

Rise of financial technology and emerging theme in the green finance research : A systematic literature review towards future research prospects

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Abstract

The aim of this study is to review and categorise the body of green finance and Financial Technology (FinTech) in order to understand thoroughly. This systematic literature using web of science databases identifying key emerging themes of FinTech innovations, which offer unique opportunities to enhance green finance by improving transparency, accessibility, and efficiency in funding environmentally sustainable projects. Ten themes of Green Finance emerged from analysis i.e. Green Financing, Green Bonds, Climate Financing, Green Infrastructure bonds, Green Insurance, Green Securities, Carbon Finance, Sustainable Finance, Green Banking and Green Economy. This study contributes to a deeper understanding of the topic at hand. There is not a single study which has covered these many themes of the green finance, which makes it an important contribution to the literature.

Subject Classification: 68T01, 68T07.

Keywords: Green finance, FinTech, Green banking, Green economy, Sustainable finance.

I. Introduction

Over the last decade, FinTech has transitioned from a disruptor, to an incumbent, to now, an infrastructure of the modern financial industry, which includes financial transactions, including payments, banking, insurance, and investment management. The revolution is supported by several technologies, including Blockchain, artificial intelligence (AI),

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machine learning and big data analytics have led to democratization to access financial services, increased transparency, speed and customer engagement. Traditional financial services remain under the threat from FinTech. With the advent of digital-only banks, peer-to-peer lending platforms, and mobile payment solutions, consumer expectations have transformed, encompassing 24/7 services, personalized financial advice, and seamless user experiences [8]. Technology allows FinTech to directly address the issues of limited banking infrastructure by offering bank-like services with far less cost and a higher return. According to Demirgüç-Kunt et al., [6], mobile banking and digital payment platforms offer millions of formerly unbanked people access to the financial system and therefore help in increasing economic participation and reducing poverty. As global climate challenges have increased, so too have the need for such financing, with green finance now a vital essence of global economic sustainability strategies. Green finance helps in potentially boosting economic growth and stabilisation by engendering green jobs and sustainable business [5]. Green finance addresses the need to align investment flows with low-carbon, environmentally sustainable, and climate-resilient development. The linkage of FinTech with green finance has been an opening up new avenues to facilitate such initiatives. FinTech facilitates transparency and efficiency in the direction of funds towards sustainable projects. Several areas especially warrant further thought - in the latter, the potential for FinTech to power the scope, scale, and reach of green finance is substantial and remain open to substantial exploration and development in both the academic and practitioner settings.

The study aims to investigate the synergy between FinTech in conjunction with green finance, specifically highlighting the extent to which FinTech innovations provide momentum and facilitate the financing of projects aligned with sustainable development. The objective of this research is to conduct a systematic review of the current literature to understand how, for instance, blockchain, AI, and digital banking platforms are being utilized in the facilitation and evolution of green finance. Key areas of focus include: Evaluating the Impact of FinTech on Green Finance, Emerging Technological Identification, Assessment of financial products and services and Regulatory and Ethical Considerations.

There are 5 reasons why exploring the intersection of FinTech with green finance is important, namely, a) Improving accessibility to capital, b) Enhancing transparency and accountability, c) Inspiration for Financial products, d) Empowering regulatory compliance and reporting, and e)

Global Shut down. Owing to this plethora of sustainability implications, there exists a substantial gap in the literature that highlights the confluences between technology innovation and sustainability.

II. Literature Review

Green finance encompasses entities such as green bonds, green funds, green banking, and climate finance, all of which are designated to fund projects that will have a positive effect on the environment [17]. Green Bond issuances are reaching new highs with a growing appetite for such products in the market [7]. The European Investment Bank and the World Bank were early innovators in this space, and the market proliferated as more municipalities, corporates and sovereigns began issuing their own green bonds. Green finance is gaining ground is green banking, meaning banks issue loans, credits, and render banking services solely to meet the financing of the projects that promote environmental sustainability [19]. As stated by Scholtens, sustainable finance fosters transparency and accountability in financial transactions to foster long-term investments in sustainable economic activities and projects. Some of the existing concerns include the lack of standardization in the definitions and reporting of green projects, regulatory obstacles and the higher initial costs of green investments [2]. On the contrary, there are several opportunities related to green finance such as new technology innovations, attracting investments with potential higher returns and a more robust economy [15]. Fintech, refers to a new breed of technology which lowers transaction costs and enhance transaction efficiency [3].

Digital banking encompasses everything from online banking that delivers traditional banking services over the internet, to neobanks, which are completely digital with no brick-and-mortar branches and provide 24/7 access to personalized financial advice and easy-to-use platforms [11]. These technologies have also contributed to the greater financial inclusion by financial services available to the unbanked and underbanked [22]. For example, mobile payments have transformed markets in Africa and Asia where banks have not been able to build traditional infrastructures [10]. Additionally, FinTech innovations help in faster loan approvals, real time risk analysis and customized insurance packages, but they also pose a dilemma such as data security.

Theoretical Integration: Bridging Models and Practice

Theory helps to strengthen the scientific value of these case studies. The Theory of Planned Behavior makes it possible to count if incentives such as SolarCoins help people adopt solar energy activities. Also, the views of Stakeholder Theory and Institutional Theory are useful in studying how traditional financial institutions react to GAW. With these insights, we can explain how adoption takes place, what leads to resistance and why systemic changes are slow moving in the traditional financial area.

III. Methodology

This study adopts a systematic review and began with establishing clear research questions that guide the entire review and define its scope. Inclusion and exclusion criteria were set to filter studies based on factors such as population characteristics, study design, language, and date of publication. Researchers then selected Web of Science, that are most likely to yield relevant literature. A comprehensive search strategy was formulated using defined keywords, Boolean operators, and filters to ensure a focused and replicable search. The initial screening phase involved reviewing titles and abstracts to eliminate irrelevant studies, followed by a full-text review of the remaining articles to confirm their eligibility.

After identifying the final set of studies, researchers extracted relevant data using standardized forms to maintain consistency. This was followed by a critical appraisal of each study's quality, using tools suited to their methodology to assess risk of bias and overall reliability. The data from these studies are then summarized and synthesized. The final step was creating a structured report that documents the systematic review process and findings in a transparent and replicable manner. This study includes the research questions, methodology, results, discussion, and conclusions, often presented according to standardized reporting guidelines like PRISMA. Through this rigorous and methodical approach, systematic reviews aim to provide high-quality evidence for research, policy, and practice.

IV. Findings

Green Financing is investment in sustainable projects that promote climate change mitigation [9]. It includes direct financing via green loans

and mortgages that provide improved terms based on the environmental profile of projects. The reach of FinTech in green financing has increased capital supply for small-scale sustainable projects and democratized investment [4]. Climate Financing concentrates on financial measures to mitigate climate change, providing funding for projects that decrease greenhouse gas emissions and increase carbon sinks. Remarkable advances like blockchain technology have played a fundamental role in registering and verifying results from climate financing projects, creating transparency and accountability in emissions trading systems and carbon credit markets. Carbon Finance aims at carbon trading and offsets, which enable companies and governments to achieve carbon reduction goals in a cost-effective manner. Digital platforms also enable the trading of carbon credits, automate the emissions reporting process, and increase the reliability of carbon markets and prevent double counting [14]. Green Bonds are used primarily for environmental projects ranging from renewable energy, energy efficiency and sustainable waste management to clean transportation projects. The use of blockchain in the issuance and management of bonds promotes transparency of the use of proceeds and the environmental impact of funded projects [1]. Sustainable Finance incorporates environmental, social and governance (ESG) standards into business and investment decisions. FinTech plays an important role by using sophisticated algorithms and analytics to help investors evaluate ESG metrics, filter out unsustainable investments and track sustainability performance of the investments [13]. Green Banking take into consideration the earth and all environmental factors when performing their operation and business strategies. Digital banking platforms have also enabled access to green financial products and services, thus promoting eco-friendly practices [12]. FinTech plays an agential role by improving resource management efficiency, financing renewable energy projects with innovative forms of underwriting, and promoting sustainable business practices through advanced data collection and analysis.

Successful Integrations: Company Case Studies on SolarCoin & Green Assets Wallet:

An Empirical Case Study To make theories useful, case studies turn them into practical examples. Because proper rules for this field have not yet been set and making laws takes time, SolarCoin and Green Assets Wallet act as showcases for new concepts. 1 SolarCoin is issued on the blockchain for each MWh of solar energy produced. The initiative has

already distributed 20 million MWH and will have helped offset close to 15 million tons of CO₂, giving us a chance to explore tokenomics and what drives certain behaviors. Compared to others, Green Assets Wallet makes it possible to track climate-verified investments, drastically reducing the verification time for green bonds from six months to four or five weeks. It has enabled more than \$500 million of investment to flow into ten African and European countries [18].

Since GAW is structured according to ICMA Green Bond Principles, we found the platform was a dependable basis for automated verification, creating a model suitable for climate bonds. Such reports demonstrate how innovations in regulatory technology (RegTech) can improve compliance and make processes clearer.

V. Discussion

Regulatory uncertainty hampers the integration of FinTech and green finance. The new wave of FinTech solutions may not account for existing regulations and this could lead to a fragmented legal framework that could stymie progress, affecting the proliferation of and global scaling of green finance solutions. Legislation that varies widely from jurisdiction to jurisdiction, for instance, and some of the different green bond standards create confusion and can deter investors. It takes intentional action from regulators to ensure that standards and practices will be harmonized to create the context where green finance technologies can develop into a thriving industry.

Data privacy, security concerns, and the digital divide challenges can affect the effectiveness and equitable access to the FinTech solutions. Blockchain technology can disrupt the marine transportation industry, despite its recognition — which is common in the particulars of the traditional finance sector — it will realize high energy consumption business practices, which is contrary to green finance. Furthermore, the dependency on complex AI and big data analyses demands widespread data accuracy, and availability that might not be realistic in many regions, especially in developing countries where there is little digital infrastructure [13].

Gaps Found in Literature Review

We do not have studies that directly link FinTech innovations to measurable environmental results. This deficiency in the literature highlight the requirement for comprehensive methodologies and rigorous

assessment of the impact and environmental benefits of existing FinTech applications for green finance. Moreover, the impact of FinTech on financial inclusion in the context of green finance also remains underexplored— especially how such trends might affect low-income and vulnerable populations in different geographical locations [16].

Theoretical Implications and Practical Implications

Implications for Policymakers: There is a need for integrated regulatory frameworks that respond to the acceleration of FinTech innovation and help align such innovation with environmental goals. These have helped to enforce international treaties by establishing a common scientific understanding of human impact on the environment, while demonstrating the need for international cooperation, as environmental challenges are often transnational.

Implications for Financial Institutions and Technology Providers: Another area of significant opportunity is the creation of new financial products that support sustainable investing because they are aligned with ESG principles. Meanwhile, the technology providers need to work on building inclusive technologies that will be pivotal in unlocking green finance opportunities, particularly in underserved and developing regions. That range from mobile solutions for low-bandwidth environments to user-friendly platforms that do not require advanced technical expertise from end users [20]. The discussions here provide a nuanced, detailed view of the complexities and options around using FinTech for green finance, highlighting the roles of different types of stakeholders in overcoming challenges and harnessing opportunities for a more sustainable future.

VI. Conclusion

The systematic literature review has highlighted the role of the Financial Technology (FinTech) in facilitating green finance represents one key element of the global transition towards sustainable development. The major findings outline that advances in FinTech innovation (e.g., blockchain, digital banking, and big data analytics) have contributed to enhancing the development of green finance through better transparency, efficiency, and availability. The result is a much more accurate account of environmental impacts, a much more efficient way for financing green projects and a wider range of investors as access to investments becomes

increasingly democratized. Terms like green bonds, climate financing, sustainable finance are emergent themes, clearly indicating how FinTech adoption is going to drive up the application of environment focused economy.

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