Volume: 13, Issue: 11 December 2025 | Impact Factor (SJIF 2025):8.737 | Journal DOI: 10.36713/epra2712 ISSN: 2277 – 5692
International Journal of Southern Economic Light (JSEL)
- Peer Reviewed Journal

THE ROLE OF CARBON MARKETS IN SUSTAINABLE FINANCE FRAMEWORKS

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Article DOI: https://doi.org/10.36713/epra25559
DOI No: 10.36713/epra25559

ABSTRACT----------
Carbon markets have emerged as key market-based instruments within sustainable finance frameworks, aimed at reducing greenhouse gas emissions while mobilizing financial resources for low-carbon development. This study examines the role of carbon markets – including emissions trading systems, carbon pricing mechanisms, and carbon offset markets – in enhancing sustainable finance effectiveness. Using a conceptual and descriptive research approach based on secondary data and existing literature, the study analyses how carbon market mechanisms influence sustainable finance outcomes and how effective sustainable finance contributes to environmental outcomes such as emission reduction and climate mitigation, as well as socioeconomic outcomes including green growth, employment, and innovation. The study further highlights the moderating role of economic and institutional factors, including GDP per capita and political stability, in shaping these relationships. The findings suggest that well-integrated carbon markets, supported by strong policy frameworks and transparent governance, can significantly strengthen sustainable finance and promote long-term environmental and economic resilience. This conceptual framework provides a foundation for future empirical research and offers practical insights for policymakers, financial institutions, and investors seeking to advance sustainable low-carbon development.

KEYWORDS:
- *Carbon markets*
- *Sustainable finance, ESG*
- *Emissions trading; Carbon pricing*
- *Green finance, Climate finance*

JEL Classification Codes
- *Q01 – Sustainable Development*
- *Q54 – Climate Change*
- *Q56 – Environment and Development*
- *G15 – International Financial Markets*
- *G18 – Government Policy and Regulation----------*

INTRODUCTION

Climate change has emerged as a major global challenge, posing significant risks to environmental sustainability, economic stability, and long-term development. Rising greenhouse gas emissions and climate-related disruptions have increased the need for effective mechanisms that can support emission reduction while maintaining economic growth. In this context, sustainable finance has gained importance as a framework that integrates environmental, social, and governance (ESG) considerations into financial decision-making to promote sustainable development. Within sustainable finance frameworks, carbon markets have become key market-based instruments for climate mitigation. Carbon markets assign a price to carbon emissions through mechanisms such as emissions trading systems, carbon pricing, and carbon offset markets. By internalizing the cost of carbon, these mechanisms create financial incentives for firms and investors to adopt cleaner technologies, improve energy efficiency, and invest

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in low-carbon projects. As a result, carbon markets play an important role in redirecting capital flows toward environmentally sustainable activities.

Carbon markets are closely connected to sustainable finance instruments, including green bonds, ESG investments, and climate finance initiatives. Carbon pricing signals help investors assess climate risks and investment viability, thereby improving capital allocation efficiency. Existing literature suggests that effective carbon market mechanisms encourage technological innovation, enhance green productivity, and contribute to emission reduction targets. At the same time, sustainable finance mobilizes public and private capital to support low-carbon transitions and climate mitigation efforts.

Despite their potential, carbon markets face several challenges that limit their effectiveness within sustainable finance frameworks. Regulatory fragmentation, price volatility, governance weaknesses, and transparency issues continue to affect market performance, particularly in developing and emerging economies. Moreover, existing studies often examine carbon markets and sustainable finance independently, resulting in limited understanding of their integrated role in achieving environmental and socioeconomic outcomes. Differences in economic capacity and institutional quality further influence the effectiveness of carbon markets and sustainable finance mechanisms.

Against this background, the present study examines the role of carbon markets within sustainable finance frameworks using a conceptual approach based on secondary data and existing literature. The study develops an integrated framework linking carbon markets, sustainable finance effectiveness, and environmental and socioeconomic outcomes, while considering the moderating role of economic and institutional factors. The study aims to provide insights for policymakers, financial institutions, and investors on strengthening carbon markets and sustainable finance strategies to support long-term sustainability and economic resilience.

REVIEW OF LITERATURE

1. **Ukatu et al., (2025)** The study examines the increasingly pivotal role of financial institutions in advancing global carbon reduction targets through capital allocation, climate risk integration, and ESG-based decision-making. The literature indicates rapid growth in green finance instruments, particularly green bonds, which support low-carbon transitions across regions. Europe demonstrates regulatory leadership through harmonized frameworks such as the EU Taxonomy, while Asia shows strong green bond expansion despite regulatory fragmentation. In contrast, Africa remains highly dependent on multilateral development banks due to political risk and high financing costs, and the Americas exhibit uneven green finance adoption driven by policy inconsistency. Overall, prior research underscores the need for financial institutions to integrate climate risk into lending practices and for policymakers to harmonize regulatory frameworks to scale global green finance effectively.
2. **Wan et al. (2025)** The study examines the interaction between trade penetration, sustainable finance, and carbon emissions in China within the framework of the country's "dual carbon" and "dual circulation" strategies. Using quantile regression and mediating models, the findings indicate that green total factor productivity (GTFP) exhibits a nonlinear relationship with carbon emissions, transitioning from an inverted U-shape to a U-shape beyond a CO_2 threshold. The literature further suggests that sustainable finance and foreign direct investment significantly contribute to emission reduction, whereas trade penetration tends to increase carbon emissions. Importantly, sustainable finance affects emissions indirectly through its positive impact on GTFP. The study emphasizes that efficiency gains and low-carbon production processes are critical for balancing economic growth with environmental protection. Overall, prior research highlights the importance of a consistent sustainable finance framework and green international cooperation in achieving China's carbon peak objectives.
3. **Chen and Ma (2024)** The study investigates the role of carbon finance development in promoting sustainable economic growth in China, with a particular focus on green total factor productivity (GTFP). Using an endogenous economic growth framework and spatial econometric models, the analysis indicates that advances in carbon finance enhance GTFP by supporting technological progress and increasing technological market turnover. The results remain robust after controlling for endogeneity, reinforcing the role of carbon finance in improving green economic efficiency. Overall, existing research highlights that well-developed

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- Peer Reviewed Journal

carbon finance systems are essential for fostering sustainable growth and balanced regional green development.

4. **Mashari et al. (2023)** The study presents a comprehensive bibliometric and literature review examining the alignment between green finance and carbon trading as mechanisms for reducing carbon emissions. The literature indicates that green finance plays a critical supporting role in funding carbon trading and offset mechanisms aligned with national commitments under the Paris Agreement. However, existing research remains fragmented, with limited integration between green finance initiatives and carbon trading systems. The study identifies substantial opportunities for future research to strengthen the linkage between sustainable finance frameworks and emissions trading effectiveness. Overall, prior research suggests that closer alignment between green finance and carbon trading can enhance emission reduction outcomes and support sustainable economic growth.
5. **Bhattacharyya (2021)** The study provides a comprehensive overview of green finance as a key mechanism supporting energy transition, climate action, and sustainable development. The literature highlights the role of green financial instruments, such as green bonds and sustainable investment schemes, in mitigating climate change and reducing environmental degradation. It also emphasizes the importance of financial disclosures, regulatory oversight, and investor participation in strengthening green finance systems. Furthermore, the review identifies key challenges, including policy fragmentation, limited standardization, and implementation barriers. Overall, existing research indicates that addressing these challenges is essential for scaling green finance and accelerating global sustainability transitions.
6. **Muchiri et al. (2025)** The study examines the nexus between green financing and carbon emissions across 29 countries, with particular attention to whether environmental protection expenditure enhances the effectiveness of green finance. Using a Panel Robust Fixed Effects Model, the analysis indicates that green finance—proxied by green bond issuance—significantly reduces carbon emissions, independent of country-specific factors such as GDP per capita and population. The literature further suggests that higher environmental protection expenditure strengthens the emission-reducing impact of green finance through a complementary effect. The study highlights the importance of regulatory frameworks, transparency, and standardized impact measurement in scaling green finance, and underscores the role of public–private collaboration in mobilizing green capital flows. Overall, existing research supports green finance as an effective policy instrument for facilitating low-carbon economic transitions.
7. **Roshid et al. (2025)** The study presents a bibliometric analysis of carbon finance research, tracing its evolution and role within sustainable finance and environmental innovation. It highlights key mechanisms such as carbon pricing, emissions trading systems (ETS), and carbon offset markets, emphasizing their importance in addressing climate change. The literature identifies major research themes, including corporate carbon disclosure, the financialization of carbon, and the integration of carbon finance into sustainable finance frameworks. Geographically, research output and collaboration are concentrated in Europe, the United States, and China, with international research networks contributing to the field's development. Emerging trends include digital innovations in carbon markets and increasing attention to climate justice, reflecting the field's responsiveness to both technological and socio-political dimensions. Overall, the review underscores the central role of carbon finance in supporting sustainable development and low-carbon transitions.
8. **Dawar et al. (2024)** The study examines the role of financial markets in supporting carbon goals through a systematic literature review, bibliometric analysis, and structural topic modelling of 372 Scopus-indexed articles. It identifies six key knowledge clusters: environmental reporting, price drivers of carbon markets, environmental policy and capital markets, financial development and carbon emissions, carbon risk and financial markets, and environmental performance and firm value. The findings indicate that quantitative approaches dominate the field and that international collaboration plays a significant role in advancing research on carbon performance and financial markets. The literature highlights the interaction between carbon market mechanisms, financial development, and firm-level carbon performance, offering valuable insights for policymakers, practitioners, and researchers in designing evidence-based decarbonization strategies. Overall, the study underscores that integrating carbon objectives with financial market instruments is essential for enabling sustainable low-carbon transitions.
9. **Billio et al., (2024)** The study provides a comprehensive review of sustainable and climate finance, proposing an integrative framework that links corporate finance, capital markets, and societal impacts. It systematically analyses literature on climate finance, sustainable finance, and financial reporting and ratings, with particular

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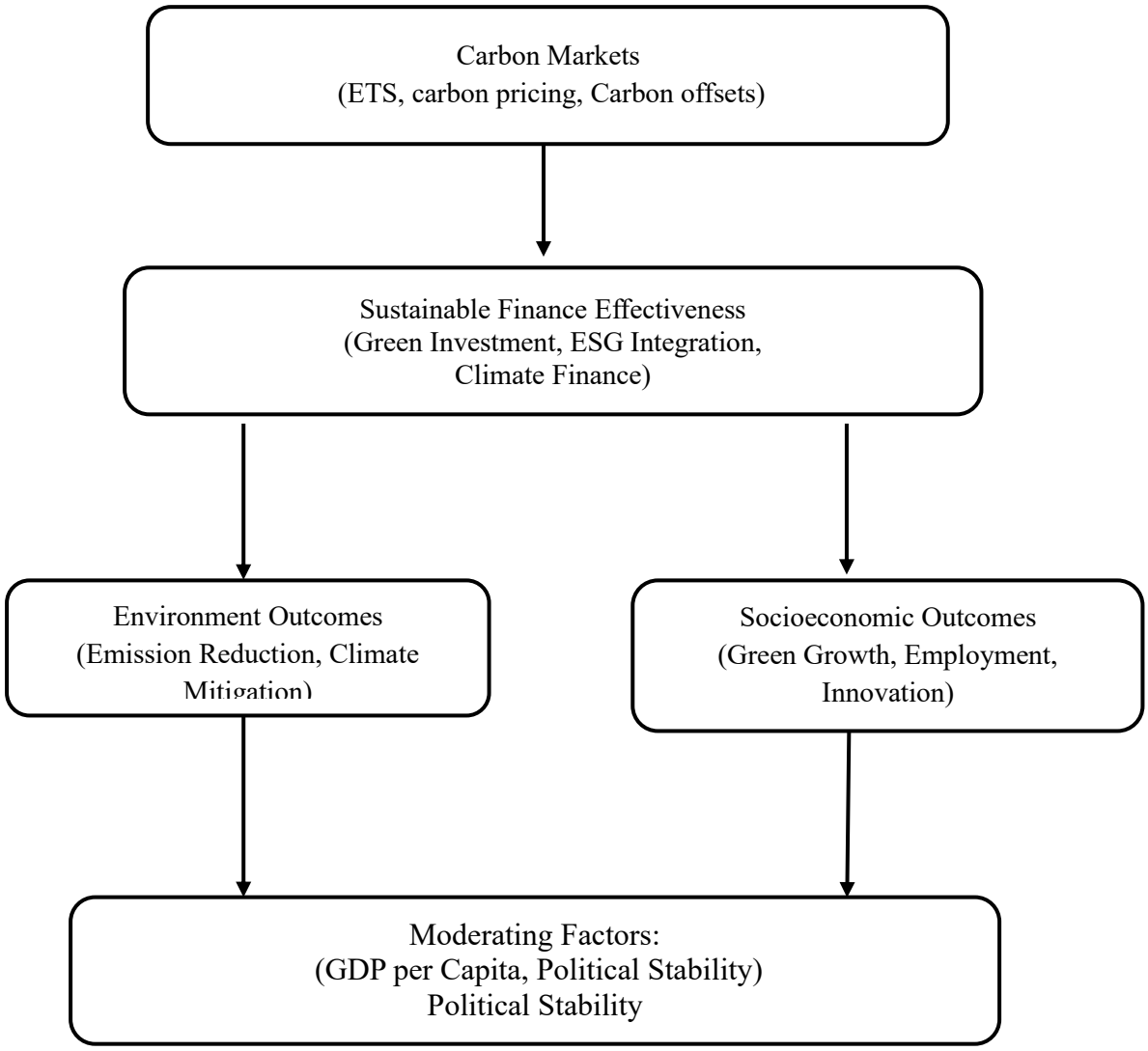
emphasis on ESG, CSR, and SDG considerations. The framework adopts an "inside-the-firm" perspective by examining corporate strategies and reporting practices, extends to capital markets through the assessment of financial instruments and investment flows, and incorporates the broader ecosystem, including regulatory, societal, and environmental interactions. The review identifies key research gaps and highlights promising policy interventions that can strengthen the integration of sustainability objectives into financial decision-making. Overall, the literature emphasizes the interconnectedness of corporate actions, financial markets, and societal outcomes in advancing low-carbon and sustainable development goals.

10. **Mashari et al., (2023)** The study conducts a bibliometric and literature review examining the alignment between green finance and carbon trading, highlighting the role of sustainable finance in supporting carbon emission reduction. The findings indicate that, although substantial research exists on green finance and carbon trading as separate domains, there remains considerable scope to better integrate these areas to enhance the effectiveness of carbon trading initiatives. The review emphasizes the need for supportive policy frameworks and financial mechanisms that can mobilize both public and private funding for carbon mitigation efforts in line with nationally determined contributions under the Paris Agreement. Overall, the literature underscores that closer integration of green finance and carbon trading mechanisms is essential for achieving global low-carbon transition objectives.
11. **Rawat (2025)** The study presents a comprehensive methodology and framework for carbon credit accounting, financial modelling, and carbon market research in both Indian and global contexts. It introduces an open-access, standardized dataset aligned with the IPCC 2006 Guidelines, UNFCCC CDM tools, Verra VCS, Gold Standard methodologies, and India's Carbon Credit Trading Scheme (CCTS 2023). The paper emphasizes transparency, reproducibility, and adherence to FAIR data principles to support research, policy development, project design, and investment decision-making. By formalizing emission and financial models within an accessible dataset, the study enhances comparability and credibility in carbon markets, offering a foundational resource for policymakers, researchers, and project developers.
12. **Liu et al., (2024)** This study examines the evolution of research on carbon market risk by reviewing 1,272 English-language publications from 2002 to 2024. The literature is primarily concentrated in China, the United States, and the United Kingdom, with most contributions originating from universities and research institutions. Four key thematic clusters are identified: foundational studies on carbon market risk, risk typologies, risk measurement methodologies, and risk mitigation strategies. Overall, these findings reflect the field's maturation and provide a structured foundation for future research on risk management within emissions trading systems and sustainable finance frameworks.
13. **Qamruzzaman and Karim (2024)** This study examines the synergistic relationship between green finance, green technological innovation, green energy adoption, and carbon neutrality using advanced panel data and nonlinear econometric techniques. The findings indicate that green finance plays a central role in mobilizing capital for renewable energy and energy-efficient technologies, thereby accelerating emissions reduction. Green technological innovation acts as a catalyst for productivity gains and long-term decarbonization, while clean energy adoption substantially reduces carbon footprints. Nonlinear analyses reveal asymmetric effects, with positive shocks in green finance and innovation producing stronger carbon-neutral outcomes than negative shocks. Overall, the evidence underscores that coordinated policies in green finance, innovation, and energy adoption are critical for achieving carbon neutrality and facilitating a sustainable low-carbon transition.
14. **Talukder, et al., (2025)** This study presents a comprehensive bibliometric review of impact investing and sustainable finance research, synthesizing 498 publications retrieved from the Web of Science and Scopus databases using the PRISMA protocol. The analysis reveals a marked increase in scholarly output over the past five years, with *Sustainability*, *Resources Policy* and *Journal of Cleaner Production* emerging as the most influential journals. Geographically, China, India, and the United Kingdom are the leading contributors to this field. Thematic analysis identifies four dominant research streams: sustainable finance for economic development, the rise of ESG investing, the influence of corporate governance and CSR on firm performance, and mobilizing sustainable finance to address climate change. Collectively, the literature underscores the growing significance of impact investing as a mechanism for channeling capital toward renewable energy and climate solutions while promoting inclusive and sustainable economic growth.

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- Peer Reviewed Journal

RESEARCH METHODOLOGY

Conceptual Model



The conceptual framework illustrates the role of carbon markets as market-based instruments influencing sustainable finance effectiveness. Sustainable finance effectiveness is conceptualized as a mediating mechanism through which carbon markets may contribute to environmental and socioeconomic outcomes. The framework further incorporates GDP per capita and political stability as moderating factors that may strengthen or weaken the effectiveness of sustainable finance in achieving sustainability outcomes. This framework is developed based on insights from existing literature and serves as a foundation for future empirical investigation.

PROBLEM STATEMENT

Despite the growing adoption of carbon markets as market-based instruments for climate mitigation, their effective integration within sustainable finance frameworks remains unclear. While carbon markets are expected to guide green investments, enhance ESG integration, and support low-carbon transitions, existing research largely examines carbon markets and sustainable finance in isolation. This fragmented approach limits understanding of how carbon market mechanisms influence sustainable finance effectiveness and contribute to environmental and

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socioeconomic outcomes. Moreover, variations in economic capacity, regulatory quality, and political stability across countries further affect the performance of carbon markets, particularly in emerging and developing economies. Therefore, there is a need for a comprehensive conceptual analysis that explains the role of carbon markets within sustainable finance frameworks and their contribution to sustainability outcomes.

RESEARCH GAP

Existing literature has extensively examined carbon markets and sustainable finance as separate domains; however, limited attention has been given to their integrated role within a unified sustainable finance framework. Most studies focus either on the functioning of carbon markets or on green and sustainable finance instruments without clearly explaining how carbon market mechanisms influence sustainable finance effectiveness and sustainability outcomes simultaneously. Additionally, there is insufficient conceptual clarity on the mediating role of sustainable finance and the moderating influence of economic and institutional factors such as GDP per capita and political stability. This gap highlights the need for a comprehensive conceptual framework that links carbon markets, sustainable finance effectiveness, and environmental and socioeconomic outcomes.

OBJECTIVES OF THE STUDY

The main objectives of the study are as follows:

- To examine the role of carbon markets in enhancing sustainable finance effectiveness.
- To analyze the influence of sustainable finance effectiveness on environmental and socioeconomic outcomes.
- To examine the moderating role of economic and institutional factors in the relationship between sustainable finance effectiveness and sustainability outcomes.

HYPOTHESES OF THE STUDY

DIRECT RELATIONSHIP

- **H1:** Carbon markets (emissions trading systems, carbon pricing, and carbon offset mechanisms) have a significant influence on sustainable finance effectiveness.

MEDIATING RELATIONSHIP

- **H2:** Sustainable finance effectiveness has a significant positive influence on environmental outcomes such as emission reduction and climate mitigation.
- **H3:** Sustainable finance effectiveness has a significant positive influence on socioeconomic outcomes including green growth, employment, and innovation.
- **H4:** GDP per capita moderates the relationship between sustainable finance effectiveness and environmental outcomes.
- **H5:** GDP per capita moderates the relationship between sustainable finance effectiveness and socioeconomic outcomes.
- **H6:** Political stability moderates the relationship between sustainable finance effectiveness and environmental outcomes.
- **H7:** Political stability moderates the relationship between sustainable finance effectiveness and socioeconomic outcomes.

NULL HYPOTHESIS

- **$H0_1$:** Carbon markets do not have a significant influence on sustainable finance effectiveness.
- **$H0_2$:** Sustainable finance effectiveness does not significantly influence environmental outcomes.
- **$H0_3$:** Sustainable finance effectiveness does not significantly influence socioeconomic outcomes.
- **$H0_4$:** GDP per capita does not moderate the relationship between sustainable finance effectiveness and environmental outcomes.

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- Peer Reviewed Journal

- **$H0_5$:** GDP per capita does not moderate the relationship between sustainable finance effectiveness and socioeconomic outcomes.

- **$H0_6$:** Political stability does not moderate the relationship between sustainable finance effectiveness and environmental outcomes.

- **$H0_7$:** Political stability does not moderate the relationship between sustainable finance effectiveness and socioeconomic outcomes.

RESULTS AND DISCUSSION

The literature suggests that carbon markets, including emissions trading systems, carbon pricing, and carbon offset mechanisms, may enhance sustainable finance effectiveness by directing capital toward environmentally responsible investments. Conceptual analysis indicates that effective sustainable finance can support environmental outcomes such as emission reduction and climate mitigation, as well as socioeconomic outcomes including green growth, employment generation, and innovation. Prior studies further suggest that these relationships tend to be stronger in economies with higher GDP per capita and greater political stability, which facilitate robust financial infrastructure, regulatory consistency, and investor confidence. Overall, the literature highlights that carbon markets can potentially support sustainability objectives when embedded within strong economic and institutional frameworks.

CONCLUSION

This study examined the role of carbon markets within sustainable finance frameworks using a conceptual approach based on secondary literature. The analysis suggests that carbon markets—through mechanisms such as emissions trading systems, carbon pricing, and carbon offset markets—have the potential to strengthen sustainable finance by guiding capital toward low-carbon and environmentally sustainable activities. The literature further indicates that effective sustainable finance can support environmental outcomes, including emission reduction and climate mitigation, as well as socioeconomic outcomes such as green growth, employment generation, and innovation.

Additionally, the study highlights that economic capacity and political stability may play an important moderating role by enhancing regulatory consistency, governance quality, and investor confidence, while institutional weaknesses and policy fragmentation can constrain outcomes, particularly in developing economies. Overall, the conceptual framework underscores the potential of carbon markets to support sustainability objectives when aligned with strong policy frameworks, transparent governance, and effective institutional mechanisms, while also providing a foundation for future empirical research.

FUTURE SCOPE OF THE STUDY

Future research can extend this conceptual framework through empirical analysis using cross-country or firm-level data to test the proposed relationships and moderating effects. Further studies may also examine sector-specific carbon markets, the role of digital technologies in carbon trading, and the integration of carbon markets with emerging sustainable finance instruments. Additionally, comparative studies between developed and developing economies can provide deeper insights into institutional and policy factors influencing carbon market effectiveness.

REFERENCES

1. ***Ukatu, C., Achimugu, D., & Anaege, A. (2025).*** *The role of financial institutions in advancing global carbon reduction targets: A literature review. International Journal of Social Science and Economics Invention, 11(2). https://doi.org/10.23958/ijssei/vol11-i02/380*
2. ***Wan, L., Zhou, Y., Wang, Y., & Zhao, T. (2025).*** *Trade penetration, sustainable finance and carbon peak: Evidence from China. Sustainable Futures, Article 101107. https://doi.org/10.1016/j.sftr.2025.101107*
3. ***Chen, Y., & Ma, G. (2024).*** *The characteristics and mechanisms of carbon finance development on green economic efficiency: An empirical analysis based on endogenous economic growth model. Frontiers in Environmental Science, 12, 1420708. https://doi.org/10.3389/fenvs.2024.1420708*
4. ***Mashari, D. P. S., Zagloel, T. Y. M., Soesilo, T. E. B., & Maftuchah, I. (2023).*** *A bibliometric and literature review: Alignment of green finance and carbon trading. Sustainability, 15(10), 7877.*

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- Peer Reviewed Journal

https://doi.org/10.3390/su15107877

5. ***Bhattacharyya, R. (2021**). Green finance for energy transition, climate action and sustainable development: Overview of concepts, applications, implementation and challenges. Green Finance, 4(1), 1–35. https://doi.org/10.3934/GF.2022001*
6. ***Muchiri, M. K., Erdei-Gally, S., & Fekete-Farkas, M. (2025).** Nexus between green financing and carbon emissions: Does increased environmental expenditure enhance the effectiveness of green finance in reducing carbon emissions? Journal of Risk and Financial Management, 18(2), 90. https://doi.org/10.3390/jrfm18020090*
7. ***Roshid, M. M., Karim, R., Bhowmik, R. C., Waaje, A., & Islam, S. (2025).** Mapping the carbon finance research: A bibliometric exploration of innovation in sustainable finance. Sustainable Finance Review. https://doi.org/10.1016/j.dsef.2025.100048*
8. ***Dawar, G., Nagariya, R., Bhatia, S., Dhingra, D., Agrawal, M., & Dhaundiyal, P. (2024).** Can financial markets help attain carbon goals? Evidence from systematic literature review, bibliometric analysis and topic modelling. Sustainability Accounting, Management and Policy Journal. https://doi.org/10.1108/SAMPJ-05-2023-0319*
9. ***Billio, M., Murgia, M., & Vismara, S. (2024).** Sustainable and climate finance: An integrative framework from corporates to markets and society. Foundations and Trends in Finance, 18(1), 1–85. https://doi.org/10.1561/114.00000058*
10. ***Mashari, D. P. S., Zagloel, T. Y. M., Soesilo, T. E. B., & Maftuchah, I. (2023).** A bibliometric and literature review: Alignment of green finance and carbon trading. Sustainability, 15(7877). https://doi.org/10.3390/su15107877*
11. ***Rawat, M. K. (2025).** Carbon credit methodology and framework: A structured approach to emission accounting, financial modelling, and carbon market research in India and global markets. Harvard Dataverse. https://doi.org/10.7910/DVN/W2D7H2*
12. ***Liu, X., Ning, X., Wu, C., & Zhang, Y. (2024).** Evolutionary trends in carbon market risk research. Energies, 17(18), 4655. https://doi.org/10.3390/en17184655*
13. ***Qamruzzaman, M., & Karim, S. (2024).** Unveiling the synergy: Green finance, technological innovation, green energy, and carbon neutrality. PLoS ONE, 19(10), e0308170. https://doi.org/10.1371/journal.pone.0308170*
14. ***Talukder, S. C., Lakner, Z., & Temesi, Á. (2025).** Exploring the research landscape of impact investing and sustainable finance: A bibliometric review. Journal of Risk and Financial Management, 18(10), 578. https://doi.org/10.3390/jrfm18100578*