

Artificial Intelligence in Carbon Accounting and Emissions Management: A Bibliometric Analysis of Research Trajectories, Methodological Trends, and Thematic Evolution

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Abstract

This study provides a comprehensive intellectual landscape of the integration of artificial intelligence (AI) with carbon accounting and emissions management. Despite the growing integration of AI in sustainability practices, a significant knowledge gap exists in understanding the systematic evolution and methodological progression of AI applications in carbon accounting. The objective of this study is to map the research trajectories and evolving paradigms of how AI technologies support decarbonization, emissions monitoring, and sustainability reporting, and to provide evidence-based guidance for future studies. A systematic bibliometric analysis was conducted in accordance with PRISMA guidelines, using the Web of Science and Scopus databases. The study covers 1,062 research publications spanning three decades from 1994 to 2025. It employed VOS viewer, Biblioshiny, and R-based bibliometric tools. Analyses included co-word networks, thematic evolution, and strategic positioning using density-centrality frameworks to identify the intellectual, conceptual, and methodological dynamics. The study highlights the AI applications in carbon accounting and emissions management across three phases: 1994-2020: Early experimentation with neural networks and footprint modeling; 2021-2023: Methodological diversification with machine/deep learning and life-cycle assessment, focusing on themes of neutrality and decarbonization; 2024-2025: Convergence on ESG reporting, emission monitoring, and net-zero strategies. The literature is heavily concentrated in leading research economies such as China, the USA, and India. Findings highlight the need for cross-disciplinary integration of AI with carbon governance, ESG disclosure, and sustainability strategies. Future studies should explore the ethical dimensions of AI-enabled carbon accounting, including fairness, transparency, and credibility in emissions measurement, disclosure, and governance.

Keywords: Artificial Intelligence (AI), bibliometric analysis, carbon accounting, decarbonization, emissions management