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SUSTAINABLE BANKING IN THE DIGITAL AGE: INSIGHTS FROM FINTECH, BLOCKCHAIN, AND GREEN FINANCE RESEARCH

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ABSTRACT

Research on sustainable banking in the digital age has gained increasing attention due to the intersection of FinTech, blockchain, artificial intelligence (AI), and environmental responsibility. This bibliometric study examines global research trends from 2015 to 2025(February) using Dimensions AI, yielding 1,052 publications after screening. VOS Viewer was employed to visualize co-authorship networks, citation patterns, and keyword co-occurrences. Sustainability emerged as the most prolific journal, while Environmental Science and Pollution Research demonstrated the highest citation impact. Influential authors include Satish Kumar and Muhammad Zoynul Abedin. At the country level, China leads in publication volume, while Ireland, Malaysia, and India show high average citations per paper. Keyword and thematic analyses reveal emerging trends in digital financial inclusion, blockchain-based transparency, AI-driven ESG analytics, green finance, and Central Bank Digital Currencies (CBDCs). The study highlights the growing integration of technology and sustainability in banking and provides a roadmap for future research, emphasizing the need for cross-disciplinary collaboration, regulatory frameworks, and empirical evaluation of sustainable digital banking innovations.

KEYWORDS: Sustainable banking, Digital finance, Green FinTech, Block chain

1. INTRODUCTION

The banking industry is currently experiencing major changes driven by two powerful forces: the need for sustainability and the rapid growth of digital technologies. Key developments such as green finance, financial inclusion efforts, and digital banking services show how the sector is adapting to meet both sustainability and innovation goals. This study aims to explore how sustainability and digital transformation are connected in banking research. By analysing academic literature using tools like VOS viewer, this paper identifies important keywords, research themes, and trends shaping the future

of sustainable banking in the digital age.

1.1 Research Objectives

This study aims to explore the evolving relationship between sustainable banking practices and digital financial innovation through a comprehensive analysis of existing literature. The specific objectives are:

1. To examine the growth and development of research on sustainable digital banking between 2015 and 2025, focusing on the number of publications and major publishing trends.
2. To identify the leading authors, journals, and institutions in this field by using citation analysis, highlighting the most influential contributors to the literature.
3. To analyse the global distribution of research output, identifying which countries and institutions are most active in publishing work on sustainable and digital banking.
4. To use VOS viewer to conduct to identify key research themes and emerging trends related to FinTech, green finance, blockchain, ESG, and digital transformation.
5. To explore the connections between different research areas, showing how sustainability and digital finance are being integrated across academic disciplines.
6. To suggest future directions for research and practice, based on observed gaps and patterns in the literature over the 2015–2025 period.

The structure of this paper is organized as follows. Section 2 provides a comprehensive review of the relevant literature, offering context and background for the study. Section 3 outlines the research methodology employed, including the tools and techniques used for keyword and thematic analysis. Section 4 presents the key findings along with a detailed discussion of the results. Section 5 highlights possible directions for future research in the domain of sustainable and digital banking. Finally, Section 6 concludes the paper by summarizing the main insights and outlining their managerial and practical implications.

2. LITERATURE REVIEW

Sustainable banking marks a significant transformation in the financial industry, shifting the focus from short-term profit maximization to a broader consideration of environmental, social, and governance (ESG) factors within core banking activities. In contrast to conventional banking models that emphasize immediate financial returns, sustainable banking is oriented towards creating long-term value through ethical lending, environmentally responsible investments, and sound governance structures [1]-[2]. This approach closely echoes the Triple Bottom Line framework—people, planet, and profit—underscoring the expanding societal responsibilities of financial institutions in tackling climate change and fostering inclusive growth [3].

From a theoretical standpoint, frameworks such as Stakeholder Theory [4] and Legitimacy Theory [5] offer valuable perspectives on the motivation behind banks' adoption of sustainability-oriented

practices. Stakeholder Theory recognizes that banks must address the interests and values of a broad range of stakeholders, while Legitimacy Theory emphasizes the importance of aligning with societal expectations and regulatory demands to maintain credibility and trust. Consequently, many banks are now incorporating ESG frameworks into their risk management, product development, and reporting procedures [6]. The growing prevalence of sustainability reporting standards, including the Global Reporting Initiative (GRI) and the Task Force on Climate-Related Financial Disclosures (TCFD), highlights this ongoing commitment to transparency and responsible business conduct [7].

2. 1 Digital Transformation in Banking

The banking industry is currently experiencing a significant transformation driven by advancements in Financial Technology (FinTech), Artificial Intelligence (AI), Machine Learning (ML), and Big Data analytics. Traditional branch-based models are rapidly giving way to digital, real-time, and customer-centric approaches, often described as Banking 4.0 [8]-[9]. The result is that digital channels have become central to the modern financial ecosystem. FinTech innovations, such as mobile payments, digital wallets, peer-to-peer lending, and algorithmic credit scoring, have substantially increased both accessibility and efficiency in banking [10]. These technological advancements have also promoted financial inclusion by enabling underserved populations to access formal financial services [11]. Digital transformation not only enhances operational efficiency but also underpins the implementation of sustainable practices. For example, cloud computing reduces dependency on paper-based processes, and AI-driven tools facilitate more effective ESG data monitoring and sustainable investment analysis [12]. Consequently, the convergence of technology and sustainability now represents a central focus in contemporary banking research.

2.2 Intersection of Sustainability and Digital Finance

The convergence of sustainability and digital finance represents a significant evolution in the financial sector, marked by the emergence of concepts such as Sustainable Digital Finance and Green FinTech. These frameworks examine how digital technologies—ranging from sophisticated financial applications to AI-driven assessments—can advance environmental and social objectives while preserving or even enhancing financial performance [13]. Contemporary FinTech tools now facilitate activities like green bond trading, carbon credit markets, and impact investing, all of which offer heightened transparency and traceability in the movement of sustainable finance. This transparency is crucial, as several studies highlight that FinTech not only streamlines the monitoring and reporting of ESG metrics but also increases investor confidence and strengthens corporate accountability [14]-[15]. Digital systems are capable of quantifying sustainability outcomes in real time—be it through analysing energy efficiency, tracking carbon emissions, or evaluating social impact. Furthermore, mobile-based microfinance and digital lending platforms are pivotal for social sustainability. By expanding access to finance for underserved and marginalized communities, these platforms foster

greater financial inclusion and contribute to equitable economic growth. This synergy between sustainability and digital transformation is especially visible in emerging economies. Here, digital banking infrastructure supports both inclusive development and climate resilience. The integration of AI-based sustainability assessments empowers financial institutions to allocate capital more effectively to environmentally responsible initiatives. Collectively, this convergence signals a broader shift in the financial sector—from a compliance-driven approach to sustainability toward one that prioritizes innovation and comprehensive ESG integration.

2.3 Integrating AI, Blockchain, and FinTech for Sustainable Banking

Blockchain has become a significant force in the digital transformation of sustainable banking, primarily due to its ability to enhance transparency, traceability, and stakeholder trust. The core feature here—a decentralized ledger—offers immutability and verifiability for financial transactions, which is especially crucial for green finance verification and ESG reporting [16]. By ensuring that records cannot be altered retroactively, blockchain allows investors and regulators to monitor the allocation of funds toward sustainability initiatives, thereby mitigating risks of greenwashing [17]. Practical applications are already evident. Blockchain platforms are being used to track the issuance of green bonds, enable renewable energy trading, and manage carbon credits [18]. For example, blockchain-based systems authenticate renewable energy certificates and automate the disbursement of climate finance via smart contracts. Central bank digital currencies (CBDCs), which also leverage blockchain, have the potential to increase transparency and efficiency in financial systems while promoting broader digital inclusion.

Despite these advantages, blockchain adoption also raises several challenges, such as high energy consumption, interoperability issues among various blockchain systems, and the complexity of evolving regulatory frameworks [19]. In tandem with blockchain's influence, green finance is establishing itself as a cornerstone of sustainable banking. The goal of green finance is to direct financial resources toward environmentally responsible projects—such as renewable energy development, sustainable agriculture, and green infrastructure—with the broader aim of facilitating the transition to a low-carbon economy [20]. The digital revolution has broadened the reach of green finance by introducing data-driven tools that assess project sustainability, quantify environmental risks, and verify outcomes. Artificial intelligence (AI) and big data analytics now enable banks to refine their green lending criteria and monitor ESG compliance in real time [21]. Digital platforms have also expanded access to green investment products, thereby democratizing participation in sustainable finance. Governments and international organizations, including the UNEP Finance Initiative and the G20 Sustainable Finance Working Group, are actively promoting digital innovation within green finance. Recent scholarship points to the emergence of Green FinTech ecosystems, where digital startups collaborate with established financial institutions to develop new sustainability-

oriented products—ranging from digital crowdfunding for renewable energy to blockchain-enabled carbon markets and AI-driven green portfolio management [22].

Nonetheless, persistent challenges remain. Issues such as data privacy, technological inequality, and inconsistent regulatory standards continue to restrain the full potential of digital green finance [23]. In conclusion, while digital technologies are transforming sustainable banking and green finance, ongoing efforts will be required to address these obstacles and realize their full promise.

Moreover, existing research treats blockchain, ESG reporting, green finance, and digital banking as separate topics, rarely examining how they interact to influence sustainable banking in a holistic way. This narrow focus leaves a noticeable gap—there's insufficient understanding of their combined impact on banks' progress toward ESG goals. Consequently, a bibliometric study tracking global research from 2015 to 2025 is especially timely here; as it can highlight key research themes, spot emerging trends, and identify leading contributors. Such an approach offers a much-needed comprehensive perspective on how digital transformation and sustainability intersect within the banking sector.

3. RESEARCH METHODOLOGY

This study employs a bibliometric approach to explore the intersection of sustainable banking, financial technologies, and emerging innovations such as artificial intelligence (AI), blockchain, and green finance. The data was sourced from the Dimensions database using a structured search query: ("Sustainable Banking" OR "Green Finance") AND ("AI" OR "Artificial Intelligence" OR "Blockchain"), targeting title and abstract fields. The search was confined to publications from 2015 to 2025, capturing over a decade of research evolution in this field. To ensure subject relevance, filters based on the Australian and New Zealand Standard Research Classification (ANZSRC 2020) were applied, limiting the results to two fields: 35 – Commerce, Management, Tourism and Services, and 3502 – Banking, Finance and Investment.

Further refinement included restricting the publication type to peer-reviewed journal articles and selecting only journals listed in UGC Journal List Group II, ensuring quality and credibility. To enhance accessibility and replicability, only Open Access (All OA) publications were included. Initially, 16,609 records were retrieved. After applying the year range filter, the dataset was reduced to 16,534. The application of the field-specific filters narrowed the dataset to 5,654 articles, which were further filtered to 3,925 based on the article type. After applying the UGC Care List II filter, 3,210 articles remained. Following the final Open Access filter, the dataset was reduced to 1,133. A detailed screening process was then conducted to remove duplicate entries and irrelevant articles that did not align with the scope of sustainable banking in connection with digital technologies. After

this step, a final set of 1,052 articles was prepared for analysis. The bibliographic metadata—including title, authors, institutions, countries, publication year, source, abstract, and citation count—was exported in CSV format. The data was retrieved on March 1, 2025. For the analytical stage, VOS viewer was employed to visualize co-authorship, and citation networks, while Microsoft Excel 2016 was used to generate a tabular representation of keyword frequencies and identify key thematic clusters based on co-occurrence data for statistical summaries and trend analysis.

4. Results and Analysis

4.1 Year wise publication

The research output trend concerning Sustainable Banking in the Digital Age, which encompasses themes like FinTech, blockchain, and green finance, exhibits an exponential growth pattern over the last decade (Figure 1). Between 2015 and 2019, publication activity was minimal, with counts that were almost negligible, indicating that the convergence of digital innovation and sustainable banking was still a nascent topic with limited engagement from both academia and industry. The period starting in 2020 signifies the onset of a notable upward trajectory, with a consistent increase in publications each year. In 2021, the research output began to gain momentum, aligning with the increasing acknowledgment of digital banking's contribution to sustainability and the wider adoption of FinTech solutions. By 2022, publication counts experienced a sharp rise, a trend that persisted through 2023 and 2024, when the total number of outputs neared 500 publications, reflecting an increase in scholarly interest, regulatory focus, and technological progress in blockchain-enabled green finance. The exponential growth curve ($R^2 = 0.8951$) illustrates that this expansion is not coincidental but adheres to a distinct and robust upward trend, signifying the field's evolution into a prominent research area. The data for 2025, currently estimated at around 560 publications, likely underrepresents the final total as it only accounts for part of the year; should the trend persist, the total for 2025 may exceed previous records. This development emphasizes that sustainable digital banking has transitioned from a niche academic focus to a vibrant, well-established field, propelled by advancements in digital finance and the global movement towards sustainable economic practices.

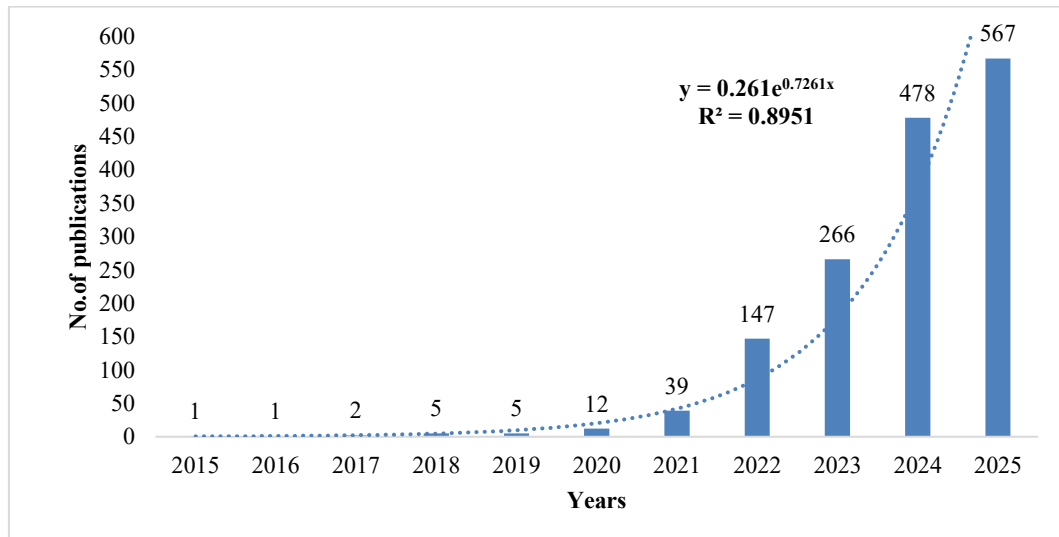


Figure 1: Year wise number of publications.

4.2 Bibliometric citation and authorship analysis

4.2.1 Journal citation

The bibliometric analysis identified a total of 196 scholarly journals contributing to the field of sustainable digital banking, green finance, and associated technologies. Applying the threshold criteria of a minimum of five publications and ten citations, 29 journals met the inclusion criteria for detailed analysis. These journals represent the most active and impactful sources in this domain between 2015 and 2025. Sustainability emerged as the most prolific and highly cited journal, contributing 376 publications and receiving 3,723 citations, with an average citation per article of 9.9. This indicates its central role in disseminating research on sustainability and digital financial transformation (Figure 2).

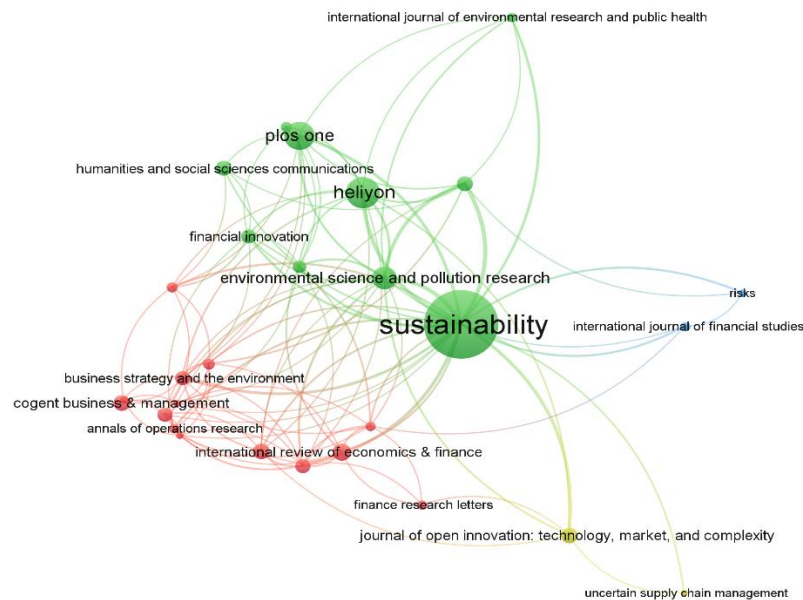


Figure 2: Network visualization of journals based on highest citations and publications

Other key journals include:

- Environmental Science and Pollution Research, with 46 articles but a remarkably high 1,820 citations — the highest average citation rate (40 citations per article) among the top sources. This reflects strong academic influence despite lower publication volume.
- Heliyon and PLOS ONE follow with 74 and 72 publications respectively, maintaining moderate citation averages (8.27 and 5.46), suggesting broad research contributions but varied influence.
- Journals such as the Journal of Innovation and Knowledge and Technological Forecasting and Social Change stand out with high mean citations per article (35.03 and 31.58 respectively), indicating that though their output is smaller, the impact per publication is significant.
- Business Strategy and the Environment and Financial Innovation also demonstrate strong citation performance, with average citations of 26.2 and 19.09 respectively, highlighting their influence in strategic and innovative aspects of sustainable finance.

Journals like the International Review of Economics and Finance and International Journal of Financial Studies also contribute meaningfully, though with moderate impact per article. The presence of interdisciplinary outlets such as Humanities and Social Sciences Communications and Cogent

Business and Management underscore the growing intersection of technology, sustainability, and societal factors. The VOS viewer visualization further highlights the central position of the journal “Sustainability”, which is closely linked to various other prominent journals through citation and co-citation patterns. Clusters in the map also reveal thematic groupings—green nodes dominate sustainability and environmental focus, red nodes are linked to strategic management and finance, while blue nodes cluster around risk and digital finance.

Table 1: Journal Productivity Analysis (Publications & Citations)

<i>Rank</i>	<i>Journal</i>	<i>Publications</i>	<i>Citations</i>	<i>Citations Mean</i>
1	Sustainability	376	3723	9.9
2	International Review of Economics and Finance	78	211	2.71
3	Heliyon	74	612	8.27
4	PLOS ONE	72	393	5.46
5	Environmental Science and Pollution Research	46	1820	40
6	Humanities and Social Sciences Communications	43	297	6.91
7	Cogent Business and Management	33	174	5.27
8	Journal of Innovation and Knowledge	32	1121	35.03
9	Business strategy and the Environment	30	786	26.2
10	Journal of Open Innovation: Technology, Market, and Complexity	29	558	19.24
11	Research in International Business and Finance	27	423	15.67
12	Technological Forecasting and Social Change	24	758	31.58
13	International Journal of Financial Studies	24	204	8.5
14	Financial Innovation	22	420	19.09

4.2.2 Citation of organisation and country

Out of 1483 organisations analysed, 211 of them met the criteria by having at least 3 documents and 10 citations (Figure 3). In the citation network visualization created using VOS viewer, 14 key institutions were mapped based on their research contributions in the selected field. Each node in the map represents an institution, and the size of the node reflects the total number of citations its publications have received. Notably, Northern University of Malaysia (762 citations) and Malaviya

National Institute of Technology (549 citations) stood out for their high citation counts, despite having relatively fewer publications (7 and 4, respectively). This suggests that their research outputs are highly impactful, as supported by their high average citations per paper—108.86 and 137.25, respectively.

On the other hand, institutions like Sunway University and Jiangsu University had higher publication counts (10 and 13), but lower average citations (31.80 and 24.46), indicating broader output but with comparatively lower impact per study. Swinburne University of Technology, though publishing only 4 papers, achieved a high citation mean of 121.00, highlighting the strong influence of its work in the field. The color-coded clusters in VOS viewer grouped institutions based on how frequently they were cited alongside each other, revealing thematic or regional linkages. For example, Chinese universities such as Fuzhou, Tongji, and Jiangsu likely formed one cluster due to similar research themes and citation patterns. Likewise, Indian institutions like O.P. Jindal University, Jaipuria Institute of Management, and Malaviya NIT appeared closely associated, potentially reflecting shared research interests or academic collaborations. The overlay visualization further offered a timeline perspective, with warmer colours (yellow/orange) indicating more recent influential publications and cooler colours (blue/purple) denoting older studies. This view helps to identify both longstanding contributors and newer institutions gaining prominence in the research landscape.

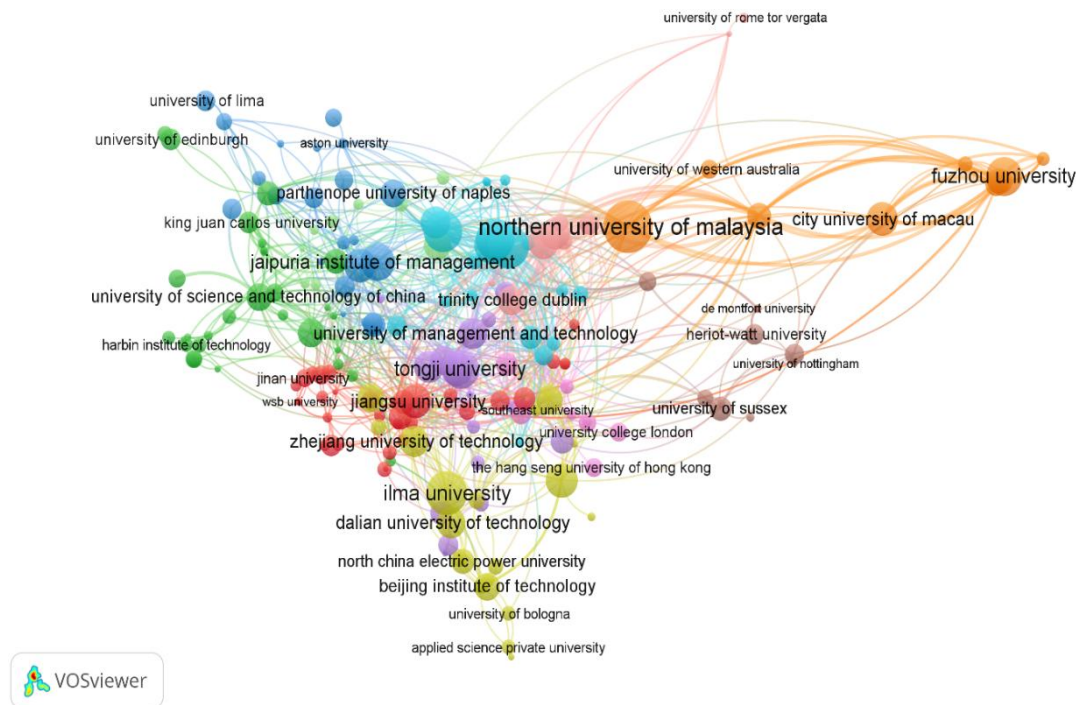


Figure 1: Network visualization of organisation based on highest citation.

In the country-level citation analysis using VOS viewer, 95 countries were initially identified as contributors to the selected research domain. After applying a threshold of a minimum of 3 documents and at least 10 citations, 65 countries met the criteria and were included in the citation map. In this visualization, each node represents a country, with its size reflecting the total number of citations received, indicating the country's research impact. China appeared as the most productive country, contributing 500 publications and receiving 6,144 citations, although its average citations per publication (12.29) were relatively modest. In comparison, countries like Ireland, with only 14 publications, achieved a much higher average citation rate of 49.43, showing strong impact despite fewer contributions. Similarly, Malaysia and India had average citations of 38.93 and 34.32, respectively, suggesting that their research outputs were both relevant and well-cited. Other countries such as the United Kingdom and Pakistan also recorded notable average citations per paper (23.87 and 25.42, respectively), highlighting their significant contributions to the field. The United States, Australia, and Italy demonstrated a balanced performance, with moderate numbers of publications and consistent citation levels. VOS viewer's clustering feature grouped countries based on similarities in citation patterns and co-occurrence, revealing regional and thematic collaborations. Countries such as Malaysia, India, and China were observed to cluster together, likely due to shared research topics and

regional connections. The overlay visualization added a time-based perspective, where yellow and orange nodes indicated countries with more recent impactful research, while blue and purple nodes represented earlier foundational work. This helped in identifying both established contributors and emerging countries gaining prominence in the research landscape.

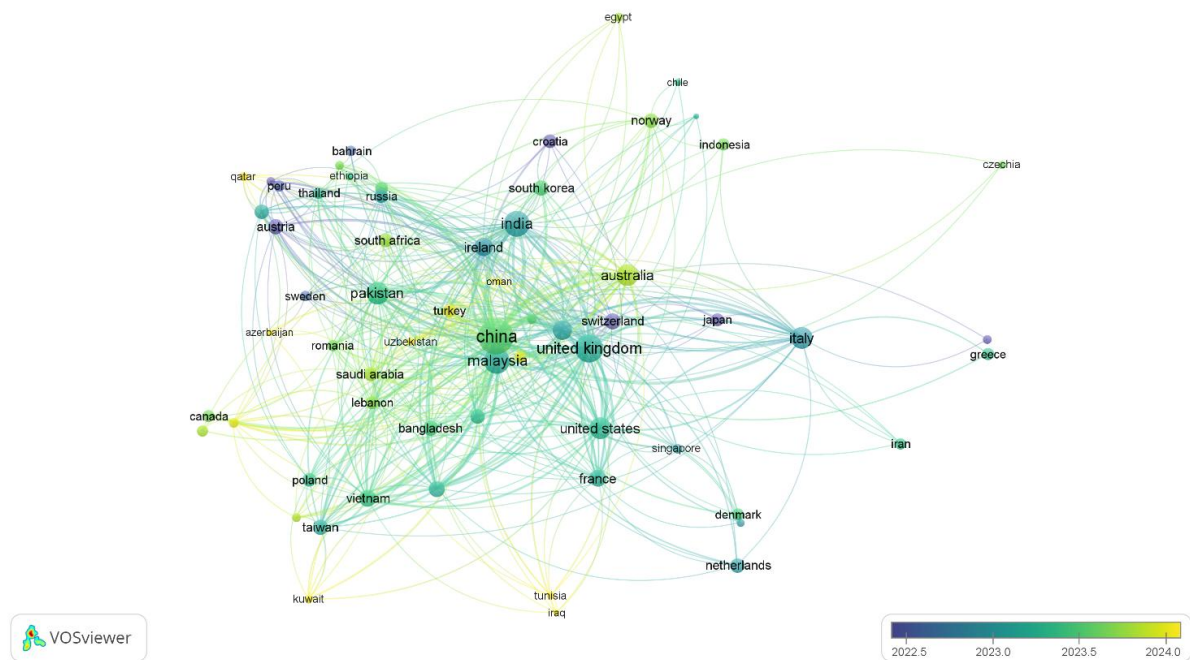


Figure 4: Overlay Visualization of countries based on highest citation

Table 2: Academic Contribution by Institution (Publications & Citations)

Rank	Organisation	Publications	Citations	Citation Means
1	Northern University of Malaysia	7	762	108.86
2	Malaviya National Institute of Technology	4	549	137.25
3	Ilma University	8	546	68.25
4	O.P Jindal university	8	485	60.63
5	Swinburne university of technology	4	484	121.00
6	Fuzhou University	8	427	53.38
7	Tongji University	7	421	60.14
8	Jaipuria Institute of Management	4	382	95.50

9	University of Ghana	3	328	109.33
10	City university of Macau	7	321	45.86
11	Sunway University	10	318	31.80
12	Jiangsu University	13	318	24.46
13	Shanghai University	5	313	62.60
14	London Metropolitan University	5	312	62.40

Table 1: Research Productivity by Country (Publications & Citations)

<i>Rank</i>	<i>Country</i>	<i>Publications</i>	<i>Citations</i>	<i>Citation means</i>
1	China	500	6144	12.29
2	United Kingdom	127	3032	23.87
3	Malaysia	58	2258	38.93
4	India	63	2162	34.32
5	Australia	57	1309	22.96
6	Pakistan	55	1398	25.42
7	United states	57	1255	22.02
8	Spain	39	827	21.21
9	Ireland	14	692	49.43
10	Vietnam	29	522	18.00
11	Italy	51	1249	24.49
12	United Arab Emirates	29	494	17.03
13	Bangladesh	21	390	18.57
14	France	24	566	23.58

4.2.3 Author citation

This section highlights the most productive and influential authors in the dataset, based on key bibliometric indicators such as the number of publications, total citations, and average citations per publication. Satish Kumar from Sunway University, Malaysia, emerges as a leading contributor with 8 publications and 807 citations, reflecting both productivity and strong influence in the field. Weng Marc Lim, also from Sunway University, has 5 publications but a higher average citation rate of 130.4, indicating a significant impact of each individual paper. Similarly, authors like Mohd Zaini Abd Karim and Arvind Upadhyay, despite having only one publication each, received high citation counts (460 and 367 respectively), suggesting their work is of notable quality or relevance. The most prolific author is Muhammad Zoynul Abedin from Swansea University, United Kingdom, with 13 publications. However, his average citation per publication (22.69) is relatively lower, pointing to a broader but more moderately cited research output.

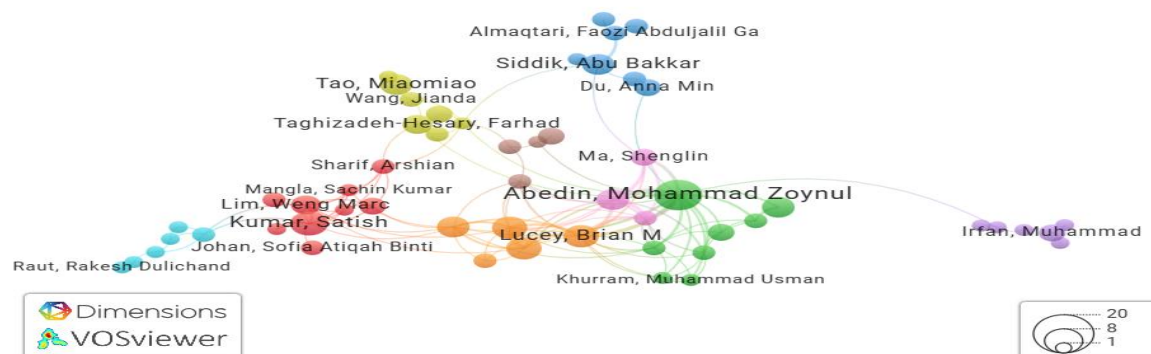


Figure 5: Network visualization of leading authors based on publication and citation.

4.3 Keyword analysis and Emerging themes

The keyword analysis has brought to light several key terms that capture the shifting dynamics of sustainable banking research. Key concepts like "Sustainable Banking," "Green Finance," and "Environmental Sustainability" highlight a strong commitment to aligning financial practices with environmental goals. Meanwhile, the growing presence of terms such as "FinTech," "Digital Finance," "Financial Innovation," and "Financial Digitalization" underscores the increasing role of technology in transforming traditional banking systems. Additionally, terms like "Financial Inclusion" and "Inclusive Finance" indicate a rising scholarly interest in closing access gaps through digital solutions. Emerging technologies are represented by keywords like "Blockchain," "Cryptocurrencies," and "Central Bank Digital Currencies (CBDCs)," showcasing their potential to transform both finance and sustainability. Likewise, the inclusion of "Artificial Intelligence (AI)" and "Machine Learning (ML)" highlights the application of intelligent systems for predictive modeling, credit analysis, and risk assessment in sustainable finance. Other relevant terms such as "ESG Performance," "Digital Transformation," and "Climate Finance" suggest an interdisciplinary approach that combines environmental, technological, and policy perspectives. Together, these keywords illustrate that sustainable banking research is at the intersection of finance, innovation, and sustainability, with a clear trend toward using technology for inclusive and environmentally responsible financial systems.

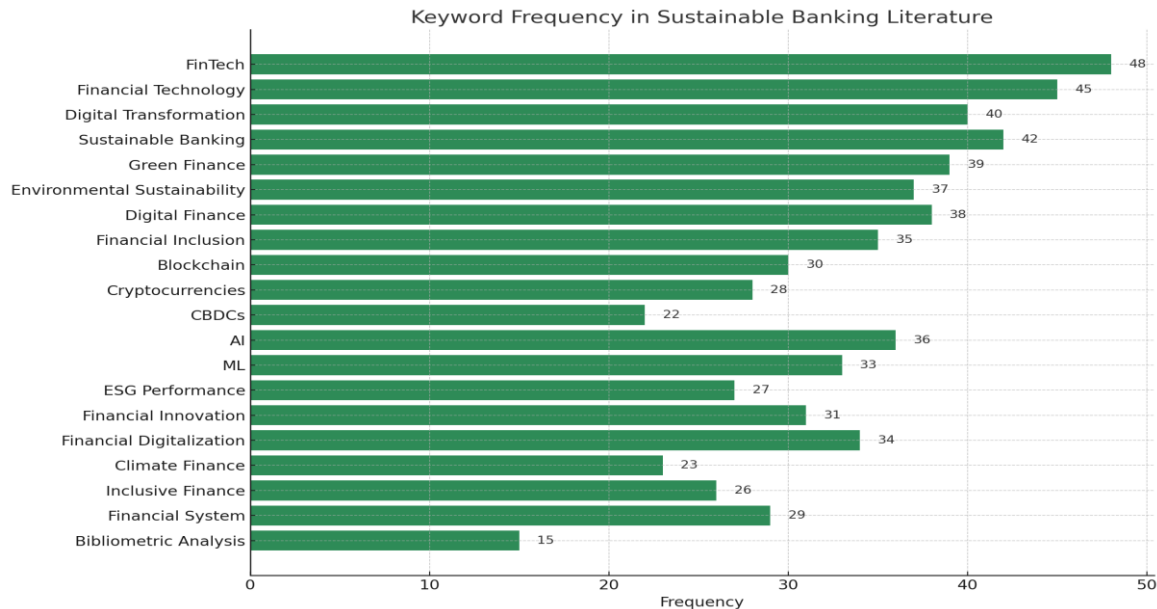


Figure 6: Distribution of Frequently Occurring Keywords in Sustainable Banking Literature

Emerging Themes

Theme 1: Fintech, Digitalization, and Financial Inclusion

This theme focuses on the technological advancements in finance, their impact on financial inclusion, and the broader implications for the financial system. It includes papers on Fintech's impact on banking, digital transformation, and the role of digital finance in expanding access to financial services [24]-[44].

Theme 2: Sustainability and Green Finance

This theme explores the intersection of finance and environmental sustainability. Papers in this theme examine the role of green finance in promoting sustainable development, the impact of financial institutions on environmental outcomes, and the development of sustainable financial products and services [45]-[61].

Theme 3: Cryptocurrencies, Blockchain, and CBDCs

This theme focuses on the emerging technologies of cryptocurrencies, blockchain, and central bank digital currencies (CBDCs), and their potential impact on the financial system and sustainability [62]-[77].

Theme 4: Artificial Intelligence and Machine Learning in Finance

This theme groups papers focusing on the application of AI and ML in various financial contexts. Papers exploring the use of AI and ML for market prediction, risk assessment, and other financial applications [78]-[83].

Table 4: Key Research Themes and Top-Cited Publications in Sustainable Banking and FinTech Literature

“Theme 1: Fintech's Impact on Financial Landscape			
<i>Title</i>	<i>Source</i>	<i>Year</i>	<i>Times Cited</i>
The emergence of the global fintech market: economic and technological determinants.	Small Business Economics	2019	471
The impact of the FinTech revolution on the future of banking: Opportunities and risks.	International Review of Financial Analysis	2022	355
Industry 4.0 in Finance: The Impact of Artificial Intelligence (AI) on Digital Financial Inclusion.	International Journal of Financial Studies	2020	349
The long-term effect of digital innovation on bank performance: An empirical study of SWIFT adoption in financial services.	Research Policy	2017	247
The effects of digital finance and financial constraint on financial performance: Firm-level evidence from China's new energy enterprises.	Energy Economics	2022	181
Digitalization in the financial industry: A contingency approach of entrepreneurial orientation and strategic vision on digitalization.	European Management Journal	2021	163
Financial inclusion: Policies and practices.	IIMB Management Review	2015	162

Building financial resilience through financial and digital literacy in South Asia and Sub-Saharan Africa.	Emerging Markets Review	2022	153
Promoting China's Inclusive Finance Through Digital Financial Services.	Global Business Review	2022	141
Can digital transformation improve the information environment of the capital market? Evidence from the analysts' prediction behaviour.	Accounting and Finance	2022	137
Financial Inclusion in Emerging Economies: The Application of Machine Learning and Artificial Intelligence in Credit Risk Assessment.	International Journal of Financial Studies	2021	135
Corporate digital transformation and trade credit financing.	Journal of Business Research	2023	134
The financial effect of firm digitalization: Evidence from China.	Technological Forecasting and Social Change	2022	132
Financial inclusion and stability in the Asian region using bank-level data.	Borsa Istanbul Review	2021	129
Digital Financial Inclusion and Sustainable Growth of Small and Micro Enterprises—Evidence Based on China's New Third Board Market Listed Companies.	Sustainability	2020	128
Fintech-based financial inclusion and bank risk-taking: Evidence from OIC countries.	Journal of International Financial Markets Institutions and Money	2021	126
Understanding China's fintech sector: development, impacts and risks.	European Journal of Finance	2021	116

Digital finance and enterprise financing constraints: Structural characteristics and mechanism identification.	Journal of Business Research	2023	98
How does FinTech affect the development of the digital economy? evidence from China.	The North American Journal of Economics and Finance	2022	83
Fintech and Financial Stability Potential Influence of FinTech on Financial Stability, Risks and Benefits.	Journal of Central Banking Theory and Practice	2020	99
FinTech and financing constraints of enterprises: Evidence from China.	Journal of International Financial Markets Institutions and Money	2023	89
Theme 2: Green Finance and Sustainability			
<i>Title</i>	<i>Source</i>	<i>Year</i>	<i>Times Cited</i>
Impact of Green financing, FinTech, and financial inclusion on energy efficiency.	Environmental Science and Pollution Research	2022	223
Examining the interconnectedness of green finance: an analysis of dynamic spillover effects among green bonds, renewable energy, and carbon markets.	Environmental Science and Pollution Research	2023	221
Digital finance and corporate ESG performance: Empirical evidence from listed companies in China.	Pacific-Basin Finance Journal	2023	187

Does it pay to go green? The environmental innovation effect on corporate financial performance.	Journal of Environmental Management	2021	169
Digital finance and sustainable development: Evidence from environmental inequality in China.	Business Strategy and the Environment	2022	129
Can sustainable investments outperform traditional benchmarks? Evidence from global stock markets.	Business Strategy and the Environment	2020	123
Blockchain market and green finance: The enablers of carbon neutrality in China.	Energy Economics	2023	121
Sustainability in FinTechs: An Explanation through Business Model Scalability and Market Valuation.	Sustainability	2020	121
Does digital finance matter for corporate green investment? Evidence from heavily polluting industries in China.	Energy Economics	2023	118
Can the green finance policy force the green transformation of high-polluting enterprises? A quasi-natural experiment based on “Green Credit Guidelines”.	Energy Economics	2022	145
Green innovation and enterprise reputation value.	Business Strategy and the Environment	2023	75
Financial inclusion and green economic efficiency: evidence from China.	Journal of Environmental Planning and Management	2022	98
Does green finance really inhibit extreme hypocritical ESG risk? A	Energy Economics	2023	107

greenwashing perspective exploration.			
Crossing the rivers by feeling the stones: The effect of China's green credit policy on manufacturing firms' carbon emission intensity.	Energy Economics	2022	94
Digital finance and renewable energy consumption: evidence from China.	Financial Innovation	2022	86
The causal relationship between green finance and geopolitical risk: Implications for environmental management.	Journal of Environmental Management	2023	90
ESG disclosure and technological innovation capabilities of the Chinese listed companies.	Research in International Business and Finance	2023	88
Theme 3: Fintech, Cryptocurrencies, and Blockchain			
<i>Title</i>	<i>Source</i>	<i>Year</i>	<i>Times Cited</i>
Time and frequency domain connectedness and spill-over among fintech, green bonds and cryptocurrencies in the age of the fourth industrial revolution.	Technological Forecasting and Social Change	2021	310
Is blockchain able to enhance environmental sustainability? A systematic review and research agenda from the perspective of Sustainable Development Goals (SDGs).	Business Strategy and the Environment	2022	262

Diversification in the age of the 4th industrial revolution: The role of artificial intelligence, green bonds and cryptocurrencies.	Technological Forecasting and Social Change	2020	243
Fintech, Cryptocurrencies, and CBDC: Financial Structural Transformation in China.	Journal of International Money and Finance	2022	173
Bitcoin: A safe haven asset and a winner amid political and economic uncertainties in the US?	Technological Forecasting and Social Change	2021	153
Blockchain for next generation services in banking and finance: cost, benefit, risk and opportunity analysis.	Journal of Enterprise Information Management	2021	133
The Effects of Central Bank Digital Currencies News on Financial Markets.	Technological Forecasting and Social Change	2022	122
Volatility spillovers across NFTs news attention and financial markets.	International Review of Financial Analysis	2022	114
Blockchain in banking and finance: A bibliometric review.	Research in International Business and Finance	2022	106
A review of the key challenges of non-fungible tokens.	Technological Forecasting and Social Change	2023	92
Sustainable finance and blockchain: A systematic review and research agenda.	Research in International Business and Finance	2023	78
Islamic Finance in the Era of Financial Technology: A Bibliometric Review of Future Trends.	International Journal of Financial Studies	2023	76

The link between sustainable business models and Blockchain: A multiple case study approach.	Business Strategy and the Environment	2023	81
Fintech in Islamic finance literature: A review.	Heliyon	2022	92
Central Bank Digital Currencies: Agendas for future research.	Research in International Business and Finance	2022	83
Markov-switching dependence between artificial intelligence and carbon price: The role of policy uncertainty in the era of the 4th industrial revolution and the effect of COVID-19 pandemic.	Technological Forecasting and Social Change	2021	86
Theme 4: AI and ML in Finance			
<i>Title</i>	<i>Source Title</i>	<i>Pub Year</i>	<i>Times Cited</i>
Literature review: Machine learning techniques applied to financial market prediction.	Expert Systems with Applications	2019	407
Artificial intelligence and fintech: An overview of opportunities and risks for banking, investments, and microfinance.	Strategic Change	2021	203
Artificial intelligence techniques in finance and financial markets: A survey of the literature.	Strategic Change	2021	120
Applications of Explainable Artificial Intelligence in Finance—a systematic review of Finance, Information Systems, and Computer Science literature.	Management Review Quarterly	2024	96

Artificial intelligence and bank credit analysis: A review.	Cogent Economics & Finance	2022	89
Behavioural finance in an era of artificial intelligence: Longitudinal case study of robo-advisors in investment decisions”.	Journal of Behavioral and Experimental Finance	2020	117

Note: The information provided above consists solely of bibliographic details—titles, publication year, sources and citation counts—sourced from Dimensions AI as of March 2025. No original textual content or analytical data were included from those works. Full references are available in the reference list to ensure transparency.

5. CONCLUSION AND FUTURE DIRECTIONS

This bibliometric study on Sustainable Banking in the Digital Age shows a clear and fast-growing research path, fuelled using new technologies—like FinTech, blockchain, AI, and machine learning—in eco-friendly financial systems. In the last ten years, academic output has moved from occasional contributions to a strong and rapid growth trend, showing that sustainable digital banking has evolved from a niche topic to a significant focus in both academia and industry. The increase in publications since 2020 aligns with a growing global awareness of climate change, the adoption of ESG principles, and the swift digital transformation of financial services. The analysis of journals and citations reveals a varied yet connected publication environment, with Sustainability and Environmental Science and Pollution Research acting as major platforms for sharing research. High-impact work comes from both highly productive institutions and those with fewer but well-cited publications, indicating that the quality of research—rather than just the quantity—affects its influence. Geographically, China is at the forefront in terms of publication numbers, while countries like Ireland, Malaysia, and India have higher average citation rates, pointing to regional strengths in impactful research. Additionally, keyword mapping highlights the interdisciplinary character of the field, where environmental, technological, financial, and policy aspects intersect.

Future research should focus on several important areas:

- **Enhancing Technology and Sustainability Integration**
Although the impact of FinTech and blockchain is well-known, more empirical research is necessary to evaluate their long-term effects on green finance adoption, operational efficiency, and systemic risk.
- **AI and Machine Learning in ESG Analytics**
There is a significant opportunity to use advanced analytics to enhance the measurement of

environmental performance, predict climate risks, and make responsible investment decisions.

- **Comparative Studies Across Countries**
Considering the differences in publication output and impact across regions, future research could examine how regulatory frameworks, cultural influences, and economic systems affect the adoption of sustainable digital banking.
- **Digital Financial Inclusion in the Sustainability Era**
Research should explore how digital solutions can not only meet environmental objectives but also tackle socio-economic disparities, especially in marginalized communities.
- **Regulatory and Governance Frameworks**
As CBDCs and decentralized finance become more prevalent, strong regulatory systems will be essential to ensure a balance between innovation, financial stability, privacy, and sustainability.

In conclusion, sustainable banking in the digital age is developing into a well-established yet quickly changing research field. Future research that adopts multidisciplinary methods, interacts with policy changes, and utilizes technological advancements will be crucial for creating a financial system that is efficient, inclusive, and environmentally sustainable.

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