

## Exploring the impact of digital financial inclusion on sustainability: A bibliometric analysis of emerging research trends

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**Abstract---**The Current Research Explore the influence of digital financial inclusion in achieving sustainable development. Through expanding its access to financial services where it supports the United Nations' Sustainable Development Goals (SDGs). This study adopted a bibliometric approach to analyze the literature review on digital financial inclusion and its role in sustainable development published between 2016 and 2024. Data is obtained from the Scopus database; after the screening process, it yielded 833 relevant documents. The study also used descriptive analysis to explore year-wise trends and prominent countries and top authors. The bibliometric study identified keyword clusters and co-authorship networks. The result shows strong publication growth after 2019, with China, the United Kingdom, and India as leading contributors. And five thematic clusters using VOSviewer software were recognized, covering finance–sustainability linkages, environmental and economic impacts, technological enablers, advanced digital technologies, and policy governance. However, co-authorship networks continue as fragmented, dominated by small regional groups. This study provides future researchers with a clear map of the existing literature and gaps that can give direction on qualitative and empirical studies.

**Keywords---**Digital Financial Inclusion, Green Development, Sustainable Development.

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## Introduction

In recent years, as countries struggle with socio-economic disparities, environmental degradation, and technological disruption, the intersection of digital financial inclusion (DFI) and sustainable development (SD) has gathered international interest. The United Nations' Sustainable Development Goals (SDGs) gave emphasis to inclusive, equitable, and sustainable growth, and there is a critical need to reduce the financial gaps in developing and emerging economies (United Nations, 2015). Previously, financial inclusion has been linked to poverty mitigation, empowerment, and economic engagement. The evolution of digital technologies has widened its focus to provide mass access to credit, savings, and payments using mobile banking, fintech products, blockchain, and digital wallets (Durai, T., & Stella, G. (2019).

Digital financial inclusion not only facilitates financial engagement but also drives environmental sustainability by supporting green investments and enhanced resource allocation and also encourages the adoption of renewable energy projects (Zhuang, Mi, Zhi, & Zhang, 2022). Empirical evidence affirms that digital finance helps to decrease energy consumption and industrial upgrading in the fast-paced emerging world (Chen, D., & Guo, X. 2023). Digital finance enhances mechanisms of governance and environmental functioning in developed nations (Li, Y., Sun, G., Gao, Q., & Cheng, C. 2023). Green digital finance schemes have been reached across China, promoting the transition towards energy and eliminating carbon force (Mi, Huang, Sohail, & Hafeez, 2024). ICT adoption in Asia has been completed in driving inclusive green development by utilizing digital knowledge-sharing and clean technologies (Zian, C., & Oguzhan, C. L. 2023).

An existing study says outside Asia, the relatedness of digital financial inclusion is also obvious. In the Middle East, mobile financial services have increased the ability of SMEs, resulting in green practices via greater transparency and operational efficiency (Almashawreh, R. 2023). In Europe, the digital payment system has increased institutional performance, making financial markets more sustainable and resistant. In Sub-Saharan Africa, usage of digital financial services assisted in poverty reduction and women's access to finance. Yet underdeveloped countries lack digital literacy, and infrastructural shortcomings pose challenges (Demir et al., 2022).

However, the intersection between digital financial inclusion and sustainable development is not always positive. There are short-term negative consequences that have been found, particularly in middle-income countries that face globalization pressures and weak environmental regulation policies (Shashwat, Chhabra, & Giri, 2025). Inconsistent access to digital technology threatens to raise inequalities, especially in marginalized communities. The main issues of digital finance are cyber threats, institutional shortcomings, and disintegrated regulatory standards. These are the negative factors and gaps to be studied for future implementation. (Anakpo, Xhate, & Mishi, 2023).

Despite these issues, DFI remains a game-changing route towards achieving the sustainable development goal. Through reducing financial inclusion gaps, green finance mobilization, and development of new innovation, it is a main driving force in economic resilience, social justice, and environmental sustainability (Bergougui 2024). The existing study thus seeks to perform a bibliometric review of peer-reviewed articles on sustainable development and digital financial inclusion published from 2016 to 2024 and answer the following RQs:

1. Which are the most prominent countries in the field of digital financial inclusion and sustainable development studies?
2. Who are the top contributing authors, and what have they contributed to this field?
3. What are the most dominant publication trends and patterns in recent times?
4. What are the most central thematic clusters and their conceptual linkages?

## Literature Review

Over the past years the existing body of literature on digital financial inclusion (DFI) and sustainable development (SD) has grown significantly, employing different methods and regional perspectives. Digital financial inclusion assists in reducing poverty and attaining inclusive growth. Studies in Belt and Road economies depict that digital financial inclusion strengthens employment and human capital development, particularly in upper-middle-income contexts; this helps the country to move towards sustainability. (He, Chen, Hu, & Zhang, 2022). Digital financial inclusion enhances finance access for small and medium-sized enterprises in Asian economies; it enables investments in green investment and industrial upgrading (Du, Hu, Wang, & Kizi, 2024). Chinese city-level research points out how human capital mediates the effect of DFI on green inclusive development (Zhang, Tian, Guo, & Gai, 2023).

Despite growth, environmental connections dominate. Firm-level evaluation depicts that digital financial inclusion improves financing disparities and green innovation in polluting sectors (Xue, L., & Zhang, X. 2022). Huge econometric analyses require digital financial inclusion, support energy efficiency and green efficiency of development, and environmental regulation acts as a moderator (Yang, Ding, Wu, Gao, Yue, & Wang, 2023). In Pakistan, digital financial inclusion establishes an unequal but net-positive impact on CO<sub>2</sub> emission reduction through renewable energy implementation (Zafar, Bhatti, Nawaz, & Ahmad, 2023). The same outlook is created in Algeria, where green technologies helped in balancing environmental degradation (Feng, S., Zhang, R., & Li, G. 2022).

Cross-national research expands the subject matter. Focus on the poverty-reducing impact of financial inclusion in the economies of African nations, and bring focus to methodological heterogeneity to quantify impacts, ranging from regressions to nonlinear specifications (Mamun, A. Y., & László, V. 2025). Present key thematic clusters in inclusive sustainable finance and have to adopt a more inclusive database combining to prevent uneven conclusions. Comparative studies also indicate that institutional quality and regional competition exert strong moderation effects on the impact of DFI on environmental performance (Mu, X., Chen, D., & Zhang, H. 2025). At the micro level, studies in Jordan find that perceived usefulness and cost are key drivers of mobile payment adoption, bridging digital finance to SME viability. In the European Union, they demonstrate that digital payments enhance operational efficiency and industry sustainability. Apart from these, research also identifies the contribution of DFI towards empowering women and ensuring gender equality, especially in low-income environments where access to finance has previously been restrictive (Almajali, Al-Okaily, Al-Daoud, Weshah, & Shaikh, 2022). In spite of infrastructure constraints, in the region of Sub-Saharan Africa, adoption of fintech has enhanced inclusive finance and minimized financial exclusion (Mlachila, Jidoud, Newiak, Radzewicz-Bak, & Takebe, 2016).

Recent existing studies also identify potential threats and constraints. Certain research refers to near-term trade-offs, wherein digital financial inclusion adoption results primarily in heightened environmental pressures with the use of energy-intensive technology (Kumari, Giri, & Malesios, 2025). Other studies speak about cybersecurity threats, technical errors, and system risks that discredit the sustainability benefits of digital systems (Gomber et al., 2018). These considerations indicate that though DFI is a strong facilitator of sustainability, its effects are contingent upon digital literacy, institutional quality, and regulatory coherence.

## Methodology

This paper utilized a bibliometric approach to analyze the intersection of digital financial inclusion (DFI) and sustainable development (SD). The Scopus database is selected as the only source for this study due to its wide coverage of peer-reviewed literature relevant to the research domain, multidisciplinary journals, structured citation information, and compatibility with bibliometric tools such as VOSviewer. A systematic search was applied using the keywords "digital financial inclusion,"

"financial inclusion," "digital finance," "mobile banking," "fintech," and "sustainable development" with Boolean operators (AND/OR) for comprehensive coverage. Searching was restricted to 2016-2024 and English-language literature, which initially resulted in 1,289 documents. After removal of duplicates and irrelevant records, the result was a final dataset of 833 documents, which was exported to CSV.

Descriptive analysis was used to present year-wise publication trends, most frequent contributing authors, and contributing countries. The second step was using bibliometric analysis with VOSviewer (v1.6.20), which provided keyword co-occurrence maps and co-authorship networks that allowed the determination of research groups, collaborative linkages, and thematic structures in the field. This two-step procedure provides a consistent overview of the intellectual landscape on DFI and sustainable development.

**Table. 1 Inclusion Exclusion Criteria**

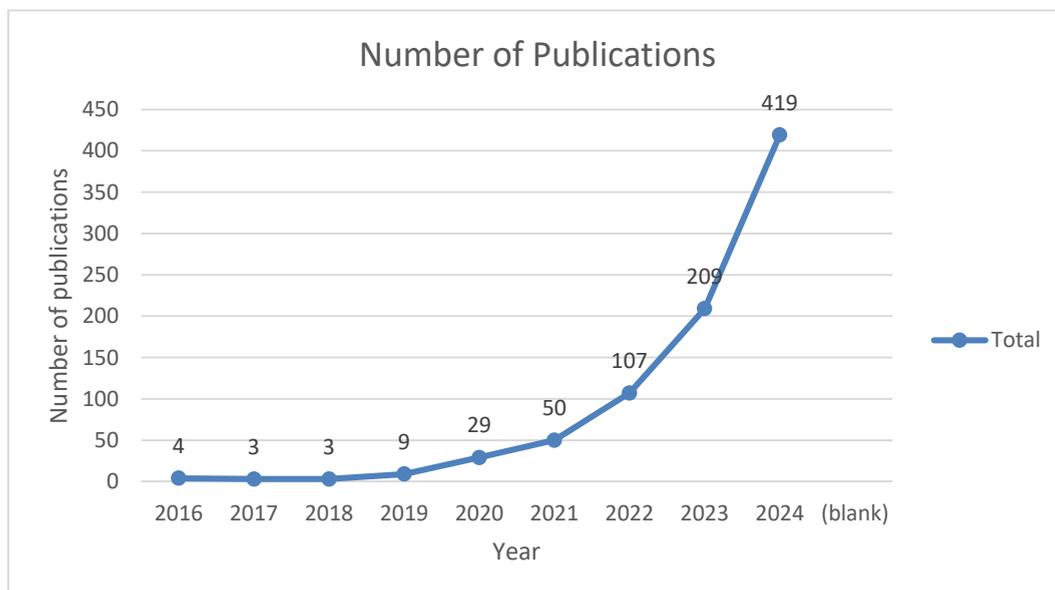
Criteria	Inclusion	Exclusion
Document Type	Articles, conference papers, and review papers	Articles, conference papers, and review papers not published in high-quality journals
Source Type	Journal	Books and chapters of books
Language Time Period	English 2016 to 2024	Any other language
Field of study	Business management and accounting; Economics; Econometrics; and Finance	Any other field

Source: The Authors

## Result and Discussion

### Descriptive Analysis

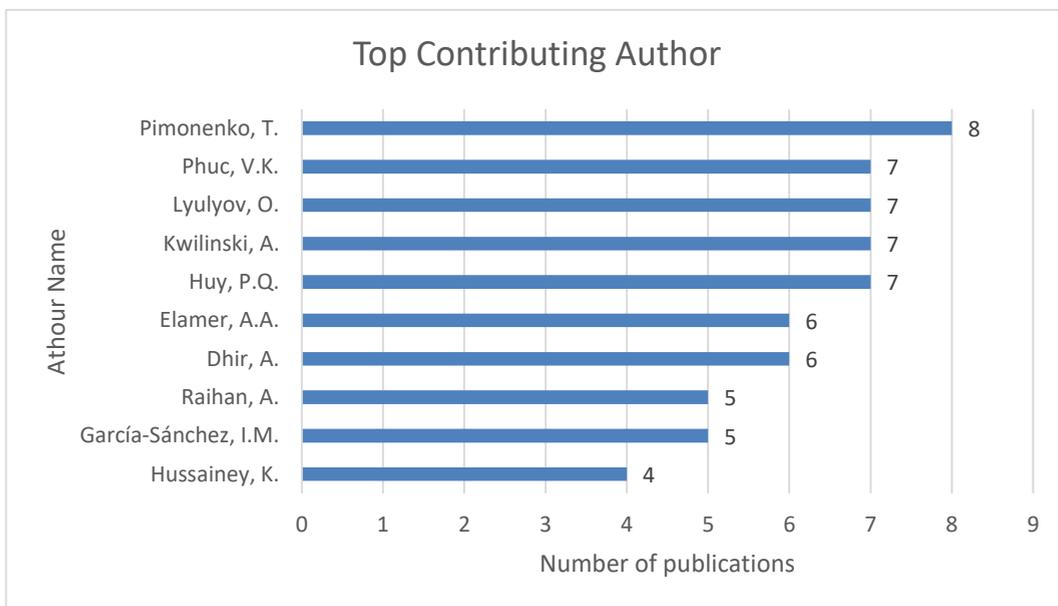
**Figure. 1** Number of paper Published in Each Year



Source: The Authors

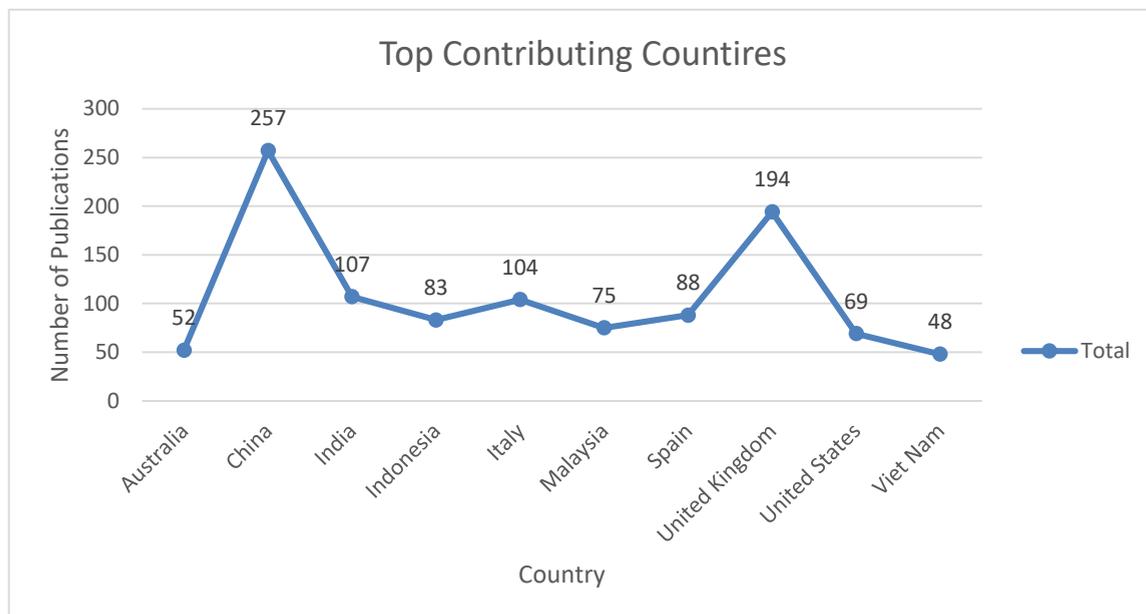
**Figure 1.** Depicts the year-by-year publication trend on digital financial inclusion and sustainable development from 2016 to 2024. The result shows an increasing trend line from 2016 to 2020, with publication rising from only 4 papers in 2016 to 29 papers in 2020. However, there is a decrease in the line from 2017 to 2018 with only 3 papers. Consequently, there was a clear acceleration, and output doubled every year, reaching 209 papers in 2023. The fastest growth is seen in 2024, with 419 publications, which generates close to 50% of the total dataset (833 papers). This reflects the rising global significance given to digital financial inclusion in attempting sustainable development issues, specifically during the post-pandemic era when digitalization and green financing enormously picked up pace.

**Figure. 2** Top Contributing Authors



Source: The Authors

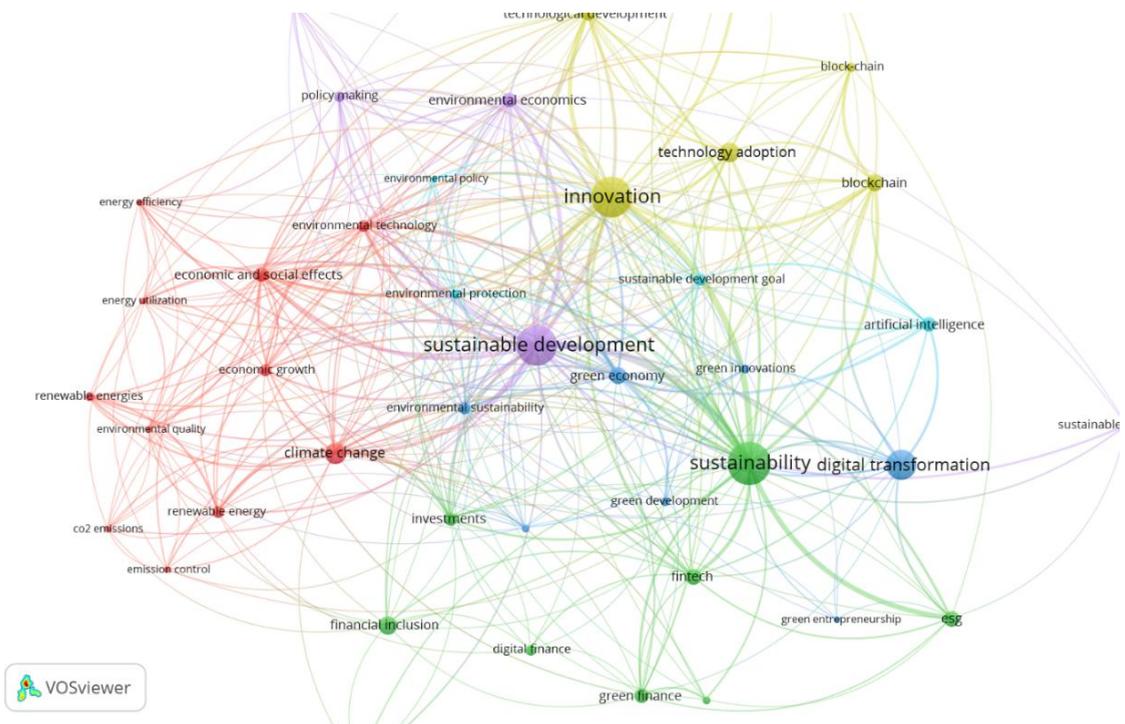
**Figure 2.** Depicts the top leading authors publishing on digital financial inclusion and sustainable development from 2016 to 2024. The most productive contributor is Pimonenko, T., with 8 publications, followed by Phuc, V.K., Lyulyov, O., and Kwilinski, A., with 7 publications each. Authors like Huy, P.Q. (6) and Elamer, A.A. (6) also appear more often. Four to five other researchers, such as Dhir, A., Raihan, A., García-Sánchez, I.M., and Hussainey, K., published between 4 and 5 contributions. The figure shows that although some authors are fairly productive, the majority have published relatively few studies, indicating that the area is new and with scattered academic contributions.

**Figure 3** Top Contributing Countries

**Source:** The Authors

**Figure 3** shows the top contributing nations in digital financial inclusion and sustainable development research (2016–2024). China has the highest contribution with 257 publications, followed by the United Kingdom (194) and India (107). Contributing countries are also active for Italy (104), Spain (88), and Indonesia (83). Countries contributing are also notable for Malaysia (75), the United States (69), Australia (52), and Vietnam (48). The findings show that developed and emerging economies are both intensively involved in this area. Asia (China, India, Indonesia, Malaysia, and Vietnam) and Europe (UK, Italy, and Spain) are the leaders in research output, which also shows global policy concern and technological advancement in combining financial inclusion and sustainability.

**Bibliometric Analysis**  
**(Bibliometric mapping with VOSviewer)**



**Figure. 4** Keyword Co-occurrence Map  
**Source.** The Authors

The keyword co-occurrence analysis (Figure 4) produced five distinct clusters, each representing a thematic research stream within the field of digital financial inclusion and sustainable development

#### **Cluster 1 (Red) – Climate Change, Energy, and Economic Impacts**

The focus of the cluster is on the economic and underlying matters of climate change mitigation and energy transformation, which surround the economic and financial effects on economies. Major keywords are CO<sub>2</sub> emissions, renewable energy use, energy efficiency, and economic growth/social implications of these changes. The analysis in this instance takes into account how dominant environmental programs are conceptualized to advance sustainable development and address issues of climate risk. This cluster puts in context the solutions presented in the other clusters and emphasizes how environmental issues become integrated into the broader sustainable development agenda.

The initial stage of research (2016-2019) mainly focused on understanding how financial inclusion helps in economic development and green energy transformation for attaining sustainable development. Hence, the primary study addressed carbon emissions, linkages of green growth, and renewable energy adoption amongst finance and environment (Geng & He, 2021; Feng, Zhang, & Lee, 2022). The later phase of research (2020-2024) widened this group by combining carbon neutrality goals and environmental technology, especially in emerging economies (Zafar et al., 2023; Bergougui et al., 2024).

#### **Cluster 2 (Green) – ESG, Digital Finance, and Sustainability**

The second cluster, the mid cluster, is the major stream, a contemporary study on finance and digitalization bridging to sustainability outcomes as an overall bridging link between technology and

policy. It is focused on sustainability, digital transformation, and new concepts in finance such as ESG (environmental, social, and governance) and green finance. The key words being identified are "FinTech" and "digital finance," along with "artificial intelligence (AI)." The key word mapping specifies that digital finance is growing and driving investment in clean energy and helping in carbon reduction (Cao, Nie, Sun, Sun, & Taghizadeh-Hesary, 2021), which provides importance to the fact that finance is one of the major factors for attaining climate- and sustainability-related targets.

The evolution of this cluster took place between 2018 and 2021, as a core connection between finance and sustainability. Early study majorly concentrated on connected green finance and inclusive growth, then the later research contribution led to ESG integration and digitalization of finance as important enablers of sustainable finance (Cao et al., 2021; Peng & Zeng, 2024). The after phase from 2022 perceived a rising prominence on digital financial inclusion as a pathway to sustainable governance and green investment mobilization (Mamun & László, 2025).

### **Cluster 3 (Yellow) – Innovation, Technology Adoption & Blockchain**

The third cluster explains the underlying technology drivers of sustainable development, with particular reference to generic innovation, the technology adoption process, and how disruptive technologies such as blockchain and AI contribute towards environmental protection. The study here looks at how such technical innovations can accelerate the achievement of the Sustainable Development Goals (SDGs). The present literature focuses on fintech and blockchain innovation potential in re-engineering the world's financial systems and driving access to sustainable choices (Liu, J., Tang, Q., & Ayangbah, F. 2024). Continuous innovation in digital spaces is essential to ensure sustainability.

This cluster explains the second evolutionary wave (2020-2024), focusing on the technology of sustainable investment. Previous works identified the role of fintech innovation in broadening inclusion (Durai & Stella, 2019). While the latest literature discovers blockchain, AI, and digital transformation accelerators for attaining SDGs (Liu, Tang, & Ayangbah, 2024; Mu, Chen, & Zhang, 2025). This shows a clear move from descriptive adoption studies to practical innovation frameworks that stress smart technologies for sustainable value creation.

### **Cluster 4 (Blue/Light Green) – Green Entrepreneurship & Digital Transformation, Artificial Intelligence**

This keyword cluster talks about the intersection of entrepreneurship, digitalization, and the use of AI in sustainable business with a focus on green business model innovation and development. It scrutinizes how AI-based technologies initiate green entrepreneurship and facilitate in-depth digital transformation towards sustainability aspects. Evidence validates that AI not only improves productivity but also leads to innovation, growth, and cleaner business practices. The key point of this study is to use AI and digital technologies for augmenting sustainable performances in organizational innovations.

This cluster mainly evolved during 2021-2024, revealing advanced technology and its contribution towards green business models and entrepreneurial sustainability. Prior study was about digital tools and their role in productivity and innovation (Li et al., 2023). The upcoming research talks on AI-based decision-making systems for cleaner production and green entrepreneurial transformation (Mi, Huang, Sohail, & Hafeez, 2024).

### **Cluster 5 (Purple) – Policy & Governance for Sustainable Development**

The last cluster is the most important institutional and structural theme, and it emphasizes the crucial role of policy and governance in directing sustainable development. Such keywords as "environmental policy," "environmental economics," and "policy-making" are applied in this cluster, which identifies that institutions and governments are central in developing and enabling environments for systemic reform. Literature asserts that strong policy conditions are important to realize the spillover into inclusive and equitable development for all from financial and technology innovations (Ed-Daoudy, A.,

& Chakir, A. 2024), encompassing the top-down context under which the whole sustainability agenda has to work.

The initial phase of this study was only on governance; however, later research explains the necessity of policy frameworks, cybersecurity standards, and inclusive regulatory systems to make sure long-term sustainable digital finance ecosystems (Anakpo, Xhate, & Mishi, 2023).

**Table. 2** Thematic Clusters Recognized from Keyword Co-occurrence Analysis

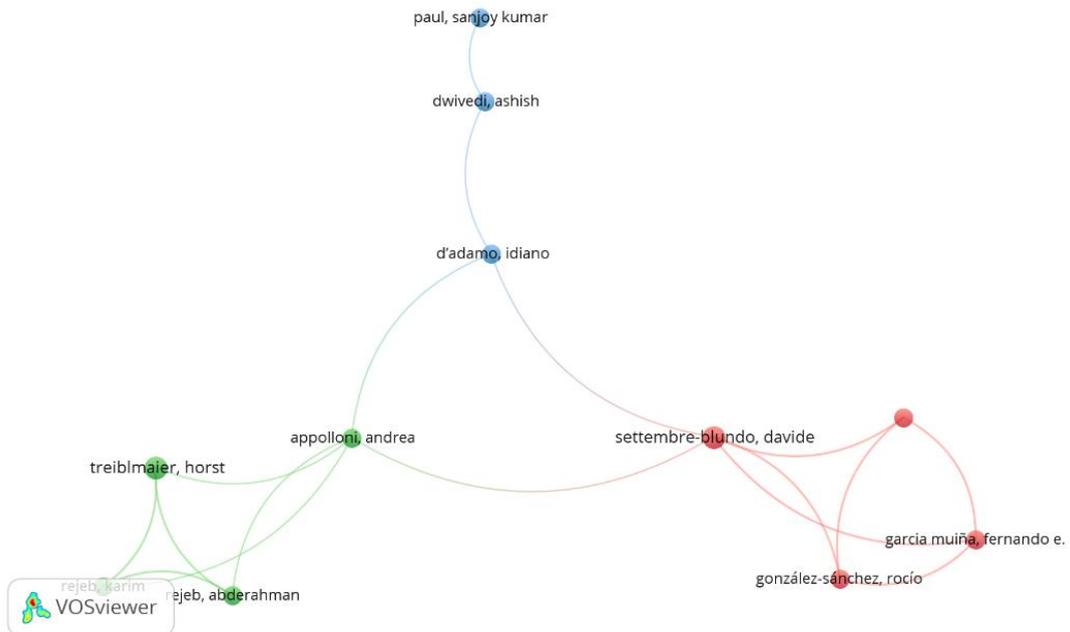
Cluster	Main Keywords	Theme
Cluster (Red)	1 Climate change, environmental policy, renewable energy, economic growth	Environmental & economic impacts
Cluster (Green)	2 Sustainable development, sustainability, green finance, financial inclusion	Core link between finance & sustainability
Cluster (Yellow)	3 Innovation, technology adoption, digitalization, blockchain	Technological enablers
Cluster (Blue)	4 Digital transformation, AI, digital technologies	Advanced digital technologies
Cluster (Purple)	5 Policy making, environmental economics, environmental protection	Policy and governance aspects

Source. The Authors

**Figure 5:** Co-authorship Network Map

Source. The Authors

**Co-authorship Network Map**



The co-authorship network (Figure. 5) produced three different clusters that linked to cooperative clusters of researchers:

**Cluster 1 (Red):** García Muina, Fernando E.; Gonzalez-Sánchez, Rocío; Medina-Salgado, María Sonia; and Settembre-Blundo, Davide. This cluster indicates great coordination among authors publishing on sustainability, corporate social responsibility, and green entrepreneurship.

The alliance between these authors largely evolved during 2018-2021, concentrating on themes such as corporate sustainability, circular economy, and green entrepreneurship. Their united work illustrates how sustainability practices have been integrated with business innovation and financial inclusion, which shows proof that the early phase of this study contributed to sustainability. Eventually, this cluster expanded to include environmental governance and sustainable corporate models, depicting a shift from general sustainability topics to green digital business transformation.

**Cluster 2 (Green):** Appolloni, Andrea; Rejeb, Abderahman; Rejeb, Karim; and Treiblmaier, Horst. This cluster represents collaboration on work in digital technology, the green economy, and supply chain management that recognizes digital financial instruments with sustainable practices. Their study evolved from discovering sustainable operations and logistics through the interconnection of fintech and blockchain applications in the supply chain to increase transparency and green performance. The evolution of this cluster shows a strong shift from operational sustainability to technology-enabled sustainable supply chains, which assist digital inclusion tools with sustainability outcomes.

**Cluster 3 (Blue):** Dwivedi, Ashish; D'Adamo, Idiano; and Paul, Sanjoy Kumar. The third cluster provides an intersection of digital innovation, fintech adoption, and green finance policy in combining financial inclusion and digital transformation.

Co-authorship analysis explores that the research domain is quite different, and narrowly grouped authors are joining regional or theme clusters. Only limited authors (Appolloni, Dwivedi, and Settembre-Blundo) are middle connectors.

Their work evolved towards analyzing fintech applications, green finance policies, and digital transformation tactics that align financial inclusion with achieving environmental objectives. This presents the modern intellectual stage of research, linking policy, governance, and technological innovation, thus merging the former conceptual and technological efforts of other clusters.

### Limitations

- I only used publications that are indexed by Scopus and are in English.
- The study is limited to 9 years of data from 2016 to 2024.
- VOSviewer is used in this study for bringing out visualizations and bibliometric analysis. The result could change in other software like BibExcel and CiteSpace.

### Future Research Directions

Digital financial inclusion and sustainable development should be some of the main directions as future areas of research. Cross-country Comparative regional analysis is needed, which will reveal the way institutional and cultural backgrounds influence the efficacy of digital financial inclusion in promoting sustainable aspects. More emphasis is required on the relatively less-researched field of gender empowerment, financial inclusion, and digital vulnerabilities, which are main factors in making equitable and secure access to financial technologies. Second, including digital financial inclusion into mainstream (ES) economic social governance and SDG indexes results accurately replicate its involvement towards sustainable development objectives. And also longitudinal analyses are necessary to track the long-term adverse effects of digital finance adoption on economic development, social development, and environmental development, thus creating more meaningful insight into its transformative powers.

### Conclusion

This paper gives a bibliometric snapshot of digital financial inclusion (DFI) and its association with sustainable development (SD) in the years 2016–2024. The results indicate a sudden rise in the production of studies post-2019, wherein more contributions were from China, the United Kingdom, and India at the global level. Thematic mapping demonstrates the research area to be multidisciplinary, uniting the fields of finance, technology, environment, and governance, and identifies fragmented collaboration networks with little international cohesion. These results confirm that indeed DFI is growing as a prominent enforcer of green finance and environmental sustainability, as required by the United Nations' Sustainable Development Goals. Yet, the field remains specialized. Aspects like gender empowerment, cyber risks, and cross-regional issues, which are less developed, have to be focused on. By mentioning trends, existing gaps, and emerging priority topics, this study not only contributes to the DFI and SD research but also carries policy-related awareness implications for policymakers, financial institutions, and researchers who want to use digital finance as a vector towards sustainable development.

### **Conflict of Interest Statement**

The authors declare that there is no conflict of interest regarding the publication of this paper.

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