Integrating policy and Practice in Carbon Credit Accounting: Evidence from India

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Abstract

Mitigation of climate change has become a global priority, and carbon credit accounting is essential to helping countries and businesses quantify, control, and offset greenhouse gas (GHG) emissions. An important step towards institutionalising carbon accounting as a component of India's low-carbon transition strategy has been taken with the launch of the Carbon Credit Trading Scheme (CCTS) and related policy frameworks. The regulatory environment, methods, sectoral applications, and implementation challenges of carbon credit accounting in India are all thoroughly examined in this study. With a focus on sector-specific intensity targets required for energy-intensive industries, the paper describes the standards and protocols for measuring, reporting, and verifying (MRV) emissions. Opportunities for the creation of carbon credits in industries like waste management, forestry, renewable energy, and green hydrogen are highlighted by the analysis of both compliance and voluntary markets. Limited MRV capacity, disparities in data quality, inadequate digital infrastructure, and low initial market liquidity are among the difficulties noted. In order to prevent regulatory overlap, the study also discusses the necessity of harmonising current environmental certificate programs with carbon credit frameworks. In addition, the study highlights how incorporating carbon credit accounting into corporate governance can improve sustainability reporting, control regulatory risks, and open up green finance options, among other strategic and financial ramifications. In order to situate India's framework within the larger global carbon market landscape, comparative insights from other emerging economies are provided. The study ends by suggesting ways to improve India's carbon credit accounting system, such as growing networks of verifiers, implementing cutting-edge digital platforms for transparency,

and gradually pursuing absolute emission caps after 2030. The goal of these suggestions is to facilitate strong, reliable, and expandable carbon accounting procedures that support India's climate pledges and help it reach its net-zero emission goals.

Keywords: Carbon Credit, MRV, CCTS, Net-Zero Emission, Renewable Energy.

Introduction

The long-term change in typical weather patterns brought on mainly by higher atmospheric concentrations of greenhouse gases (GHGs), such as carbon dioxide (CO2), is known as global climate change. In addition to having detrimental effects on ecosystems, weather extremes, and human health, these gases trap heat, causing global warming. As of 2025, atmospheric CO2 levels are still at an all-time high, adding to a warming trend that is fraught with dangers and unknowns. Climate change is now a daily reality that impacts business, society, and policy worldwide rather than being a remote threat. International collaboration and national commitments are essential to halting warming and achieving the global goal of keeping temperature increases well below 2°C, ideally 1.5°C above pre-industrial levels.

By giving the right to emit one tonne of CO2 equivalent a tradable value, carbon credits are a market-based mechanism that encourages emission reductions. They operate in voluntary offset markets or cap-and-trade schemes, giving nations and businesses the flexibility and financial means to meet emission targets. Entities can make up for any emissions they are unable to immediately eliminate by purchasing credits from verified emission reduction projects, such as waste management, forestry, or renewable energy. As the overall quantity of credits decreases over time, innovation and investments in greener technologies are stimulated. Through stringent measurement, reporting, and verification (MRV) procedures, carbon credits also encourage accountability and transparency.

Extreme heat events, floods, and economic effects are among the increasing climate risks that India, the world's third-largest GHG emitter, faces. It has committed to achieving net-zero carbon emissions by 2070 and is a signatory to the Paris Agreement. India’s pathway includes ambitious goals under the "Panchamrit" action plan: reaching 500 GW of non-fossil energy capacity and meeting 50% of energy demand through renewables by 2030; cutting CO2 emissions by 1 billion tonnes; and reducing carbon intensity of its GDP by 45% from 2005 levels by 2030. Strong carbon accounting frameworks are necessary to measure, report, and validate emissions for both regulated and voluntary markets in an accurate manner. In addition to luring green investments, carbon credit schemes will help Indian industries conform to global and national climate goals.

To guarantee believable, open, and expandable climate action, it is crucial to comprehend and improve India's carbon credit accounting systems. This entails assessing the policies in place, sector-specific emissions methodologies, MRV capacity, and global market integration. In addition to suggesting changes to legal frameworks, digital infrastructure, and international collaboration, the study seeks to identify issues like data quality, verification bottlenecks, and market liquidity. In keeping with its climate pledges and sustainable development goals, this information helps India move towards a low-carbon economy.

Research Questions

Question 1) How is carbon credit accounting structured and regulated in india?

Question 2) What are the current practices and challenges?

Question 3) How does india compare with other emerging economies?

Literature Review

Carbon credit accounting is an evolving and essential component of worldwide environmental and financial reporting, increasingly significant in India as the nation progresses in its climate pledges and carbon market development.. Sahay (2023) Carbon credits are marketable licenses that authorise companies to emit designated quantities of greenhouse gases (GHGs), generally quantified in tonnes of CO2 equivalent .Engel et al. (2008)

The accounting for these credits entails the recognition, measurement, reporting, and verification of emissions and offset credits as financial or intangible assets in business disclosures.(*Financing Climate Futures*, 2018)

Internationally, institutions such as the Greenhouse Gas Protocol (GHGP) facilitate emissions monitoring; nevertheless, India still lacks thorough, standardised accounting criteria tailored to carbon credits. As a result, Indian enterprises frequently implement diverse, company-specific accounting procedures for carbon credits and emissions trading, resulting in inconsistencies and issues in comparability within financial reporting..Kumar et al. (2022)Safari et al. (2019)Sovacool (2017) The absence of standardised accounting regulations for carbon credits results in ambiguous and contradictory reporting. Insufficient Monitoring, Reporting, and Verification (MRV) capacity and a lack of verifiers adversely affect the reliability and accuracy of emissions data. Issues pertaining to the quality, standardisation, and transparency of data, frequently resulting in Indian enterprises either failing to report or reporting inconsistently. Integrating carbon credit accounting with existing environmental rules and other certificate markets, such as Renewable Energy Certificates (RECs), can be challenging. Wei et al. (2011)

Ambiguous tax regulations and financial considerations that modify the impact of carbon credit trades on financial performance accounting. Fiscal and Strategic Implications.

An increasing number of individuals perceive carbon credit accounting as a means to enhance firm sustainability reporting, address regulatory challenges, and secure green financing. Its function extends beyond mere compliance; it also influences investor confidence and corporate governance via ESG (Environmental, Social, and Governance) disclosures. The existence of several methodologies in accounting currently impedes the full realisation of these advantages. Diverse perspectives and emerging tendencies India's structure is being juxtaposed with that of other developing countries. This indicates the necessity to gradually transition from intensity-based emissions targets to absolute caps. It also indicates the necessity to enhance digital infrastructures, such as blockchain, to increase the transparency of carbon markets. The Green Credit Program and the Carbon Credit Trading Scheme (CCTS), recently initiated by the government, aim to enhance India's carbon accounting system and foster greater market integration. Chu and Majumdar (2012). (*Climate Change 2014 - Synthesis Report*, 2015)

The literature emphasises the necessity of establishing uniform, transparent, and scalable carbon credit accounting systems in India. To actualise the potential of carbon credit accounting as a catalyst for India's low-carbon transition and climate objectives, it is essential to enhance verifier networks, digital MRV tools, legislative clarity, and international collaboration. Devarajan (2006)

This article elucidates the existing understanding of carbon credit accounting in India, encompassing its fundamental concepts, applications by enterprises, challenges encountered, and potential evolution within the global climate finance framework. Barnett et al. (2005)

Regulatory and Policy Framework of Carbon Credit Trading in India

The Carbon Credit Trading Scheme (CCTS) in India, officially launched in 2023 and set to become operational in 2025, signifies a significant development in the Indian carbon market. The initiative creates a comprehensive national structure for the trading of verified carbon credits, promoting the decarbonisation of the Indian economy by assigning a price to greenhouse gas (GHG) emissions.

Two Fundamental Supports: The CCTS is constructed upon two mechanisms:

- **Compliance Mechanism:** Requires energy-intensive industries to adhere to mandatory emissions intensity targets. Offset/Voluntary Mechanism: Promotes the engagement of various entities in greenhouse gas reduction initiatives to generate tradable credits.

- **Carbon Credit Certificates:** Each certificate grants the holder recognition for the reduction of one tonne of CO_2 equivalent. Market Incentives: Entities that surpass their objectives may sell excess credits, but those who underperform are required to acquire credits for compliance.(pbi.gov)

The CCTS replaces the previous Perform, Achieve, and Trade (PAT) Scheme, transitioning the emphasis from energy efficiency (quantified by energy savings) to the reduction of absolute GHG emissions and intensity.

The Bureau of Energy Efficiency (BEE) manages the CCTS, establishes sector-specific intensity targets, supervises monitoring, reporting, and verification (MRV), and provides Carbon Credit Certificates. The responsibilities of BEE encompass: Formulating and revising comprehensive MRV techniques. Accrediting and overseeing third-party verifiers. Overseeing compliance and offset regimes.

Cooperative Administration

The Ministry of Power oversees policies and partners with BEE on sector selection and regulatory coherence. The National Steering Committee for the Indian Carbon Market (NSCICM), consisting of representatives from various ministries, guarantees transparency, accountability, and intersectoral collaboration. Additional regulatory bodies, such as the Central Pollution Control Board, participate in imposing sanctions for non-compliance.

India's CCTS establishes industry-specific targets for greenhouse gas emissions intensity across critical sectors. The targets are quantified in tonnes of CO_2 equivalent emissions per tonne of product and pertain to sectors like aluminium, cement, iron and steel, petrochemicals, pulp and paper, refineries, and textiles.

Company Name	Sector	Baseline Intensity (2023-24)	Target 2025-26	Target 2026-27
Hindalco Industries Ltd (Taloja)	Aluminum	1.3386	1.3057	1.2563
Tata Steel Ltd (Jamshedpur)	Iron & Steel	2.3804	2.3362	2.2699
SAIL Bokaro Plant	Iron & Steel	3.2056	3.1254	3.0052

Entities that do not reach targets are required to acquire credits; those that exceed expectations may bank or sell excess credits. The electricity industry, now responsible for 40% of India's greenhouse gas emissions, is anticipated to be included in future compliance phases. Incorporation with the Green Credit Programme and Renewable Energy Certificates.

The Green Credit Programme (GCP), introduced in October 2023, incentivises voluntary environmental initiatives—such as tree planting, water conservation, sustainable agriculture, and mangrove preservation—through the allocation of green credits.

The GCP operates independently of CCTS while providing supplementary incentives for voluntary stakeholder participation. Credits are allocated and monitored using an electronic registry administered by the Indian Council of Forestry Research and Education (ICFRE).

Renewable Energy Certificates (REC) The REC Mechanism is a market-oriented instrument designed to enhance renewable energy production and support Renewable Purchase Obligations (RPO).

Integration initiatives are in progress to establish a cohesive trading platform for carbon credits, renewable energy certificates (RECs), and green hydrogen certificates, which:

Enables effortless adherence for sectors to carbon and renewable energy regulations. Avoids double-counting and improves market efficiency.

Unified MRV frameworks, digital registries, and blockchain-based solutions are being tested to guarantee transparency, traceability, and fraud prevention inside the integrated system.

India's regulatory structure for carbon credit trading—rooted in the CCTS, overseen by BEE, and aligned with both voluntary (GCP) and renewable (REC) systems—constitutes a resilient, progressive paradigm for attaining national climate objectives and facilitating cross-sector decarbonisation. It underscores governmental compliance and volunteer initiatives while fostering innovation and market incentives for carbon reduction.

Research Methodology

The paper examines the evolution, structure, and impacts of carbon credit accounting systems in India through a qualitative research methodology. To understand both theoretical and practical dimensions, policy texts, industry practices, and regulatory developments must be analysed.

Secondary data is gathered and examined in a systematic way. The sources include government notices, industry reports, case studies, and scholarly writing. Data is organised in a way that makes it easy to see patterns, problems, and how well carbon accounting methods work.

Current Practices in Carbon Accounting in India

India's compliance carbon market, governed by the Carbon Credit Trading Scheme (CCTS), mandates that substantial, energy-intensive organisations conform to sector-specific greenhouse gas (GHG) emissions intensity objectives. The primary element here is the obligatory Monitoring, Reporting, and Verification (MRV) systems.

Categories of Projects in the Voluntary Market

Besides compliance, India's voluntary carbon market allows individuals and groups to engage in climate change by producing project-based credits across several significant categories:

- **Renewable Energy:** Initiatives such as solar, wind, hydroelectric, and biomass produce tradable credits while reducing greenhouse gas emissions. Forestry and Land Use: Initiatives related to soil carbon, mangrove restoration, reforestation, and afforestation contribute to the sequestration or mitigation of emissions. Waste-to-Energy: Credits are granted for initiatives that convert waste into bioenergy, capture landfill methane, or produce biogas. Green hydrogen: The new national missions facilitate the generation of credits for the production and utilisation of hydrogen using renewable methods.
- **Credit Generation, Verification, and Trading Mechanisms:** Compliance-based or voluntary projects calculate net emission reductions, supply baseline data, and demonstrate additionality—proof that emissions reductions would not have occurred in the absence of the project.

The MRV cycle encompasses project registration, independent validation (before issuance), regular monitoring, verification by accredited organisations, and the ultimate issuance of carbon credits overseen by the national register.

Trading: Government-sanctioned exchanges, such as the Indian Carbon Market platform, facilitate the listing and trading of carbon credits, hence enhancing price discovery, liquidity, and transparency. To prevent duplicate counting, standardised register systems govern the acquisition, disposition, and storage of credits by entities.

Blockchain Pilots, Digital Platforms, and Registry Systems

India makes investments in blockchain experiments and digital platforms to improve market efficiency and protect data integrity

- **Digital MRV Platforms:** State-of-the-art platforms allow for the safe uploading, monitoring, and automated analysis of credit and emissions data. Automation lowers the possibility of fraud and human error. Blockchain Pilots: To ensure tamper-proof records, transparency, and immediate traceability from project registration to end-use retirement, pilots are being conducted to record credit issuance and trade on blockchain networks. Electronic Registry Systems: These electronic registers, which are run by BEE and affiliated organisations, keep track of who owns, retires, and transfers all carbon credits. They also offer uniform market and compliance processes. They facilitate cross-market involvement by being connected to Green Credit and Renewable Energy networks.

Real-World Application and Sectoral Background

Large corporations (such as those in the steel, cement, and aluminium industries) electronically record their emissions and set up an independent verification every year.

Community-based reforestation and rural solar are examples of voluntary projects that adhere to rigorous validation and registration processes and are frequently backed by private consultants or non-governmental organisations. Digital innovation speeds up MRV turnaround times and boosts India's reputation for exporting carbon credits both domestically and abroad.

A Way to Compare Indian Practices to Global Standards

India's carbon credit accounting is evaluated through a framework that juxtaposes regulatory design, monitoring methodologies, certificate integrity, and market mechanisms with established global standards, specifically the EU ETS, China's National ETS, Brazil's CBIO, and South Africa's Carbon Tax program. India's Carbon Credit Trading Scheme (CCTS) is based on how much pollution comes from different industries and uses both mandatory and voluntary ways. This is different from China's absolute cap mechanism and the EU ETS's robust MRV and penalty system.

Indian MRV (Monitoring, Reporting, and Verification) protocols are getting better so that they follow worldwide best practices more closely. However, they are still not as good as the finest schemes, which include automation, digital registries, third-party verifiers, and open-access reporting. The push for unified registries for carbon credits, RECs, and green credits is like Brazil and South Africa's efforts to make the market more open and integrated. It also illustrates that the globe wants increased openness and connection under Article 6 of the Paris Agreement. Regulated businesses must check, record, and verify their greenhouse gas emissions every year against sector-specific goals. BEE-approved third-party verifiers look over these reports. They have to buy credits if they don't obey the regulations. These procedures are moving forward, but they are having problems getting people to verify them and their regional capability is not as strong as it could be. All certified renewable energy, forestry, waste-to-energy, and new green hydrogen projects make credits. To give out credits that can be exchanged or used to make claims, project developers follow specified procedures, submit in impact evaluations, and go through a process of verification. Credits are calculated using verified baselines and other information. MRV agencies check the credits, which are kept in electronic registers and exchanged on platforms for exchanges. This makes sure that the prices are fair and that there is enough money to go around. India is trying out blockchain-based registries and automated MRV systems to make data more accurate, faster, and more

open. They are accomplishing this by applying what they learnt from digital traceability systems that are utilised in the carbon markets of China and the EU.

Issues and Limits

Capacity Gapse aren't enough verifiers, notably in the agricultural and small-scale sectors.

It's challenging to compare and get accepted in foreign marketplaces when reporting frameworks are split up and uneven.When trading starts, there isn't much liquidity and prices aren't stable. The fact that the REC and ESCert markets are so volatile demonstrates how hard this is.If credits, RECs, and other certifications are utilised in more than one market, they could be tallied twice, which makes them less trustworthy.Issues with credit ownership, taxes, and following international rules make investors less sure and the law less clear.

A look at how India, China, Brazil, and South Africa are doing

China: It is ahead in growing compliance and exportable credits because it has absolute cap models, speedier MRV digitisation, and coordinated registry administration.

- **Brazil:** The government keeps a close eye on things, there is an emphasis on biofuels (CBIO credits), and there is a strong technological MRV infrastructure to make the market more honest.
- **South Africa:** The carbon tax adds price signals to emission targets, but its optional credit and market size are still modest.
- **Lessons for India:** The necessity for uniform registries, strong verification, open digital platforms, a careful move to absolute caps, and unambiguous legislation.

Changes in the law, new digital technologies, and the merging of markets are all making it easier for India to keep track of carbon credits. It is important to take the next steps, which include increasing the capacity of verifiers, standardising and digitising MRV, setting absolute caps, and connecting with global carbon markets. India needs to make these changes in order to take strong action on climate change, promote green finance, and keep its promises to reach net-zero emissions in a credible and efficient way.Some futuristic ideas are

Expansion of the Verifier and MRV Networkand Speed up the process of giving third-party MRV agencies money, training, and accreditation. Set up automatic monitoring, predictive analytics for baselines, and blockchain for traceability that can't be changed. After 2030, stop using sectoral intensity-based targets and start using hard emission caps, like other countries do. Make Indian norms more like those of Article 6 of the World Trade Organisation, join programs that help trade across

borders, and make it easier to connect with registries in the EU, China, and South Africa.

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