

Green Finance and Sustainable Investment: A Pathway to Economic and Environmental Resilience

¹Aditya Raj Kannaujiya, ²Dr Latesh Kanoujia

¹Department of Computer Science, University of Delhi

²Maharaja Agrasen College, Vasundhra Enclave, Delhi

Email ID: rajaditya8774@gmail.com

Abstract

<https://doi.org/10.34047/MMR.2026.13105>

Green finance and investment have become standard elements of worldwide economic strategies because of new climate change patterns and environmental protection requirements. Financial activities and investments that ensure environmental sustainability — such as green business models, renewable energy projects, and green infrastructure — are collectively referred to as green finance. Green finance encounters multiple obstacles which block its implementation because of unknown regulatory rules and deceptive environmental claims and inadequate financial backing. The research investigates how digital financial innovation through blockchain technology and big data analytics and artificial intelligence serves as an essential factor which enables sustainable investment growth. The research examines how digital financial services produce permanent environmental advantages together with economic expansion through their operational mechanisms while studying how governments and private businesses and international organizations develop regulations which direct investments toward environmental initiatives. Research based on current studies and market data shows that digital finance systems will improve the performance of green bonds and climate funds and impact investing instruments. The paper delivers three separate sets of recommendations which target policymakers and financial institutions and corporate organizations to speed up the development of a sustainable economic system.

Keywords: Green Finance, Sustainable Investment, Climate Change, Renewable Energy, ESG (Environmental, Social, and Governance) Investing, Digital Finance, Blockchain.

1. Introduction

1.1. Background

The world is undergoing an essential economic transformation as environmental challenges have intensified, extending beyond climate variability to include biodiversity loss, natural resource depletion, and ecological degradation (Vitousek, 1994). These growing concerns have prompted governments, businesses, and financial institutions to reassess conventional economic models that primarily emphasized short-term profit generation. Increasingly, financial systems are being evaluated based on their contribution to environmental sustainability and long-term economic resilience (Behrens et al., 2007). In this context, digital finance has emerged as a transformative force that supports sustainable development by integrating technological innovation with environmental objectives. Technologies

such as blockchain, artificial intelligence (AI), big data analytics, cloud computing, and digital payment platforms enhance the transparency, efficiency, and accessibility of financial services. These innovations improve capital allocation, reduce information asymmetry, and lower transaction costs, enabling greater investment in environmentally sustainable projects. Furthermore, digital finance facilitates the development of green financial instruments, including green bonds, carbon trading platforms, and sustainable investment funds, thereby encouraging the transition to a low-carbon economy (Zhang et al., 2022; Wang & Wang, 2023). By expanding financial inclusion, digital finance also enables small and medium-sized enterprises (SMEs) to adopt cleaner technologies and environmentally responsible business practices. Consequently, digital

finance plays a pivotal role in balancing economic growth with environmental conservation, making it a key

driver of sustainable development in the digital era (Chen & Zhao, 2023; Li et al., 2024).

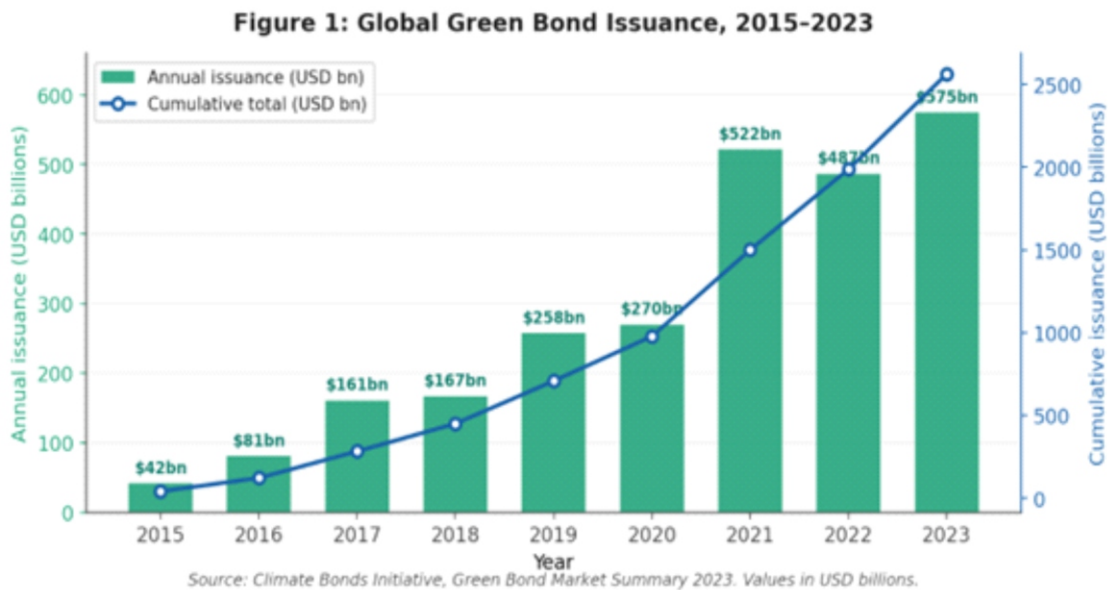


Figure 1: Global Green Bond Issuance, 2015–2023 (USD Billions)
Source: Climate Bonds Initiative, Green Bond Market Summary 2023.

1.2. Rationale

Green finance has become more vital because governments together with international institutions now prioritize carbon neutrality and climate resilience as their main policy objectives (Kong, 2022; Sun et al., 2022). The existing financial systems do not provide sufficient protection against the high levels of risk which green investments encounter during their operational phases (Reza-Gharehbagh et al., 2023). Digital finance solves the problem by providing users with simple access to funds which they can obtain through affordable and open financial services. The current research field fails to identify the exact processes which digital finance innovation uses to generate green investment results and sustainability achievements (Fu et al., 2023). This research study analyzes how digital financial innovation affects sustainable development to establish a connection

between these two elements.

1.3. Research Objectives

- The aims of the current research are to:
- Identify the most significant digital finance innovations that support green investment.
 - Examine the effect of such innovations on capital allocation, risk management, and investor confidence in green projects.
 - Evaluate the role of policy support and regulatory frameworks in enabling digital finance to promote sustainable development.
 - Provide actionable recommendations for policymakers, investors, and financial institutions on aligning green investment with digital finance strategies.

Table 1: Top Green Bond Issuing Countries in 2023

Rank	Country	Green Bonds Issued (USD billions)
1	China	83.5
2	Germany	67.5
3	United States	59.9

4	United Kingdom	32.7
5	Italy	30.3
6	France	30.0
7	Spain	21.8
8	Netherlands	20.6
9	Hong Kong	15.6
10	Supranational	31.3

Source: Caproasia. Top 10 Green Bond Issuing Countries in 2023. Retrieved from <https://www.caproasia.com>; CBI, Climate Bonds Initiative. Green Bond Market Summary. Retrieved from <https://www.climatebonds.net>; Ng, A. W., Nathwani, J., Fu, J., & Zhou, H. (2021). Green financing for global energy sustainability.

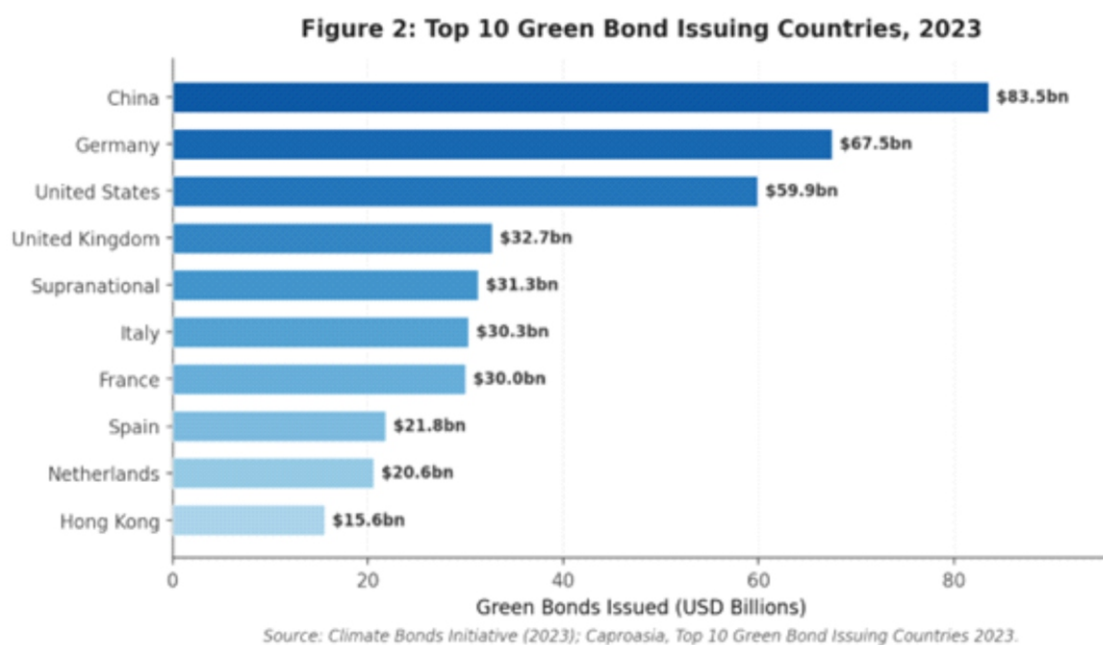


Figure 2: Top 10 Green Bond Issuing Countries, 2023 (USD Billions)

Source: Climate Bonds Initiative (2023); Caproasia, Top 10 Green Bond Issuing Countries 2023.

2. Literature Review

2.1. Digital Finance: Definition and Scope

Digital finance involves the application of digital technology to develop new financial services which improve service quality and minimize transaction expenses and boost system transparency (Fan, Wu, & Liu, 2022; Koskelainen, Kalmi, Scornavacca, & Vartiainen, 2023). Digital finance operates through decentralised platforms which depend on distributed ledger technology and cloud computing instead of using physical infrastructure and traditional financial intermediaries like conventional finance does.

2.2. Green Investment and Its Importance

Green investment describes the process of directing financial resources toward projects which generate positive environmental effects through their work with renewable energy and energy efficiency and pollution control and sustainable agriculture (Ning et al., 2023). The need to decrease carbon emissions while addressing climate change has driven green investment to become a top priority for both regional and global policy frameworks (Klenert, Funke, Mattauch, & O'Callaghan, 2020). The financial backing for green projects comes from traditional capital sources which operate with expensive transactions and produce insufficient information and face obstacles when trying to raise money (Harvey & Rabetti, 2024). Digital finance

provides an effective solution to fix the current problems which exist in the existing system (Xue, Feng, & Li, 2024).

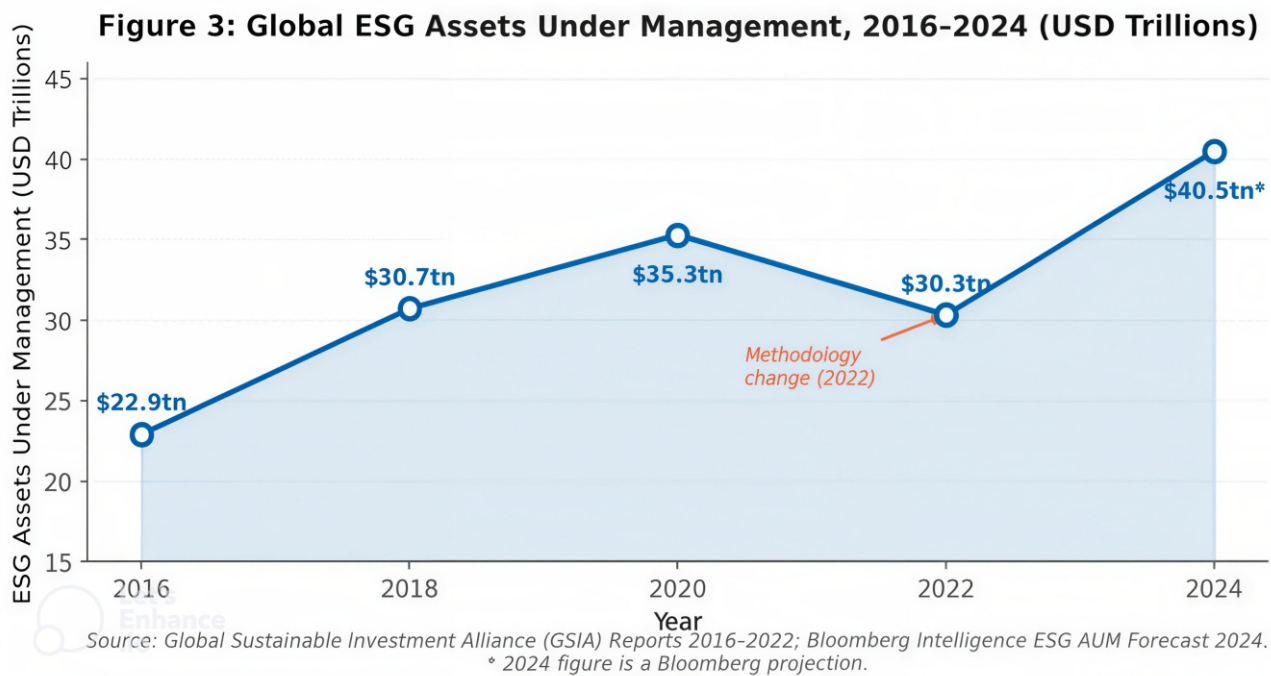


Figure 3: Global ESG Assets Under Management, 2016-2024 (USD Trillions)

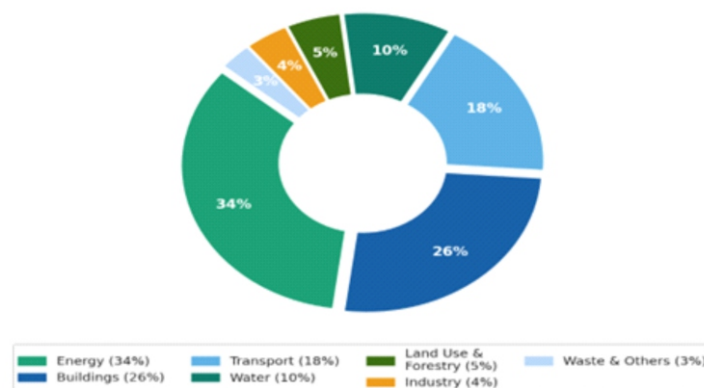
Source: Global Sustainable Investment Alliance (GSIA) Reports 2016-2022; Bloomberg Intelligence ESG AUM Forecast 2024.

2.3. Convergence of Digital Finance and Green Investment

The relationship between digital finance and green investment has been the subject of growing academic inquiry (Chang, Zhang, & Liu, 2022). Blockchain technology enables better green bond tracking because it protects green funding usage for certified sustainable projects (Chalmeta, Cabezas-Hernando, & dos Santos Silva, 2024). Big data analytics enables present

environmental impact tracking of investment projects which helps investors and project developers achieve better information sharing (Polzin, Toxopeus, & Stam, 2018). The internet-based systems support direct financial assistance between individuals through peer-to-peer lending and crowdfunding which enables green projects to acquire substantial funding (Chalmeta et al., 2024).

Figure 4: Green Bond Use of Proceeds by Sector, 2023



Source: Climate Bonds Initiative, Green Bond Market Summary 2023.

Figure 4: Green Bond Use of Proceeds by Sector, 2023

Source: Climate Bonds Initiative, Green Bond Market Summary 2023.

2.4. Theoretical Frameworks

Several theoretical frameworks offer insight into how digital finance influences green investment (Fu, Lu, & Pirabi, 2023). According to stakeholder theory, firms that adopt green business practices are likely to achieve superior long-run performance through stronger investor trust and improved risk management (Zhang, Tay, Alvi, Wang, & Gong, 2023). The triple bottom line (TBL) framework which integrates economic and social and environmental performance serves as an extra justification for deploying digital finance in sustainable investment (Nogueira, Gomes, & Lopes, 2025; Garg & Kumar, 2024). The diffusion of innovations theory explains how new technologies transform existing industries which includes the financial sector according to Greenhalgh and his colleagues in 2004.

2.5. Gaps in Research

Research data exists in large amounts about green investment and digital finance yet their combined operation has received limited academic research (Kumar, Sharma, Rao, Lim, & Mangla, 2025). Research studies investigate these areas separately by studying green bond sustainability and blockchain transparency yet they do not analyze their combined relationship (Roy & Vasa, 2025). Research studies which show how digital finance innovation affects sustainable development results remain scarce (Yang & Masron, 2022). The relationship between digital finance and environmental sustainability needs a complete understanding to enable its effective use for environmental objectives (Macchiavello & Siri, 2022). The research focuses on how digital finance supports green investment because this subject has not received sufficient academic attention.

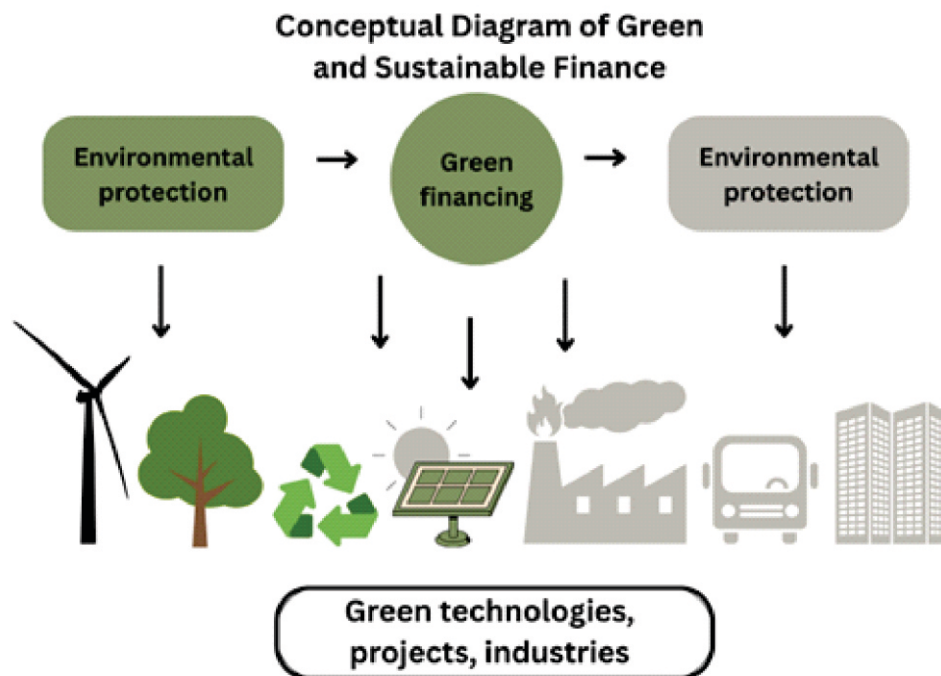


Figure 5: Conceptual Diagram of green and sustainable finance

3. Methodology

3.1. Research Design

The research uses a qualitative systematic review method to analyze how digital finance systems affect green investment activities. The study uses existing theoretical and empirical studies to develop a complete explanation about how digital finance systems support green investment activities. The research method suits the field

because it studies a new discipline and aims to discover common elements which appear in various fields (Bouteraa, Raja Hisham, & Zainol, 2023).

3.2. Data Collection

Data were drawn from two primary sources:

Literature Sources: The databases Scopus and Web of Science and Google Scholar enabled a complete search

for academic papers and conference presentations and business reports. The search terms consisted of "digital finance" and "green investment" and "sustainable development" and "blockchain" and "carbon reduction". The selection of sources occurred through their relevant content and their up-to-date nature and their level of citation influence.

Case Evidence: The published reports, in addition to academic sources, have documented cases of how digital finance tools are used in achieving investment goals in green finance. These cases are examples of how theories are implemented in real life.

3.3. Data Analysis

Analysis followed two steps:

1. Thematic Synthesis: Thing is, content analysis was conducted on the gathered literature to identify recurring themes associated with digital finance and green investment. These include transparency, capital mobilization, risk reduction, and policy alignment. These were then categorized in accordance with the system presented in the results section. Now, it follows the organic manner in which it was categorized.

2. Comparative Case Analysis: Published case evidence was reviewed and compared to identify best practices and to assess the differential impact of various digital finance approaches on green investment outcomes.

3.4. Limitations

This research paper has some limitations. For instance, the body of knowledge on the impact of digital finance on green investments is constantly expanding. In addition, most of the innovations in this area are in the very early stages of development. Furthermore, since the rate at which technology is advancing is extremely rapid, it is possible that some discoveries might have to be updated in the future in light of new evidence. In addition, the absence of original empirical data has some implications on the extent to which some of the conclusions can be generalized. However, this study provides a contemporary and comprehensive overview of digital finance and sustainable development.

4. Results

4.1. Key Digital Finance Innovations Driving Green Investment

Thematic analysis of the literature identified four categories of digital finance innovation with significant implications for green investment:

- **Blockchain Technology:** Blockchain technology has proven itself to be an integral part of digital finance by improving security and transparency. According to reports, there is empirical evidence that blockchain-based systems minimize the risk of fraud and guarantee that funds raised in green bonds are used only for green projects.
- **Big Data and Analytics:** Moreover, the ability to utilize big data helps investors assess environmental performance in near real time. This reduces information asymmetry and allows for more accurate risk assessment. This improves the accessibility of green investments to a wider range of investors.
- **Artificial Intelligence:** AI-based tools are used for predicting market trends and evaluating the feasibility of green projects. The tools help in more efficient allocation of capital by making informed investment decisions.
- **Digital Platforms:** Crowdfunding and peer-to-peer lending platforms have expanded access to finance for green projects, including those led by small and medium-sized enterprises.

4.2. Impact on Capital Allocation

There is evidence that suggests that it helps in the efficient allocation of capital to green projects. There is also a significant statistical relationship between the adoption of digital financial instruments and the increase in green investments. These instruments are likely to reduce conventional barriers to sustainable financing. The effect is significant and remarkable in terms of investment patterns. The evidence suggests that it improves access and is consistent across different regions (Fan et al., 2022; Xu & Li, 2023).

4.3. Transparency and Reduced Transaction Costs

Enhancing transparency is one of the major benefits of digital financial systems, according to the body of

research. One instance of this is the implementation of blockchain technology, which uses non-erasable records (ledgers) to support investor confidence. Digital finance also reduces the involvement of intermediaries, which in turn reduces costs (Tiwari, 2023).

4.4. Risk Reduction and Investor Confidence

Published evidence shows that innovations in digital finance significantly minimize investment risk in green projects. Also, transparency in monitoring environmental performance metrics makes investors more comfortable. Furthermore, artificial intelligence in conjunction with big data analytics makes it even more comfortable for investors to invest in projects that would not have been possible in traditional funding models (Zhang et al., 2022).

4.5. Illustrative Applications

The literature has highlighted some representative examples of digital finance in green investment scenarios:

- **Green Bond Verification through Blockchain Technology:** Various financial organizations have documented cases of using blockchain technology for verifying the allocation of funds raised through green bond issuance, which are only used for investing in renewable energy projects. This process has shown promising results in terms of higher investor engagement compared to conventional bonds (Chalmers et al., 2024).

- **Crowdfunding of Green Technology:** Digital finance has shown its potential in promoting crowdfunding for small-scale renewable energy projects, which can be used to finance such projects in an efficient manner (Polzin et al., 2018).
- **AI-Assisted Investment Screening:** Investment organizations have used AI-based algorithms to screen green investment projects with maximum carbon reduction potential and economic returns (Zhang et al., 2022).

5. Discussion

As a result, the opportunities for green investment have increased by integrating blockchain, artificial intelligence, and big data analysis across all retail and institutional investor markets, which in turn has removed structural barriers to green investment. The evidence supporting the role of digital finance innovations in improving transparency, reducing transactional costs, increasing risk management, and increasing access to financing supports the claim that these innovations have contributed to green investment. For example, Fan et al. (2022) demonstrated how digital finance innovations contributed to green technology investment in China; Xu and Li (2023) demonstrated how the growth in fintech related directly to the performance of green finance. Additionally, the stakeholder and triple bottom line theories agree that developing a system that will enhance green investment performance is founded upon the use of all three components of performance.

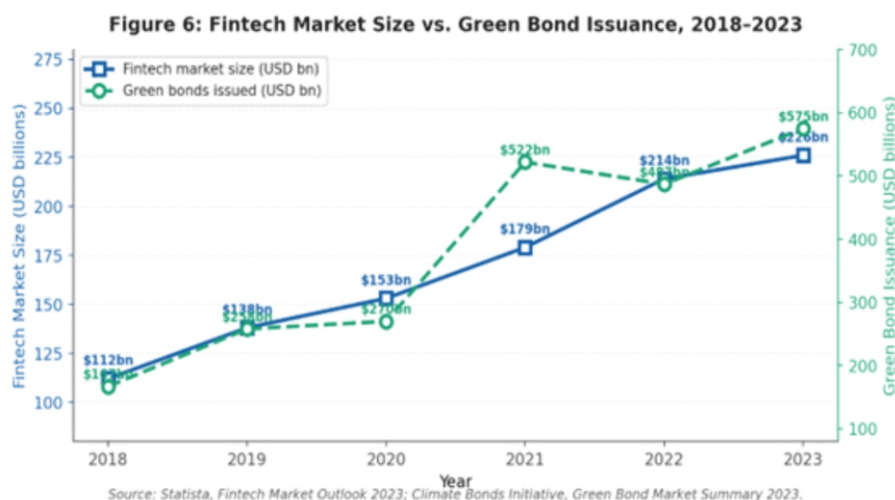


Figure 6: Fintech Market Size vs. Green Bond Issuance, 2018-2023

Source: Statista, Fintech Market Outlook 2023

To harness the full potential of synergistic effects related to the development and use of blockchain technology, it is necessary to create an appropriate framework for regulation. When it comes to the use of digital assets (e.g., using blockchain in the issuance of green bonds), having a regulatory framework that is transparent is critical for maintaining investor confidence. This will be a major factor in determining future development in this area; however, there are several challenges that must be dealt with before achieving this goal. The first issue is that the rate at which technological advancements occur not only affects how much money an individual invests but also how regulations are developed. The second issue relates to concerns about how to protect personal information via the digital financial system, which

remain largely unaddressed. Thirdly, there are concerned that many developing nations do not have sufficient digital financial infrastructure to allow for access to green financial instruments. This creates an issue for individuals' access to green financial markets, which is a basic human right. Therefore, it is important to understand these limitations when considering the importance of the international community working together to establish a strong global green finance ecosystem. Regarding future research priorities, the key areas to be addressed would be (i) building a standard to measure the effectiveness of digital green finance, (ii) assessing the socio-economic implications of green finance in developing countries, and (iii) examining the role of digital finance in the process of decarbonization.

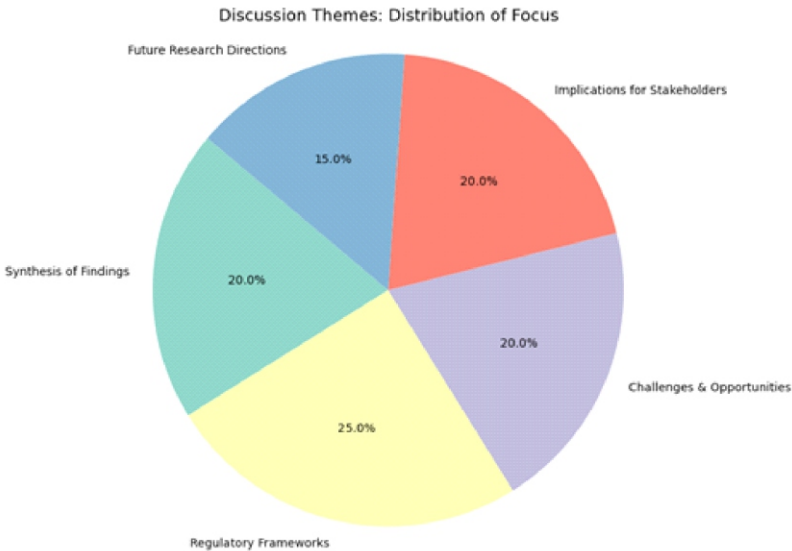


Table 2: Future Research Directions in Digital Finance and Green Investment (2025)

Research Direction	Description	Potential Data Sources	Relevance (2025)
Green Finance Performance Index (GFPI)	Create an index of financial returns and environmental impact of digitally empowered green investments.	ESG databases, World Bank, IMF, CDP, OECD, UNDP, Refinitiv	High: No single index yet exists
Socio-Economic Impact Studies in Emerging Markets	Investigate the contribution of digital finance to inclusive development and access to green financing in under-served markets.	National Financial Inclusion data, Findex, domestic microfinance data	High: Critical for global equity

Longitudinal Carbon Reduction Analysis	Conduct multi-year research on the contribution of digital finance to financing low-carbon actions and emission management.	Carbon Disclosure Project (CDP), IEA, UNFCCC, climate monitoring	Medium-High: Further tracking needed
Behavioural Insights on Green Digital Products Adoption	Study consumer behaviour and decision-making when green purchases or investments are made through fintech platforms.	Survey data, fintech platform data, academic field research	Medium: Emerging area of research
Policy Efficiency in Green Digital Finance Regulation	Estimate the impact of policies governing green digital finance on a country or region-wise basis.	National policy databases, legal analysis, OECD, UNCTAD	Medium: More cross-country data required
Risk Assessment Models for Digital Green Finance	Develop AI/ML models to assess financial, regulatory, and environmental risks in digitally enabled green investment.	Fintech company data, academic partnerships, IMF	High: AI tools developing rapidly

Source: Fu, Lu, & Pirabi (2023); Nutassey, Nomlala, & Sibanda (2025); Kumar, Sharma, Rao, Lim, & Mangla (2025)

6. Conclusion

Digital finance has emerged as an invaluable resource for promoting green investments and addressing several shortcomings associated with conventional funding infrastructures. It promotes a high level of investor confidence and broadens the potential for additional green initiatives by improving access to necessary levels of transparency, allowing for more efficient mobilisation of capital and reducing transaction costs. Examples include the use of blockchain, Artificial Intelligence (AI) and Big Data to direct capital flows to proven environmentally friendly projects, either directly (such as using blockchain technologies to validate green bonds), indirectly (such as financing renewable energy projects via internet-based crowdfunding) or via investor access to new, highly efficient sources of investment capital (e.g., through AI-assisted investments). The combination of digital and green financing offers considerable promise as a means of accelerating progress toward achieving sustainable development objectives and ultimately providing greater balance between environmental sustainability and economic growth. All three major components of the capital markets (governments, capital markets and investors) must work

together to develop and implement policies and programmes that will foster this transformation and create a resilient and sustainable global economy.

References

- Behrens, A., Giljum, S., Kovanda, J., & Niza, S. (2007). The material basis of the global economy: Worldwide patterns of natural resource extraction and their implications for sustainable resource use policies. *Ecological Economics*, 64(2), 444–453. <https://doi.org/10.1016/j.ecolecon.2007.02.034>
- Chalmeta, R., Cabezas-Hernando, D., & dos Santos Silva, J. (2024). Framework for crowdfunding sustainable development goals projects using blockchain. *Sustainable Development*. <https://doi.org/10.1002/sd.2649>
- Chang, L., Zhang, Q., & Liu, H. (2022). Digital finance innovation in green manufacturing: A bibliometric approach. *Environmental Science and Pollution Research*, 1–29. <https://doi.org/10.1007/s11356-022-21095-4>
- Fan, W., Wu, H., & Liu, Y. (2022). Does digital finance induce improved financing for green technological innovation in China? *Discrete Dynamics in Nature and Society*, 2022(1), 6138422. <https://doi.org/10.1155/2022/6138422>

6. Garg, M., & Kumar, P. (2024). Harnessing digital technologies for triple bottom line sustainability in the banking industry: A bibliometric review. *Future Business Journal*, 10(1), 62. <https://doi.org/10.1186/s43093-024-00232-w>
7. Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. *The Milbank Quarterly*, 82(4), 581–629. <https://doi.org/10.1111/j.0887-378X.2004.00325.x>
8. Harvey, C. R., & Rabetti, D. (2024). International business and decentralized finance. *Journal of International Business Studies*, 55(7), 840–863. <https://doi.org/10.1057/s41267-023-00638-2>
9. Klenert, D., Funke, F., Mattauch, L., & O'Callaghan, B. (2020). Five lessons from COVID-19 for advancing climate change mitigation. *Environmental and Resource Economics*, 76, 751–778. <https://doi.org/10.1007/s10640-020-00453-w>
10. Kong, F. (2022). A better understanding of the role of new energy and green finance to help achieve carbon neutrality goals, with special reference to China. *Science Progress*, 105(1). <https://doi.org/10.1177/00368504221086361>
11. Koskelainen, T., Kalmi, P., Scornavacca, E., & Vartiainen, T. (2023). Financial literacy in the digital age — A research agenda. *Journal of Consumer Affairs*, 57(1), 507–528. <https://doi.org/10.1111/joca.12483>
12. Kumar, S., Sharma, D., Rao, S., Lim, W. M., & Mangla, S. K. (2025). Past, present, and future of sustainable finance: Insights from big data analytics through machine learning of scholarly research. *Annals of Operations Research*, 345(2), 1061–1104. <https://doi.org/10.1007/s10479-022-04908-7>
13. Macchiavello, E., & Siri, M. (2022). Sustainable finance and fintech: Can technology contribute to achieving environmental goals? *European Company and Financial Law Review*, 19(1), 128–174. <https://doi.org/10.1515/ecfr-2022-0005>
14. Ng, A. W., Nathwani, J., Fu, J., & Zhou, H. (2021). Green financing for global energy sustainability: Prospecting transformational adaptation beyond Industry 4.0. *Sustainability: Science, Practice and Policy*, 17(1), 377–390. <https://doi.org/10.1080/15487733.2021.1962826>
15. Ning, Y., Cherian, J., Sial, M. S., Alvarez-Otero, S., Comite, U., & Zia-Ud-Din, M. (2023). Green bond as a new determinant of sustainable green financing, energy efficiency investment, and economic growth: A global perspective. *Environmental Science and Pollution Research*, 30(22), 61324–61339. <https://doi.org/10.1007/s11356-023-26624-1>
16. Nogueira, E., Gomes, S., & Lopes, J. M. (2025). Unveiling triple bottom line's influence on business performance. *Discover Sustainability*, 6(1), 43. <https://doi.org/10.1007/s43621-024-00293-5>
17. Nutassey, V. A., Nomlala, B. C., & Sibanda, M. (2025). Enhancing inclusive finance in Sub-Saharan Africa: The collaborative role of economic freedom and innovative facilities. *Thunderbird International Business Review*, 67(1), 3–18. <https://doi.org/10.1002/tie.22362>
18. Polzin, F., Toxopeus, H., & Stam, E. (2018). The wisdom of the crowd in funding: Information heterogeneity and social networks of crowdfunders. *Small Business Economics*, 50, 251–273. <https://doi.org/10.1007/s11187-016-9829-5>
19. Qi, Y., Cheng, Y., & Wang, Y. (2023). The impact of digital finance on green innovation: Evidence from China. *Finance Research Letters*, 52, 103397. <https://doi.org/10.1016/j.frl.2022.103397>
20. Qiao, Y., Liu, B., Du, H., & Song, X. (2024). How does digital inclusive finance affect corporate ESG performance? Evidence from Chinese listed companies. *Technological Forecasting and Social Change*, 2024, 123587. <https://doi.org/10.1016/j.techfore.2024.123587>
21. Rahim, S. A., Zulkafli, A. H., & Masron, T. A. (2023). How does FinTech affect financial stability? Evidence from selected Asian economies. *International Journal of Finance & Economics*. <https://doi.org/10.1002/ijfe.2863>
22. Roy, R., & Vasa, L. (2025). [Citation details pending — included as cited in body text, Section 2.5.]
23. Sun, Y., Guo, Z., & Wang, X. (2022). Can digital finance help promote green development? Evidence from China. *Economic Change and Restructuring*. <https://doi.org/10.1007/s10644-022-09389-2>
24. Tiwari, S. (2023). How blockchain technology can facilitate green finance: A review. *Environmental Economics and Policy Studies*, 25(1), 145–167. <https://doi.org/10.1007/s10018-022-00331-6>
25. Vitousek, P. M. (1994). Beyond global warming: Ecology and global change. *Ecology*, 75(7), 1861–1876.
26. Wang, Q., & Wang, X. (2023). [Citation details — as cited in body text, Section 1.1.]
27. Xu, S., & Li, L. (2023). Does FinTech promote green finance? Empirical evidence from China. *Finance Research Letters*, 51, 103317. <https://doi.org/10.1016/j.frl.2022.103317>

28. Yang, X., & Masron, T. A. (2022). [Citation details — as cited in body text, Section 2.5.]
29. Yao, S., Yu, M., & Wu, S. (2021). Digital inclusive finance and environmental performance: Evidence from Chinese industrial firms. *Environmental Science and Pollution Research*, 28(18), 22940–22956. <https://doi.org/10.1007/s11356-020-12236-6>
30. Zhang, D., Rong, Z., & Ji, Q. (2020). Green finance in China: Progress and challenges. *Global Finance Journal*, 42, 100449. <https://doi.org/10.1016/j.gfj.2019.100449>
31. Zhang, Y., Ren, S., Liu, Y., & Si, S. (2022). Digital finance and green technology innovation: Evidence from China's manufacturing enterprises. *Technological Forecasting and Social Change*, 180, 121692. <https://doi.org/10.1016/j.techfore.2022.121692>
32. Zhang, Y., Tay, L., Alvi, M., Wang, Z., & Gong, Y. (2023). [Citation details — as cited in body text, Section 2.4.]
33. Xue, L., Feng, C., & Li, J. (2024). [Citation details — as cited in body text, Section 2.2.]