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Carbon Credit: A Tool for Reducing Global Greenhouse Gas Emissions

Dr. M.K. Singh

Associate Prof. Botany, K. S. Saket P. G. College Ayodhya, U.P.
Email. *manishsinghsaket1@gmail.com*

ABSTRACT

Carbon credits are a clever market-based tool aimed at cutting down global greenhouse gas emissions. They allow individuals, companies, and governments to balance out their carbon footprints by investing in environmental projects that either reduce or eliminate emissions altogether. This idea first popped up in the late 1980s and really took off with the launch of the Clean Development Mechanism (CDM) under the Kyoto Protocol. This mechanism gave developed countries a way to meet their emission reduction goals by funding projects in developing nations. (1,2). As concerns about climate change intensify, carbon credits have become a crucial component of national and international strategies aimed at achieving sustainability and net-zero emissions goals. The carbon credit market is characterized by a dual structure comprising compliance markets, which are regulated by government entities, and voluntary markets that allow participants to engage in carbon offsetting without regulatory obligations. While these mechanisms provide significant environmental benefits, including support for renewable energy, reforestation, and community development initiatives, they are not without controversy. Criticism has emerged regarding the integrity and effectiveness of various carbon offset projects, with reports of human rights abuses and environmental injustices associated with certain initiatives (3,4).

Carbon credits enable countries and corporations to trade allowances that represent the right to emit a certain quantity of GHGs, thus creating financial incentives for emissions reductions. The significance of carbon credits lies in their potential to support the transition to a low-carbon economy while driving innovation in sustainable practices and technologies (5,6). Historically, the framework for carbon credits was established in the late 1990s with the Kyoto Protocol, which mandated specific emission reduction targets for developed countries. This cap-and-trade system allowed nations to buy and sell allowances, thereby promoting cost-effective ways to meet their targets. The Paris Agreement further advanced this concept by encouraging countries to set their own national contributions to emissions reductions and fostering mechanisms for international cooperation and trading of carbon credits (7,8). Today, carbon credits are utilized in both compliance and voluntary markets, addressing emissions from sectors such as electricity generation, transportation, and agriculture (9).

KEYWORDS- Carbon credit, Greenhouse gas emissions, tCO_2e

INTRODUCTION

Carbon credits, or carbon offsets, refer to carbon emissions reductions or removals, measured in tonnes of carbon dioxide equivalent (tCO_2e). The concept of carbon credit, introduced in the Kyoto Protocol, 1997 and reinforced by the Paris Agreement, 2015 aims to reduce greenhouse gases (GHG) emissions through carbon trading. Each carbon credit permits the emission of one tonne of CO_2 or its equivalent. These credits are generated by projects that absorb or reduce carbon emissions and are certified by international bodies like the Verified Carbon Standard (VCS) and the Gold Standard.

The concept of carbon offsetting emerged in the late 1980s, when policymakers began to address climate change mitigation seriously. At first, carbon crediting initiatives were founded on voluntary agreements; nevertheless, the concept developed into an essential instrument for executing market mechanisms aimed at regulating greenhouse gas (GHG) emissions, which encompasses emissions trading systems. (10). The initial and most crucial carbon crediting initiative was the Clean Development Mechanism (CDM), which was established under the Kyoto Protocol. This mechanism enabled developed nations to fulfill their emission reduction commitments by investing in mitigation projects located in developing countries (11). As the carbon market evolved, a variety of crediting programs emerged, catering to both compliance and voluntary purchasers. These programs, which encompass governmental bodies and independent non-governmental organizations (NGOs), formulated their own standards and criteria for carbon credits, thereby ensuring quality and integrity throughout the issuance process (10). The dynamics of carbon credit markets depend on the equilibrium between the supply generated by emission reduction initiatives such as renewable energy and reforestation, and the demand from regulated entities or voluntary purchasers (11). Despite the well-meaning objectives behind these initiatives, the execution of carbon offset projects has encountered criticism. Reports detailing human rights violations, particularly in prominent offset projects like the Kasigau Corridor REDD+ project in Kenya and the Southern Cardamom REDD+ project in Cambodia, have raised alarms regarding the social and environmental repercussions of such projects. In these cases, local communities have experienced systemic harassment and evictions associated with carbon offset schemes, underscoring the necessity for thorough consideration of the social ramifications alongside climate objectives (12).

Furthermore, the efficacy of carbon markets has sparked considerable discussion, particularly in relation to environmental justice. Although foundational environmental legislation, such as the Clean Air Act, was designed to reduce pollution across all communities, there are assertions that modern carbon trading initiatives have unintentionally sustained environmental racism, disproportionately affecting communities of colour (13). This ongoing dialogue highlights the intricate challenges associated with employing carbon credits as a strategy for diminishing global greenhouse gas emissions, as well as the necessity for comprehensive frameworks that emphasize both environmental and social equity.

The Carbon Credit Trading Scheme (CCTS) in India functions as a strategy aimed at reducing greenhouse gas (GHG) emissions through the application of carbon pricing. This scheme consists of two primary elements: a compliance mechanism for obligated entities, mainly within industrial sectors, and an offset mechanism that permits voluntary participation. Carbon credits were created as a means to reduce greenhouse gas emissions. Companies receive a specified number of credits that decrease over time. Any excess credits can be traded with other companies. The availability of carbon credits offers a financial motivation for companies to decrease their carbon emissions. Projects initiated by South Pole are certified in accordance with ICROA-approved carbon certification standards, which involve stringent multi-step verification processes that projects must complete to secure carbon credits. This procedure ensures that the project and the associated emission reductions are authentic, sustainable, and additional.

At the start of a project, we make some initial estimates, which we call ex-ante. However, carbon credits can only be issued after we've actually seen the emissions reductions happen—this is known as ex-post. This approach ensures we're being precise. As a result, projects need to be monitored continuously throughout their lifespan. The length of these monitoring periods can differ, but they have to stick to certain limits. The data gathered during this monitoring phase gets put together into reports that are sent to the relevant standards. These reports are then validated and verified by external bodies, known as VVBs, and undergo a thorough review by the carbon standard auditor. Once everything checks out, the information is made available on a public registry to promote transparency. To further enhance transparency and avoid double counting, once they're certified, carbon credits are issued, transferred, and permanently retired, each with unique serial numbers in publicly accessible emission registries. There are numerous checks and balances at every step of the carbon credit issuance process, and the carbon certification standards are always evaluating and improving their methods as new technologies and best practices come to light.

History

The concept of carbon credits emerged as a significant mechanism in the global effort to combat climate change, primarily through international agreements aimed at reducing greenhouse gas (GHG) emissions. The origins of carbon credits can be traced back to the Kyoto Protocol, an international treaty established in 1997 and enacted in 2005, which was designed to commit 192 countries to specific targets for reducing GHG emissions that contribute to global warming (14).

The Kyoto Protocol

The Kyoto Protocol represented a groundbreaking approach to addressing climate change by instituting legally binding commitments for developed countries, referred to as Annex I countries, to reduce their emissions of greenhouse gases. The treaty set a collective target of cutting emissions by 5% below 1990 levels during the commitment period of 2008-2012 (15). Under the Protocol, each country was assigned a specific number of allowances known as Assigned Amount Units (AAUs), which represented the maximum amount of emissions they could legally emit. Countries that exceeded their emissions targets had the option to purchase surplus allowances from those who managed to reduce their emissions below their assigned limits, thus establishing a cap-and-trade system at an international level (16).

The Paris Agreement

Following the Kyoto Protocol, the Paris Agreement, adopted in 2015, marked a significant evolution in international climate policy. The agreement, which brought together over 180 countries, aimed to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with an aspiration to limit the increase to 1.5 °C. A critical aspect of the Paris Agreement was its flexible framework, which allowed countries to set their own nationally determined contributions (NDCs) towards emission reductions. This agreement also incorporated mechanisms for voluntary cooperation, as outlined in Article 6, enabling countries to trade carbon credits to meet their climate goals (17).

Implementation of Carbon Credit Systems

As carbon credit systems developed, they began to encompass both compliance markets, driven by government mandates and regulations, and voluntary carbon markets, where businesses and individuals could purchase credits to offset their emissions. The establishment of such markets was aimed at creating financial incentives for emissions reductions, fostering innovation in low-carbon technologies, and ultimately contributing to the overall goal of achieving net-zero emissions by the mid-21st century. Various initiatives have emerged to facilitate the functioning of carbon credit markets, including project-based methodologies for quantifying emissions reductions from specific activities, such as forestry, renewable energy, and methane capture projects. These methodologies are critical for verifying the authenticity and efficacy of carbon credits, ensuring that they represent real and measurable reductions in atmospheric carbon concentrations. Through these international frameworks and market mechanisms, carbon credits have become a vital tool in the ongoing global effort to mitigate climate change and support the transition to a sustainable low-carbon economy. (18)

Types of Carbon Credits

Carbon credits can be categorized into several distinct types based on their sources, methodologies, and the contexts in which they are utilized.

Based on Project Type

Blue Carbon

Blue Carbon credits are generated from coastal and marine ecosystems, such as mangroves, salt marshes, and seagrasses. These ecosystems play a crucial role in sequestering carbon and mitigating climate change while also providing additional benefits like biodiversity support and coastal protection.

Green Carbon

Green Carbon credits are derived from terrestrial ecosystems, primarily forests and grasslands. These credits are generated through projects that promote reforestation, afforestation, and sustainable land management practices aimed at enhancing carbon storage in biomass and soils.

Yellow Carbon

Yellow Carbon credits are linked to agricultural practices that enhance soil carbon storage. They are generated from initiatives that improve soil health and management, leading to increased carbon sequestration in agricultural lands (19).

Types of Carbon Credit Mechanisms

Cap and Trade Systems

Cap and trade systems are some of the most well-known Carbon Credit Mechanisms out there. In these setups, a regulatory authority establishes a total limit, or 'cap', on the greenhouse gases that can be emitted in a particular area or industry. This cap is then broken down into tradable units called carbon credits, with each credit usually allowing for the emission of one tonne of CO_2 equivalent. Companies that manage to emit less than their allotted credits can sell their extra credits to those that go over their limits, creating a market for carbon credits. The way a cap-and-trade system is structured encourages businesses to cut their emissions faster than the cap requires, as they can make a profit by selling any surplus credits. As the cap tightens over time, overall emissions in the sector decrease, helping to foster a gradual shift towards a lower-carbon economy. (18).

Carbon Offsets

Carbon offsets are closely tied to carbon credits, acting as a way to balance out emissions. They come into play when a project or initiative is funded that leads to a decrease or elimination of greenhouse gas emissions in another area. For instance, putting money into reforestation or renewable energy projects can create carbon offsets, which businesses can then use to offset their own emissions. These offsets can be traded on voluntary carbon markets, giving companies another tool to help manage their carbon footprint. The main difference between carbon credits and carbon offsets is their function: carbon credits are a unit of measurement that limits emissions, while carbon offsets are a way to compensate for investments in projects that reduce emissions (20).

Mechanisms of Carbon Credit Systems

Fundamentals of Carbon Credit Mechanisms

Carbon Credit Mechanisms are essentially market-driven tools that encourage the reduction of greenhouse gas emissions by putting a price tag on every tonne of CO_2 or its equivalent that gets cut down or taken out of the atmosphere. The goal here is to create a financial motivation for businesses and organizations to lessen their environmental footprint, helping to meet global climate objectives by making those who pollute pay for their emissions while rewarding those who manage to cut back. The effectiveness of these mechanisms hinges on solid methodologies for calculating emission reductions and thorough verification processes. Methodologies are the set rules and procedures used to measure the emission reductions a project achieves compared to a baseline scenario. Verification, carried out by independent third parties, ensures that the reductions claimed are genuine, measurable, and additional, which helps to foster trust and credibility in the system. (21).

Implementation Challenges

While Carbon Credit Mechanisms hold great promise for cutting down emissions, they come with their fair share of challenges. Critics point out that cap-and-trade systems can sometimes lead to an overabundance of carbon credit trading, which could weaken their overall impact if the caps are too relaxed. Plus, the intricate process of verifying and maintaining the integrity of these carbon credits can create significant obstacles. To tackle these issues, it's crucial for those involved in cap-and-trade systems to get a good grasp of the specific regulations and reporting requirements tied to their programs. This understanding will not only help them comply with verification processes but also boost the overall effectiveness of carbon credit systems. (8, 9)

Impact on Global Greenhouse Gas Emissions

Overview of Greenhouse Gas Emissions Trends

In recent years, global greenhouse gas emissions have exhibited notable fluctuations, particularly in the wake of the COVID-19 pandemic. Following a significant decline in 2020 due to reduced economic activity, emissions rebounded in 2021 and 2022, primarily driven by an increase in carbon dioxide (CO_2) emissions from fossil fuel combustion as economies recovered. In 2022, CO_2 emissions rose by 8% compared to 2020 and by 1% relative to 2021, with natural gas consumption contributing significantly to this increase, despite a decrease in emissions from coal consumption by 6%. Overall, U.S. greenhouse gas emissions increased by 0.2% in 2022 compared to the previous year, reflecting ongoing economic recovery efforts (22).

Sectoral Contributions to Greenhouse Gas Emissions

Understanding the sectoral contributions to greenhouse gas emissions is crucial for identifying effective mitigation strategies. Globally, electricity and heat production emerge as the largest contributors to emissions, followed by sectors such as transport, manufacturing, construction, and agriculture. In the United States, however, the transportation sector accounts for a more significant portion of emissions compared to the global average, highlighting regional variations in emission sources (23)

Role of Carbon Credits

Carbon credit systems have been introduced as market-driven solutions designed to cut down on greenhouse gas emissions. These initiatives enable the trading of credits, which act as permits allowing a specific amount of greenhouse gases to be emitted. In theory, they encourage emission reductions by letting organizations that manage to lower their emissions below a designated limit sell their surplus allowances to those who are over the cap. However, there are growing concerns about how effective these programs really are, especially when it comes to the actual reductions in emissions that they achieve.

Efficacy of Carbon Credit Projects

Recent studies indicate that many climate mitigation projects associated with carbon credits may not deliver the anticipated reductions in emissions. For instance, a meta-study revealed that less than 16% of carbon credits issued corresponded to actual emission reductions, with certain projects, like clean cookstove initiatives, achieving as little as 11% of their claimed reductions (25). This discrepancy raises concerns about the integrity and reliability of carbon credit markets, emphasizing the need for rigorous monitoring and verification processes to ensure that claimed reductions are genuinely realized (26).

Challenges and Risks

While carbon credits can play a role in mitigating emissions, they are not without challenges. Projects designed to avoid greenhouse gas emissions or enhance removals may inadvertently cause local harm, such as displacement of communities or environmental degradation (26). Therefore, it is vital for carbon credit projects to not only focus on emissions reductions but also consider their broader social and environmental impacts.

Criticisms and Challenges

Carbon credits have been a pivotal mechanism in global efforts to mitigate greenhouse gas emissions; however, they have faced significant criticisms and challenges that raise questions about their effectiveness and integrity.

Adverse Impacts on Local Communities

One of the major criticisms of carbon crediting projects is their potential adverse impact on local communities. Reports indicate that these projects can exacerbate existing environmental issues rather than alleviate them, leading to a situation where the intended benefits of carbon reduction are overshadowed by negative consequences for local populations (27). Such outcomes highlight the need for thorough assessments of the social implications of carbon projects.

Misuse and Greenwashing

Critics argue that carbon credits can enable a form of "greenwashing," wherein companies are allowed to continue polluting while purchasing credits to offset their emissions. This practice creates a perception that they are actively combating climate change, potentially leading to complacency regarding the need for direct emissions reductions (28). Furthermore, there are concerns that carbon credits may not provide a long-term solution to climate change, as they could lock in high-carbon infrastructure rather than promote the necessary transition to sustainable practices.

Regulatory Framework and Implementation Challenges

The world of carbon credits is a bit of a maze it's complicated and often lacks consistency. Take Article 6 of the Paris Agreement, for example; it's designed to improve the quality and trustworthiness of carbon credits by setting up systems for validation, verification, and the exchange of mitigation outcomes between countries. But, as you might expect, putting these articles into action hasn't been smooth sailing. There have been delays and disagreements among nations, highlighting the bigger struggle of getting international climate policies to mesh with what's happening on the ground locally. These governance challenges can create holes in accountability and transparency, which might ultimately undermine trust in carbon markets. (29).

Proposed Reforms and Solutions

Strengthening Carbon Credit Standards

To enhance the credibility and effectiveness of carbon credit systems, it is essential to establish and refine robust governance frameworks within carbon crediting programs. Effective governance includes ensuring transparency, accountability, and continuous improvement, thereby fostering trust among stakeholders and potential buyers of carbon credits (30). The development of clear criteria for what constitutes a 'high-integrity' carbon credit is paramount and involves collaboration among various actors in the market. Benchmark setters and certification standards play crucial roles in this process by providing guidelines based on scientific research and best practices, ensuring that carbon projects meet stringent criteria for quality and sustainability (31).

Addressing Methodology and Additionality Concerns

A key reform we really need is a standardized way to evaluate additionality. This concept is all about making sure that the carbon emissions reductions or removals from a project wouldn't have happened if the project hadn't been put into action. By introducing clear eligibility criteria, we can cut down on the subjectivity and the administrative hassle that comes with evaluating each project individually. This method will help guarantee that only those projects that truly provide extra carbon benefits are eligible for crediting, ultimately boosting the overall integrity of the carbon market. (26).

Monitoring and Verification Protocols

To ensure accurate reporting and avoid exaggerating carbon credits, we need strong monitoring and verification protocols. Crediting programs should adopt thorough verification processes, including independent audits of project data, to confirm that the reported emissions reductions are both credible and well-supported. This approach not only safeguards the integrity of the carbon market but also builds trust among buyers who want to be sure their investments are truly contributing to the reduction of greenhouse gas emissions. (26).

Community Involvement and Benefits

Integrating local community stakeholders into the decision-making processes of carbon projects is vital for their long-term success and sustainability. Programs like REDD+ demonstrate the benefits of engaging local communities, allowing them to direct how carbon revenues are utilized to support their development needs, such as education and healthcare (32). This participatory approach aligns local economic interests with environmental goals, thereby enhancing project effectiveness and community buy-in.

Gradual Transition to Durable Removals

A phased transition from temporary to more durable carbon removal solutions is recommended, aligned with the advancement of removal technologies by 2050. This strategy allows for immediate action in protecting and enhancing natural carbon stocks while simultaneously encouraging investments in long-term carbon removal solutions (33). Such flexibility is essential to respond to the urgency of climate change while ensuring the sustainable management of natural resources.

Technological Innovations

Technological advancements, particularly in monitoring and verification, are set to enhance the transparency and effectiveness of carbon credit mechanisms. Innovations such as blockchain technology and improved Monitoring, Reporting, and Verification (MRV) systems can facilitate accurate tracking of emissions reductions, ensuring that projects deliver on their promises. Furthermore, satellite monitoring technologies can provide real-time data for forest carbon projects, thereby enhancing the credibility of the credits generated (21). These advancements are essential for addressing existing criticisms and improving the overall impact of carbon credits on global emissions.

CONCLUSION

The idea of carbon credits has become a crucial market-driven tool in the fight against the growing issue of global greenhouse gas (GHG) emissions. By assigning a monetary value to carbon reductions, this system encourages industries, governments, and communities to embrace cleaner technologies, enhance energy efficiency, and invest in renewable energy initiatives. The findings compiled in this review suggest that carbon credit programs, whether they operate through compliance markets under international agreements like the Kyoto Protocol and Paris Agreement, or through voluntary markets-have made a significant impact on lowering net emissions and promoting sustainable development. That said, the effectiveness of carbon credits in addressing climate change does have its drawbacks. Issues like market fluctuations, double counting, insufficient verification processes, and the potential for "carbon leakage" can compromise the environmental credibility of these initiatives. Additionally, while carbon credits can help achieve cost-effective emission reductions, they shouldn't be viewed as a replacement for direct, substantial decarbonization efforts in high-emission sectors. The long-term success of carbon credit systems hinges on enhancing transparency, ensuring thorough monitoring, and reporting, and aligning credit issuance with scientifically sound emission reduction strategies. On a global scale, carbon credits can serve as a link between urgent climate action and the larger shift towards net-zero emissions. They create opportunities for international collaboration, technology sharing, and climate financing, especially benefiting developing countries with significant carbon sequestration capabilities. As the effects of climate change become more severe, incorporating carbon credits into a comprehensive climate policy framework-backed by strict standards, fair participation, and ongoing innovation-will be vital for maximizing their positive effects. Ultimately, carbon credits, when designed and implemented with environmental integrity and social fairness, can serve as a catalyst for both mitigating GHG emissions and advancing the world toward a more sustainable, climate-resilient future.

REFRENCES

1) https://offsetguide.org/what-are-carbon-crediting-programs/

2) https://aquila.is/knowledge-hub-article/global-carbon-credit-markets-opportunities-and-challenges/

3) https://offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/protocols-standards/

4) https://www.somo.nl/carbon-offsets-often-disenfranchise-communities/

5) https://eos.com/blog/carbon-credits/

6) https://carboncreditcapital.com/carbon-credits-global-commitments-kyoto-paris/

7) https://offsetguide.org/what-are-carbon-crediting-programs/

8) https://www.investopedia.com/terms/c/carbon_credit.asp

9) https://ecocart.io/how-to-get-paid-for-carbon-credits/

10) https://offsetguide.org/what-are-carbon-crediting-programs/

11) https://aquila.is/knowledge-hub-article/global-carbon-credit-markets-opportunities-and-challenges/

12) https://offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/protocols-standards/

13) https://www.somo.nl/carbon-offsets-often-disenfranchise-communities/

14) https://climateseed.com/blog/understanding-carbon-credits

15) https://carboncreditcapital.com/carbon-credits-global-commitments-kyoto-paris/

16) https://www.investopedia.com/terms/c/carbon_credit.asp

17) https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism

18) https://terrapass.com/blog/carbon-finance-systems-what-is-involved-and-how-can-you-participate/

19) https://www.sylvera.com/blog/carbon-credit-project-types

20) https://extension.psu.edu/understanding-carbon-credits-and-offsets

21) https://pollution.sustainability-directory.com/term/carbon-credit-mechanisms/

22) https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

23) https://ourworldindata.org/emissions-by-sector

24) https://www.theguardian.com/environment/2023/sep/19/do-carbon-credit-reduce-emissions-greenhouse-gases

25) https://www.mpg.de/23737687/climate-impact-of-carbon-crediting-projects-substantially-overestimated

26) https://offsetguide.org/what-makes-high-quality-carbon-credits/

27) https://offsetguide.org/what-are-common-criticisms-about-carbon-credits/

28) https://corpgov.law.harvard.edu/2024/12/05/carbon-credits-an-overview-of-a-climate-controversy/

29) https://insights.issgovernance.com/posts/carbon-credits-an-overview-of-a-climate-controversy/

30) https://icvcm.org/es/los-principios-fundamentales-del-carbono/

31) https://www.southpole.com/blog/the-evolving-definition-of-integrity-in-the-carbon-market

32) https://www.conservation.org/projects/chyulu-hills-carbon-project

33) https://sciencebasedtargets.org/blog/deep-dive-the-role-of-carbon-credits-in-sbti-corporate-net-zero-standard-v2