



(REVIEW ARTICLE)



AI in green financing: Catalyst for change or overstated promise?

Chukwuka Michael Oforgu ¹, Anuoluwapo Joshua Gabriel ², Andrew Chinonso Nwanakwaugwu ³, Temitope Kadri ¹, Tewogbade Shakir Adeyemi ¹ and Oluwole Fagbohun ^{4,*}

¹ *Readrly Limited, United Kingdom.*

² *Pavolera Technology Limited, United Kingdom.*

³ *Accenture, United Kingdom.*

⁴ *Carbonnote, USA.*

World Journal of Advanced Research and Reviews, 2025, 26(03), 2626-2633

Publication history: Received on 19 May 2025; revised on 25 June 2025; accepted on 27 June 2025

Article DOI: <https://doi.org/10.30574/wjarr.2025.26.3.2477>

Abstract

Artificial Intelligence (AI) has become a revolutionary catalyst across various sectors, and green financing represents yet another area experiencing its profound impact. As the world faces mounting pressure to combat climate change, financial institutions and investors are increasingly leveraging AI to enhance sustainable investment strategies, assess environmental risks, and ensure transparency in green finance initiatives. This paper critically examines the role of AI in green financing, assessing whether it is a genuine catalyst for change or an overstated promise burdened by technological and regulatory limitations. AI-driven innovations are shaping green bond assessment, ESG (Environmental, Social, and Governance) scoring, carbon credit trading, and predictive climate risk modelling. These advancements highlight both opportunities and challenges in sustainable finance. AI's ability to process vast amounts of unstructured environmental data allows for improved decision-making.

However, concerns regarding data bias, greenwashing, and the absence of standardised AI governance frameworks raise questions about its reliability and fairness. Machine learning models contribute to enhanced risk assessment and portfolio optimisation, yet regulatory inconsistencies and the opacity of AI decision-making processes often hinder their widespread adoption. Real world applications and case studies offer valuable insights into AI's effectiveness in driving green financial practices. Emerging trends, including AI-powered sustainability disclosures and blockchain-integrated AI systems, present promising solutions for greater transparency in green financing. This paper evaluates whether AI serves as a revolutionary enabler of sustainable finance or whether its potential is overstated, requiring stronger regulatory and ethical oversight to ensure meaningful impact.

Keywords: Artificial Intelligence; Green Finance; ESG Scoring; Carbon Credit Trading; Sustainable Investment; Climate Risk Modelling; Machine Learning; Greenwashing; Financial Regulation; Blockchain in Finance; AI Ethics

1. Introduction

The escalating threat of climate change has necessitated a fundamental shift in global financial systems towards sustainability. Green finance has emerged as a crucial mechanism in this transition, facilitating investments in environmentally friendly projects that align with global carbon neutrality goals (Fu et al., 2023). The integration of Artificial Intelligence (AI) into green finance has introduced a new paradigm, enhancing data-driven decision-making, optimising resource allocation, and improving risk assessment. The potential of AI to revolutionise sustainable finance is increasingly recognised, yet concerns regarding its limitations and governance remain at the forefront of academic and policy discussions (Chishti et al., 2024). Green finance encompasses a broad spectrum of financial instruments, including green bonds, sustainability-linked loans, and carbon credit markets, all of which contribute to mitigating

* Corresponding author: Oluwole Fagbohun

climate change (Schmittmann and Teng, 2021). AI technologies, particularly machine learning and predictive analytics, have significantly improved the evaluation of environmental, social, and governance (ESG) criteria, offering enhanced transparency and accuracy in assessing corporate sustainability performance (Sule et al., 2024). AI's capability to analyse vast amounts of unstructured environmental data has provided financial institutions with a more comprehensive understanding of climate-related risks, thereby strengthening sustainable investment strategies (Chen et al., 2024).

Despite these advancements, the effectiveness of AI in green financing remains a subject of debate. While proponents argue that AI-driven financial models can accelerate the transition to a low-carbon economy, sceptics highlight concerns related to data biases, regulatory fragmentation, and the potential for AI-enabled greenwashing (Lee, Hussain, and Abass, 2025). Moreover, AI's reliance on vast computational resources raises its own environmental footprint, posing ethical dilemmas in its deployment within sustainability initiatives (Wang et al., 2025). Given these complexities, this paper critically evaluates whether AI serves as a genuine catalyst for change in green finance or whether its transformative potential is overstated.

Objective and Scope

The primary objective of this paper is to examine the intersection of AI and green finance, assessing both its transformative potential and inherent limitations. The study aims to:

- Explore AI-driven innovations in green finance, including applications in green bond assessment, ESG scoring, carbon credit verification, and climate risk modelling.
- Analyse key benefits and challenges, particularly in relation to AI's ability to enhance transparency, mitigate financial risks, and optimise sustainable investments.
- Evaluate the balance between technological advancements and regulatory/ethical concerns, focusing on issues such as AI biases, greenwashing risks, and the absence of standardised governance frameworks.

Through an in-depth review of case studies, regulatory policies, and empirical research, this paper seeks to provide a nuanced perspective on AI's role in shaping the future of green finance. While AI presents promising solutions for sustainable investment and environmental accountability, its potential remains contingent on overcoming regulatory challenges, ethical considerations, and technological limitations.

2. AI's Role in Green Financing: Opportunities and Applications

2.1. Green Bond Assessment

Green bonds have become a crucial financial tool in combating climate change, channeling investment capital toward sustainable and eco-friendly initiatives. The assessment and verification of green bonds, however, present significant challenges, particularly concerning transparency and the prevention of greenwashing. AI plays a transformative role in this space by automating sustainability verification and improving risk assessment mechanisms. AI-driven tools, such as machine learning models and blockchain-based verification systems, enhance the credibility of green bonds by analysing vast datasets to detect inconsistencies in sustainability claims (Chen et al., 2024). These tools assess the environmental impact of projects by integrating real-time data from various sources, including satellite imagery, company disclosures, and third-party sustainability reports. AI-powered automation streamlines due diligence processes, reducing the time and cost associated with bond issuance while improving accuracy (Ojukwu et al., 2024).

A key challenge in green bond markets is greenwashing, the misrepresentation of environmental credentials to attract investment. AI mitigates this risk by leveraging natural language processing (NLP) and sentiment analysis to scrutinise corporate sustainability disclosures and identify discrepancies between stated environmental goals and actual practices (Xu, 2024). Moreover, AI-driven rating models enable financial institutions to assess climate-related risks more effectively, thereby enhancing investor confidence and fostering a more sustainable financial ecosystem (Mehryar, Yazdanpanah and Tong, 2024). Despite these advantages, the implementation of AI in green bond assessment is not without limitations. The lack of universally accepted standards for AI-driven sustainability assessments poses a challenge, as different rating methodologies may yield inconsistent results. Additionally, reliance on historical data limits AI's ability to account for emerging environmental risks, necessitating continuous updates to training datasets and analytical models (Olawade et al., 2024a). Addressing these challenges requires the development of robust AI governance frameworks to ensure the reliability and ethical use of AI in green finance.

2.2. ESG (Environmental, Social, and Governance) Scoring

ESG factors have become critical in investment decision-making, with AI playing a central role in enhancing ESG scoring methodologies. Traditional ESG assessments rely on manual data collection and subjective evaluations, often leading to inconsistencies and biases. AI-driven ESG scoring systems, in contrast, enable real-time data processing and objective analysis by aggregating information from diverse sources, including regulatory filings, news articles, and social media platforms (Riyath and Jariya, 2024). One of the most significant applications of AI in ESG scoring is NLP, which automates the extraction of ESG-related information from corporate disclosures and financial reports. NLP models identify key sustainability indicators and assign quantitative scores based on predefined criteria, ensuring a more standardised and transparent assessment process (Xu, 2024). AI-powered sentiment analysis further refines ESG scores by analysing media coverage and public perception of companies' sustainability initiatives, offering a more holistic view of corporate responsibility.

Beyond data extraction, machine learning algorithms enhance ESG risk assessment by identifying patterns and predicting potential sustainability-related controversies. AI models assess corporate governance structures, labour practices, and environmental impact, enabling investors to make informed decisions regarding ESG-compliant investments (Zhou et al., 2025). Furthermore, AI facilitates dynamic ESG scoring, continuously updating scores based on real-time data, thereby reducing reliance on outdated or self-reported information (Joseph et al., 2025; Xiao and Xiao, 2025). Despite these advancements, challenges persist in AI-driven ESG scoring. Data quality remains a primary concern, as inconsistencies in reporting standards across industries and jurisdictions impact the accuracy of AI-generated ESG scores. Additionally, the proprietary nature of many AI models limits transparency, raising concerns about algorithmic biases and the potential for manipulation in ESG assessments (Dao et al. 2024). To address these issues, industry-wide standardisation and regulatory oversight are necessary to ensure the credibility and fairness of AI-driven ESG evaluations.

2.3. Carbon Credit Trading and Verification

The growing demand for carbon credit markets as a mechanism for mitigating climate change has led to increased scrutiny over their transparency, efficiency, and fraud prevention. Carbon credit trading enables organisations to offset their carbon emissions by purchasing credits from projects that reduce or remove greenhouse gases (GHGs) from the atmosphere. However, concerns regarding the credibility of carbon credits, fraudulent activities, and inaccurate emissions reporting necessitate robust verification mechanisms. Artificial Intelligence (AI) is increasingly being leveraged to enhance the reliability of carbon markets by addressing these challenges through fraud detection, automated verification, and real-time emissions monitoring.

2.3.1. AI-Powered Fraud Detection in Carbon Markets

One of the significant challenges in carbon credit trading is the potential for fraudulent activities, including the issuance of non-existent or exaggerated credits. AI-driven fraud detection mechanisms utilise machine learning algorithms to analyse transactional patterns, identify anomalies, and flag potential cases of fraud. By leveraging historical data, AI can detect irregular trading behaviours, ensuring that only legitimate credits are circulated within the market (Moses, 2023). In addition, AI-powered blockchain integration enhances the security and traceability of carbon credit transactions. Blockchain technology, when combined with AI, ensures that carbon credits are recorded immutably, preventing double counting and fraudulent claims. Smart contracts, powered by AI, automate the validation of transactions by cross-referencing carbon offset data from multiple sources, thereby improving market credibility (Baklaga, 2024).

2.3.2. Use of AI for Real-Time Monitoring of Emissions

Accurate and real-time emissions monitoring is essential for ensuring the integrity of carbon credit markets. AI-driven satellite imagery and remote sensing technologies provide real-time data on carbon sequestration efforts, such as afforestation, reforestation, and soil carbon capture (Oladeji and Mousavi, 2023). By integrating AI with sensor networks and IoT devices, emissions data can be continuously tracked, reducing reliance on manual verification processes. AI models also play a critical role in estimating carbon sequestration potential by analysing vast datasets, including weather patterns, land use changes, and industrial emissions records. Machine learning algorithms process this data to predict the effectiveness of carbon offset projects, ensuring that credits are allocated based on actual emissions reductions rather than speculative projections (Nikam and Shewale, 2025).

2.4. Predictive Climate Risk Modelling

Climate risk modelling is crucial for financial institutions and policymakers aiming to mitigate the economic impacts of climate change. AI-driven predictive analytics enhances the ability to assess future climate risks by leveraging vast datasets, identifying trends, and simulating potential environmental scenarios.

2.4.1. Machine Learning Algorithms for Forecasting Environmental Risks

Traditional climate risk assessment methods rely heavily on historical data, which may not capture emerging risks driven by climate change. AI-based predictive models, such as deep learning and neural networks, offer improved forecasting capabilities by analysing complex climate interactions (Indiazi, 2025). These models assess various environmental factors, including temperature fluctuations, extreme weather events, and sea-level rise, providing financial institutions with actionable insights into future climate risks. A key advantage of AI in climate risk modelling is its ability to integrate diverse data sources, such as satellite imagery, weather reports, and financial data. By continuously learning from new information, AI models refine their predictions, offering more accurate risk assessments for industries reliant on climate-sensitive resources (Khalid et al., 2024).

2.4.2. AI-Enhanced Portfolio Diversification Based on Climate Risk Factors

Investors and asset managers increasingly rely on AI-driven risk models to optimise portfolio diversification in response to climate risks. AI-enhanced portfolio management strategies incorporate climate data to adjust investment allocations, minimising exposure to assets vulnerable to climate-related disruptions (Olawumi and Oladapo, 2025). For instance, AI models can evaluate the financial stability of companies based on their environmental footprint, ESG performance, and regulatory compliance. By integrating sustainability metrics into investment strategies, AI helps mitigate financial losses associated with climate-induced market fluctuations (Olawade et al., 2024b).

Despite these advancements, challenges persist in AI-driven climate risk modelling. The reliability of predictive models depends on the quality and availability of climate data, which varies across regions and industries. Additionally, the interpretability of AI models remains a concern, as opaque decision-making processes may limit their acceptance among financial stakeholders. Addressing these challenges requires continuous model refinement, regulatory oversight, and the integration of explainable AI (XAI) techniques to enhance transparency.

3. Challenges and Limitations of AI in Green Finance

3.1. Data and Algorithmic Challenges

Artificial Intelligence (AI) has been increasingly employed in green finance to optimise investment decisions, assess environmental risks, and support regulatory compliance. However, its effectiveness is often undermined by significant data and algorithmic challenges. One of the primary concerns is the inconsistency and bias in ESG (Environmental, Social, and Governance) and climate data. ESG reporting standards vary across jurisdictions and industries, making it difficult for AI models to synthesise and compare information effectively (Addy et al., 2024). Many AI models rely on self-reported corporate sustainability disclosures, which are prone to selective reporting and greenwashing practices. Furthermore, ESG data quality issues, including missing, incomplete, or outdated information, hinder AI-driven insights (Herath and Herath, 2024).

Another limitation is AI's dependence on historical data, which may not accurately reflect future sustainability risks. Climate change introduces dynamic and non-linear risks that historical datasets fail to capture, leading to inaccurate AI-driven predictions (Alzoubi and Mishra, 2024). Machine learning models, particularly those trained on past financial and environmental trends, may struggle to incorporate emergent risks such as sudden regulatory shifts, technological breakthroughs, or climate tipping points (Debrah et al., 2022). The inability of AI systems to adapt to such uncertainties reduces their utility in long-term green finance planning.

3.2. Regulatory and Ethical Concerns

A major challenge in AI-driven green finance is the lack of standardised AI governance frameworks. Currently, financial regulators worldwide have not established unified rules for AI's role in sustainable finance, leading to discrepancies in how AI-based ESG ratings, climate risk assessments, and investment recommendations are interpreted (Wang et al., 2025). The absence of clear regulatory guidance creates uncertainty for investors and financial institutions, limiting AI's integration into mainstream green finance operations (Hidayat-ur-Rehman and Hossain, 2024). Moreover, AI can contribute to greenwashing—the misrepresentation of sustainability credentials. Some AI models, particularly those used for ESG scoring, rely on corporate disclosures and third-party reports that may be manipulated or misrepresented

to appear more environmentally friendly than reality (Kathan et al., 2025). Without transparent and auditable AI methodologies, investors risk being misled by biased or exaggerated ESG ratings.

Beyond regulatory concerns, ethical issues in AI decision-making pose challenges in green finance. The explainability and accountability of AI models remain critical issues, as many machine learning algorithms operate as "black boxes," making it difficult for stakeholders to understand how investment decisions are made (Chishti et al., 2024). If AI-driven decisions lead to financial losses or sustainability failures, it is unclear who should be held accountable: the AI developers, financial institutions, or regulators. Addressing these concerns requires the adoption of explainable AI (XAI) frameworks that enhance model interpretability and ensure responsible AI deployment in sustainable finance (Dash, 2025).

3.3. Operational and Implementation Barriers

The deployment of AI in green finance faces high computational and financial costs, particularly in training and maintaining complex machine learning models. AI models require substantial computational power, which not only increases operational expenses but also raises concerns about AI's own environmental footprint (Alzoubi and Mishra, 2024). The energy-intensive nature of AI processing contradicts the sustainability goals of green finance, necessitating the development of energy-efficient AI algorithms to mitigate its carbon impact (Dash, 2025). In addition, traditional financial institutions exhibit resistance to AI adoption due to the complexity of AI models and a lack of trust in AI-generated insights. Many institutional investors and regulators are accustomed to conventional financial risk assessment models and hesitate to transition to AI-driven approaches without clear evidence of their superiority (Addy et al., 2024).

The perceived lack of human oversight in AI-driven decision-making further fuels scepticism, as financial institutions remain concerned about AI errors leading to regulatory non-compliance or investment misallocation (Hidayat-ur-Rehman and Hossain, 2024). To overcome these barriers, financial institutions must prioritise AI-human collaboration models, where AI augments human expertise rather than fully replacing traditional decision-making processes. Strengthening industry-wide AI education, regulatory alignment, and investment in explainable AI solutions will be essential for AI's successful integration into green finance.

4. Case Studies and Emerging Trends in AI-Driven Green Finance

4.1. Real-World Applications of AI in Green Finance

Artificial Intelligence (AI) is increasingly being deployed by financial institutions, investment firms, and fintech startups to optimise sustainable finance initiatives. AI-powered tools improve green finance decision-making by enhancing risk assessment, fraud detection, and compliance automation. The following case studies illustrate AI's role in green finance and highlight key success stories.

4.1.1. AI-Driven ESG Scoring by MSCI and Sustainalytics

MSCI and Sustainalytics have developed AI-powered ESG (Environmental, Social, and Governance) rating systems that analyse vast datasets, including corporate reports, news sentiment, and regulatory filings. Natural Language Processing (NLP) models extract key sustainability indicators, providing investors with transparent and dynamic ESG scores (Olawumi and Oladapo, 2025). These AI-enhanced ESG ratings have enabled institutional investors to make informed decisions, reducing exposure to greenwashing.

4.1.2. JP Morgan's AI-Powered Climate Risk Modelling

JP Morgan has integrated AI into its climate risk modelling to predict the financial impact of extreme weather events on investments. Their deep learning models analyse meteorological data, supply chain vulnerabilities, and regulatory risks to help clients adjust their portfolios (Iseal, Joseph and Joseph, 2025). This AI-driven approach has improved asset managers' ability to hedge against climate-induced financial instability.

4.1.3. Fintech Startups Using AI for Green Bonds and Carbon Markets

Fintech companies such as ClimateTrade and Persefoni leverage AI to enhance transparency in green bonds and carbon credit trading. AI-powered blockchain integration ensures real-time verification of emissions reductions, reducing the risk of fraudulent carbon credit claims (Lin et al., 2025). These startups have demonstrated how AI can drive accountability and efficiency in sustainable finance markets.

4.2. Future Prospects and Emerging Trends

The rapid evolution of AI technologies continues to shape the future of green finance, offering new opportunities for improving sustainability reporting, regulatory compliance, and financial transparency.

4.2.1. AI-Powered Sustainability Disclosures and Automated Regulatory Compliance

Financial regulators are increasingly mandating detailed sustainability disclosures, requiring corporations to align their financial statements with climate risk factors. AI-powered compliance tools use NLP and predictive analytics to automate regulatory reporting, reducing manual errors and ensuring consistency with evolving sustainability regulations (Olawumi and Oladapo, 2025).

4.2.2. Integration of AI with Blockchain for Enhanced Transparency in Green Finance

AI and blockchain integration is a promising trend in green finance, addressing challenges related to fraud, data manipulation, and accountability. AI-driven smart contracts automatically validate and execute transactions in carbon markets, green bonds, and sustainable supply chains. This ensures that sustainability claims are backed by verifiable data, mitigating greenwashing risks (Dash, 2025).

4.2.3. The Role of Generative AI in Adaptive, Real-Time ESG Reporting

Generative AI is becoming increasingly influential in sustainable finance by supporting the dynamic updating and refinement of ESG reporting frameworks in real time. These models dynamically assess corporate sustainability performance by analysing real-time data streams, such as satellite imagery, energy consumption patterns, and regulatory filings. Financial institutions can leverage generative AI to provide stakeholders with continuously updated ESG assessments, improving investor confidence and regulatory compliance (Acharya et al., 2025).

5. Conclusion and Recommendations

5.1. Summary of Key Findings

AI has introduced transformative possibilities in the green finance sector, enhancing environmental risk assessments, ESG scoring, and sustainability disclosures. AI-driven financial solutions have shown substantial potential in improving decision-making for green investments, reducing the risk of greenwashing, and automating regulatory compliance (Chishti et al., 2024). However, challenges persist. Data inconsistency, biases, and lack of standardised AI governance remain significant barriers to AI's full integration into green finance (Debrah et al., 2022). Additionally, high computational costs and ethical concerns related to transparency in AI-driven sustainability assessments raise concerns among financial regulators and investors (Olawumi and Oladapo, 2025). While AI offers an advanced toolkit for green finance, its impact is contingent on regulatory frameworks, transparency, and accountability measures. Without clear governance structures, AI may inadvertently contribute to greenwashing and financial misallocation in sustainability investments (Alzoubi and Mishra, 2024).

5.2. Recommendations for Stakeholders

To ensure AI's effective and responsible deployment in green finance, stakeholders must take proactive measures to address current limitations. Financial institutions should prioritise AI transparency by implementing explainable AI (XAI) frameworks that enhance trust in automated sustainability assessments. In addition, they need to strengthen AI-based risk assessment models by incorporating real-time environmental data to improve predictive accuracy. Equally important is the development of AI-human collaboration models, which can reduce over-reliance on opaque, black-box AI decision-making processes in green investment strategies (Raman et al., 2025). Policymakers and regulators must establish clear AI governance frameworks tailored to green finance, ensuring standardised ESG reporting and accountability mechanisms across markets (Chishti et al., 2024). This includes the implementation of mandatory AI auditing protocols designed to identify and mitigate algorithmic biases, while also preventing AI-driven greenwashing (Debrah et al., 2022). In tandem, regulatory bodies should foster cross-sector collaboration among AI developers, financial authorities, and sustainability experts to co-create robust and future-proof policy environments that support ethical AI deployment.

For researchers and developers, a critical priority is conducting in-depth studies on AI's long-term role in climate finance, with a particular focus on zero-shot learning models that enable adaptive sustainability forecasting in rapidly changing environmental contexts (Iseal, Joseph and Joseph, 2025). There is also a pressing need to investigate AI's carbon footprint and develop energy-efficient machine learning algorithms that align with green finance objectives

(Dash, 2025). Furthermore, exploring the integration of blockchain technology with AI presents a promising avenue to improve traceability, auditability, and trust in green financial instruments, reducing the likelihood of data tampering and enhancing transaction integrity (Alzoubi and Mishra, 2024). AI holds enormous potential to revolutionise green finance by enhancing transparency, improving investment decision-making, and automating regulatory compliance. However, its true impact will depend on responsible deployment, robust governance, and meaningful interdisciplinary collaboration. Only through coordinated efforts by financial institutions, regulators, and researchers can AI's transformative capabilities be harnessed effectively, ensuring that sustainable finance systems remain credible, transparent, and impactful.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Acharya, D. B., Kuppam, K., and Divya, B. (2025). Agentic AI: Autonomous Intelligence for Complex Goals—A Comprehensive Survey. *IEEE Access*.
- [2] Addy, W. A., Ofodile, O. C., Adeoye, O. B., Oyewole, A. T., Okoye, C. C., Odeyemi, O., and Ololade, Y. J. (2024). Data-driven sustainability: How fintech innovations are supporting green finance. *Engineering Science and Technology Journal*, 5(3), 760-773.
- [3] Moses, N. (2023). The Role of AI in Optimizing Carbon Credit Trading and Green Bonds.
- [4] Kathan, M. C., Utz, S., Dorfleitner, G., Eckberg, J., and Chmel, L. (2025). What you see is not what you get: ESG scores and greenwashing risk. *Finance Research Letters*, 74, 106710.
- [5] Dao, Daniel, Chu, Ngoc Anh, Bowden, James, and Cummins, Mark. (2024). ESG Greenwashing and Applications of AI for Measurement. University of Strathclyde, Glasgow. Financial Regulation Innovation Lab White Paper Series.
- [6] Alzoubi, Y. I., and Mishra, A. (2024). Green artificial intelligence initiatives: Potentials and challenges. *Journal of Cleaner Production*, 468, 143090.
- [7] Synergizing AI and Blockchain: Innovations in Decentralized Carbon Markets for Emission Reduction through Intelligent Carbon Credit Trading. *Journal of Computer Science and Technology Studies*, 6(2), 111-120.
- [8] Chen, J., Meng, W., Chen, Y., and Zhou, W. (2024). To be an eco- and tech-friendly society: Impact research of green finance on AI innovation. *Journal of Cleaner Production*, 466, 142900.
- [9] Chishti, M. Z., Dogan, E., and Binsaeed, R. H. (2024). Can artificial intelligence and green finance affect economic cycles? *Technological Forecasting and Social Change*, 209, 123740.
- [10] Dash, S. (2025). Green AI: Enhancing sustainability and energy efficiency in AI-integrated enterprise systems. *IEEE Access*, 13, 21216-21230.
- [11] Debrah, C., Chan, A. P. C., and Darko, A. (2022). Green finance gap in green buildings: A scoping review and future research needs. *Building and Environment*, 207, 108443.
- [12] Olawade, D. B., Wada, O. Z., Ige, A. O., Egbewole, B. I., Olojo, A., and Oladapo, B. I. (2024). Artificial intelligence in environmental monitoring: Advancements, challenges, and future directions. *Hygiene and Environmental Health Advances*, 100114.
- [13] Fu, C., Lu, L., and Pirabi, M. (2023). Advancing green finance: A review of sustainable development. *Digital Economy and Sustainable Development*, 1(20).
- [14] Hidayat-ur-Rehman, I., and Hossain, M. N. (2024). The impacts of Fintech adoption, green finance and competitiveness on banks' sustainable performance: digital transformation as moderator. *Asia-Pacific Journal of Business Administration*.
- [15] Mehryar, S., Yazdanpanah, V., and Tong, J. (2024). AI and climate resilience governance. *iScience*, 27, 109812. <https://doi.org/10.1016/j.isci.2024.109812>
- [16] Indiazi, C. (2025). The Roles of AI on Predictive Analytics in Managing Climate Change Risks in Reinsurance. *Gospodarka i Innowacje*, 55, 39-49.

- [17] Joseph, O.O., Kevin-Alerechi, E., Olumide, O.T., Sunday, D., Fagbohun, O. and Olanrewaju, S. (2025) 'Reimagining green financing with AI: A technological approach to sustainability', *Journal of Artificial Intelligence, Machine Learning and Data Science*, 3(1), pp. 2346–2352.
- [18] Khalid, J., Chuanmin, M., Altaf, F., and Ashraf, M. U. (2024). AI-Driven Risk Management and Sustainable Decision-Making: Role of Perceived Environmental Responsibility. *Sustainability*, 16(6799).
- [19] Lee, C. C., Hussain, J., and Abass, Q. (2025). An integrated analysis of AI-driven green financing, subsidies, and knowledge to enhance CO2 reduction efficiency. *Economic Analysis and Policy*, 85, 675-693.
- [20] Zhou, Xiaoyong, Li, Gaochao, Wang, Qunwei, Li, Yangganxuan, and Zhou, Dequn. (2025). Artificial intelligence, corporate information governance and ESG performance. *Journal of International Financial Markets, Institutions and Money*, 102, 102747.
- [21] Nikam, K.S. and Shewale, S., 2025. Machine learning in climate change prediction and carbon credit optimization. *International Research Journal of Modernization in Engineering, Technology and Science*, 7(4), pp.6003–6010. Available at: <https://www.doi.org/10.56726/IRJMETS73595> [Accessed 24 June 2025]
- [22] Schmittmann, J.M. and Teng, C.H., 2021. How green are green debt issuers? IMF Working Paper No. WP/21/194. Asia and Pacific Department. Washington, D.C.: International Monetary Fund. Available at: <https://www.imf.org/en/Publications/WP/Issues/2021/07/30/How-Green-Are-Green-Debt-Issuers-462681> [Accessed 24 June 2025].
- [23] Oladeji, O., and Mousavi, S. S. (2023). Towards AI-driven Integrative Emissions Monitoring and Management for Nature-Based Climate Solutions. Stanford University, Precourt Institute for Energy.
- [24] Olawade, D. B., Wada, O. Z., David-Olawade, A. C., et al. (2024). Artificial Intelligence Potential for Net Zero Sustainability: Current Evidence and Prospects. *Next Sustainability*, 4, 100041.
- [25] Olawumi, M. A., and Oladapo, B. I. (2025). AI-Driven Predictive Models for Sustainability. *Journal of Environmental Management*, 373, 123472.
- [26] Ojukwu, P.U., Cadet, E., Osundare, O.S., Fakeyede, O.G., Ige, A.B. and Uzoka, A., 2024. Advancing green bonds through FinTech innovations: A conceptual insight into opportunities and challenges. *International Journal of Engineering Research and Development*, 20(11), pp.565–576. Available at: <http://www.ijerd.com> [Accessed 24 June 2025].
- [27] Raman, R., Ray, S., Das, D., and Nedungadi, P. (2025). Innovations and barriers in sustainable and green finance for advancing sustainable development goals. *Frontiers in Environmental Science*, 12, 1513204.
- [28] Herath, S. K., and Herath, L. M. (2024). Investigation Into the Barriers to AI Adoption in ESG Integration and Identification of Strategies to Overcome These Challenges. In *Social and Ethical Implications of AI in Finance for Sustainability* (pp. 286-311). IGI Global.
- [29] Riyath, M. I., and Jariya, A. M. I. (2024). The role of ESG reporting, artificial intelligence, stakeholders, and innovation performance in fostering sustainability culture and climate resilience. *Journal of Financial Reporting and Accounting*, 21(2), 110-135.
- [30] Xiao, Y., and Xiao, L. (2025). The impact of artificial intelligence-driven ESG performance on sustainable development of central state-owned enterprises listed companies. *Scientific Reports*, 15(1), 8548.
- [31] Iseal, S., Joseph, O., and Joseph, S. (2025). AI in Financial Services: Using Big Data for Risk Assessment and Fraud Detection.
- [32] Lin, S. C., Tian, F., Wang, K., Zhao, X., Huang, J., Xie, Q., ... and Deng, L. (2025). Open FinLLM leaderboard: Towards financial ai readiness. *arXiv preprint arXiv:2501.10963*.
- [33] Sule, A. K., Eyo-Udo, N. L., Onukwulu, E. C., Agho, M. O., and Azubuike, C. (2024). Green finance solutions for banking to combat climate change and promote sustainability. *Gulf Journal of Advance Business Research*, 6(2), 376-410.
- [34] Wang, Q., Sun, T., and Li, R. (2025). Does Artificial Intelligence (AI) enhance green economy efficiency? *Humanities and Social Sciences Communications*, 12(12), 56-78.
- [35] Xu, J. (2024). AI in ESG for financial institutions: An industrial survey. *IEEE Transactions on Sustainable Computing*, 1(1).
- [36] Baklaga, L. (2024). Synergizing AI and Blockchain: Innovations in Decentralized Carbon Markets for Emission Reduction through Intelligent Carbon Credit Trading. *Journal of Computer Science and Technology Studies*, 6(2), 111-120.