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FINTECH AND SUSTAINABLE DEVELOPMENT: A SYSTEMATIC REVIEW OF FINANCIAL INCLUSION, GREEN FINANCE, AND DIGITAL TRANSFORMATION

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ABSTRACT

Objective: This study aims to systematically examine the role of Financial Technology (FinTech) in advancing sustainable development by identifying key research themes, trends, and gaps that link digital financial innovation with the Sustainable Development Goals (SDGs).

Research Design & Methods: A qualitative Systematic Literature Review (SLR) was employed using data from Scopus, Web of Science, and Google Scholar data (2017–2025). After a rigorous screening process, total of 259 articles were analyzed bibliometrically, with 48 full-text articles examined qualitatively using VOSviewer and thematic analysis to identify research clusters, trends, and knowledge gaps.

Findings: The research findings reveal four major research clusters: (1) green finance and environmental sustainability, (2) economic growth and innovation, (3) core technologies such as artificial intelligence (AI) and blockchain, and (4) financial inclusion and digital adoption. The results indicate a transformational pathway in which technological innovation enhances financial inclusion and economic development, ultimately supporting sustainability outcomes. However, significant gaps remain, particularly in integrating multiple technologies and in directly linking FinTech to green finance and the implementation of the SDGs.

Implications: This study highlights the need for an integrated regulatory framework, improved digital infrastructure, and enhanced financial literacy to maximize FinTech's contribution to sustainable development, especially in developing countries.

Contribution & Value Added: This study contributes by providing a comprehensive framework that connects FinTech, sustainability, and the SDGs, while identifying critical research gaps and future directions toward a holistic, policy-driven, sustainable financial ecosystem.

Keywords: FinTech, Sustainability, Financial Inclusion, Green Finance, Digital Innovation.

JEL codes: O16, G21, Q56
Article type: research paper

INTRODUCTION

The integration of financial technology (FinTech) and sustainability principles has become one of the most transformative developments in the global economy. The growing demand for sustainable development and a greener economy has repositioned digital innovation from an operational tool to a strategic driver in achieving the Sustainable Development Goals (SDGs) set by the United Nations (Offiong et al., 2025). This transformation is driven by advanced technologies such as artificial intelligence (AI), blockchain, big data analytics, and the Internet of Things (IoT), which are fundamentally reshaping financial systems and enabling more efficient, inclusive, and sustainable financial services (Khare et al., 2024; Tariq, 2025).

Various FinTech innovations, such as blockchain, AI, big data analytics, and mobile banking, have enhanced operational efficiency, transparency, and security in financial services. These technologies not only meet the needs of retail consumers but also help promote financial inclusion by narrowing the gap in access to formal financial services. Additionally, this development creates new opportunities for sustainable financial instruments, such as green finance and environment-based financing (Galeone et al., 2024). Digitalization enables customers to

access and even use financial services independently (self-service), thereby increasing efficiency and flexibility in their use (Widagdo and Sa'diyah, 2023).

Globally, the green finance market has seen a significant surge. The share of green finance rose from just 0.1% in 2012 to 4% of total global assets in 2022, with the volume of green instrument issuances growing to US$600 billion over the same period (Opoku et al., 2026). By 2023, the global volume of green finance issuances had already surpassed US$1 trillion (Ben Abdallah, 2026). This growth reflects a shift in investors' priorities toward incorporating environmental, social, and governance criteria into their decision-making processes, driven by the urgency of climate change and global urbanization, which is projected to encompass 70% of the world's population by 2050 (Offiong et al., 2025).

Financial Technology (FinTech) has emerged as a transformative force in the modern financial system, significantly reshaping the way financial services are provided and accessed by individuals and businesses. Over the past few decades, the rapid expansion of digital innovation has enabled companies to adapt to an increasingly global market by offering more efficient, flexible, and inclusive financial solutions (Desalegn and Tangl, 2022). Technologies such as blockchain, AI, big data analytics, and digital banking have improved operational efficiency, transparency, and security, while expanding financial access and reducing inequality.

The integration of FinTech into the financial system has also contributed to progress in sustainable development. By reducing transaction costs, eliminating geographical barriers, and improving access to financial services, digital financial solutions have enabled broader participation in economic activities (Widagdo and Sa'diyah, 2023). In addition, FinTech plays a key role in facilitating green finance initiatives, ethical investments, and environmentally sustainable business practices through digital platforms that promote resource efficiency and reduce environmental impact (Galeone et al., 2024). FinTech promotes financial inclusion while serving as a key driver of the transition to sustainability.

Furthermore, several studies indicate that FinTech plays a critical role in enabling the transition to a sustainable economy, particularly by increasing the use of renewable energy and green financing. A study by Ye et al. (2023) in China found that FinTech growth significantly drives the use of renewable energy, with financing scale and income levels as the primary mediating factors. FinTech can also lower barriers to investment by improving access to financing, reducing transaction costs, and enhancing companies' operational efficiency. Furthermore, integrating of environmental, social, and governance (ESG) principles into FinTech innovations further strengthens the financial sector's role in achieving sustainable development goals. The implementation of ESG not only enhances financial institutions' ability to manage environmental and climate change risks, but also promotes a more responsible and sustainable financial system (Galeone et al., 2024).

This study aims to conduct a systematic literature review to map the intellectual landscape of digital financial innovation in relation to sustainable development. This study systematically examines how FinTech innovations contribute to sustainable development by identifying key themes, mapping research trends, and highlighting existing gaps in the literature. This study highlights the role of technology in the sustainability of FinTech and reveals the fragmentation of its application in green finance. It also provides a framework linking FinTech, financial inclusion, and sustainable development. By identifying knowledge gaps, these findings offer insights for policymakers and practitioners.

LITERATURE REVIEW

FinTech is defined as technology-driven innovation in financial services that generates new business models, processes, and products with a significant impact on global financial systems (Klimontowicz et al., 2024). In the context of sustainable development, FinTech serves not only as a tool for improving transaction efficiency but has evolved into a multidimensional enabler that encompasses social, economic, and environmental aspects (Offiong et al., 2025). The role of FinTech in sustainable development is multifaceted and is heavily influenced by the institutional context, the level of digital readiness, and the economic structure of a region. Therefore, a comprehensive analysis is needed to understand FinTech's contribution to sustainability, including social inclusion and environmental sustainability, as well as its impacts and limitations in various contexts (Offiong et al., 2025).

Financial Inclusion and Social Equity

FinTech has been recognized as one of the main instruments for increasing financial inclusion and reducing social inequality, in line with the SDGs, especially in poverty alleviation and inequality reduction (Tidjani and Madouri, 2024). Digital platforms such as e-wallets and mobile banking can reduce transaction costs and overcome geographical barriers, thus enabling people who previously lacked access to banking services to join the formal financial system (Kaur and Negi, 2025). However, there is a risk of a digital divide emerging, where gaps in access to technology and digital literacy can widen new inequalities if not balanced with inclusive policies (Foster et al., 2021).

Within the context of culture and religious values, Islamic FinTech shows significant potential in increasing financial inclusion, particularly in Muslim-majority countries. Sharia-compliant platforms that integrate social

instruments such as zakat, infaq, sedekah, and waqf (ZISWAF) can increase efficiency and transparency in the distribution of social funds (Dwiputra and Juliana, 2025). This finding is supported by studies showing that value alignment is an important factor in FinTech adoption in certain societies (Offiong et al., 2025). Additionally, local context-based innovations such as the Pay As You Go (PAYG) solar energy financing model in Kenya demonstrate that FinTech can integrate social and environmental objectives simultaneously. However, its scalability remains limited under certain conditions (Rolffs et al., 2015).

Financial Innovation and Economic Development

FinTech's role in economic transformation is increasingly evident through its ability to drive business innovation and operational efficiency. At the macro level, the development of the digital financial sector has been shown to contribute to improved environmental performance and support the Environmental Kuznets Curve hypothesis (Fakher and Ahmed, 2023). At the micro level, FinTech helps small and medium-sized enterprises (SMEs) adopt sustainable business models by increasing efficiency and reducing resource constraints. The combination of FinTech and green leadership can significantly improve a company's environmental performance (Tian et al., 2023). In addition, the digital ecosystems developed by large companies such as Alibaba and Tencent demonstrate how cross-sector integration can increase the scalability of FinTech innovation (Zhang-Zhang et al., 2020). Thus, FinTech not only serves a role as a financial tool, but also as a catalyst for economic transformation through digital innovation.

Green Finance and Environmental Sustainability

FinTech enables the development of innovative financial instruments such as green bonds, carbon tracking, and sustainability-linked loans that aim to support environmentally friendly projects (Jain et al., 2024; Opoku et al., 2026). However, the implementation of green finance still faces various challenges, such as the lack of investment-worthy projects (bankable projects) and the absence of clear taxonomy standards, which can cause uncertainty for investors. Additionally, there is a risk of greenwashing, where sustainability claims are not always supported by real impacts (Perera et al., 2026). Many FinTech initiatives have not been proven to have an impact on environmental sustainability (Benami and Carter, 2021). Investment in technology must be balanced with policies for the success of FinTech-based green finance.

Regulation, Policy, and Institutional Framework

Regulations and policies play a crucial role in determining the success of FinTech implementation in supporting sustainable development. Technologies such as blockchain and AI offer transparency and efficiency, but they also present challenges related to energy consumption, regulatory standards, and cross-border coordination (Hoang et al., 2022). In certain contexts, alignment between regulations and cultural values has been shown to boost the adoption of FinTech. For example, policy support for Islamic FinTech in Southeast Asia has driven the growth of Sharia-compliant platforms in countries such as Indonesia and Malaysia (Offiong et al., 2025).

However, the literature also highlights disparities in the distribution of FinTech benefits due to differences in digital development across countries (Li et al., 2020). In addition, policies such as regulatory sandboxes and innovation hubs, while promoting innovation, also carry the potential risk of regulatory capture if not closely monitored (Bayram et al., 2022). Therefore, an adaptive and collaborative regulatory framework is needed to ensure that FinTech development supports SDGs inclusively and sustainably.

METHODS

This study employs a qualitative approach using the Systematic Literature Review (SLR) method in the field of FinTech to comprehensively analyze the relationship between digital financial innovation and sustainable development. This method was chosen because it provides a systematic synthesis of various previous studies and identifies trends, patterns, and remaining research gaps. The research process was conducted in two main stages: (1) systematic literature collection and screening, and (2) bibliometric and thematic analysis, as illustrated in Figure 1. First, a systematic literature review was conducted using three major academic databases Scopus, Web of Science (WoS), and Google Scholar employing a combination of Boolean search terms such as ("FinTech" OR "financial technology" OR "financial innovation") AND ("sustainability" OR "sustainable development" OR "green finance" OR "financial inclusion") to capture a comprehensive global perspective. The retrieved articles were exported to CSV format and underwent rigorous data cleaning, including duplicate removal, metadata verification, relevance filtering, and the exclusion of non-English and non-peer-reviewed publications to ensure the quality of the dataset. Second, the analysis phase employs bibliometric and thematic approaches to identify research networks and classify the literature into key areas. This study combines conceptual mapping with analytical procedures to understand how FinTech innovations support sustainable development and to identify research gaps in technology integration.

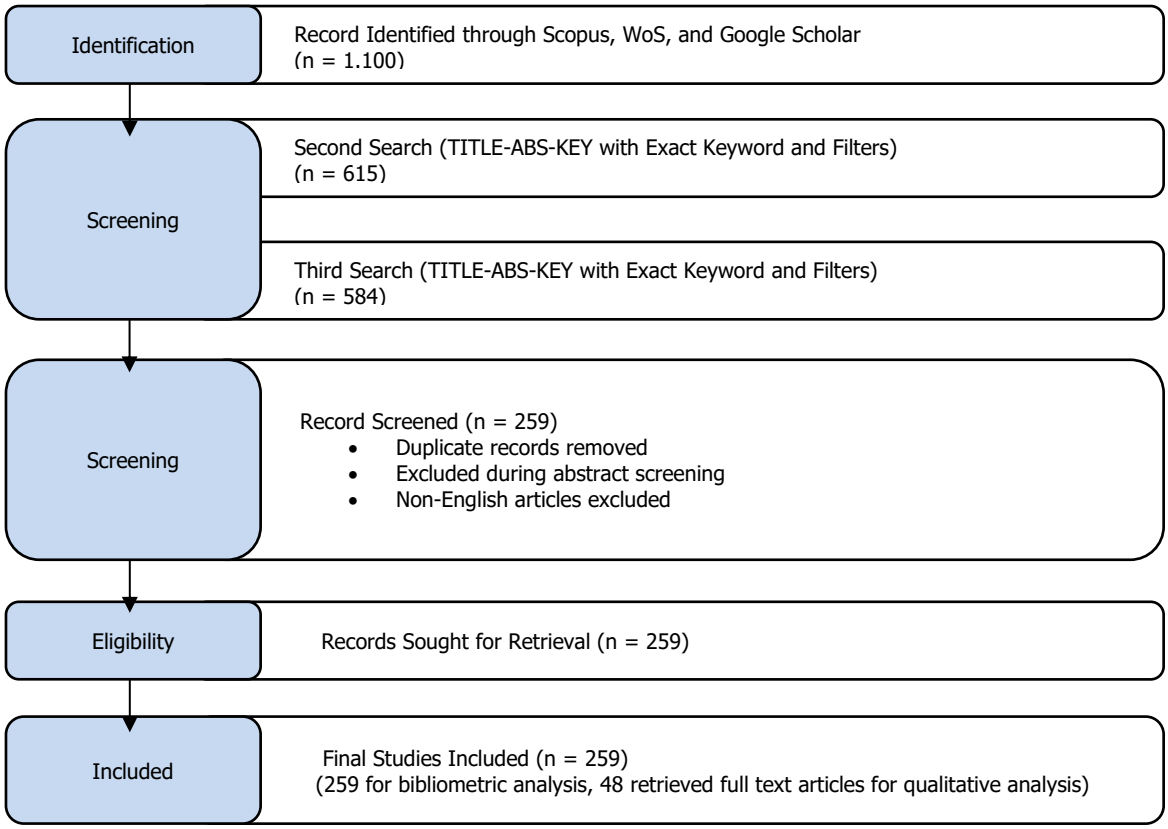

Figure 1. Systematic Literature Review and Analytical Framework

RESULT

Research Cluster Analysis

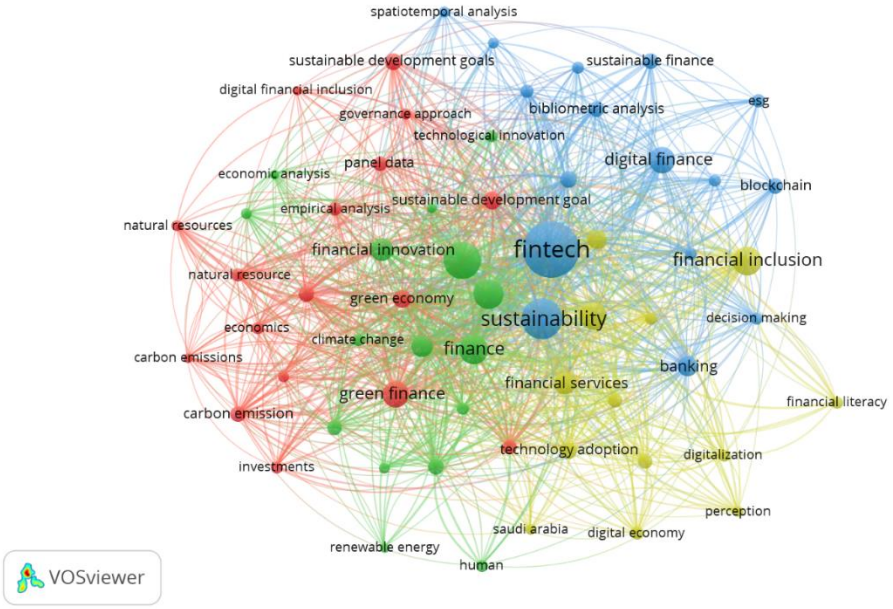

Figure 2. VOSviewer-Based Cluster Mapping of FinTech and Sustainability Research

Cluster analysis based on VOSviewer mapping shows that the intellectual structure of research on FinTech and sustainability is divided into four main groups, interconnected but with distinct different focuses, as illustrated in Figure 2 and Table 1. The first cluster highlights the connection between FinTech and environmental sustainability, focusing on topics such as green finance, carbon emissions, and the SDGs, positioning FinTech as an enabler of green financing, enhanced ESG transparency, and support for environmentally friendly investments. The second cluster focuses on economics, particularly the role of FinTech in driving economic growth, innovation, and sustainable development, where FinTech catalyses improvement in the efficiency of the financial system and in financing the productive sector. Meanwhile, the third cluster represents core technology, dominated by FinTech, digital finance, artificial intelligence, and blockchain, indicating that research developments are heavily influenced by technological advancements such as AI and blockchain in creating financial systems that are more automated, predictive, and transparent. The fourth cluster focuses on implementation aspects, particularly regarding financial inclusion, the digital economy, and technology adoption, which represent the demand side of FinTech, especially in the context of developing countries and SMEs' access to digital financial services.

Table 1. Cluster-Based Thematic Classification of FinTech and Sustainability Research

Theme	Sub-Theme	Reference Count	Reference Weight (%)
Green Finance, Environmental Sustainability, and SDGs	Green finance	32	12.36%
	Environmental sustainability	7	2.70%
	Climate change	5	1.93%
	Carbon emissions	2	0.77%
	SDGs / Sustainable development goals	8	3.09%
	Sustainable development	53	20.46%
	Green economy	8	3.09%
Economic Growth, Innovation, and Development	Economic growth	16	6.18%
	Economic development	6	2.32%
	Innovation	59	22.78%
	Financial innovation	20	7.72%
	Technological innovation	8	3.09%
	Investment	18	6.95%
	Financial development	5	1.93%
Core Technology (AI, Blockchain, Digital Finance)	FinTech	161	62.16%
	Digital finance	38	14.67%
	Artificial intelligence	10	3.86%
	Blockchain	19	7.34%
	Machine learning	7	2.70%
	Banking	22	8.49%
	Sustainability (tech-linked)	69	26.64%
Financial Inclusion, Digital Economy, and Adoption	Financial inclusion	42	16.22%
	Digital financial inclusion	6	2.32%
	Digital economy	9	3.47%
	Digital transformation	9	3.47%
	Digitization / Digitalization	2	0.77%
	Technology adoption	9	3.47%
	Financial services	11	4.25%
	Financial system	6	2.32%

Overall, the findings reveal a structured transformation pathway, beginning with technology development (Cluster 3), followed by its adoption within the digital economy and financial inclusion (Cluster 4), which in turn drives economic growth and innovation (Cluster 2), and ultimately contributes to environmental sustainability (Cluster 1). This underscores the strategic role of technologies such as AI and blockchain in bridging FinTech with the sustainability agenda. However, this mapping also reveals research gaps, particularly the lack of studies that simultaneously integrate various technologies such as AI, blockchain, and smart contracts within the context of SDG-based green finance, as well as the scarcity of research focused on policy implementation (policy-driven FinTech sustainability). Therefore, future research should adopt a more holistic, integrated approach to maximize the role of FinTech in driving an inclusive, innovative, and sustainable financial system.

Dynamics of Global Collaboration and Research Dominance

The development of FinTech research has experienced rapid growth since 2013, with an annual growth rate of 60.62%, driven by technological advances such as AI, blockchain, and financial digitalization (Nefla and

Jellouli, 2025). However, the key finding lies not only in the increasing number of publications, but also in the growing role of global collaboration in shaping the direction and quality of research. FinTech is evolving as an interdisciplinary field that inherently requires cross-border integration, making international collaboration key to accelerating the diffusion of knowledge and innovation (Kumar and Simic, 2025; Salleh et al., 2025). Global collaboration patterns reveal dynamic networks, particularly among countries such as China, the United States, and India, which serve as knowledge hubs, as illustrated in Figure 3. This collaboration not only increases research productivity, but also significantly strengthens scientific impact, as reflected by the high citation rates of cross-country collaborative publications. In addition, international cooperation enables the integration of various perspectives, including in the development of new themes such as green finance, platform-based innovation, and AI integration into the global financial system.

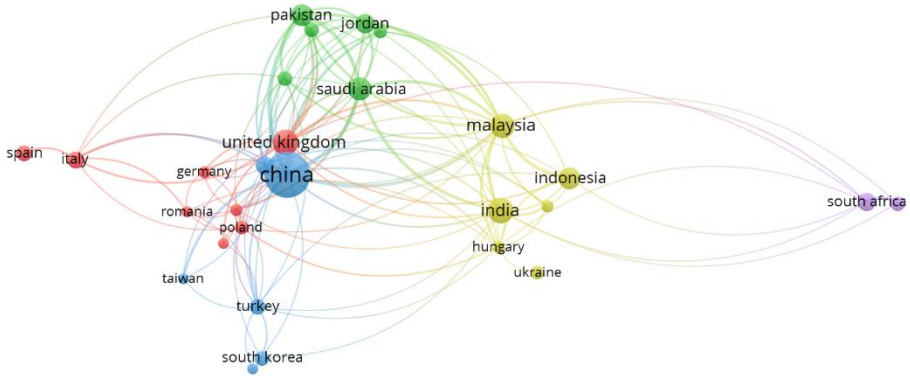

Figure 3. Global Collaboration Network in FinTech and Sustainability Research

However, the literature also reveals inequalities in global collaboration networks. Regions such as Africa and parts of South Asia remain relatively under-involved, indicating that access to international collaboration is unequal (Kumar and Simic, 2025). On the other hand, developing countries such as India and Malaysia are increasingly playing a role in global networks, signalling a shift towards more inclusive collaboration (Rahman et al., 2024). The main supporting factors in this regard are government policies and investments in digital infrastructure, which have been shown to increase a country's collaborative capacity and research contribution (Rahman et al., 2024). In addition, the dynamics of global collaboration are influenced by international events, such as the COVID-19 pandemic, which significantly increases research connectivity and encourages collaboration on strategic issues, such as the sustainability and resilience of the financial system (Jellouli, 2025). This shows that global FinTech collaboration is adaptive and responsive to changes in the global environment.

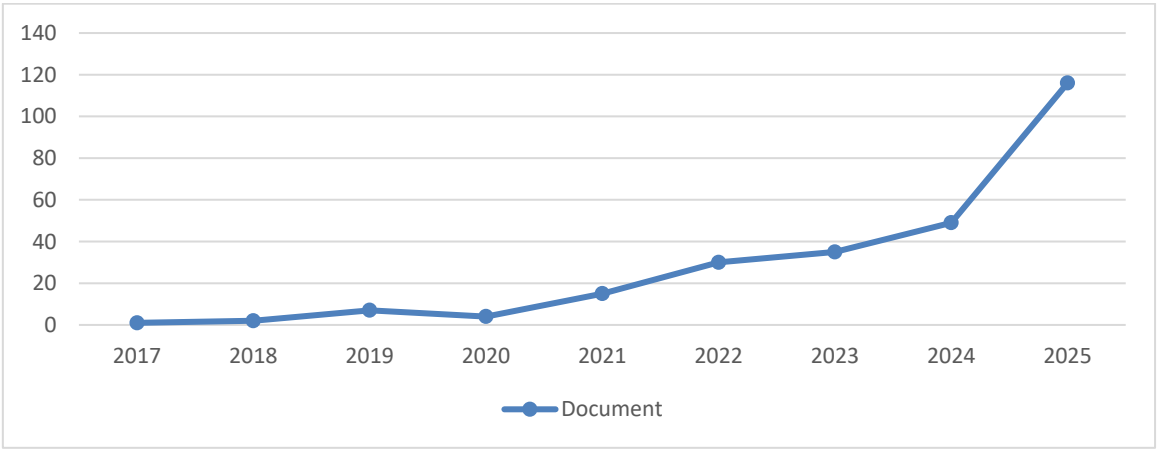

Figure 4. Publication Trend of FinTech and Sustainable Development Research (2017–2025)

The publication trend for FinTech and sustainable development shows a clear and rapid upward trajectory over time, as illustrated in Figure 4. Starting from a very limited number of studies in 2017–2019 (1–7 papers), this field is still in its early stages of exploration. Despite a slight decrease in 2020 (4 documents), research activity increased significantly from 2021 onwards, rising sharply from 15 documents in 2021 to 30 in 2022, and continuing to grow to 35 in 2023 and 49 in 2024. The most significant spike occurred in 2025, reaching 116 documents, indicating a strong expansion phase. Overall, this pattern reflects growing academic and practical interest, positioning FinTech as an increasingly important field in supporting sustainable development and signalling significant opportunities for further research.

DISCUSSION

Technology Dominance as a Core Driver of FinTech Sustainability

FinTech has revolutionized the financial industry through the use of information technology and digital systems, significantly enhancing the efficiency, transparency, and accessibility of financial services (Almasria et al., 2024). The dominance of technology in FinTech not only affects the performance of the financial sector but also serves as a key driver of economic, social, and environmental sustainability (Jain et al., 2024). This is because FinTech integrates technology, data, and user-centric approaches to create financial systems that are more adaptive and focused on sustainability goals (Almasria et al., 2024). Innovations such as blockchain, mobile banking, algorithmic credit scoring, and digital platforms have expanded access to financial services while increasing transparency, making them key enablers of sustainable development (Broby and Yang, 2025).

Specifically, technological advancements such as AI and machine learning (ML) improve decision-making quality and support more sustainable business models through more accurate data analysis (Elias et al., 2024). Meanwhile, digital payment systems can improve transaction efficiency, reduce operational costs, and decrease reliance on physical resources, thereby positively impacting company performance and user satisfaction (Au and Kauffman, 2008; Liu et al., 2015). On the other hand, blockchain technology plays a crucial role in enhancing trust and transparency through a decentralized ledger system, thereby strengthening accountability and promoting sustainable investment (Sangwan et al., 2019; Wang et al., 2019). This combination of technologies demonstrates that FinTech serves not only as a technical innovation but also as a strategic infrastructure in supporting a more sustainable financial system.

Furthermore, FinTech directly contributes to sustainable development by increasing financial inclusion and integrating sustainable practices into the economic system (Calle-Nole et al., 2023). Organizational innovation in FinTech also strengthens the link between technology and sustainability performance by improving operational efficiency and service quality (Rehman and Hossain, 2024; Udeagha and Muchapondwa, 2023). In addition, FinTech plays a key role in promoting green finance by facilitating the flow of funds to environmentally friendly projects through digital platforms and technology-based investment markets (Ashta, 2023; Boumaiza, 2025; Puschmann et al., 2020). As a result, FinTech companies that integrate innovation and sustainability have a competitive advantage in addressing global challenges such as climate change and resource constraints. Overall, the dominance of technology in FinTech is a key driver of the transformation toward a more inclusive, efficient, and sustainable financial system, and contributes to achieving global development goals.

Fragmentation Between Technology and Green Finance

Many studies discuss technologies such as AI, blockchain, and ML as part of the financial sector's digital transformation, yet dot not explicitly link them to the goals of green finance and environmental sustainability (Broby and Yang, 2025; Nefla and Jellouli, 2025; Puschmann and Khmarskyi, 2024). Meanwhile, the literature on green finance tends to focus more on instruments such as green bonds, ESG investing, and sustainable finance, but often fails to systematically integrate the technological dimension (Puschmann and Khmarskyi, 2024). In fact, terms such as "green finance," "sustainable fintech," and "ESG innovation" are often used interchangeably without clear definitions, indicating conceptual ambiguity in this field (Georgeson et al., 2017). Therefore, a more structured definition is needed, such as the concept of "green fintech," which combines financial technology innovation with environmental sustainability goals (Kwong et al., 2023). The lack of integration can hinder a comprehensive understanding of how technology can effectively support the transition to a sustainable financial system.

The literature emphasizes the need to develop an integrative framework that bridges the gap between technological innovation and green finance. Policy integration that links ethical, innovative, and sustainability aspects is becoming increasingly important, especially in addressing global challenges such as climate change (Mamun and László, 2025). Several studies indicate that fintech can serve as a catalyst for strengthening green finance and sustainable development by improving efficiency, transparency, and risk management (Bayram et al., 2022; Cen and He, 2018). In addition, the use of AI and fintech has proven effective in strengthening the link between green finance and the real economy, as well as accelerating the growth of green financing through more accurate risk analysis (Peng et al., 2023).

Nevertheless, there remains a research gap regarding the long-term impacts of technology on the environment and social aspects, highlighting the need for a more holistic approach. The adoption of AI and fintech is positively correlated with improved environmental and social performance, particularly in institutions with robust digital infrastructure (Siminică et al., 2025). This indicates that integrating technology and green finance is not merely a conceptual exercise but also has a tangible impact on achieving sustainability goals. Therefore, developing a framework that links fintech innovation, green finance, and ESG performance is crucial for the financial sector.

FinTech as an Enabler of Financial Inclusion and Sustainable Development

FinTech is increasingly recognized as a transformative catalyst in the modern financial system, particularly in advancing financial inclusion and sustainable development. The literature consistently highlights that FinTech

enables broader access to financial services by leveraging digital platforms, mobile technology, and data-driven innovations, thereby reaching previously underserved and unbanked populations (Arner et al., 2020; Calle-Nole et al., 2023; Jain et al., 2024). This expanded access not only increases individuals' financial participation but also helps reduce inequality and promote inclusive economic growth. Additionally, integrating technology into financial services has significantly reshaped traditional transaction mechanisms, improving efficiency, speed, and transparency across financial operations (Salleh et al., 2025). This improvement is crucial for supporting sustainability goals, as it reduces operational costs, enhances resource efficiency, and enables a more effective allocation of financial capital to productive and environmentally responsible sectors. FinTech is crucial not just for financial access but also for systemic change towards sustainable development. Digital financial ecosystems enable innovative solutions like microfinance and digital payments, which enhance economic resilience. However, its success relies on supportive regulations and user literacy.

By leveraging its transformative role, FinTech is widely recognized as a key driver of financial inclusion, particularly in addressing the structural barriers faced by underserved populations and small enterprises in developing countries (Bayram et al., 2022). Traditional banking systems often fail to reach these groups due to high operational costs, stringent documentation requirements, and limited physical infrastructure. In this context, FinTech offers an alternative by leveraging digital platforms and mobile-based solutions, enabling broader and more flexible access to financial services. FinTech facilitates expanded access to financial services by leveraging mobile technology, digital wallets, and online lending platforms to provide capital and financial tools to low-income communities (Johnson and Lee, 2021). This innovation has a significant impact on "people in remote areas," who are typically excluded from the formal financial system due to geographic isolation, low income, or a lack of credit history (Gudipati et al., 2025). By lowering transaction costs and simplifying access requirements, FinTech reduces entry barriers and enables individuals and micro-enterprises to participate actively in economic activities, thereby promoting inclusive growth.

Furthermore, empowering the financially underserved population through FinTech has significant implications for sustainable development. Enhancing financial inclusion boosts individuals' capacity to save, invest, and manage financial risks, which in turn supports poverty reduction and economic stability. This aligns with the achievement of the SDGs, particularly those related to reducing inequality and promoting inclusive economic development (Elias et al., 2024; Ellili, 2024). The primary contribution of FinTech is to democratize access to financial services and foster long-term socioeconomic resilience. The impact depends on digital literacy, regulatory support, and infrastructure. FinTech inclusion requires institutional and policy support to ensure equitable outcomes. FinTech also supports sustainable development and responsible economic growth. FinTech integration has attracted academic attention because it offers innovative solutions to financial exclusion and green financing. In this regard, FinTech not only digitizes financial services but also redefines its role in supporting long-term sustainable development.

The central aspect of this contribution lies in FinTech's ability to advance the SDGs. By expanding financial inclusion and enabling access to capital, FinTech supports efforts to reduce inequality (SDG 10) and promote inclusive economic growth (SDG 8) (Jain et al., 2024; Salleh et al., 2025). Furthermore, FinTech facilitates sustainable investment by connecting investors with environmentally responsible projects, thereby accelerating the transition to a low-carbon and sustainable economy. This function is crucial for addressing global climate challenges, where access to efficient and transparent financing mechanisms remains a major obstacle. In addition, FinTech is playing an increasingly important role in facilitating green finance by developing innovative financial instruments and platforms. Digital solutions have enabled the emergence of green bonds, crowdfunding for sustainability projects, and impact investment ecosystems (Vasile and Manta, 2025). The concept of sustainable FinTech further reinforces this alignment, as it explicitly integrates financial innovation with environmental goals and SDG-oriented development strategies (Park and Yoon, 2024).

Beyond financing, FinTech also promotes sustainability by enhancing supply chain dynamics. The integration of FinTech with Industry 4.0 technologies enhances transparency, traceability, and accountability across production and distribution processes, while smart contracts automate compliance and sustainability reporting (Soni et al., 2022). However, the effectiveness of FinTech in driving sustainable development depends on the presence of key supporting pillars, including digital identity systems, interoperable payment infrastructure, and efficient digital government services. These fundamental elements are necessary to ensure that FinTech solutions are scalable, inclusive, and capable of supporting a complex financial ecosystem (Mamun and László, 2025). Furthermore, the link between financial inclusion and sustainable finance underscores the need to advance both dimensions simultaneously to achieve meaningful development outcomes. Looking ahead, a coordinated policy and regulatory framework is essential to realize the potential of FinTech fully. Governments and regulators are encouraged to develop integrated digital finance strategies that simultaneously promote financial inclusion and sustainability.

FinTech's Role in Promoting the Green Economy and the SDGs

FinTech has emerged as a crucial driver in accelerating the transition towards a green economy while also advancing the SDGs. Literature emphasizes that FinTech fundamentally transforms financial services by integrating digital innovations into the financial system, thereby enhancing efficiency, accessibility, and transparency (Thakkar

and Bhuyan, 2024). This transformation enables financial institutions and stakeholders to redirect capital flows towards more sustainable and socially responsible activities. Consequently, FinTech not only reshapes how financial transactions are conducted but also redefines the role of finance in supporting the global sustainability agenda.

FinTech facilitates the integration of financial services with sustainable development goals, creating a more inclusive and environmentally responsible economic system. Through digital platforms, FinTech expands access to financial resources, supports green investment initiatives, and enables the efficient allocation of capital to environmentally sustainable projects. This integration is crucial for addressing global challenges such as climate change, inequality, and resource scarcity. FinTech's strength lies in its ability to bridge the gap between financial innovation and sustainability by aligning technological advancements with long-term development goals. However, the realization of this potential depends on a supportive regulatory framework, digital infrastructure, and cross-sector collaboration, which are essential to ensure that FinTech-driven growth translates into measurable sustainable outcomes. However, realizing this potential depends on a supportive regulatory framework, digital infrastructure, and cross-sector collaboration, all of which are essential to ensuring that FinTech-driven growth translates into measurable sustainable outcomes.

First, FinTech plays a central role in promoting green finance and sustainable development by redefining the structure and objectives of traditional financial services. The literature emphasizes that FinTech enables the financial system to become more sustainability-oriented by facilitating investments that aligned with environmental goals and integrating green principles into financial operations (Vergara and Agudo, 2021). This transformation enables financial institutions to move beyond profit-oriented models towards a framework that integrates the creation of environmental and social value, thereby enhancing the role of finance in supporting the sustainable development agenda.

Second, FinTech promotes financial inclusion and contribute to achieving the SDGs. Through digital payments and mobile banking, FinTech reduces barriers to access in developing countries. FinTech helps individuals and small businesses in underserved areas access capital and financial services, thereby reducing inequality. This inclusive approach not only supports economic growth but also contributes to social and environmental sustainability by empowering communities to engage in productive and responsible economic activities.

Third, FinTech facilitates sustainable investment by introducing innovative financial instruments and platforms. FinTech promotes sustainable investment through innovative financial tools such as green bonds and crowdfunding for sustainability projects. This enhances investment efficiency and transparency, supports investors in advancing environmentally responsible initiatives, and aligns financial markets with sustainability goals.

Finally, FinTech helps drive the adoption of green technology and supports climate action by providing more effective financing for sustainable energy and eco-friendly innovations (Misra et al., 2024). Furthermore, FinTech promotes innovation in clean technology by supporting new business models and financing structures that encourage the development and implementation of sustainable solutions. This role is crucial in accelerating the transition to a low-carbon economy and addressing global climate challenges.

Specific SDG Contributions of FinTech

FinTech is making an increasingly significant contribution to supporting the achievement of various SDGs, particularly through enhanced financial inclusion, economic growth, innovation, and environmental sustainability. In the context of SDG 10 (reduced inequalities), FinTech expands access to financial services through mobile banking and digital lending, thereby reaching segments of society that were previously underserved, including women and low-income communities, ultimately aiding in the reduction of economic disparities and enhancing overall welfare (Bhattacharjee, 2024; Fu et al., 2023). Furthermore, in support of SDG 8 (economic growth and decent work), FinTech serves as a catalyst for economic growth by fostering the development of SMEs and the micro-sector through easier access to financing, which contributes to job creation and increased economic activity (Salleh et al., 2023). Under SDG 9 (Industry, Innovation, and Infrastructure), FinTech serves as a key driver of innovation through digital transformation and the development of technology-based financial solutions capable of addressing social and economic challenges more efficiently (Thakkar and Bhuyan, 2024). In addition, FinTech also contributes to environmental sustainability through the development of green finance and by promoting more sustainable consumption and production patterns, including support for the circular economy and environmentally friendly investments. Overall, FinTech serves not only as a financial technology innovation but also as a strategic tool for promoting inclusive, sustainable development that is focused on achieving the SDGs.

FinTech has significant potential to drive sustainability, but faces structural and empirical constraints that hinder its overall impact. The main challenge is the lack of empirical evidence regarding the effectiveness of FinTech in achieving environmental outcomes, particularly in reducing carbon emissions and increasing green investment. Many studies have conceptually linked FinTech to sustainability, but there is a lack of robust quantitative and longitudinal data. Without strong empirical validation, measuring FinTech's actual contribution to environmental performance becomes difficult, which limits its credibility among policymakers and institutional investors.

In addition, the full realization of FinTech's potential is hindered by interrelated barriers, including regulatory constraints, the digital divide, and low financial literacy. The rapid evolution of FinTech often outpaces the legal framework, creating uncertainty and hindering innovation, particularly for green financial instruments. The technology gap is particularly significant in developing countries with uneven digital infrastructure. Limited internet access and a lack of financial and digital literacy hinder the adoption of FinTech and the realization of its benefits.

Differences in Focus Between Developed and Developing Countries

In developing countries, the adoption of FinTech still faces several fundamental barriers, including limited digital infrastructure, weak regulatory capacity, and a wide digital divide (Mamun and László, 2025). This situation means that the implementation of FinTech is not merely a technological issue, but is also closely linked to social and institutional readiness. Nevertheless, developing countries have become a "natural laboratory" for various financial technology experiments, such as cryptocurrency and alternative financing models, due to the high demand for financial inclusion (Campbell-Verduyn and Giumelli, 2022). However, adoption of more complex technologies such as blockchain remains relatively limited due to resource constraints and system readiness (Rahman et al., 2024). Therefore, the primary focus in developing countries is on how FinTech can address limited access, enhance financial inclusion, and meet the basic economic needs of the population. In addition, cultural factors and local economic characteristics also influence patterns of technology adoption, so research in developing countries tends to be more context-specific and relevant to regions with similar conditions (Almaqtari et al., 2025). In fact, academic contributions from countries such as India and Malaysia indicate that developing nations are increasingly shaping the global discourse on FinTech and sustainable development (Rahman et al., 2024).

Conversely, in developed countries, the focus of FinTech development tends to shift towards the optimization of technology, advanced innovation, and the strengthening of regulatory frameworks. With higher levels of economic welfare, education, and regulatory quality, developed nations possess the capacity to adopt technology in a more systematic and integrated manner (Mohammed et al., 2023; Vasile and Manta, 2025). Since fundamental barriers such as access and infrastructure have been largely addressed, research efforts are now focused on improving system efficiency, integrating advanced technologies such as artificial intelligence and big data, and developing green finance and ESG-based financial systems. In addition, developed countries also place greater emphasis on governance, regulatory compliance, and financial system stability in the face of digital disruption. Nevertheless, disparities remain, particularly between urban and rural areas in terms of the development of digital human capital and the adoption of advanced technologies (Vasile and Manta, 2025), making policies such as strengthening digital infrastructure and developing regional innovation hubs essential to ensuring equitable development.

Regulatory and Governance Gaps

Regulation plays a crucial role in ensuring that FinTech innovations effectively contribute to sustainable development. FinTech is widely recognized as a transformative tool capable of improving economic and social outcomes while fostering a more balanced relationship between human activities and the environment (Gong et al., 2024). However, despite this potential, the development of regulatory frameworks, particularly those related to Regulatory Technology (RegTech) and governance technology, remains limited and underexplored in current research (Ibrahim et al., 2024). This gap shows that while technological innovation is advancing rapidly, institutional and regulatory mechanisms are not keeping pace.

From a sustainability perspective, regulation is crucial not only for fostering innovation but also for managing its environmental consequences. Several studies emphasize that governments must actively regulate the FinTech market to address environmental challenges, including pollution and resource inefficiency (Ersin and Bildirici, 2024). Although FinTech is often associated with positive contributions to sustainable development, its actual environmental impact remains unclear. Some empirical findings even indicate a positive correlation between the expansion of FinTech and CO_2 emissions, suggesting a potential unintended negative effect on environmental sustainability (Ersin and Bildirici, 2024; Tao et al., 2022). This paradox underscores the importance of governance mechanisms that ensure FinTech development is aligned with environmental goals.

Beyond environmental issues, governance is crucial for mitigating systemic and operational risks within the FinTech ecosystem. The rapid growth of FinTech has introduced new vulnerabilities, including fraud, cybersecurity threats, and systemic instability, particularly as FinTech institutions increasingly replace the role of traditional banks (Panait et al., 2024; Purnamasari et al., 2024). Without strong regulatory oversight, these risks could undermine financial stability and sustainability goals, underscoring the need for a comprehensive governance framework.

Policy-oriented literature strongly recommends the development of an integrated and adaptive regulatory framework to support the sustainable growth of FinTech. Policymakers are encouraged to design systemic regulations that not only facilitate innovation but also address environmental and social impacts (Adebayo, 2022; Klimontowicz et al., 2024). In addition, another aspect that often goes unnoticed is the need to "green" financial technology itself. This involves incorporating environmental considerations into the design and operations of FinTech to support clean energy financing, improve energy efficiency, and facilitate sustainable investment flows.

In parallel, enhancing corporate accountability through transparent governance practices is also emphasized as a key step in aligning FinTech activities with sustainability goals.

Potential of Sustainable FinTech Ecosystem Models

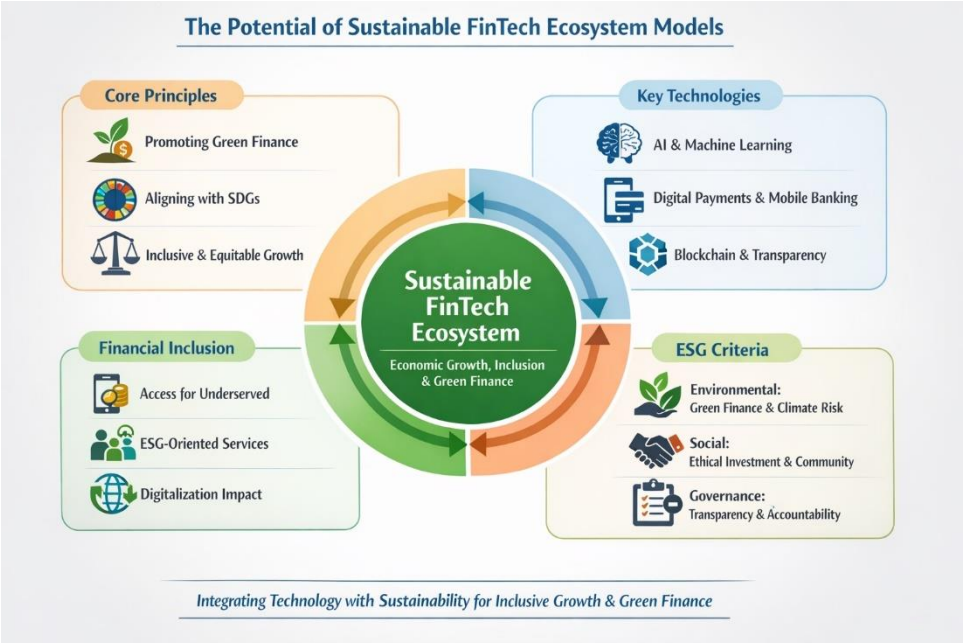

Figure 5. Sustainable FinTech Ecosystem Model Integrating Technology, Financial Inclusion, and ESG Principles

A sustainable FinTech ecosystem model that integrates digital technology, financial inclusion, and ESG principles to drive sustainable development, as illustrated in Figure 5. At its core, FinTech serves as a bridge between economic growth, green finance, and inclusion, supported by key technologies such as AI, blockchain, and digital payments that enhance the efficiency, transparency, and accessibility of financial services (Almasria et al., 2024). In addition, core principles such as green finance and alignment with the SDGs reinforce FinTech's contribution to addressing global challenges, while financial inclusion expands access for underserved groups. ESG-based evaluations ensure that FinTech innovations remain mindful of environmental, social, and governance considerations. Overall, this model demonstrates that integrating technology and sustainability can create a financial system that is more inclusive, transparent, and focused on sustainable development.

Knowledge Gaps and Future Research Directions in FinTech and Sustainable Development

FinTech is recognized as a crucial tool for sustainable development, facilitating financial inclusion and advancing the achievement of the SDGs. Through digital platforms, FinTech enhances access to financial services and creates new funding methods. However, there remains a knowledge gap in integrating regarding FinTech into sustainability, encompassing conceptual, empirical, and implementation aspects.

The main gap lies in the lack of explanation regarding the mechanisms and effectiveness of FinTech applications in green energy investments. Most studies focus on the benefits of the technology, but there is a lack of robust evidence regarding how it works, operational challenges, and cost reductions for sustainable projects. FinTech is often seen as contributing to sustainability, but its specific relationship with the SDGs remains unclear and unsystematic. This limitation stems from a lack of research on the long-term environmental and social impacts of FinTech on sustainability. Furthermore, there is currently no systematic framework that explicitly links FinTech innovations to specific SDGs, resulting in fragmented insights that are less relevant to policy-making. In fact, some empirical findings suggest that the impact of FinTech and blockchain technology on sustainability performance remains insignificant or inconsistent, indicating a gap between technological advancements and their actual impact on sustainability.

Structural challenges, including fragmented and dynamic regulations, hinder the implementation of FinTech in support of sustainable development, creating uncertainty for stakeholders. In addition, technological limitations, infrastructure gaps, and low financial literacy hinder the integration of AI into sustainable financial systems and exacerbate the lack of access to FinTech services for vulnerable communities. On the other hand, ethical considerations are also a major concern, given that the increasing use of data-driven technologies raises risks related to privacy, transparency, and algorithmic bias, thereby requiring a stronger governance framework.

Furthermore, the literature review also reveals additional gaps that enrich the research discourse. The role of stakeholders in the development and adoption of sustainable FinTech remains poorly understood. Although the roles of investors and consumers have been identified as drivers of green finance practices, the mechanisms for collaboration among the government, the private sector, financial institutions, and end users remain unclear (Serdarušić et al., 2024; Wu and Kao, 2022). Additionally, integration between sustainable finance principles and corporate governance remains largely reactive, with many organizations adopting ESG practices merely to comply with regulations rather than as a strategy for long-term value creation (Wang et al., 2024). This limits FinTech's transformative potential in promoting sustainability.

Another gap is evident in the cross-sector integration of green technologies. Although technologies such as blockchain and AI have proven capable of enhancing transparency and energy efficiency, their implementation remains limited to large corporations and has not yet been widely adopted in other sectors such as agriculture, construction, logistics, and healthcare (Fakher and Ahmed, 2023; Safaee and Yadegari, 2022). In addition, gender dimensions in FinTech adoption have not received sufficient attention, despite evidence that digital technology can enhance financial inclusion. The gap in digital access and literacy between men and women remains a significant barrier (Ashta and Herrmann, 2021; Taneja et al., 2024). Another challenge relates to the scalability of FinTech platforms in supporting social entrepreneurship, as there is still limited research explaining how innovations can evolve from the pilot stage into models that can be widely replicated (Drobetz et al., 2024; Pizzi et al., 2021).

Furthermore, collaboration between the public and private sectors has not yet reached its full potential. Although regulations have been extensively reviewed, the synergy between private-sector innovation and the government's role in creating a conducive ecosystem has not yet been fully explored (Udeagha and Breitenbach, 2023). On the other hand, cross-regional comparative research remains limited, particularly in Africa, which has experienced rapid FinTech growth but is underrepresented in the global literature (Ajide, 2016). In fact, variations in socio-economic conditions in the region provide important insights into the application of FinTech. Future research should adopt an integrative and interdisciplinary approach. Comparative studies across sectors and countries are essential for understanding differences in regulation and culture.

CONCLUSION

This study highlights that FinTech plays a transformative role in advancing sustainable development by integrating technological innovation with the financial system. The findings highlight those digital technologies such as AI, blockchain, and digital payments significantly enhance financial inclusion, improve efficiency, and support sustainable economic growth. FinTech has proven to be a key driver in aligning financial services with the SDGs, particularly in promoting inclusive growth, facilitating green investment, and accelerating the transition to a low-carbon economy.

However, this study also reveals substantial fragmentation between technological innovation and green finance. The lack of conceptual clarity and an integrated analytical framework limit the ability to fully capture the synergistic potential of "green fintech." Furthermore, structural challenges such as regulatory inconsistencies, technology gaps, and uneven digital infrastructure continue to hinder the effective integration of multi-technology ecosystems, particularly in developing countries. These differences underscore the importance of a contextual approach, where developing countries focus on access-driven innovation, while developed countries emphasize efficiency and sustainability-driven progress. Furthermore, while FinTech shows strong potential in supporting certain SDGs, particularly in clean energy financing, industrial innovation, and climate action, empirical evidence on its long-term environmental and social impacts remains limited. This highlights the critical need for more robust, data-driven, and longitudinal research to validate its actual contributions.

In conclusion, while FinTech serves as a powerful catalyst for a sustainable and inclusive financial system, its full potential can only be realized through a stronger regulatory framework, improved digital infrastructure, greater financial literacy, and deeper integration of technology and with the sustainability agenda. This study contributes to the literature by synthesizing fragmented insights into a structured understanding of the FinTech–SDG linkages, while also offering practical implications for policymakers and the industry to design an inclusive and green financial ecosystem. However, the study is limited by its reliance on bibliometric and secondary data, which may not fully capture real-time industry dynamics. Therefore, future research should combine empirical and mixed-methods approaches to provide more comprehensive and context-specific evidence on the sustainable impact of FinTech.

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