million hectares, which expansive region is shared with Burkina Faso (36%) and Niger (24%) (World Bank Group, 2020). This vast forest resource acts as a natural carbon sink, offering opportunities for projects like REDD+ (Reducing Emissions from Deforestation and Forest Degradation) and improved forest management to generate carbon credits. However, while Benin has made strides in forest conservation, deforestation and degradation remain concerns. Addressing these issues through reforestation initiatives and sustainable forest management practices can create carbon credit opportunities while contributing to forest restoration and biodiversity conservation.

5.3.4.2 Renewable Energy

Currently, Benin relies heavily on fossil fuels for electricity generation. Transitioning to renewable energy sources like solar, wind, and hydropower can significantly reduce emissions and generate carbon credit (IRENA, 2022). The National Policy for the Development of Renewable Energies (PONADER), established by the Ministry of Energy in the Republic of Benin in 2020, provided a comprehensive overview of the state of renewable energies in the country. Despite the nation's vast potential, the report revealed that Benin has yet to witness widespread adoption of renewable energy technologies. Regarding solar energy, Benin experiences solar radiation ranging from 3.5 to 5.5 kWh/m²/day, increasing from the south towards the northwest and north, with a significant proportion of diffuse radiation compared to direct. In the realm of wind energy, available wind measurements in Benin indicate that only the coastal strip exhibits a notable potential, with consistent wind speeds throughout the year. These speeds, measured between 10 and 12 meters above the ground, range from 4 to 6 m/s along the coastal zone and from 1 to 2 m/s in the northern part of the country. Benin possesses a substantial potential in agricultural residues, which currently remain untapped and are largely burned in fields. These residues hold significant value for bioenergy production. The exploitation of biomass energy resources could play a crucial role in addressing the recurrent

electricity crises in the country. Despite potential, the sector requires significant investment and infrastructure development to realize its full carbon credit generation potential.

5.3.4.3 Agriculture

In the intricate tapestry of Benin's economic fabric, agriculture reigns supreme, serving as the backbone of the nation's prosperity, contributing substantially to the country's Gross Domestic Product (GDP). However, beneath the surface of this vital sector lies a dual narrative. While agriculture sustains the heartbeat of the nation, certain prevalent practices pose a considerable challenge. Slash-and-burn clearing, the unrestrained use of synthetic fertilizers, and inadequate manure management emerge as silent contributors to greenhouse gas emissions, particularly methane and nitrous oxide. Yet, amidst these challenges, a beacon of hope emerges in the form of climate-smart agriculture (CSA). This holistic approach unveils a spectrum of strategies designed to not only mitigate emissions but transform agriculture into a net contributor to carbon sequestration.

Within the realm of CSA, various initiatives take centre stage:

- **Conservation Agriculture:** By steering away from extensive tillage, introducing cover crops, and championing crop diversification, this practice becomes a cornerstone in fortifying soil health and fostering enhanced carbon sequestration.
- **Integrated Nutrient Management:** A paradigm shift towards optimizing fertilizer use, embracing organic amendments, and championing composting not only addresses emissions but reshapes the agricultural landscape by reducing reliance on synthetic fertilizers.
- **Agroforestry:** Introducing the harmonious integration of trees into agricultural landscapes not only enhances carbon sequestration but also bestows a myriad of benefits, from enriching soil fertility to fostering biodiversity.
- **Improved Water Management:** Efficient irrigation practices not only curtail water wastage but also play a pivotal role in addressing methane emissions associated with rice cultivation.

As these climate-smart practices take root, a flow of benefits and co-benefits unfolds:

- **Carbon Credits:** Beyond the environmental dividends, the implementation of these practices unlocks the potential to generate carbon credits through diverse methodologies. This not only provides a financial impetus for farmers but also propels the trajectory of sustainable land management.
- **Enhanced Productivity:** The ripple effects of improved soil health, judicious water management, and nutrient cycling transcend emissions reduction. They usher in a new era of heightened agricultural yields, contributing significantly to bolstering food security.
- **Reduced Vulnerability:** Beyond the realm of emissions reduction, climate-smart practices fortify resilience against the impacts of climate change. Droughts and floods become less formidable adversaries, ensuring the longevity and prosperity of both farmers and the wider community.

In navigating the delicate equilibrium between challenges and opportunities, Benin's agricultural landscape holds immense promise as a key player in the generation of carbon credits, thereby shaping a sustainable and resilient future.

5.3.4.4 Waste disposal

The waste disposal sector in Benin is a promising yet limited player, with the potential to make a meaningful contribution to reducing emissions.

In this sector, Benin faces inherent challenges in waste collection, treatment, and disposal, marked by widespread open burning practices. Despite these hurdles, the landscape presents an opportunity for transformative measures. Initiatives like waste composting, biogas production, and enhanced landfill management not only address the existing waste management challenges but also play a crucial role in reducing methane emissions—a substantial contributor to the country's carbon footprint. Embracing these practices not only aligns with global environmental objectives but also opens up the potential to generate carbon credits.

5.3.4.5 Certifications Program for Carbon Credits

Carbon credits are certifications that represent the reduction or removal of greenhouse gas emissions, usually measured in metric tons of carbon dioxide equivalent (CO₂e). Carbon credit certifications verify and authenticate emission reductions from voluntary projects around the world within regulated market frameworks. These certifications provide transparency and trust in the carbon market, allowing buyers to be confident in the environmental impact of their purchases and project developers to demonstrate the credibility of their projects.

There are several certification programs for carbon credits. The main ones to consider looking at African perspective include:

5.3.4.5.1 VERRA

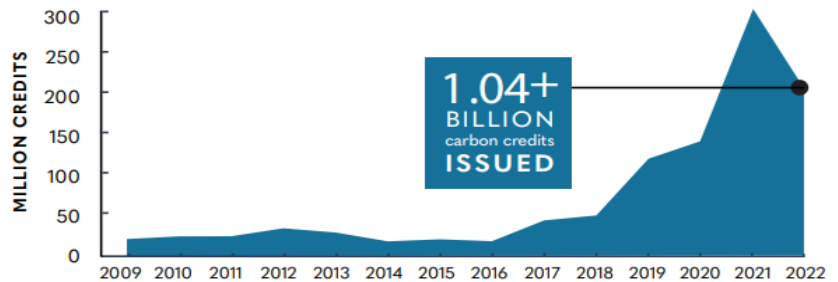
Previously known as Verified Carbon Standard, Verra was established in 2007, originated from the vision of environmental and business visionaries recognizing the necessity for enhanced quality assurance within voluntary carbon markets. Today, the organization oversees the preeminent voluntary carbon markets initiative, the Verified Carbon Standard (VCS) Program. In addition to managing various programs, Verra serves as an incubator for novel concepts, aiming to create substantial environmental and social value on a global scale, and actively promotes the adoption of these programs across the globe.

Verra's VCS Program is at the forefront of developing methodologies and tools to harness the carbon reduction potential of AFOLU projects, covering categories such as Afforestation, Reforestation, Agricultural Land Management, Improved Forest Management, and more. Despite these advancements, AFOLU projects encounter significant challenges, including natural risks like fire and climate change, internal management issues, and external risks related to community engagement and land tenure. To ensure the environmental integrity of VCUs issued from AFOLU projects, Verra manages a pooled buffer account. Here, projects deposit a risk-adjusted percentage of their emission reductions, covering carbon losses in the event of reversals in any individual project. This approach safeguards the credibility of carbon credits issued by addressing challenges and preserving the integrity of emission reduction efforts.



THE VCS PROGRAM IN NUMBERS

CREDIT ISSUANCES



CREDIT RETIREMENTS

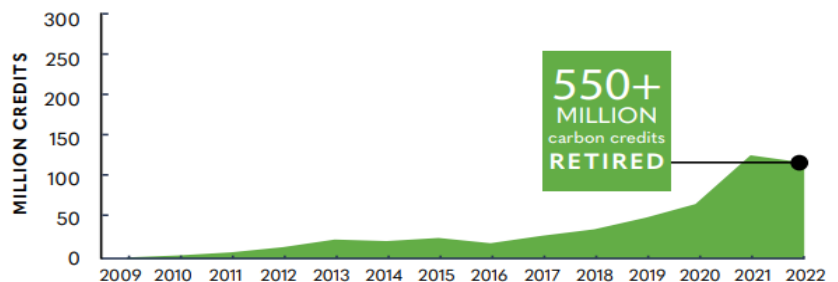


Figure 15: Global Carbon Credit Issuance by VCS (2009-2022)

Source: Verra Annual Report 2022.

In terms of number of projects issued by VCS by region, Africa occupied the third place with 11%.

❖ Example of carbon credit project issued under Verra in West Africa

Several carbon credit projects have been issued by Verra in West Africa including:

- [Pendjari and W-Benin National Parks REDD+ Project](#)

The Pendjari and W-Benin National Parks REDD+ project aims to safeguard natural ecosystems in the parks and nearby hunting zones by addressing key deforestation drivers. Strategies include engaging local communities, managing regional transhumance and pastoralism, supporting education, promoting sustainable practices, creating employment opportunities, and training rangers for law enforcement. These activities reduce human pressure on natural resources, enhance ecosystem protection, and provide additional income for long-term park funding and local employment. Despite being a protected area, the project faces threats like agricultural land demand, conflicts among communities, and deforestation for fuel.

The VCS-registered project, led by African Parks Benin, focuses on Agriculture, Forestry, and Other

Land Use (AFOLU) activities with a REDD (Reduced Emissions from Deforestation and Degradation) approach. The project covers a vast area of 1,214,239 hectares, aiming to achieve an estimated annual emission reduction of 228,923. The VCS methodology applied is VM0009, and the project has been validated by AENOR International S.A.U. The crediting period spans from 1st, 24/08/2017, to 23/08/2047. Additionally, the project aligns with the Climate, Community & Biodiversity (CCB) Third Edition standard, with verification approved and the same estimated annual emission reduction and project type as the VCS. The project is spearheaded by African Parks Benin and covers 1,214,239 hectares.

- [Reforestation of Degraded Forest Reserve Areas in Ghana, West Africa](#)

Miro Forestry manages over 10,000 hectares of standing plantations, expanding at a rate of 3,000 hectares annually. Their sustainable timber products include plywood, rotary veneer, poles, sawn timber, and wood biomass. The plantations are Forest Stewardship Council™ (FSC™) certified, adhering to responsible forest management standards. Located around 7° north of the equator in Ghana, the tropical climate features average monthly temperatures of 24°C to 28°C and annual rainfall between 1,300 - 1,650mm. The company focuses on reforesting degraded land, designated as a forestry reserve, with support from the Ghanaian Forestry Commission. Committed to high environmental, ethical, financial, and social standards, Miro Forestry aims for international forestry certification on all plantations and seeks to be a preferred partner for communities, the government, and international development and finance.

Miro Forestry Developments Limited, based in London, United Kingdom, is the proponent of a Verified Carbon Standard (VCS) project situated in the Ashanti region of Ghana. The project falls under the Agriculture, Forestry, and Other Land Use (AFOLU) category, specifically Afforestation, Reforestation, and Revegetation (ARR). With a project area covering 5,768 hectares, the estimated annual emission reductions are 46,229. The VCS methodology AR-ACM0003 is employed, and the project is currently in the process of seeking verification approval. The total buffer pool credits stand at 41,879. AENOR International S.A.U. serves as the VCS project validator. The project registration date is 01/03/2022, and the crediting period spans from 24/03/2016 to 23/03/2046. Miro Forestry aims to contribute to sustainable forestry practices with high standards of environmental and social responsibility in its reforestation initiatives.

- [Niger Acacia Senegal Plantation Project](#)

The initial Afforestation, Reforestation, and Revegetation (ARR) project in Niger, known as the Niger Acacia Senegal Plantation Project (NASPP), aims to rejuvenate deforested and severely degraded areas in the Sudano-Sahelian region of the Republic of Niger. The project's objective is to empower local communities to embrace sustainable agro-forestry practices through the establishment of plantations using the indigenous *Acacia senegalensis* (Acacia Senegal) species. NASPP marks the inaugural attempt in Niger to implement large-scale Acacia Senegal plantations in regions where natural regeneration of dry forests is challenging. To enhance the project's viability, revenue generated from the sale of emission reduction credits, attributed to carbon sequestration in the plantations, will serve as an additional income source complementing the earnings from the sale of gum arabic obtained from the acacia trees.

The project with ID 2382, located across Diffa, Dosso, Maradi, Niger, Tillaberi, and Zinder in Niger, is under the Verified Carbon Standard (VCS) and is led by Achats Service International based in Niamey, Niger. They can be contacted at +227 74 12 22 or nigerbiocarbhone@gmail.com. The project, focusing on Agriculture Forestry and Other Land Use (AFOLU) activities, particularly Afforestation, Reforestation, and Revegetation (ARR), has been successfully registered with an estimated annual emission reduction of 24,957. Spanning 8,472 hectares, the project follows the VCS methodology AR-ACM0003 and is under the validation of AENOR International S.A.U. The project registration date is 25/10/2021, and its crediting period extends from 21/12/2005 to 20/12/2035.

- [Reforestation of Degraded Forest Reserves in Ghana](#)

This Afforestation, Reforestation, and Revegetation (ARR) project under the Verified Carbon Standard (VCS) aims to reforest 15,000 hectares of degraded forest reserves in Ghana. The initial project instance covers 1,506 hectares in the Asubima Forest Reserve in the northern part of the Ashanti region. Managed by FORM Ghana, a company established in 2007 and certified by the Forest Stewardship Council (FSC) since January 2010, the project follows high sustainability standards in both social and ecological aspects. The implementation of the VCS carbon project aligns with these stringent operational standards, with a planned expansion of 1,000 hectares per year for new project areas and instances. The first project instance anticipates generating 360,943 Verified Carbon Units (VCUs) over the 40-year crediting period.

The project, currently awaiting verification approval, aims to reforest 20,000 hectares of land. The estimated annual emission reductions are 8,815, contributing to a total of 78,751 Buffer Pool Credits. The project falls under the Agriculture Forestry and Other Land Use (AFOLU) category and follows the VCS Methodology AR-AM0003. Validated by SCS Global Services, the project's registration date is 06/04/2020, with a crediting period term from 01/03/2008 to 29/02/2048.

- [Blitta – Togo Solar Power Plant](#)

The 70 MW solar PV plant in Blitta, Togo, is West Africa's largest and the country's first renewable energy facility. It currently operates at 50 MW capacity, with an upcoming 20 MW expansion anticipated by 2023/2024. Located in Blitta-Losso, surrounded by neighboring villages, the plant is expected to save over one million tonnes of CO₂ emissions over its 25-year lifetime. With an annual production of 88,000 MWh, the project aligns with Togo's clean energy strategy, targeting 50% renewable electrification by 2025 and 100% by 2030. The estimated emission reductions for the initial crediting period are 464,040 tCO₂e, averting 66,291 tCO₂e annually. Beyond mitigating greenhouse gas emissions, the project aims to provide social benefits, including enhanced social services, job creation, and contributions to sustainable economic growth, employment, education, and gender equality.

The registered VCS project (ID: 3298) involves multiple proponents and falls under the category of Energy Industries (renewable/non-renewable sources). With an estimated annual emission reduction of 61,326, the project encompasses 117 hectares. Validated by LGAI Technological Center, S.A. (Applus+), it was registered on 01/06/2023, initiating the crediting period from 12/06/2021 to 11/06/2028. The project status indicates its successful registration, and issuance records are available for viewing.

5.3.4.5.2 GOLD STANDARD

The Gold Standard is another prominent certification program for carbon credits. Founded in 2003 by WWF and various international NGOs, it was created to guarantee that carbon emission reduction projects maintained the utmost environmental integrity while also promoting sustainable development. In response to the adoption of the Paris Climate Agreement and the Sustainable Development Goals, Gold Standard introduced a best practice standard known as Gold Standard for the Global Goals. This standard aims to optimize impact, generate value for global communities, and contribute to the well-being of the planet in light of climate and sustainable development initiatives.

As of the conclusion of 2023, Gold Standard has provided 304 million carbon credits from projects situated in over 100 diverse countries globally.

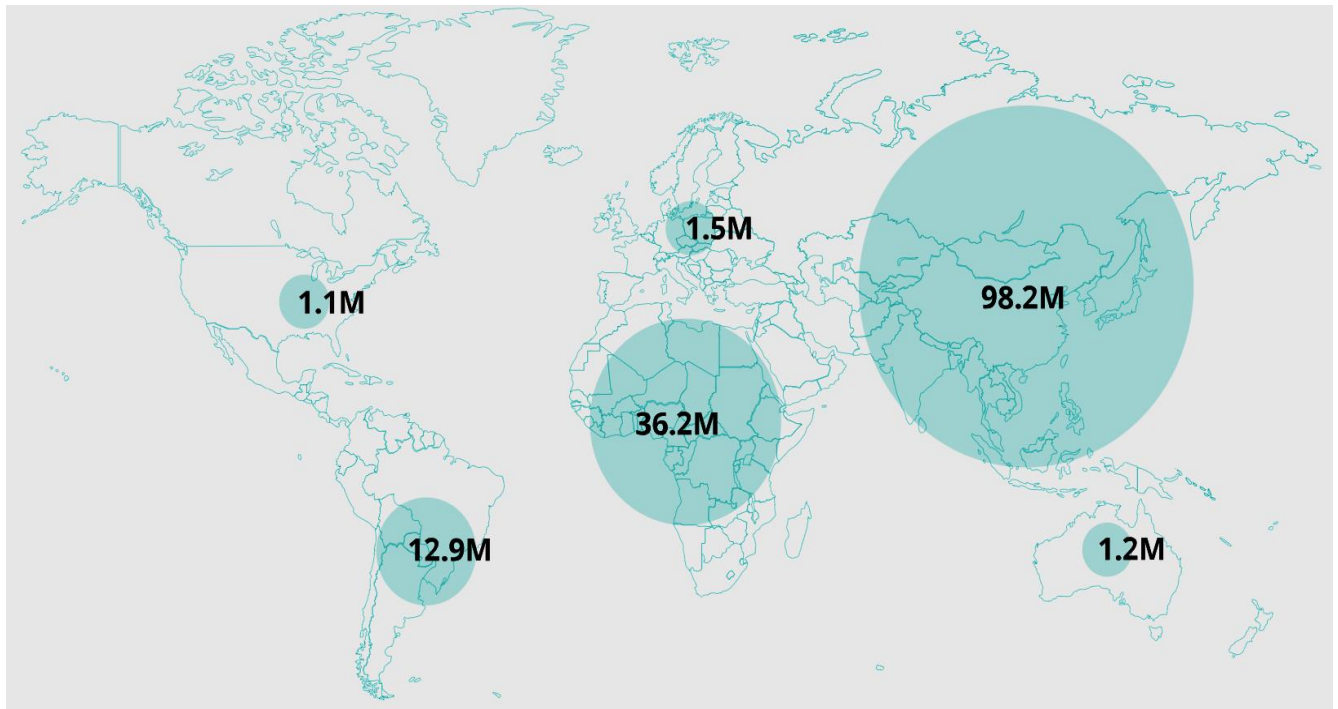


Figure 16: Gold Standard credit issuances by region.

Source: Gold Standard, 2024.

The leading region for Gold Standard credit issuances is Asia, represented by the tallest bar, 98.2 million tCO₂e. **Africa's** issuance is represented by the second-tallest bar, reaching 36.2 million tCO₂e.

❖ Example of carbon credit project issued under Gold Standard in West Africa

Numerous carbon credit initiatives in West Africa have been authorized under the Gold Standard, encompassing:

- **Efficient Cookstoves in Benin and Togo – VPA2 – Ecobénin – Wanrou Efficient Cookstoves in Atacora/Donga Region.**

The project aims to combat deforestation and land degradation in the Atacora/Donga Departments by enhancing energy efficiency in rural households facing climate change. Registered under the PoA

"Efficient cookstoves in Benin and Togo," it targets over 10,000 households in Toucountouna and Ouaké municipalities, areas heavily reliant on traditional three-stone cookstoves. More than 3,500 households will adopt the Wanrou efficient cookstoves, known for their successful adoption in previous trials. Approximately 300 rural women will be trained as instructors for stove construction. The Wanrou stoves, addressing energy efficiency and reducing wood-energy consumption, aim to replace traditional cookstoves, contributing to greenhouse gas emission reduction and forest preservation. These stoves also improve health outcomes, reduce women and children's time spent collecting firewood, and create local jobs. Additionally, the project plans to deploy solar kiosks and thermal electric generators, with carbon credits generated solely through Wanrou stove deployment.

This project has been certified Gold Standard Certified Project in the category of Energy Efficiency – Domestic. It has issued a total of 36,084 carbon credits, with 22,260 credits being retired.

- Native Clean Water Programme West Africa: VPA (01) Ghana

The inaugural micro-scale VPA, part of the Native Energy Clean Water Programme West Africa, is designated as VPA (01) in Ghana. It marks the initiation of the micro-scale PoA "Native Energy Clean Water Programme West Africa." The primary objective of this VPA is to diminish the usage of woody fuels in domestic and non-residential water treatment processes by introducing energy-efficient clean water technology as an alternative to boiling. CME Native Energy is responsible for implementing this VPA in the Greater Accra Region of the Republic of Ghana. Adhering to the Gold Standard methodology named "Technologies and Practices to Displace Decentralized Thermal Energy Consumption," this micro-scale VPA incorporates various project technologies or activities aimed at displacing thermal energy consumption, with a specific focus on Biosand filters within existing baseline practices.

This project falls under the project type category of Energy Efficiency – Domestic. Having successfully obtained certification, this initiative has issued a total of 74,103 carbon credits, contributing significantly to the reduction of carbon emissions. Notably, 34,500 credits from this total have been retired, signifying a tangible and impactful step towards environmental sustainability and energy efficiency.

- JOIL Jatropha Plantation in Ghana

The JOIL Jatropha plantation initiative is situated near Yeji, the district capital of the Pru District Assembly in the Brong Ahafo Region of Ghana. Its primary objectives include expanding plantation activities to address climate change, enhancing open shrubland's land use, generating employment opportunities in rural areas through sustainable biofuel production, and improving the overall livelihood of local communities. The project collaborates with local communities and out-growers to promote sustainable practices. The goal is to plant approximately 3,944.20 hectares with Jatropha curcas, with 1,018.0 hectares planted in 2018 and the remaining planted in 2022.

This project has been certified as a Gold Standard Certified Project in the Afforestation and Reforestation (A/R) category. It has issued a total of 18,752 carbon credits, with 5,674 credits being retired.

- Improved Cookstove and Safe Water Programme – Nigeria – VPA 06

The proposed VPA aims to widely distribute low greenhouse gas (GHG) water purification technologies (WPS) to schools and other institutions in Nigeria. Utilizing carbon finance, the VPA intends to assist local partners involved in the operation, sales, distribution, and maintenance of diverse WPS technologies.

This Gold Standard Certified Project, named "Improved Cookstove and Safe Water Programme – Nigeria – VPA 06," falls under the category of Energy Efficiency – Domestic. It has issued a total of 86,824 carbon credits, with 40,821 credits being retired.

- Illoulofin PV Solar Plant – Defissol

The DEFISSOL project in Benin aims to enhance the country's electricity infrastructure and reduce its dependency on neighboring nations by establishing a 25 MWp solar photovoltaic power plant in Onigbolo. Aligned with the government's strategy, the project seeks to ensure a reliable, secure, and sustainable power supply at a lower cost. Additionally, it prioritizes the modernization of the Société Beninoise d'Énergie Électrique's (SBEE) information system to enhance performance. The project anticipates socio-economic benefits, including job creation, and environmental impact through a significant reduction of 25,000 tons of CO₂-equivalent emissions annually over 25 years. The competitive production cost of the Onigbolo power plant is expected to contribute to lower energy production costs in Benin. The project is currently in the planning stage and has not yet received certification.

5.3.4.5.3 OTHER STANDARDS

❖ Climate, Community and Biodiversity Standards (CCB Standards)

The Climate, Community, and Biodiversity Standards (CCB Standards) assess projects involved in land management across their entire lifecycle, from initial development to execution. Originally created by the Climate, Community, and Biodiversity Alliance (CCBA) and subsequently overseen by Verra since November 2014, these standards are instrumental in integrating optimal practices and comprehensive benefits into project planning and execution. The CCB Standards serve several key purposes:

1. Identification of projects that concurrently address climate change, support local communities and smallholders, and conserve biodiversity.
2. Promotion of excellence and innovation in both project design and implementation.
3. Mitigation of risks for investors and offset buyers while expanding funding opportunities for project developers.

By focusing on projects that yield net positive benefits for climate change mitigation, local communities, and biodiversity, the CCB Standards are applicable to various land management initiatives. This includes projects reducing greenhouse gas emissions from deforestation, forest degradation, and other ecosystems, as well as those sequestering carbon through activities like reforestation, afforestation, agroforestry, and sustainable agriculture. The standards are designed to be applicable throughout the entire project lifecycle, from initial design to ongoing monitoring.

The Climate, Community, and Biodiversity Standards (CCB Standards) have seen significant engagement, with 45 projects validated and 82 projects verified. This has resulted in the issuance of 370,318,450 CCB-labeled Verified Carbon Units (VCUs), reflecting the substantial impact of these projects on climate change mitigation, community support, and biodiversity conservation. Moreover, a noteworthy 200,315,927 CCB-labeled VCUs have been retired, indicating the utilization and recognition of these credits in offsetting carbon emissions and contributing to sustainable practices. These figures underscore the effectiveness and widespread adoption of the CCB Standards in fostering environmentally and socially responsible land management projects.

❖ **International Sustainability and Carbon Certification (ISCC)**

ISCC is a globally applicable sustainability certification system that encompasses various sustainable feedstocks, including agricultural and forestry biomass, biogenic wastes and residues, circular materials, and renewables. It is one of the world's largest certification systems, with over 9,000 valid certificates in more than 130 countries. Developed through an open multi-stakeholder process, ISCC is governed by an association with over 250 members, including research institutes and NGOs. Functioning as a no-deforestation standard, ISCC is strongly committed to protecting forests, high-carbon stock lands, and biodiversity. Its vision is to promote the production of biomass and other raw materials in an environmentally, socially, and economically sustainable manner.



Figure 17: ISCC Certifications Issued

ISCC Certifications Issued

❖ **Sustainable Development Verified Impact Standard**

The Sustainable Development Verified Impact Standard (SD VISta) Program provides a versatile framework with defined rules and criteria for guiding the development, execution, and evaluation of projects striving to achieve impactful sustainable development benefits. SD VISta allows projects to align their social and environmental impacts with the United Nations Sustainable Development Goals

(SDGs), offering a flexible approach to fostering measurable outcomes. This program serves as a valuable tool for donors and investors to identify, support, and channel financial resources to initiatives that contribute to tangible sustainable development results.

In terms of quantifiable impact, SD VISTa has listed 140 projects and registered 37 of them. The program has issued a total of 31,706,464 SD VISTa-labeled Verified Carbon Units (VCUs), reflecting the substantial achievements of these projects in delivering sustainable development benefits. Additionally, 14,079,983 SD VISTa-labeled VCUs have been retired, highlighting the active use and recognition of these credits in contributing to sustainable development goals. These statistics underscore the effectiveness of SD VISTa in facilitating and promoting projects that make measurable and positive contributions to both social and environmental aspects.

5.4 Process of Implementing of a Carbon Credit Project

In the dynamic landscape of environmental sustainability, entrepreneurs play a pivotal role in driving positive change while unlocking financial opportunities. Understanding the intricacies of carbon credit building is crucial for entrepreneurs, particularly in regions like West Africa, where emerging markets hold immense potential for impactful initiatives. The process involves a systematic approach, from project identification to credit issuance, and demands a nuanced understanding of carbon markets. Entrepreneurs who grasp these steps not only contribute to global climate goals but also position themselves strategically to harness the financial benefits offered by the carbon market. This knowledge empowers entrepreneurs to navigate complexities, build sustainable projects, and seize the economic potential of carbon credits, fostering a synergy between environmental stewardship and financial prosperity. In essence, a comprehensive understanding of carbon credit development equips entrepreneurs to not only make a positive impact on the environment but also capitalize on the growing financial opportunities within the carbon market.

In this sub-chapter, we have examined several existing approaches to the various stages of setting up a carbon credit project, including methodologies from major carbon project certification standards such as Verra and Gold Standard. This has allowed us to propose the following steps for the implementation of a carbon credit project by young entrepreneurs in West Africa.

Overview of Steps:

1. Project Conceptualization and Initial Assessment
2. Project Design and Strategic Planning
3. Compilation of a Project Design Document
4. Evaluation of Project Activities and Formulation of Implementation Strategy
5. Completion of Financing and Investment Arrangements
6. Approvals, Validation, and Registration
7. Project Implementation and Ongoing Monitoring

8. Verification, Credit Issuance, and Certification
9. Carbon Credit Sale and Market Integration

5.4.1 Project Conceptualization and Initial Assessment

a. Project idea

Project proponents must clearly define the objectives, activities, and geographical scope of their carbon projects from the outset, along with identifying crucial participants and partners. Unfortunately, some proponents bypass this foundational phase, diving into complex design processes focused on measuring and monetizing carbon benefits without a well-defined understanding of the actual activities generating these benefits. It's essential to distinguish between the tangible project activities that yield carbon benefits (e.g., tree planting, forest conservation, clean cooking technologies, etc.) and the technical design aspect, involving the calculation, documentation, and certification of carbon benefits under specific standards. Additionally, there may be an overarching project aligned with broader objectives. This holistic perspective underscores that a carbon project encompasses more than just quantifying carbon benefits, requiring continuous consideration throughout design and feasibility assessments. Many aspects of the process involve articulating objectives, offering initial definitions of project activities, making preliminary determinations of project scale, area, and boundaries, and defining key project participants.

b. Draft Project Idea Note

A Project Idea Note (PIN) serves as a concise overview of a proposed project, commonly utilized to initiate discussions with governments, investors, and technical support. This summary provides a valuable opportunity for project proponents and stakeholders to reassess fundamental project assumptions, incorporating elements such as project objectives, activities, and participants. Additionally, the PIN emphasizes the importance of characterizing the baseline, offering a realistic depiction of what would occur without the project's intervention. For projects related to REDD (Reducing Emissions from Deforestation and Forest Degradation), it prompts a detailed exploration of land-use dynamics, distinguishing between degradation and deforestation processes. Proponents are encouraged to substantiate this scenario with historical data on degradation or deforestation trends, critically examining common perceptions and seeking objective evidence. Further guidance on baseline characterization can be found in REDD and AR (Afforestation and Reforestation) guidance documents.

Creating a Project Idea Note (PIN) should not create an assumption of guaranteed project feasibility for project proponents. A thorough and critical feasibility assessment must be conducted in the subsequent step before substantial resources are allocated or any definitive commitments with other parties are established. In cases where a PIN is presented to potential investors and government authorities prior to completing a feasibility analysis with positive outcomes, it is recommended to clearly communicate that feasibility assessment is still pending. It's important to highlight that many of the initial assessments undertaken during the PIN development can be repurposed for a more comprehensive feasibility analysis later in the project planning process.

c. Perform a comprehensive evaluation of project feasibility.

A feasibility assessment provides a chance to thoroughly examine the project and determine the genuine viability of utilizing carbon finance. Given this consideration, before proceeding with the subsequent phases of project design, it is crucial to undertake an initial evaluation of the project's potential. The feasibility assessment is not just a procedural stage in the project cycle; instead, it represents a pivotal decision point, offering an occasion to approach the project with an open-minded, critical, and thorough perspective. It is imperative to recognize during this process that a favorable outcome is not assured, and there might be a necessity to redesign or even abandon the project.

It is recommendable, whenever feasible, engaging an independent expert or entity for a (pre-) feasibility assessment. This not only brings in additional technical and market expertise but also offers a valuable external perspective. Many project proponents, especially those seeking finance for rural development or conservation goals in a specific area, often view their projects in the context of broader objectives. However, they may unintentionally overlook or underestimate certain requirements and constraints unique to each project. Introducing an "outside perspective" at this stage serves as a crucial "reality check" to evaluate the project's likely viability. When approached in this manner, the feasibility assessment becomes instrumental in early identification of non-viable projects, preventing the creation of unrealistic stakeholder expectations and unnecessary expenditure of substantial human, technical, political, and financial resources. On the flip side, a robust feasibility analysis can enhance the confidence of investors and stakeholders, thereby adding value for project proponents.

5.4.2 Project Design and Strategic Planning

After completing preliminary project design and feasibility analysis, project proponents can now advance to the concrete phases of project planning and design. This involves developing a Project Design Document (PDD) or Project Description (PD) for external validation, addressing technical, procedural, legal, financial, and stakeholder engagement aspects. Securing project finance and validation, critical for success, demands significant resources, time, and perseverance. Proponents must navigate challenges early on, emphasizing the importance of addressing the financial aspects of planning and design promptly.

a. Define a Target Market or Standard

Project proponents must determine the suitable standard and, consequently, the targeted market segment based on the project's attributes, anticipated carbon benefits, location, and compatibility with existing methodologies.

b. Ensure Effective Community Engagement

Engaging with the community is vital for the success of the project, a point underscored by both the CCB Standards and Verra. Firstly, local communities often inhabit areas targeted for carbon projects, and their involvement is essential for successful project implementation. Engaging communities helps in understanding and respecting their rights, needs, and concerns, contributing to social sustainability. Additionally, involving local residents ensures that the project aligns with the community's values and practices, minimizing potential conflicts and fostering a sense of ownership. Furthermore,

community support can enhance project credibility and acceptance, facilitating smoother interactions with regulatory authorities. The insights and knowledge of local communities are valuable in designing effective and culturally sensitive project interventions, ultimately leading to more sustainable and equitable outcomes. Overall, community engagement is integral to building trust, promoting social co-benefits, and ensuring the overall success and acceptance of carbon credit projects.

c. Plan for Project Design

The subsequent set of preparatory decisions and activities will assist in organizing the project design efforts.

- Establishing roles and responsibilities for the design and implementation of the project:

Projects usually engage various stakeholders with diverse roles, requiring a wide range of skills and expertise, such as technical proficiency, community development, rural enterprise development, legal knowledge, and business acumen. Different entities may contribute at various stages of the project, some focusing on design, while others remain involved throughout the project's lifespan. Clearly defining roles and responsibilities in the early stages enhances efficiency, minimizes confusion, and prevents conflicts. Ideally, these arrangements should be formalized through agreements and Memoranda of Understanding (MoUs).

- Reach consensus on the management and distribution of carbon revenues (benefit-sharing):

It is crucial to reach an agreement on how carbon revenues generated from project activities will be allocated and managed, commonly referred to as benefit-sharing in community-focused projects. Various partners, including landowners, project implementers, monitoring teams, and investors, may have legitimate claims on carbon revenues, raising legal questions regarding carbon rights. Regardless, carbon revenues play a vital role in implementing core project interventions, and stakeholders involved in specific activities should have a rightful share of revenues, even if they are not legal owners of forest carbon. Therefore, establishing a transparent and robust agreement on managing carbon revenues and other financial streams among all relevant stakeholders early in the process is essential. These agreements should ideally be formal and legally binding, considering the unique partnership and economic interests of the project.

d. Secure Project Development Finance and Structure Agreements

The project design and technical development phases of a carbon project require substantial resources, and while the conceptual and assessment phase can be completed with limited internal resources, advancing through development demands additional investment. The more developed the project, the lower the risks and the higher the expected value of carbon credits. Project proponents may opt for finance agreements early in the development process for various reasons, including securing startup capital, accessing technical expertise through partnerships, and mitigating market price risk in carbon markets. Financing alternatives encompass self-financing for well-resourced organizations, donor support from overseas development assistance or private donors, and forward finance from investors, buyers, or commercial project developers. Each financing option involves trade-offs, and negotiation of investment and purchase agreements can occur at different stages of

project development to secure working capital or support verification. Careful consideration of risks, costs, and commitments is essential throughout the financing process.

e. Preliminary Design of Project Activities

During the initial phases of project design, project proponents should outline general project activities. As the design progresses, these activities must be detailed, incorporating specific techniques, timelines, and resources. This detailed planning is crucial for assessing carbon benefits and preparing a Project Design Document (PDD). For community-based projects, participatory planning involving multiple stakeholders is essential to ensure comprehensive representation and broad engagement. Integration with baseline projections of deforestation and social impact assessments is recommended. The specific activities will vary based on the project type (e.g., afforestation, reforestation, agroforestry). Careful planning is emphasized, addressing drivers of land-use change and linking financial support to improved outcomes.

Project activities entail various costs, risks, and benefits for participants, influenced by the nature of the activities and participants' roles. Project design and budgeting should adopt a balanced approach to distributing payments and benefits at the community level. It is crucial to offset opportunity costs resulting from changes in land-use practices and address the needs of vulnerable and marginalized groups. Compensation mechanisms may involve a combination of individual or group payments and in-kind or public good investments.

f. Social and Biodiversity Impact Assessment

Projects seeking CCB certification necessitate thorough social and biodiversity impact assessments, surpassing local regulatory requirements for Environmental Impact Assessments (EIAs). The integration of social impact assessments early in the project design process offers numerous benefits, including enhanced project design, early identification and mitigation of potential negative impacts, the basis for designing effective incentives for local stakeholders, and improved market position and pricing. To align with CCB Standards, assessments should cover pre-project conditions, reference scenarios, projections, potential negative impacts, indicator identification, and a monitoring plan for project impacts. The Manual for Social Impact Assessment of Land-Based Carbon Projects provides guidance on developing a credible project theory of change, essential for effective carbon benefits delivery and identification of social and environmental impacts.

g. Assess Non-Permanence Risks and Develop Mitigation Strategies

Conducting a thorough risk assessment is crucial for sound project design, and under the VCS, it directly influences the quantity of carbon credits that project proponents are eligible to claim.

All carbon projects face the potential risks that could compromise their performance and the permanence of emission reduction and removals. Permanence, a critical concern for carbon projects, distinguishes them from any other activities or projects. Identifying risks early is essential for project development, reflected in the design of activities and risk mitigation strategies. Both CCB and VCS mandate risk assessments, with VCS using the AFOLU Non-Permanence Risk Tool. This tool determines a non-permanence risk buffer percentage, safeguarding against project failures or future reversals of carbon benefits. Risk discounts, based on project risks and management capacity, can be

as high as 60%. Risks are categorized into internal, natural, and external risks, with effective risk mitigation strategies mitigating buffer percentages. Buffer credits may be released based on ongoing project performance and risk assessments, ensuring the integrity of issued credits. In the CDM, this risk assessment is not formally required for AR projects, as permanence risk is addressed through temporary CER issuance.

h. Maintain Ongoing Liaison with Regulators

Maintaining consistent communication with government agencies and stakeholders is an ongoing and crucial aspect of project development. The responsibility for this communication should be clearly assigned among project participants. As regulatory frameworks for forest carbon projects continue to evolve in many countries, establishing and nurturing relationships with relevant government entities, particularly the Designated National Authority (DNA), becomes vital to mitigate potential risks and avoid delays in review and approval processes. This is particularly critical for REDD/REDD+ projects, given the evolving national strategies and policy frameworks. Proactively engaging with authorities, staying informed about changes in carbon standard-setting bodies, and closely following developments in methodologies and requirements are essential to navigate the evolving landscape of rules and regulations. Additionally, maintaining open dialogue with validators or verifiers is advisable to receive timely feedback on potential changes in standards and requirements.

5.4.3 Compilation of a Project Design Document

The Project Design Document (PDD) serves as the primary document containing essential information and analysis that outlines project features, quantifies carbon benefits, and presents a monitoring plan. It serves as the foundation for the independent validation and verification of the project's emission reductions or removals. In the context of the VCS, this document is referred to as the Project Description (PD), but for the purpose of this guidebook, the term PDD will be used as the general term.

a. Structure PDD Team

Developing a Project Design Document (PDD) can be challenging, especially for first-time project developers, given the complexity of methodologies under carbon credit certification program. Seeking specialized external input from consultants or commercial project developers with expertise in PDD development can be beneficial. While external support is valuable, project proponents should stay closely involved, understanding the PDD's content, data sources, and the monitoring plan. Balancing internal capacity development with external expertise is crucial for long-term project success, as completely outsourcing responsibilities may pose risks and lead to delays during validation and verification.

b. Choose a Methodology

For programs generating carbon credits, standardized methodologies are essential to quantify a project's environmental or social impacts and determine the issued carbon credits. These methodologies establish a baseline scenario, measure project outcomes, and assess potential leakage effects or unintended impacts. Various approved methodologies exist under different carbon credit standards, each with specific applicability criteria. The selection of a methodology has implications

for monitoring requirements, eligible project activities, and other crucial aspects of project design and implementation. Project developers should thoroughly assess which methodology suits their project context, considering the complexity and potential impact on project viability. Keeping abreast of available methodologies, updates, and new additions under relevant standards is crucial, as the selection process is influenced by technical, financial, and policy considerations. Expert advisory support is recommended to make an informed decision that accurately quantifies impacts and facilitates the generation of verifiable carbon credits or compliance units from the project.

c. Conduct PDD Analyses

Establishing credible and verifiable documentation is crucial at every stage, supporting statements and assumptions during validation and verification.

The key elements include:

- **Spatial Boundaries:** Clearly identifying project areas using remote-sensing and/or GPS technology, considering baseline reference areas and a leakage belt for REDD projects.
- **Land Eligibility:** Meeting eligibility criteria, with distinctions between CDM and VCS requirements for Afforestation and Reforestation (AR) projects.
- **Additionality:** Demonstrating that project activities are undertaken to generate carbon credits and revenues, following dedicated tools provided by CDM and VCS.
- **Starting Conditions, Baseline, and With-Project Scenarios:** Capturing conditions at project start, developing baseline scenarios, and estimating future carbon benefits, emphasizing the importance of robust justifications for barriers in the case of additionality.
- **Quantification of Emission Reductions or Removals:** The process involves projecting land use under the baseline scenario, determining the carbon volume associated with baseline land uses, and comparing it with the carbon volume under the project scenario. The exact volume of carbon credits generated depends on actual project performance, monitored, and verified by an independent auditor. Assumptions in these estimates should be robust, transparent, and credible, considering potential sub-optimal project performance, data uncertainties, and necessary discounts for leakage and non-permanence risks. This careful estimation is crucial for the credibility and success of the project.
- **Leakage:** Addressing inherent risks of leakage, whether in the form of activity-shifting or market leakage, with the requirement for careful consideration and quantification, if unavoidable.
- **Non-Permanence Risk Assessment:** The validation/verification body evaluates the risk assessment undertaken by the project proponent, scrutinizing data, rationales, assumptions, justifications, and documentation supporting the non-permanence risk rating. This process is crucial for ensuring the integrity of issued credits and managing the risks associated with potential reversals of carbon benefits.

d. Prepare the PDD

Compiling the Project Design Document (PDD) is considered a relatively straightforward process once all necessary analyses and planning exercises have been completed. The Gold Standard and Verra provide mandatory templates for PDDs, and developers are encouraged to study these standards, ensuring conformance to criteria and methodology applicability. Key guidelines for a smooth preparation and validation process include being clear, concise, and focused on essential information, avoiding unnecessary elaboration or inclusion of non-essential details. Developers should reference external documents for supplementary information, maintain organized evidence for key data and assumptions, and ensure consistency in arguments and dates throughout the document. Naming, organizing, sharing, storing, and backing up files should follow fixed rules for the entire PDD writing team. Reviewing examples of successfully validated PDDs from CDM, VCS, and CCB websites can be helpful, but developers should be cautious as acceptance may vary between projects and validators.

5.4.4 Evaluation of Project Activities and Formulation of Implementation Strategy

Reviewing project activities and developing a project implementation strategy involves a comprehensive assessment of planned activities and the formulation of a strategic plan for executing the project. This phase requires detailed planning, including specific techniques, timelines, and resource allocation. The goal is to ensure a well-designed, viable project that aligns with the chosen carbon standard and methodology.

a. Re-Assess Feasibility and Adjust Project Activities

Project design is a dynamic and iterative process that incorporates feedback from technical analyses, risk evaluations, legal considerations, and social and environmental impact assessments. It involves stakeholder consultations, regulatory interactions, and continuous refinement based on changing assumptions and new information. The finalization of calculations in the Project Design Document (PDD) is not the endpoint; rather, it prompts a reassessment of overall project viability. This reassessment allows for adjustments to project design and interventions, considering insights gained from analyses on factors like land-use change, leakage and permanence risks, and social impacts. The goal is to ensure that the project remains adaptive and aligned with its objectives.

b. Budgeting and Financial Projections

Solely relying on carbon revenue may not be adequate to meet all project costs. Additional income from various forest products or services is crucial.

Project proponents, armed with a detailed account of project activities and carbon benefit projections from the Project Design Document (PDD), can now refine financial projections and budgets. These financial plans should encompass both the concluding phases of project development and the long-term expenses associated with project implementation, monitoring, and verification. Key cost elements should be considered. While revenues from carbon credits may only materialize after several years of project implementation, financing structures must be established to bridge the gap until the issuance and sale of carbon credits. Financial projections should be comprehensive, incorporating

diverse revenue sources (e.g., timber sales in AR projects) and accounting for various costs, including those related to securing additional capital. Given that carbon revenues alone may not cover all project costs, the financial model should reflect unique project characteristics, revenue streams, financing arrangements, and organizational structure. Developing a robust financial model is crucial for engaging potential investors.

c. Defining Management Structure for Implementation

Project proponents and partners must establish clear roles, responsibilities, and management structures for project implementation, including identifying which tasks will be undertaken by different implementing entities. Depending on the project's scope and requirements, new entities such as partnerships, corporations, NGOs, or fiduciary trusts may need to be formed. Legal advice is recommended to navigate the complexities of organizational setup, considering various project activities, financial needs, objectives, and local regulations. For community-based projects, effective ongoing management often involves investing in governance and management capacity, focusing on areas such as organizational development, financial management, governance transparency, leadership accountability, representation of interest groups, rural education, and partnerships and networking opportunities.

5.4.5 Completion of Financing and Investment Arrangements

Securing investment for project implementation is a flexible process that can occur at various stages of project development, from the initial idea stage to after verification and credit issuance. Agreements for finance or sale may be established at different points, impacting risk discounts, carbon revenues, upfront finance, and expertise brought into project development. Different arrangements with buyers or investors can apply to different volumes of carbon credits generated in specific periods, influencing project dynamics and financing options.

Commercializing carbon credit involves defining advantageous financing arrangements and selecting suitable partners, which can be challenging due to geographical distance and evolving stakeholder priorities. Various types of entities may provide finance or revenue, including buyers, investors, brokers, and donors, each offering different roles and interests. Buyers may acquire offsets for regulatory or voluntary commitments, investors seek returns from financing, brokers facilitate transactions, and donors may fund core activities. Different commercialization models determine revenue timing, pricing, marketing costs, and buyer identification.

When it comes to arranging financial agreements, another critical factor to consider, project proponents should seek legal advice to address specific project needs and understand key aspects like risk, liability, and costs. Buyers' lawyers prioritize their clients' interests, so having legal representation can protect the project's interests. The most common agreement for commercializing carbon credits is the emissions reduction purchase agreement (ERPA), covering aspects such as credit delivery, risk allocation, default remedies, costs, reporting obligations, contract duration, and miscellaneous provisions.

5.4.6 Approvals, Validation, and Registration

Project proponents need to ensure that all essential documentation, permits, approvals, and agreements are secured as the project progresses beyond the initial design and development stages. This includes obtaining necessary approvals from the host country and completing the validation process, as well as obtaining any local or national permits unrelated to the carbon aspect of the project (such as taxes or operational permits). Failing to obtain these permits at both the carbon standard and national regulatory levels could hinder project implementation and pose significant investment risks. Additionally, internal contractual agreements related to financial management, revenue distribution, carbon rights transfer, and implementation roles must be finalized. While formal government approval may not be required for voluntary market standards, it can instill confidence in investors.

a. Host Country Approval

Ongoing communication with host country regulatory authorities is crucial for carbon projects, including voluntary ones. CDM projects necessitate a Letter of Approval (LoA) from the Designated National Authority to register and generate carbon credits, affirming compliance with sustainable development criteria. The process for obtaining this LoA varies by country and should be initiated early to prevent delays in revenue generation. While formal government approval isn't mandated for VCS or CCB Standards, government endorsement can enhance credibility for pre-compliance buyers and investors, mitigating regulatory risks and potential delays.

b. Stakeholder Consultation

Local stakeholder engagement is vital for the success of forest-based carbon projects and should commence early in project planning and continue throughout. Standards like the CDM mandate formal stakeholder consultation, ensuring local stakeholders understand and have an opportunity to comment on project activities. While the VCS encourages stakeholder consultation, it's integral to risk assessment and credit allocation. The CCB Standards emphasize stakeholder participation in project design, goal setting, and monitoring plan review. Even for projects not seeking CCB certification, these standards provide valuable guidance on inclusive, culturally appropriate consultation methods. Public comment periods during validation are required under the CDM and CCB Standards, facilitating transparency and accountability.

c. Validation

Validation is a critical step in the certification process of carbon projects, where an independent auditor reviews project documentation to ensure compliance with standards and methodologies. This process confirms the project's eligibility to generate carbon credits and its formal acceptance and registration under the chosen standard, such as the Gold Standard or the Verra program certification.

During validation, the auditor conducts desk reviews, site visits, and prepares a draft validation report, which may include requests for additional information or adjustments to project design. The project proponent is given an opportunity to address any identified issues before the final report is issued. This report is made publicly available on the respective registry website. The validation process is conducted by auditors accredited under the chosen standard, and project proponents are responsible for identifying, contracting, and paying the validator. Due to a potential shortage of accredited

validators, it's advisable to plan for validation well in advance. The Verra program provides detailed guidance on the validation process in its Program Guide.

To ensure a smooth validation process, project proponents should consider conducting a test run prior to the formal audit and consult relevant manuals and guidelines provided by the certification bodies. This proactive approach can help avoid delays and increase the chances of successful validation.

d. Registration

Registration is a pivotal step for forest-based carbon projects, indicating formal recognition of eligibility to generate credits under standards like Verra or the Gold Standard. Unlike the CDM, registration under Verra is streamlined, typically occurring when credit issuance is requested post-verification. Similarly, the Gold Standard requires documentation submission and a completeness check before registration. Both standards may charge fees for registry accounts, with potential considerations for charitable or small projects.

5.4.7 Project Implementation and Monitoring

Carbon credit project implementation involves executing the planned activities outlined in the project design document (PDD) to achieve emission reductions or removals.

a. Implementation

The implementation phase of a carbon credit project involves initiating activities such as tree planting, forest conservation, or improved land management. While these activities can start before validation, significant investment typically awaits validation to mitigate risks. Each project's implementation details are unique and depend on various local factors, project types, and scales. It's crucial to invest time and effort in designing, planning, and reviewing project activities at every stage. Implementation must adhere closely to the specifications outlined in the project design document (PDD), as verification will assess how well the project followed its original design.

b. Monitoring

Monitoring is a crucial step in realizing the value of carbon from a project, as it provides verifiable evidence of GHG benefits. Poor monitoring plans or implementation can lead to loss of carbon credit revenue. Project participants must adhere to the monitoring plan outlined in the PDD, which includes social and biodiversity impact monitoring for CCB-certified projects. Monitoring is an ongoing activity conducted by project participants or contractors and is essential for successful verification and credit issuance. Data must be thoroughly documented and presented to auditors during verification. Regular reassessment of the monitoring plan helps identify issues early, and some risks may require more frequent monitoring. Flexibility in monitoring plans is limited under the CDM, but VCS allows for some deviations if they do not impact quantification accuracy. Overall, accurate data, robust monitoring systems, and efficient management are vital for carbon credit issuance.

5.4.8 Verification, Credit Issuance, and Certification

Verification is a crucial step preceding the issuance of carbon credits, where an external auditor certifies the actual GHG benefits achieved and monitored by the project. This process is based on the

monitoring results collected by the project developer according to the validated monitoring plan outlined in the PDD.

Under both the Gold Standard and Verra (formerly VCS and CCB), the verification process involves several key steps:

- Submission of a monitoring report summarizing emission reductions based on monitored data.
- Site visit by the auditor to ensure adherence to the monitoring plan described in the PDD.
- Preparation of a draft verification report by the auditor, which may include requests for clarification or correction.
- Issuance of the final verification report and verification statement certifying the volume of carbon credits generated.

The timing of the first verification event is critical for project proponents, as it can impact project revenues and costs. Early verification can lead to early revenues but involves additional monitoring efforts and costs. The frequency of subsequent verifications varies depending on the certification program.

a. For the Gold Standard:

- Verification ensures compliance with the standard's criteria, with issuance requested through the Gold Standard Registry.
- Issuance is subject to an issuance fee based on the volume of credits issued.

b. For Verra:

- Verification leads to the issuance of Verified Carbon Units (VCUs) requested through an approved VCS Registry.
- Issuance is less complex compared to the CDM, with fees charged by the VCS Association and registry operators.

Both programs have specific procedures for verification, issuance, and fee structures, with the Gold Standard emphasizing sustainable development and Verra focusing on emissions reductions and removals. Additionally, ongoing monitoring and verification are essential to maintain certification and ensure the credibility of carbon credits.

5.4.9 Carbon Credit Sale and Market Integration

When successfully verified, the verifier will issue a verification report to the carbon program registry (e.g. Verra). The registry will then officially issue you a certain quantity of carbon credits, usually in "vintages" representing discrete Monitoring Reporting & Verification periods. With credits in hand, it's time to promote their sale. Develop marketing materials highlighting the project's impacts and benefits. Attend carbon conferences to network with potential buyers and brokers. List credits for sale on registries, exchanges, or work directly with brokers. Negotiate sale contracts with compliance or voluntary buyers. Clearly establish price, timing of transactions, credit retirement obligations. Once

sold, ensure credits are transferred properly and promptly retired by the buyer through the registry to validate use. For ongoing projects, repeat the verification and crediting process periodically to produce new vintages for continued sale. Strive for steady relationships with repeat buyers over time.

Larger projects may integrate into emerging global carbon programs to access bigger markets. Continual improvement helps increase sales and optimize the project's carbon impact over its full crediting life. With dedication and strategy, carbon credit sales can provide long term revenue for emission reduction activities.

5.5 Implications and Insights

Interpretation of the findings and discussion of their implications for policy and practice are crucial aspects of research that help in understanding the significance of the results and how they can be applied in real-world scenarios. In the context of investigating the potential of carbon market finance to support green innovation and entrepreneurship in West Africa, particularly in Benin Republic, the interpretation of the findings and their implications will provide valuable insights for policymakers, investors, and entrepreneurs.

The research underscores the significant potential for utilizing carbon market finance to foster green innovation and entrepreneurship in West Africa, particularly in Benin Republic. It emphasizes the importance of comprehending global carbon market mechanisms, including carbon pricing strategies, to facilitate the transition towards a low-carbon economy. Additionally, the study highlights the pivotal role of youth opportunities, green innovation, and entrepreneurship in driving sustainable development in the region. Furthermore, the findings shed light on the process of implementing carbon credit projects as a vital step towards promoting sustainable practices among young West African green entrepreneurs and innovators. The research underscores the implications of integrating non-market environmental values, such as carbon sequestration, into decision-making processes for sustainable forest management, stressing the necessity of considering both market and non-market values in policy development.

The implications of these findings for policy and practice are multifaceted. Firstly, policymakers in Benin Republic and other West African nations can utilize the insights from this research to craft and implement effective policies that foster green innovation and entrepreneurship through carbon market finance. By integrating carbon pricing mechanisms and supporting the development of carbon credit projects, governments can create an enabling environment for sustainable business practices. Moreover, investors can leverage the opportunities presented by carbon market finance to support green initiatives in the region. By investing in projects focused on reducing carbon emissions and promoting environmental sustainability, investors can contribute to mitigating climate change while also yielding financial returns in the long term. For entrepreneurs, the research provides valuable guidance on navigating the complexities of the carbon market industry and capitalizing on emerging opportunities in green innovation. By understanding the mechanisms of carbon pricing and the process of implementing carbon credit projects, entrepreneurs can develop sustainable business models aligned with global environmental goals.

CHAPTER SIX

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The research study titled "Investigating the Potential of Carbon Market Finance to Support Green Innovation and Entrepreneurship in West Africa: Case Study of Benin Republic" aims to address the challenges and opportunities in financing sustainable initiatives in the region. With a growing emphasis on combating climate change and promoting sustainable development, there is a need to explore how carbon market finance can be leveraged to support green innovation and entrepreneurship in West Africa. The study focuses on understanding the mechanisms and scope of global carbon markets, assessing the financial potential of carbon markets for green initiatives, identifying key sectors for carbon credit generation, and analysing the process of implementing carbon credit projects. By examining these aspects, the research seeks to provide insights that can guide policymakers, investors, and entrepreneurs in harnessing the potential of carbon market finance to drive sustainable practices and economic growth in Benin Republic and beyond. Through a comprehensive analysis of the role of carbon market finance in supporting green innovation and entrepreneurship, this research aims to contribute to the development of practical tools and strategies that can help youth innovators and entrepreneurs tap into the opportunities presented by carbon markets. By bridging the gap between environmental sustainability and economic viability, the study aims to pave the way for a more sustainable and resilient future for West Africa, particularly in Benin Republic.

In brief, this research has made significant contributions to understanding the potential of carbon market finance as a catalyst for supporting green innovation and entrepreneurship in West Africa, with a specific focus on Benin Republic. By examining the mechanisms and scope of global carbon markets, assessing their financial potential, identifying key sectors for carbon credit generation, and analyzing the process of implementing carbon credit projects, this study has provided valuable insights for policymakers, investors, and entrepreneurs in the region. The findings underscore the importance of leveraging carbon market finance to drive sustainable development, combat climate change, and foster green entrepreneurship. By integrating these insights into policy development and business strategies, stakeholders can create a more environmentally conscious economy that promotes innovation and long-term sustainability in West Africa.

Overall, this research sets the stage for further exploration and action in harnessing the power of carbon market finance to support green initiatives, ultimately contributing to the region's sustainable development goals and the global fight against climate change.

6.2 Recommendations

As we conclude our exploration into the potential of carbon market finance to support green innovation and entrepreneurship in West Africa, particularly in Benin Republic, it is imperative to translate our findings into actionable recommendations. Building upon the insights gleaned from our research, these recommendations aim to offer practical guidance for policymakers, investors, and entrepreneurs alike, facilitating the effective utilization of carbon market finance to drive sustainable development in the region.

Several actionable recommendations emerge from our research findings including:

6.2.1 Policymakers:

- ❖ Develop and implement supportive policies that incentivize green innovation and entrepreneurship through carbon market finance. This can include providing tax incentives, subsidies, and regulatory frameworks that encourage investment in sustainable projects.
- ❖ Establish clear guidelines and standards for carbon credit projects to ensure transparency, accountability, and environmental integrity in the market.
- ❖ Collaborate with international organizations and stakeholders to access funding and technical assistance for capacity building in carbon market finance.

6.2.2 Investors:

- ❖ Allocate funds towards green innovation and entrepreneurship projects that have a positive impact on reducing carbon emissions and promoting environmental sustainability.
- ❖ Conduct thorough due diligence on potential investments in carbon credit projects to assess risks, returns, and environmental benefits.
- ❖ Explore partnerships with local organizations and entrepreneurs to co-finance green initiatives and leverage expertise in the field.

6.2.3 Entrepreneurs:

- ❖ Seek training and capacity building opportunities to enhance knowledge and skills in developing and implementing carbon credit projects.
- ❖ Collaborate with local communities and stakeholders to ensure social and environmental sustainability in green projects.
- ❖ Utilize innovative financing mechanisms, such as crowdfunding and impact investing, to access capital for green entrepreneurship ventures.

6.2.4 Collaboration and Knowledge Sharing:

- ❖ Foster collaboration between policymakers, investors, and entrepreneurs to create a supportive ecosystem for green innovation and entrepreneurship.
- ❖ Share best practices, lessons learned, and success stories in leveraging carbon market finance to inspire and guide others in the field.
- ❖ Engage in dialogue with relevant stakeholders to address challenges and explore opportunities for scaling up green initiatives in the region.

By implementing these recommendations, policymakers, investors, and entrepreneurs can collectively harness the potential of carbon market finance to drive sustainable development, promote green innovation, and foster entrepreneurship in West Africa, with a specific focus on Benin Republic. This collaborative effort can lead to a more resilient and environmentally conscious economy that benefits both present and future generations.

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APPENDIXES

Appendix 1: