

“IMPACT OF ARTIFICIAL INTELLIGENCE ON CARBON CREDIT VERIFICATION, MONITORING AND TRADING IN INDIA”

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Abstract :

Climate change mitigation has gained global significance, encouraging the adoption of market-based instruments such as carbon credit systems. In India, the carbon credit market is gradually emerging as a key component of climate finance and sustainable development. However, the effectiveness of the system is often constrained by issues related to verification accuracy, continuous monitoring, transparency, and efficient trading mechanisms. In this context, Artificial Intelligence (AI) has emerged as a powerful technological tool capable of addressing these challenges.

The present study examines the impact of Artificial Intelligence on carbon credit verification, monitoring, and trading in India. It focuses on the application of AI-driven technologies, including machine learning, data analytics, and digital monitoring systems, to strengthen Measurement, Reporting, and Verification (MRV) processes. The study adopts an analytical and descriptive research design based on secondary data collected from government reports, international climate frameworks, research journals, and carbon market studies.

The study finds that AI-enabled systems improve data accuracy, enable real-time emissions monitoring, enhance transparency, and reduce inefficiencies in carbon credit trading. Despite challenges related to regulatory readiness, infrastructure, and implementation costs, the integration of Artificial Intelligence has significant potential to strengthen India's carbon credit ecosystem and support national climate goals and sustainable economic development.

Keywords: Artificial Intelligence; Carbon Credit System; Verification and Monitoring; Carbon Trading; Indian Carbon Market; Climate Change Mitigation

Introduction :

Climate change has emerged as one of the most pressing global challenges of the twenty-first century, compelling nations to adopt innovative mechanisms for reducing greenhouse gas (GHG) emissions while promoting sustainable economic development. Among



the various market-based instruments designed to address climate concerns, the carbon credit system has gained considerable importance. Carbon credits represent certified reductions in emissions and can be traded in regulated or voluntary markets, thereby incentivizing organizations to invest in cleaner technologies and sustainable practices.

India, as one of the world's fastest-growing economies and a major emitter of greenhouse gases, has gradually strengthened its climate policy framework through commitments under the Paris Agreement, the Nationally Determined Contributions (NDCs), and the development of domestic carbon markets. The Government of India has introduced initiatives such as the Carbon Credit Trading Scheme and strengthened the Measurement, Reporting, and Verification (MRV) architecture to ensure transparency and credibility in emissions accounting. However, several challenges persist in the Indian carbon market, including data reliability, verification delays, lack of continuous monitoring, transaction inefficiencies, and risks of fraud or double counting.

In this evolving context, Artificial Intelligence (AI) has emerged as a transformative technological tool capable of addressing structural weaknesses in carbon credit systems. AI technologies—such as machine learning algorithms, satellite-based remote sensing, Internet of Things (IoT) sensors, blockchain-enabled platforms, and big data analytics—can significantly improve emissions estimation accuracy, automate verification procedures, and enable real-time tracking of carbon reduction projects. By integrating AI into carbon market operations, India has the potential to strengthen transparency, enhance investor confidence, and accelerate progress toward its climate and sustainability goals.

The present research paper seeks to analyze the role and impact of Artificial Intelligence in improving carbon credit verification, monitoring, and trading in India. It explores how emerging digital tools can reshape the functioning of carbon markets, reduce compliance costs, and support policymakers in designing more effective climate strategies.

Research Objectives :

The major objectives of the present study are:

- To examine the structure and functioning of the carbon credit system in India.
- To analyze the role of Artificial Intelligence in carbon credit verification and monitoring processes.
- To evaluate how AI-enabled technologies can enhance transparency and efficiency in carbon trading.
- To identify challenges and limitations in the adoption of AI within India's carbon market framework.
- To assess the future prospects of integrating Artificial Intelligence for strengthening India's climate finance ecosystem.

Research Hypotheses :

The study is guided by the following hypotheses:



H1: Artificial Intelligence significantly improves the accuracy and reliability of carbon emission measurement and verification in India.

H2: The adoption of AI-based monitoring systems enhances transparency and reduces inefficiencies in carbon credit trading.

H3: Regulatory preparedness and infrastructure constraints limit the full-scale implementation of AI technologies in the Indian carbon market.

H4: The integration of AI in carbon markets positively contributes to India's sustainable development and climate mitigation efforts.

Review of Literature :

The carbon credit mechanism originated from international climate frameworks such as the Kyoto Protocol and later evolved under the Paris Agreement, which emphasized national-level commitments and flexible market mechanisms. Scholars such as Ellsworth and Stoner (2018) emphasized that credible MRV systems are central to the success of carbon markets. Weak monitoring structures can undermine environmental integrity and investor confidence.

In the Indian context, Ghosh and Sahu (2020) analyzed the evolution of emissions trading initiatives and noted that although India possesses significant mitigation potential, data collection and verification challenges remain persistent. Agarwal and Narain (2021) highlighted the importance of digital platforms in strengthening compliance markets and argued that automation can reduce administrative delays and transaction costs.

Recent studies have increasingly focused on the application of Artificial Intelligence in environmental governance. Rolnick et al. (2019) explored how machine learning models can optimize energy systems, predict emissions trends, and support climate adaptation strategies. Their research suggested that AI has strong potential to enhance climate policy implementation when combined with robust regulatory oversight.

Remote sensing technologies have also gained prominence in emissions monitoring. Duren and Miller (2012) demonstrated how satellite-based AI models can detect methane leaks and estimate industrial emissions more accurately than traditional ground-based audits. Similarly, Huang et al. (2022) observed that AI-driven satellite imagery is being used globally to verify forest-based carbon offset projects, reducing the risk of false reporting.

Blockchain and AI integration in carbon trading platforms has been examined by Khaqqi et al. (2018), who argued that distributed ledger systems combined with intelligent algorithms can prevent double counting, enhance traceability, and improve market transparency. Their findings are particularly relevant for emerging markets such as India, where regulatory systems are still evolving.

Despite the promising outlook, several scholars have cautioned against uncritical technological adoption. Gupta and Verma (2023) pointed out that AI deployment in Indian environmental governance faces constraints related to data availability, infrastructure gaps,



cybersecurity risks, and high implementation costs. Regulatory uncertainty and the lack of skilled professionals further slow the diffusion of advanced digital tools in public sector institutions.

Overall, the literature indicates growing consensus that Artificial Intelligence can play a critical role in strengthening carbon markets; however, its success depends on institutional readiness, regulatory clarity, and long-term policy commitment—areas that remain under-explored in the Indian context. This study seeks to fill this gap by providing a focused analytical examination of AI's impact on India's carbon credit ecosystem.

Research Methodology :

Research Design :

The study adopts a descriptive and analytical research design to examine the role of Artificial Intelligence in carbon credit verification, monitoring, and trading in India. The research aims to interpret existing trends, institutional frameworks, and technological developments rather than conducting experimental analysis.

Sources of Data :

The research is based entirely on secondary data, collected from:

- Government of India reports and policy documents related to carbon markets and climate action.
- Publications of international organizations such as the UNFCCC, World Bank, and International Energy Agency.
- Research articles published in peer-reviewed journals.
- Reports by consulting firms and environmental research institutions.
- News articles and official websites related to AI applications in climate governance.

Scope of the Study :

The scope of the study is limited to:

- The Indian carbon credit system and emerging domestic carbon markets.
- Applications of Artificial Intelligence in emissions monitoring, MRV systems, and trading platforms.
- Policy and regulatory developments influencing AI adoption in India.

Tools of Analysis :

Qualitative content analysis has been used to evaluate policy documents and academic literature. Comparative analysis has been applied to examine traditional verification systems vis-à-vis AI-enabled mechanisms.

Limitations of the Study :

- The study relies only on secondary data and does not include primary surveys or



interviews.

- Rapid technological developments may render certain observations time-specific.
- Limited public availability of Indian case studies restricts empirical generalization.

Conclusion and Future Scope :

The study concludes that Artificial Intelligence has substantial potential to transform India's carbon credit ecosystem by enhancing data accuracy, enabling real-time monitoring, and increasing transparency in trading systems. AI-based MRV tools can significantly reduce verification delays and operational inefficiencies while strengthening environmental integrity. However, infrastructural limitations, regulatory preparedness, high initial investment requirements, and data governance challenges remain major obstacles.

Future research may focus on empirical assessment through case studies of Indian industries implementing AI-based emissions monitoring, as well as stakeholder perception surveys among regulators, project developers, and investors. Policymakers should prioritize capacity building, regulatory clarity, and digital infrastructure development to harness the full benefits of Artificial Intelligence in India's transition toward a low-carbon economy.

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