

**From Financial Innovation to Environmental Transformation:
A Bibliometric Study on the Role of Green Financial Technology in Achieving
Sustainable Development**

KELLACHE Roumaissa

COFIFAS Laboratory, Oum El Bouaghi University (Algeria),
kalleche.roumaissa@univ-oeb

Received: 03/09/2025

Accepted: 28/10/2025

Published: 25/11/2025

Abstract:

The study addresses the role of green financial technology as a strategic mechanism for achieving sustainable development, through a bibliometric analysis of Scopus-based research (2015–2025) using VOSviewer and Bibliometrix. The results revealed a gradual growth in scientific output followed by a surge between 2022 and 2024, identifying seven subfields covering green finance, sustainable development, and renewable energy, with emerging key themes such as green bonds. China, India, and the United States led in scientific impact, with Chinese universities as major research hubs. The study recommends developing regulatory frameworks, enhancing digital infrastructure, and strengthening international cooperation to ensure sustainability.

Keywords: Green Financial Technology, Sustainable Development, Bibliometric Analysis.

JEL Classification: G20, O33, C88

1. Introduction:

In light of accelerating environmental and economic challenges, the concept of green financial technology has emerged as a strategic mechanism that combines digital innovation and environmental conservation, with the aim of supporting the transition to a sustainable and more nature-friendly economy. This concept is based on the use of innovative financial tools, such as blockchain, cloud computing, and artificial intelligence, to facilitate financial transactions effectively and transparently, while reducing the environmental footprint of traditional financial activities. Green finance directed through this technology includes investment in renewable energy projects, sustainable agricultural practices, and innovative environmental solutions, thereby contributing to reducing carbon emissions and enhancing environmental quality.

Studies have shown that integrating financial technology into sustainable development plans has dual benefits: on the one hand, it promotes financial inclusion and improves access to capital, and on the other hand, it increases the efficiency of resource allocation and reduces environmental waste. Cooperation between the financial sector and financial technology also opens up new opportunities to achieve the United Nations Sustainable Development Goals, especially given the urgent need for innovative solutions to address climate change, poverty, hunger, and environmental and social justice. Hence, green financial technology is the cornerstone of building a global economy capable of addressing environmental challenges and ensuring sustainable growth for future generations.

1.1. Problem Statement:

Based on the above, the problem statement of this study is to identify the main areas that should be of interest to researchers in the field of green financial technology and its practices, with a focus on addressing the shortcomings of previous studies, thereby opening the door to discovering new research trends and topics that have not received sufficient scientific investigation. Based on this, the problem can be formulated in the following central question: What are the most prominent research trends in the field of green financial technology as an innovative mechanism for achieving sustainable development?

This leads to the following sub-questions:

- To what extent does green financial technology contribute to the achievement of sustainable development goals?
- How has scientific production related to green financial technology and sustainable development evolved over time according to data from the Scopus platform?
- Who are the most influential researchers in this field according to Scopus platform publication indicators?
- Which countries and research institutions are leading the way in producing research on green financial technology and sustainable development, according to Scopus platform data?
- What are the existing research gaps, and what emerging topics can be addressed in the field of green financial technology?

1.2. Study methodology:

In light of Thietart's (2014) identification of three possible methods of exploration, namely theoretical exploration, empirical exploration, and mixed exploration, with his emphasis on exploration based on the inductive method, this study relied on theoretical exploration. This was done by addressing various conceptual and theoretical frameworks related to green financial technology.

In addition, a bibliometric analysis of data from 1,666 studies published in the Scopus database between 2015 and 2025 was conducted using VOSviewer and Bibliometrix software to analyse the results of the studies comprehensively and clearly.

1.3. Importance and objectives of the study:

Green FinTech represents a nascent intersection between digital transformation and sustainable finance. Although the term is new, its roots extend to the rapid developments witnessed in both the FinTech and Green Finance sectors over the past two decades. The importance of this study stems from two main dimensions:

First, green financial technology is an innovative tool for supporting sustainable development by promoting environmental sustainability and reducing the environmental footprint of economic activities.

Second, the added value of bibliometric studies in this field, as they provide a knowledge framework that highlights research practices and trends related to green financial technology, identifies the most prominent researchers, institutions and countries contributing to it, and provides scientific sources and references that facilitate researchers' in-depth exploration of this field.

In this context, the study seeks to achieve the following objectives:

- Clarify the concept of green financial technology.
- Study and analyse the relationship between green financial technology and sustainable development.
- Identify the most prominent researchers, countries, and reference research institutions in this field. Reveal research gaps and propose contemporary topics to support the research agenda in the field of green financial technology.

1.4. Review of Previous Studies and References:

a. Review of Previous Studies and International References:

In light of recent studies that have addressed the role of green financial technology in achieving sustainable development, it can be observed that there is an integrated line of research linking digital transformation, fintech, and green finance in supporting environmental and economic goals. A study (2025) by Zaid and Al entitled: The Future of Green Finance: How Digital Transformation and FinTech Drive Sustainability showed that integrating green finance with FinTech and digital transformation using questionnaires and hierarchical regression analysis on Saudi bank data increases the effectiveness of sustainability strategies, which intersects with the results of a study by Yao and Al (2025) entitled: Effect of Coupling and Coordinated Development of Green Finance and FinTech on Corporate Risk-Taking (2025), which relied on Chinese company data and a standard analysis methodology to prove that institutional integration between FinTech and green

finance mitigates risk and supports green innovation. Similarly, the study by Wang and Fu (2025) entitled *FinTech, Risk Management and Banking Green Credit – using panel data for Chinese banks* – showed that FinTech improves green lending by raising risk management efficiency, which is consistent with the study by Wang, Yin and Yu (2025) entitled: *The Impact of FinTech on Corporate Green Innovation*, which found using a correlation analysis between the FinTech index and green innovation indices that FinTech promotes strategic innovation in companies. In the banking context, a study by Badrous et al. (2025) entitled *FinTech Adoption and Commercial Banks' Environmental Performance*, using a questionnaire and structural equation modelling, demonstrated that FinTech adoption improves the environmental performance of banks by activating green accounting, a finding supported by a study (2025) Osei-Assibey Bonsu entitled: *Does FinTech Lead to Enhanced Environmental Sustainability?* which compared China and India using PLS-SEM and confirmed that green innovation plays a key mediating role between FinTech and environmental sustainability. At the sectoral level, a study by Qin and Tan (2025) entitled *Lighting a Green Future: The Role of FinTech in the Renewable Energy Transition* using the FinTech index and entropy methodology showed that FinTech contributes to the transition to renewable energy by improving capital allocation, while the study by Xu and Chen (2025) entitled *Does FinTech Foster the Development of Green Finance?* (2025) showed through a panel analysis of regional data that the impact of FinTech on green finance varies according to the maturity of financial systems. This research correlation is rooted in *Green FinTech: Developing a Research Agenda* (2024), which provided a systematic review of 74 papers and revealed research gaps, particularly in the use of artificial intelligence, and is reinforced in *Unleashing FinTech's Potential: A Catalyst for Green Bonds Issuance* (2024), which demonstrated through bond market analysis that FinTech increases green bond issuance by empowering intermediaries and promoting environmental awareness, confirming the integral role of FinTech in all green finance pathways to achieve sustainable development.

b. Review of Previous Arabic Studies and References:

There are numerous Arabic studies that have addressed the topic of green financial technology (Green FinTech) and sustainable development, among which a few can be highlighted. For example, the study by Zamel Mohamed El-Sayed and Abdallah Hasnaa Mohamed (2025), entitled “*The Impact of Green Financial Technology and Green Finance on Achieving Sustainable Development in Institutions*”, sought to measure the effect of these technologies on institutional performance and sustainability, adopting a descriptive-analytical approach. It concluded that green FinTech, along with green finance tools, enhances capital efficiency and strengthens institutional competitiveness, recommending the development of regulatory frameworks to promote application. Similarly, the study by Asmaa Draji and Nour El-Houda Dahmani (2024), “*Green FinTech Companies as a New Trend for Financing Environmentally Friendly Investments*”, aimed to analyze the work of Stripe Climate in financing carbon removal projects through crowdfunding, using case study methodology and financial data analysis. The findings revealed the capacity of such firms to

mobilize significant resources rapidly, with success depending on transparency and user engagement. In another study, Brish Rabah and Hamla Azzedine (2023), “The Contribution of Green Financial Technology to the Growth of Green Finance for Supporting Sustainable Development Dimensions – A Case Study of Europe”, examined the role of Green FinTech in fostering sustainability. The research highlighted how eco-friendly financial technologies reduce costs, expand accessibility, and improve risk management through tools such as blockchain and big data. Within the Arab context, the study by Asmaa Waneesi and Abed Tahari (2022), “The Role of Green Finance in Achieving the Goals of Sustainable Development Projects”, employed an applied approach and concluded that both the Arab region and the world face significant environmental challenges, with demand for digital green finance projected to grow rapidly, stressing the need for enhanced environmental awareness policies and innovative financing mechanisms. Finally, the study by Roqaya Hadadou (2021), “Green Finance as a Tool for Green Economy and Achieving Sustainable Development in Algeria”, revealed the limited spread of green finance in Algeria, aimed to assess its role in steering the economy toward sustainability, and recommended the development of digital-supported green financial products to overcome traditional barriers.

c. Review of Previous Foreign Studies and References in Bibliometric Analysis:

In recent years, bibliometric studies in the field of green financial technology and sustainable development have expanded significantly, with several studies addressing this intersection from different angles. Tamasiga et al. (2022) presented a bibliometric and methodological analysis linking financial technology and the green economy in African countries, establishing an integrated framework to support the transition to sustainability. The results showed an increasing research interest in the concept of Green FinTech and its role in green growth. In the same context, Kozar and Wodnicka (2024) focused on a bibliometric analysis of research combining financial technology and green finance, identifying 27 key research areas and highlighting gaps related to the green labour market and green competencies, while Kozar and Paduszyńska (2024) identified 19 green research areas in studies linking financial technology and sustainable development, most notably green finance and green innovation. Omeragić et al. (2024) reviewed, through bibliometric analysis, the role of financial technology in supporting climate action and clean energy, highlighting applications such as blockchain and robo-advisors in supporting green investments. On the other hand, Dar et al. (2024) presented a bibliometric study revealing how the integration of financial technology with green finance promotes the transition to a low-carbon economy, while Bansal et al. (2025) combined bibliometric analysis and a systematic review to consolidate the literature on sustainable digital finance, proposing a conceptual framework for its role in achieving sustainable development goals. Wang et al. (2025) also presented a comprehensive bibliometric analysis of the evolution of green finance research, identifying three main research phases and emerging topics such as the digital economy and green energy, while Parveen et al. (2025) linked financial inclusion and green finance through a bibliometric analysis that showed the close interconnection between them as pillars for achieving sustainable development goals. In another study, Bhatnagar

and Sharma (2022) identified key enablers of green finance, such as technological innovation and fiscal policies, based on a bibliometric analysis of Scopus sources, while Bhatnagar et al. (2021), through bibliometric analysis, discussed the possibility of the Fourth Industrial Revolution becoming a catalyst for accelerating the adoption of green finance and its support for sustainable development.

2. Theoretical Framework:

2.1 What is green financial technology?

Services with the aim of providing more efficient and effective products and services. (Chen, Ma, Li, & Zhou, 2024, p. 05) The Financial Stability Board has defined this field as technology-based innovation in financial services, which leads to the emergence of new business models, procedures, and products that have a tangible impact on improving service delivery. Fintech also represents modern business models offered by financial institutions or electronic companies, capable of bringing about fundamental changes in the financial services sector due to their innovative nature (Tao & Renke, 2018, p 223). Among its main tools are: the internet, big data, artificial intelligence, communication technologies, distributed systems, and cybersecurity solutions. Its activities include digital finance, loans and deposits, crowdfunding, peer-to-peer (P2P) lending, robo-advisors, blockchain, and virtual currencies (Xiang, Zhi, & Cheng, 2019, p 1).

With the establishment of Fintech as a key instrument for developing and expanding financial services, a recent trend has emerged towards employing it to support environmental sustainability and address climate change, known as green financial technology. The latter aims to integrate digital solutions with environmental goals by reducing the negative impact of financial activities while enhancing economic efficiency (Hamla & Berrich, 2022). Advanced technologies such as big data, cloud computing, blockchain, and artificial intelligence contribute to enabling green finance by reducing information asymmetry and verification costs, expanding innovation in green financial products and services, simplifying traditional procedures, and enhancing operational efficiency to deliver higher-quality and more effective green financial services (Changan, Long, Shikuan, Cunyi, & Khaldoun, 2024, p. 72).

2.2 The relationship between green financial technology and sustainable development:

Green financial technology has become a new trend for achieving sustainable development and is of great importance in the literature, as it has a positive impact on the quality of the environment, ultimately making it a key factor in promoting green growth and reducing the carbon footprint. In a study conducted by Li et al. (2022) to examine the relationship between green financial technology and green growth in China during the period 2007-2017, the results showed that this technology accelerates green growth by promoting renewable energy, energy storage, and clean transportation, while mediating and enhancing the impact of energy by attracting investment, improving efficiency, and achieving sustainable development. In the same vein, Abid, Ulucak, and Danish (2020) found that green financial technology helps industries produce goods in a cleaner and more environmentally friendly way by replacing fossil fuels with renewable energy sources and

improving efficiency in production and operational processes.

Technological developments are closely linked to environmentally friendly development, with innovation playing a crucial role in reducing environmental impacts and accelerating the transition from traditional to sustainable economic models. The importance of cooperation between green finance and financial technology in combating climate change is evident. A study on green finance policies in China highlighted a significant reduction in industrial gas emissions and pointed to the role of green financial technology in reducing sulphur dioxide emissions. China is already a leader in green finance, and according to Muganyizi et al. (2021), there is a call for faster development of related products, improvement of green credit capabilities, and encouragement of green financial technology companies to participate in environmental activities and reduce systemic risks. (Sohail, Khan, Akbar, & Svobodova, 2024, p. 07)

In this context, it is worth noting that green fintech companies have rapidly developed into a key growth area in the environmental fintech ecosystem, with the sector seeing increasing inflows of venture capital. Demand is centred around data and metrics related to the environmental transition, yet investments are mainly directed towards environmental accounting and reporting solutions, with no clear solutions supporting a rapid transition to a clean or climate-adapted economy. These companies rely on the wealth of climate information available from academia, the public and non-profit sectors, making the need for robust and reliable climate analytics urgent to ensure the effectiveness of green finance. These companies are classified into several types depending on the service provided, such as: green digital asset solutions, green digital innovation and lending solutions, green digital risk analysis and insurance technology, digital platforms for green crowdfunding and cooperative financing, green digital investment solutions, green digital payment and accounting solutions, and digital environmental, social and corporate governance data and analytics solutions. (Derradji & Dahmani, 2024, p. 58). On the practical side, the Ant Forest project proposed by Ant Financial is a leading example of the use of green financial technology, with the company covering a range of business models in financial technology such as mobile payments, money management, consumer loans, and big data-based credit. The project aims to harness digital technology to finance tree planting, with users planting a virtual tree using ‘green energy’ collected from low-carbon practices, and a real tree being planted when a certain energy threshold is reached. By April 2017, more than 220 million users had contributed to the planting of 85 million trees in western China, raising individual awareness of environmental protection and connecting investment institutions with green finance. (Tao & Renke, 2018, p. 224)

In terms of environmental and economic impact, investing in green projects reduces carbon pollution in the short and long term, facilitates the implementation of renewable energy and energy efficiency measures, and enables the development of advanced technology and sustainable production methods. Green finance promotes energy efficiency and green buildings and reduces dependence on fossil fuels, contributing to a carbon-neutral economy and aligning financial strategies with climate goals. (Sohail, Khan, Akbar, & Svobodova, 2024, p. 02) Research by Udeagha and Muchapondwa (2023) indicates that

green financial technology supported by big data analysis, the Internet of Things, and machine learning can efficiently serve large numbers of people and reduce emissions through the sharing economy.

Thakor (2020) also emphasises that innovation in blockchain contributes to the advancement of financial technology and facilitates the achievement of sustainable development goals and the Paris Agreement. Financial technology helps improve the financial sector by adopting green practices such as environmental loans and investments (Sohail, Khan, Akbar, & Svobodova, 2024, p. 04), which is important given the banking sector's dependence on environmental sustainability and economic growth. This technology enables financial institutions, both public and private, to increase green loan sales and direct capital towards sustainable projects that reduce environmental impact.

The emergence of financial technology has driven the development of green finance, promoted the issuance of green bonds, and diversified investment portfolios. (Kozar & Paduszyńska, 2024, p. 06) The theory of technological spillovers (Ning et al., 2023) explains how green finance and green credit interact, with advances in one supporting the other. Green financial technology also reduces the cost of transactions and credit investigations, speeds up decision-making in green finance and risk management, and plays a role in ensuring the authenticity and traceability of green assets through blockchain technology. (Sohail, Khan, Akbar, and Svobodova, 2024, p. 02)

Financial technology itself is a low-carbon green industry, as it reduces physical mobility, consumes fewer resources, and encourages new environmentally friendly business models such as the sharing economy. It also contributes to providing clean energy to the poor and facilitating green savings and investment. This reduces the gap in access to banking services and promotes sustainable economic growth through green financing for environmental projects.

Finally, it can be said that despite the clear advantages of green financial technology, it faces challenges, most notably the lack of clear regulatory frameworks, weak digital infrastructure in some regions, and the potential for misdirected green investments. Some technical solutions may also lead to unintended environmental impacts if not managed carefully. Nevertheless, the opportunities are promising, as this technology can expand the scope of green finance, stimulate innovation, enhance transparency, and support the transition to a low-carbon economy, making it a strategic tool for achieving global sustainable development goals.

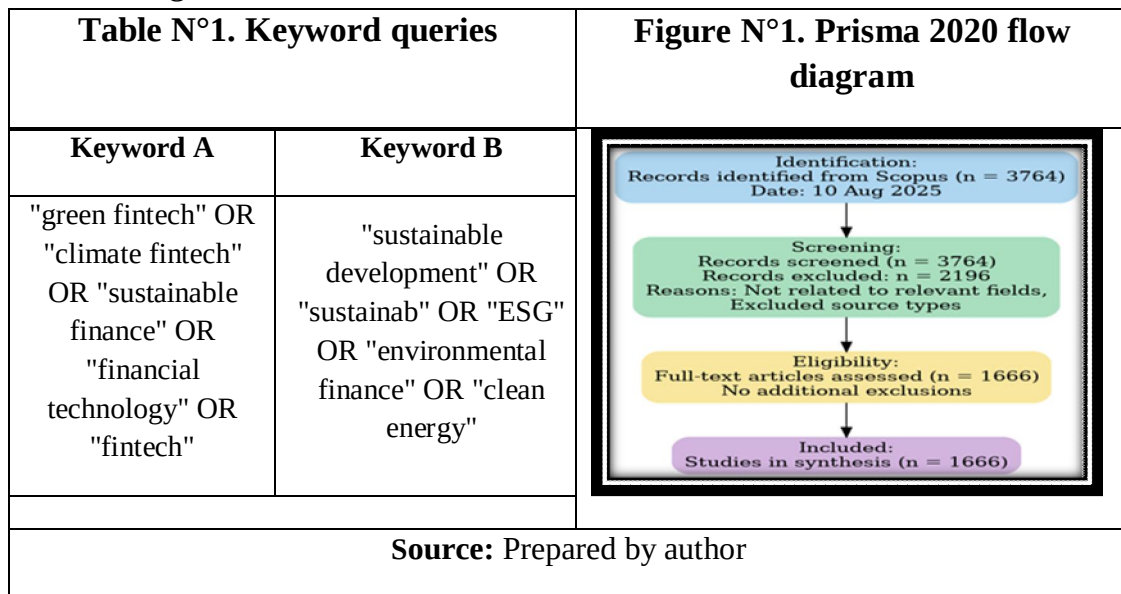
3. Methodology and Analytical Tools:

3.1 Data source and search strategy:

On the impact of adopting green financial technology on sustainable development. The study relied on the Scopus database, where the advanced search formula was used according to two sets of keywords, as shown in Table 1. Then, the time frame was set for the period from 2015 to 2025, starting from 2015, which represents an important turning point in global interest in sustainable development goals. In September of that year, the United Nations launched the 2030 Agenda for Sustainable Development, which included 17 global

goals, leading to a noticeable increase in studies linking finance, technology, environmental protection, and social justice. This period also witnessed a global rise in the financial technology sector with the spread of digital applications, electronic wallets, and artificial intelligence technologies in banking services, in addition to the emergence of blockchain technology. The terms ‘Green FinTech’ and ‘Climate FinTech’ began to be used in scientific research during this phase.

In a subsequent phase, the PRISMA 2020 framework was used to document the screening steps, select studies, and analyse data in a systematic and organised manner. This is illustrated in Figure 1.



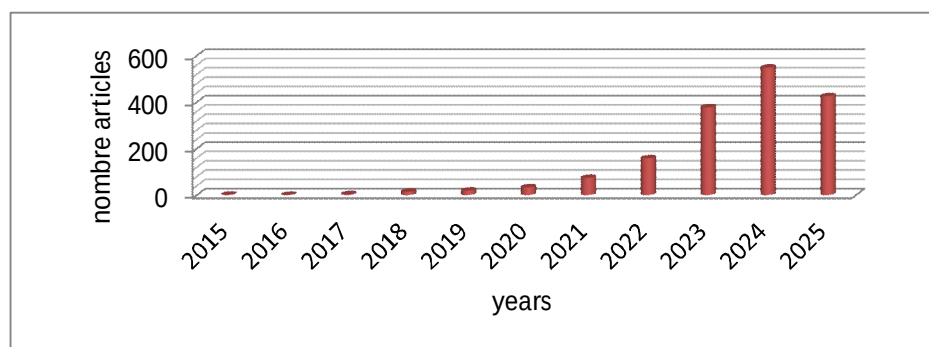
After conducting a systematic and organised analysis of the data, VOSviewer software will be used to prepare network maps (whether for authorship, citations, or keywords). in addition to relying on the Bibliometrix package in R, with the Biblioshiny interface, in order to perform a comprehensive analysis that includes the thematic map and various analysis indicators.

3.2 Presentation and analysis of bibliometric study results:

a. Analysis of the number of publications by year

The following figure presents the annual evolution of scientific production in the field of financial technology and sustainable development during the period (2015–2025), highlighting the main research trends and the growth stages experienced in this field.

Figure N°2. Annual evolution of publications



Source: Outputs of the Scopus database

B. Keyword analysis

Figure N°3. Keyword co-occurrence network

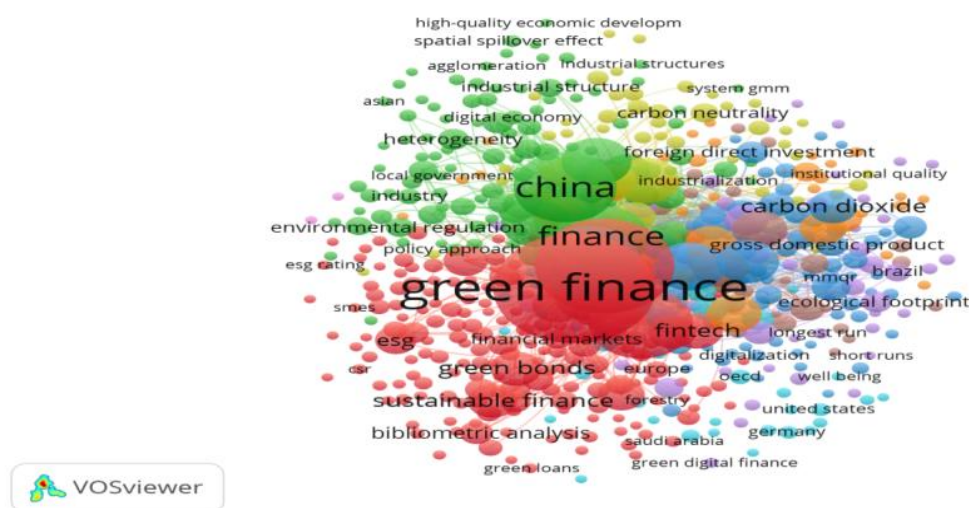


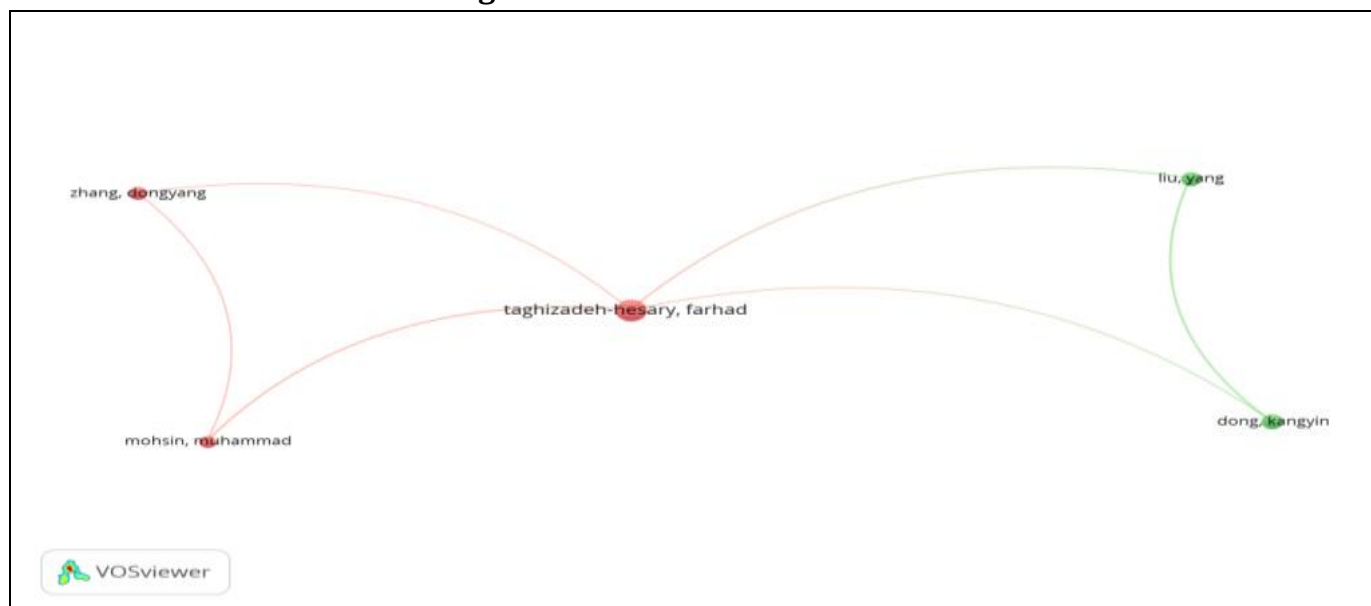
Figure 3 shows that there are seven sub-areas (clusters) for research on this topic, which are divided into two general areas: green finance (the red cluster and related clusters) and sustainable development and renewable energy (the other clusters in green and blue and their associated clusters). This indicates that the field of green finance is complex and closely linked to many other concepts, such as sustainable finance, green bonds, green loans, financial technology, carbon neutrality, environmental footprint, economic growth and solar energy.

It is also clear that some concepts, such as China, carbon dioxide, digital economy and environmental regulation, are frequently repeated, as highlighted by the size of the circles in the map, where the size of the node reflects the frequency of the term's appearance in the database, while the links indicate the strength of the relationship between keywords in previous studies.

C. Analysis of researchers results

The following figure shows a collaborative network map between authors, showing the links between researchers who have published joint research:

Figure N°4. Authors collaboration network



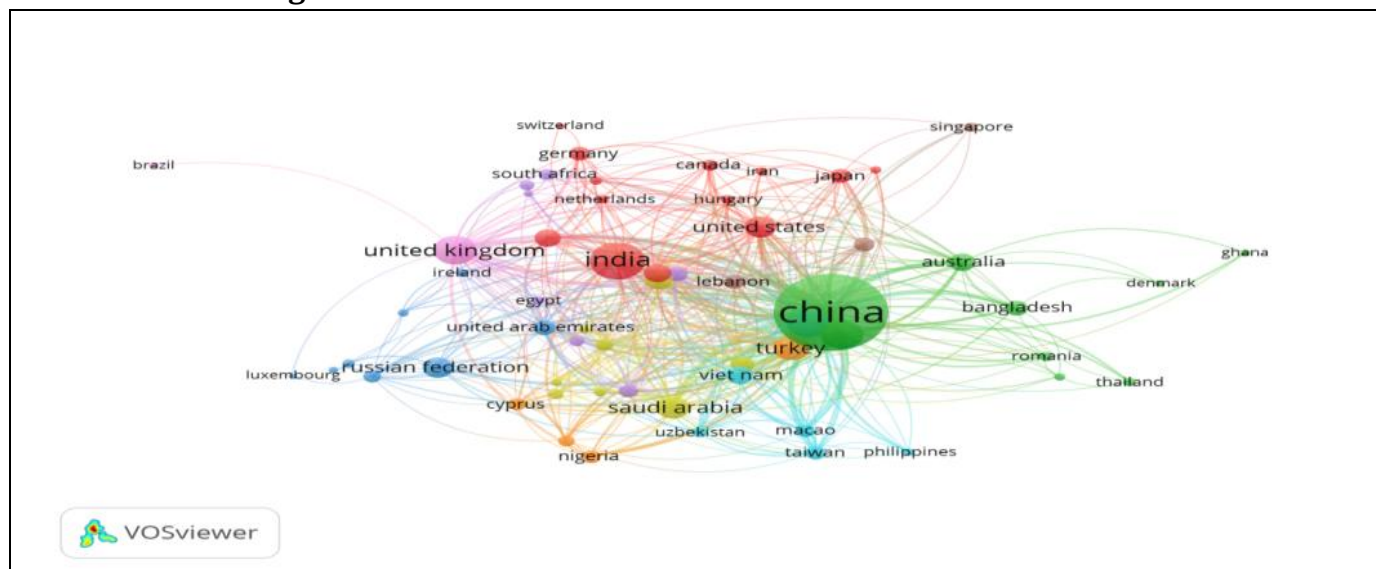
Source: Outputs of VOSviewer

The figure represents a collaborative network map between authors created using VOSviewer, where nodes show the names of researchers and their size reflects their research activity, while colours represent interconnected research groups, and lines represent collaborative relationships and the number of joint publications. It is clear that Taghizadeh-Hesary, Farhad forms a central hub connecting two main groups, one in red comprising researchers such as Zhang, Dongyang and Mohsin, Muhammad, and the other in green comprising researchers such as Liu, Yang and Dong, Kangyin, highlighting his role in strengthening the links between the two research networks.

D. Analysis of the results of countries and research institutions

The country-level analysis reveals that China, India, and the United States stand out as the most influential and central actors in this field, while other nations mainly serve as regional or bilateral research partners. As illustrated in Figure (5), research collaboration is structured into distinct clusters: China leads the green cluster as the main hub with strong ties to several Asian, European, and African countries; the red cluster brings together India, the United States, and major industrialized nations alongside Asian partners; the blue cluster connects Russia, certain European states, and Middle Eastern countries; and the orange cluster links Saudi Arabia with African and Asian countries. Meanwhile, other clusters show weaker connections, with Brazil remaining relatively isolated and Singapore acting as a bridging node across different research networks.

Figure N°5. International collaboration network of countries

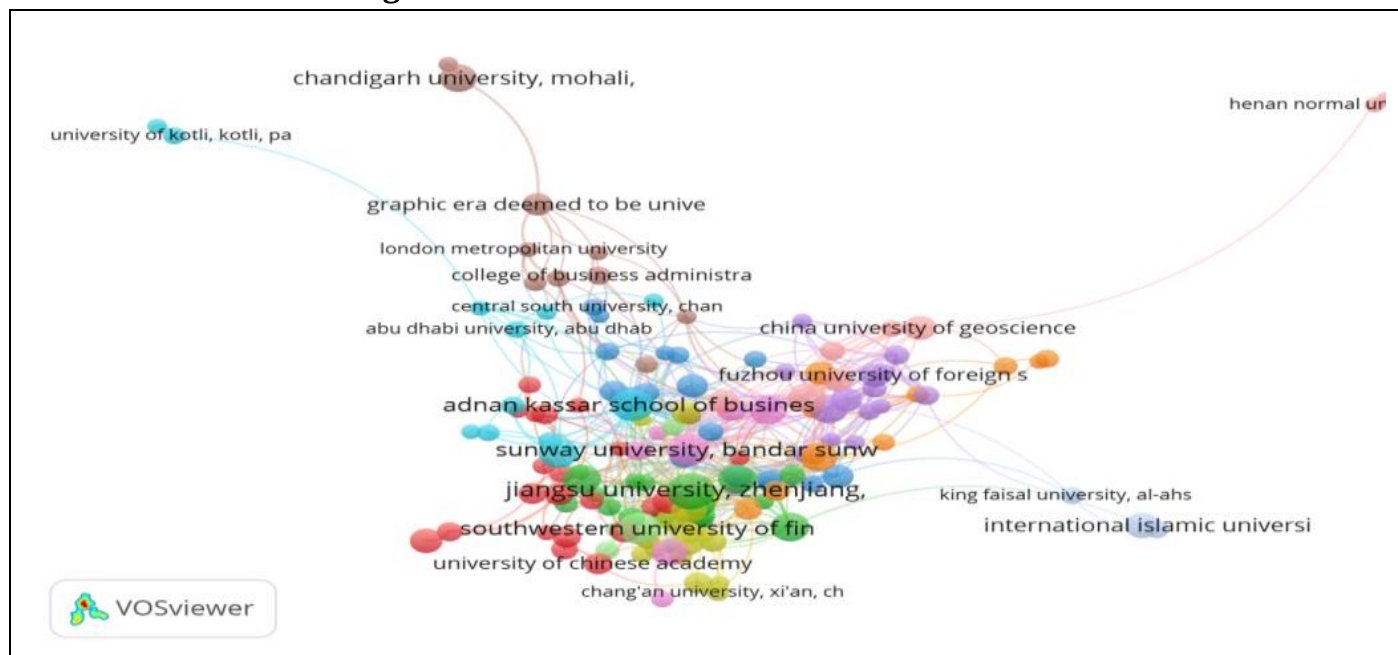


Source: Outputs of VOSviewer

With regard to research institutions, Figure (6) indicates that Jiangsu University, Zhenjiang, Southwestern University of Finance, and Sunway University, Bandar Sunway emerge as pivotal hubs of collaboration, given their extensive connections with numerous other institutions. This underlines their significant role in advancing scientific production. Moreover, a strong cluster is observed among Chinese universities such as China University of Geoscience, Central South University, and Chang'an University, Xi'an, reflecting China's substantial academic concentration in this domain.

In parallel, the map highlights the existence of regional and international cooperation networks, encompassing institutions from diverse countries. Examples include the International Islamic University in Malaysia, Abu Dhabi University in the United Arab Emirates, and King Faisal University in Saudi Arabia, alongside several universities in the United Kingdom, India, and Lebanon.

Conversely, certain institutions display relatively limited collaborative ties, such as Henan Normal University and the University of Kotli, suggesting a modest level of engagement compared to the central hubs. Overall, the map illustrates that research collaboration tends to be concentrated within a set of leading universities, while smaller networks radiate from them at both regional and international levels.

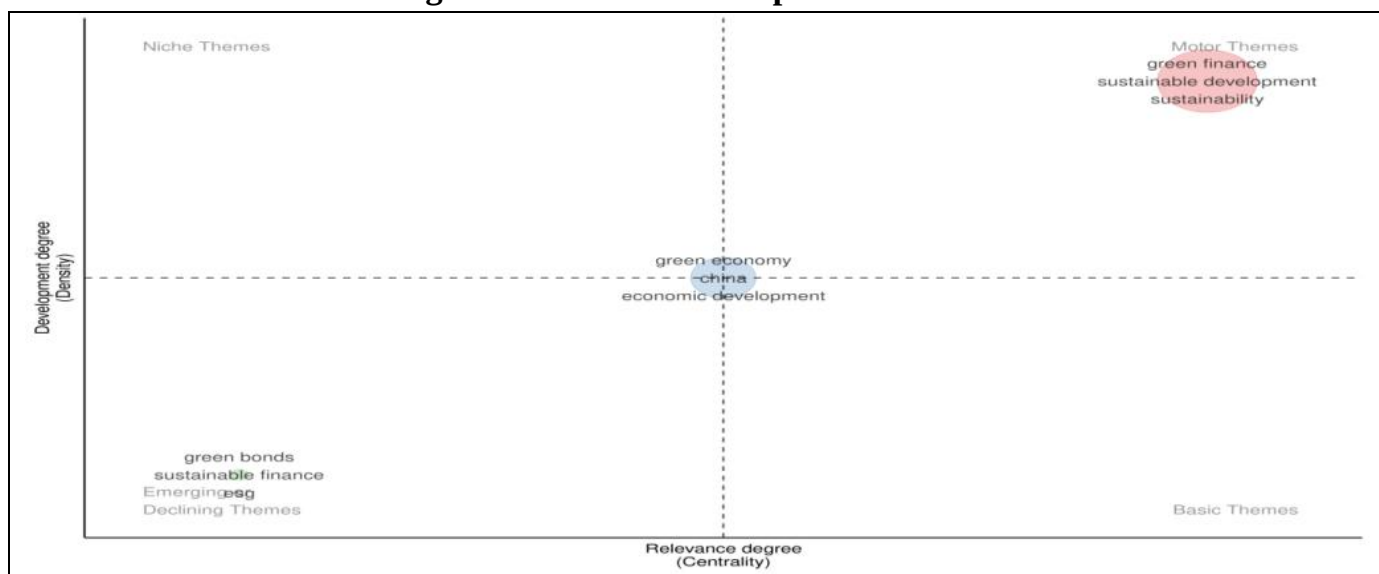
Figure N°6. Research institutions collaboration network

Source: Outputs of VOSviewer

Factor analysis and the thematic map will be employed in the final stage. The integration of these two tools contributes to providing a comprehensive perspective that combines an understanding of the conceptual structure of the field with the identification of each topic's position within its research life cycle. This, in turn, supports the scientific interpretation of the results and assists in formulating precise research recommendations.

E. Thematic Map of Research Themes

This map is used to classify the identified topics according to their research relevance and level of development, thereby enabling the identification of motor themes, basic themes, and emerging or declining them

Figure N°7. Thematic Map of Research Themes

Source: Outputs of Bibliometrix

The figure (7) represents a thematic map illustrating the distribution of research topics along two axes: the horizontal axis indicates the degree of relevance or centrality, while the

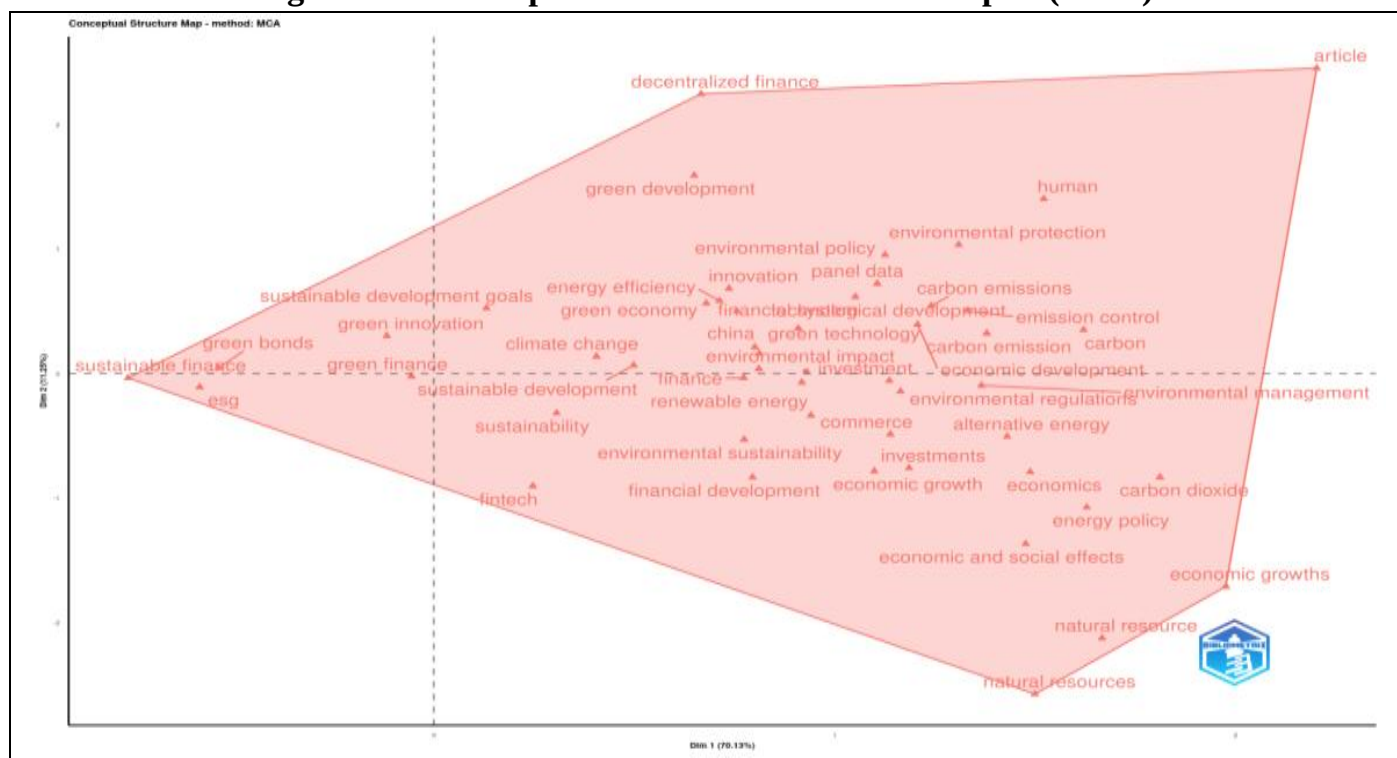
vertical axis represents the degree of development or density. It is evident that topics such as “green finance,” “sustainable development,” and “sustainability” are located in the upper-right quadrant, indicating that they are motor themes with high relevance and a strong level of development, often constituting core areas in the field. In contrast, terms such as “green economy,” “China,” and “economic development” are positioned in the middle, reflecting moderate importance and their diffusion across multiple research domains.

On the other hand, topics such as “green bonds” and “sustainable finance” appear in the lower-left quadrant, suggesting that they represent emerging or declining themes, either still under development or losing momentum. The upper-left and lower-right quadrants are almost empty, implying a noticeable absence of niche themes (highly specialized topics) or basic themes (fundamental but weakly developed topics) within the analyzed sample.

F. Conceptual Structure of Research Topics Using (MCA)

The objective of multiple Correspondence analysis is to uncover the underlying conceptual structure of the research field by identifying the main dimensions or axes that organize the relationships among concepts and keywords. This approach enables a deeper understanding of the overall structure of the research domain.

Figure N°8. Conceptual Structure of Research Topics (MCA)



Source: Outputs of Bibliometrix

The structural analysis using Multiple Correspondence Analysis (MCA) reveals that the research field integrating sustainable finance, environmental policies, and green technology is divided into five main interconnected clusters. The green finance and investment cluster focuses on financing mechanisms for the transition toward a green economy, such as green bonds and responsible investment (ESG). The environmental policy and green development cluster addresses legislation and policies aimed at sustainable development. The sustainability and environmental technology cluster is the densest in

terms of concepts, encompassing renewable energy, green technology, climate change, and carbon emissions. Meanwhile, the economy and natural resources cluster explores the relationship between resource exploitation and economic growth while considering environmental and social dimensions. There are also specialized peripheral topics, such as decentralized finance and the impact of blockchain on green finance. The integration of the network map and thematic map shows that green finance and sustainable development act as key research drivers, while themes such as the green economy, economic development, and China represent basic and central areas requiring further development. In contrast, green bonds and sustainable finance appear as emerging themes that combine both research relevance and thematic advancement.

4. Discussion of Results:

The results of the bibliometric analysis revealed that scientific production in the field of green fintech and sustainable development experienced a gradual evolution from 2015 to 2021, followed by a sharp increase between 2022 and 2024, reaching its peak in 2024 with a total of 549 publications. This research surge clearly answers the sub-question regarding the temporal evolution of scientific output and reflects the growing international interest, institutional support, and funding directed toward this field.

The keyword analysis revealed the presence of seven interconnected subfields, which fall under two main areas: green finance and sustainable development, and renewable energy. This addresses the sub-question concerning research gaps and emerging topics. Concepts such as sustainable finance and green bonds emerged as developing or nascent themes, indicating promising research opportunities that merit further exploration.

With respect to the researcher network, the results showed that Taghizadeh-Hesary, Farhad constitutes a central hub connecting multiple research groups. This answers the sub-question concerning the most influential authors and highlights his role in strengthening international research linkages. Regarding countries and institutions, the analyses revealed that China, India, and the United States are the most productive and influential in this field. Leading institutions such as Jiangsu University, Southwestern University of Finance, and Sunway University ranked as central research hubs. This addresses the sub-question concerning leading countries and institutions, reflecting the strength of the research structure and academic collaboration within these nations.

At the level of the thematic map, topics such as green finance and sustainable development appeared as motor themes characterized by high centrality and strong development. Meanwhile, topics such as green bonds and sustainable finance were positioned as emerging or declining themes, guiding researchers toward future research priorities to strengthen these areas and ensure sustained attention. Collectively, the results provide a comprehensive overview of current research trends and future gaps, forming a knowledge base that supports research and strategic planning in the field of green fintech and sustainable development.

The findings are therefore consistent with the theoretical and conceptual frameworks outlined in the study. The theoretical perspective highlighted green fintech as a strategic tool to enhance financial inclusion and achieve sustainable development by integrating digital

solutions with environmental objectives. The bibliometric results confirmed that core themes such as green finance and sustainable development, which were emphasized in prior literature, are indeed receiving a high level of attention and research development. Conversely, emerging themes such as green bonds require further applied studies to strengthen their scientific presence. Moreover, the dominance of specific countries and research institutions in the scientific landscape reflects the theoretical framework's emphasis on the importance of research infrastructure and institutional resources in supporting green innovation.

Thus, the study demonstrates the complementarity between the theoretical and conceptual foundations and the empirical analysis, granting its results strong explanatory power and establishing a solid basis for guiding future research policies.

5. Conclusion:

Sustainable development is the common goal for the future of humanity, and green finance and environmentally friendly financial technology are driving forces for sustainable economic development through their support for technological innovation and industrial restructuring, thereby reducing dependence on polluting energy sources. Financial technology is inherently green, and green finance needs its support to become more inclusive and widespread. The shift towards a sustainable economy is an inevitable trend for economic development, and financial technology and green finance have provided unprecedented opportunities to build this system, which requires the development of new policies to promote their integration and expand their practical applications.

The findings are consistent with the theory of technology diffusion, which states that the adoption of innovations goes through successive stages, beginning with early adoption and ending with widespread diffusion. This is reflected in the research boom recorded between 2022 and 2024, which represents a turning point towards maturity in academic interest in green financial technology. The results also confirm what innovation theory has proposed about the role of innovations in finding new solutions to environmental challenges, with topics such as green bonds emerging as a financial innovation aimed at financing the transition to a low-carbon economy. Thus, the applied results are not limited to describing research trends, but interpret them within established theoretical frameworks that help understand the factors influencing the spread and adoption of green fintech globally.

Based on the above, several research directions can be proposed to deepen studies in this field, including:

- Strengthening applied research on emerging topics such as green bonds and sustainable finance, supported by practical case studies across various economic sectors.
- Expanding international research collaboration networks, particularly between developing and developed countries, to foster knowledge exchange and the dissemination of best practices in green fintech.
- Developing flexible regulatory and legislative frameworks that support innovation in sustainable finance, with precise standards to measure and evaluate the environmental impact of funded projects.

➤ Encouraging investment in digital infrastructure in countries with limited resources to ensure their effective integration into green finance solutions and technologies.

➤ Integrating bibliometric analyses on a regular basis into national research policies to track emerging trends and identify future scientific priorities.

6. References:

- Changan Wang, Long Wang, Shikuan Zhao, Cunyi Yang, Khaldoun Albitar, **The impact of Fintech on corporate carbon emissions: Towards green and sustainable development**, Business strategy and the environment, 33(06),2024, p72;
- Chen Lang, Ma Rui, Li Jang, Zhou Fengjiao, **Revolutionizing sustainable economic growth in China: Harnessing natural resources, green development, and fintech for a greener future**, Resources Policy, 92,2024, p05;
- Derradji Asma, Dahmani Nourelhouda, **Green fintech companies as a new trend for financing green eco-friendly investments -Case study of the American company Stripe Climate –**, Economic Development Review, 09(01), 2024, p58;
- Hamla Azeddin, Berrich Rabah, **The contribution of green fintech to the growth of green finance to support the dimensions of sustainable development – a case study of Europe**, Algerian Journal of Economic Performance, 07(01), 2022;
- Kozar Łukasz, Paduszyńska Marta, **FinTech and Sustainable Development: Study Focused on Identifying Green Research Areas**, Procedia Computer Science, 2024, p06;
- Sohail Mariam, Khan Soha, Akbar Ahsan, Svobodova Libuse, **Empowering sustainable development: The crucial nexus of green fintech and green finance in Luxembourg's banking sector**, Journal of Infrastructure, Policy and Development, 08(07), 2024, pp 02-07;
- Tao Cen, Renke He, **Fintech, Green Finance and Sustainable Development Advances in Social Science**, Education and Humanities Research, 291, 2018, pp223-224;
- Xiang Deng, Zhi Huang, Cheng Xiang, **FinTech and Sustainable Development: Evidence from China Based on P2P Data**, Sustainability journal, 11, 2019, p01.