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Analysing Sustainable Marketing and Green Finance Trends in the Age of Artificial Intelligence through Bibliometric Review

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ABSTRACT

The convergence of artificial intelligence (AI), sustainable marketing and green finance is redefining how businesses and financial institutions drive sustainability-led transformation through digital intelligence and data-driven decision-making. This study conducts a comprehensive bibliometric review and thematic evolution analysis to examine the intellectual landscape, knowledge structure, and potential of research integrating AI with sustainability-oriented marketing and financial systems. Using 762 Scopus-indexed journal articles published between 2004 and 2026, the analysis employs Bibliometrix and VOSviewer to evaluate publication trends, influential authors, leading institutions, top journals, and country-level contributions. Thematic progression indicates a shift from conceptual sustainability and ethical marketing discourses to AI-based predictive analytics, ESG risk modelling, and intelligent decision-support systems in green finance. The findings confirm that AI enhances transparency, accountability, and performance in sustainability-oriented market behaviour and investment systems. This study provides an integrated understanding of how AI-driven innovation accelerates sustainable value creation in marketing and finance. It further identifies emerging areas such as decentralized finance, green digital ecosystems and AI-powered consumer behaviour analytics as promising directions for future research.

1. Introduction

In the modern world, alternative forms of financing, including foreign aid, remittances, and green finance, are the crucial components of economic development. Over time, conservative finance methods fall short of meeting the demands of economic factors. This is evident in both developed

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and developing nations [1]. However, cash heavily influences the development process. By acknowledging its importance, many national and international organizations have made more active plans to promote businesses that include easy access to loans [2].

In recent years, the role of green finance has become crucial in addressing climate change. Moreover, it adopts low-carbon economic transitions and supports sustainable development. Green finance collects financial tools and processes before making any investment decisions. These tools consider environmental considerations. It includes a broad range of programs such as sustainability-linked loans, green bonds, and ESG-driven investment strategies [3,4]. Green financing is the driving force behind the development of urban sustainable progress and the green economy [5]. With this sudden growth, financial markets have seen significant growth, which leads to more research. This analysis focuses on this area for a better understanding of its effects, reasons, and changing forms. The global policy agenda related to the emergence of green finance. Governments and financial institutions have adopted new sustainability-oriented policies and tools to shift to carbon neutrality and the UN Sustainable Development Goals [6]. Additionally, empirical research has demonstrated clear benefits of green finance, which can enhance enterprise-level innovation and efficiency [7,8]. It can bring in more investments [9] and collaborations between low carbon usage and pollution control [10]. To promote sustainable energy development, it is found that there are several hurdles. The most significant one, in many countries, is the lack of funds for such projects. These popular green finance tools are likely to be a possible remedy in supporting capital accretion for sustainable projects. Green bonds, environmental sustainability-focused investments, and other financial tools direct investment toward renewable energy initiatives. Better returns are encouraging the world towards greener energy sources, looking at them as worthwhile investments [11].

Artificial intelligence (AI) helps improve and support green financial activities in various ways. It supports innovative financial tools and sustainable investment portfolios while assessing the environmental risk [12]. Green and inclusive finance must be integrated with AI to endorse sustainable development and energy efficiency [13]. In world finance, environmental safety and sustainability are given importance with an aim to build a pollution-free world. However, it is not with old portfolio models that neglect environmental risks. Therefore, the much-needed green-focused investment strategies are beneficial for attaining financial performance as well as ecological flexibility [14]. This acts as a potential policy tool that evaluates the impacts of space and time and checks its mechanism [15]. Green development helps individuals attain financial independence while making responsible environmental choices without compromising sustainability [16]. In addition, digital innovations are reforming trust, traceability, and authority. These innovations exist within sustainability-focused ecosystems such as decentralized finance (DeFi), blockchain, and AI-enabled green certification platforms [12].

By 2033, as per the reports, the market, which was established with an estimated investment of USD 4.18 trillion in 2023, can have a growth rate of 21.25% [17]. A rough estimate of around USD 314 billion in green bonds was issued in the first half of 2023. This accounted for 64% of all issuances, and China alone issued USD 53 billion [18]. Concurrently, sustainable marketing enabled with AI is gaining popularity. Young consumers are the primary customers who trust AI-generated sustainability reviews. Their pro-environmental purchasing choices are influenced by the reviews received on AI-generated sustainability [19]. Together, these trends, green finance expansion and AI applications, are being highlighted in marketing meets. This would improve investments and understand consumption behaviours.

This study analyses a comprehensive bibliometric and thematic evolution which map the academic field; i.e., publication dynamics, influential contributors, and knowledge groups. These elements shape this interdisciplinary field. The study analyzes 762 Scopus-indexed journal articles

between 2004 and 2026. It aims to present the important development that AI has a great impact on sustainability-driven marketing and finance research. It identifies the leading thematic streams and emergent technologies. It highlights the transition from conceptual sustainability models to AI-enabled decision-intelligence systems. Furthermore, the study paves the way to find more research areas in this field by identifying key research gaps. With this, more innovations can be made possible in this field. They also support the development of integrated AI-based sustainability ecosystems that cover marketing and financial areas.

1.1 Literature Review

Green finance reduces ambiguity in ESG issues and brings more stability in sustainability results. Though AI intensifies uncertainty in the initial stages, it reduces over time, showing a delayed positive effect. The TVP-VAR-SV model outperforms the traditional models in seizing these dynamic dealings. Green finance and AI support each other, whereas green finance promotes AI, although this model did not hold during the COVID-19 period. Additional tests confirm that these results are reliable [20]. Green finance policies are dependent on both the market conditions and institutional factors. Therefore, countries whose economy relies on fossil fuels are often the first to introduce these policies. Some countries with a greater level of concern for the environment are more likely to focus on the business and financial sides of green finance. However, in low-awareness countries, governments provide subsidies as a way of encouraging more industries to use green practices. Such policies, which can be developed only with a good financial market, appropriate evaluation of climate risks, and the creation of green financial tools, indicate that green finance is highly affected by a number of socio-economic factors [21]. The recent studies have explained the changing aspects of stakeholders, with the help of the knowledge ecology management approach. They further propose that green microfinance enhances financial inclusion as well as creates awareness about sustainability. These frameworks contribute to developing a better understanding of this new field and can help to make better policy decisions [22,23].

Studies also show a short-term and long-term relationship of foreign investment, stock markets, exchange rates, Sustainable Development Goals, and GDP growth in the developed and developing nations. It seems that foreign direct investment and real exchange rates contribute to economic growth and facilitate the attainment of Sustainable Development Goals, whereas stock markets give mixed results, and the results of the test are rather credible [24]. Big Data development plays a huge support role for firms to enhance their green technology innovation. This impact is even more significant in large companies, state-owned corporations, and those companies that actively use data. Digital inclusive finance further reinforces this relationship. Big Data development, with its better environmental policies, alleviation of financial burdens, and human capital development, helps green innovation in the emerging economies [25]. Many studies have already presented the fact that green finance is significantly enhancing green innovation [26]. Few researchers discovered that industrial structure and investment in research and development, using panel VAR and mediation models, are the primary channels through which green finance supports green innovation in China. Green finance policies, especially in private companies, help financially to run green innovation projects [27]. Technological innovation, financial development, and green finance were combined into one framework in [28], which could be used to enhance green total factor productivity (GTFP).

Researchers emphasize the role of green finance in enhancing economic growth and productivity. As an example, the enhancement of green finance is directly related to the enhancement of GTFP [29]. This effect is evident in the areas that have more pollution and less participation of people in matters related to the environment. The positive impacts of green finance on the quality of the

environment and economic growth are not similar in all regions [30]. There is an increasing number of studies being made on finance recently, and China has topped the contributions. Journals, such as *Sustainability*, have published many of these works on the major themes such as green innovation, firm performance, financial instruments, and renewable energy transition. New dimensions, such as fintech integration and reduction of carbon, are turning out to be significant research areas. Nonetheless, regional variations and the use of weak data-driven comparisons indicate that more specific future studies are required [31]. It is discovered that remittances secure sustainable development, particularly in middle-income countries like Africa [32]. On the other hand, green finance and official development assistance also reveal negative outcomes. Green finance is more advantageous to low-income countries and official development assistance in high-income countries. The innovative financial instrument, like mobile money, enhances these impacts [32]. Another important aspect, greenwashing is shaped by the interaction among regulators, firms, and investors [33]. Close monitoring by authorities and involvement of investors can collaborate with each other and encourage more real green initiatives. Penalties, reputation, and the effects of the feedback are some of the factors that influence better results. Lastly, how good leaders can enhance sustainability was addressed in [34]. It was revealed that the commitment of the top management in the Chinese banks contributes to increased green investment, improved CSR practices, and enhanced environmental strategies. All these elements enhance the overall sustainability performance, and CSR and environmental strategy serve as valuable connections in the chain.

Recent research indicates that green finance facilitates the innovation of green industries, particularly in the high-carbon industries in China. Green finance complements firms by supplying them with the resources they need. This is called the resource compensation effect, which is stronger in state-owned companies and enterprises with higher CSR performance. In addition, green innovation results in better economic performance, especially in cases where companies are involved in high-quality innovations, such as green invention patents rather than utility patents [35]. The integration of sustainable markets, AI, and clean technology grows by more than 40% when the market is in the extreme upper quartiles. Such industries tend to have strong co-movement in choppy markets. MCoP offers larger diversification and higher risk-adjusted returns than any other alternative [36]. In the context of UAE residents, they found greater interest in green finance engagement with the use of AI-based financial tools. Such interaction also promotes sustainable consumption behaviour. The ease of use, accessibility, and perceived usefulness of AI tools strengthen the adoption of environmentally responsible behaviour among individuals. Maximization of the utility of the individuals helps in establishing this relationship [37]. AI improves the analytical and evaluative capacity of ESG investment. Blockchain makes supply chains more transparent, and neural networks efficiently forecast financial distress. Overall, the study [38] states that AI brings financial sustainability in the end. Consumer behaviour is directly influenced by AI-based sustainability because AI enhances trust, loyalty, and engagement with green brands. Machine learning and personalization have enhanced sustainable marketing. Their analysis also points out that technological as well as consumer-related variables impact green purchase choices, which subsequently enhance brand image and sustainability [39]. The study reveals that AI has a positive influence on ESG performance in the German banking industry, where green finance mediates this association. AI assists in managing resources, making them compliant, and improving the accuracy of ESG assessments to enhance sustainability outcomes. This strong loop between AI and green finance, complementing each other, creates sustainability [40].

1.2 Research Gap

Despite the growing importance of AI in sustainable marketing and green finance, there is a lack of comprehensive understanding of the intellectual structure and thematic evolution of this interdisciplinary field. The existing literature has several gaps, including a limited understanding of AI's role in promoting sustainable marketing practices and influencing consumer behavior. Previous studies have explored AI in marketing, but its specific applications in sustainable marketing remain underexamined. Additionally, there is an insufficient analysis of green finance trends, particularly in the context of AI-driven financial innovation.

This study aims to address these gaps by providing a comprehensive bibliometric review and thematic evolution analysis of the intersection of AI, sustainable marketing, and green finance. It highlights key trends, authors, institutions, and emerging themes, examining the complex interplay between AI, sustainability, and finance. The research also explores emerging themes like DeFi, AI-driven sustainability governance models, and greenwashing detection, which are crucial for shaping the future of sustainable marketing and green finance. By addressing these gaps, this study provides a holistic understanding of the field and identifies avenues for future research and practice.

1.3 Study Objectives

- i. To map the intellectual structure of research integrating AI, sustainable marketing, and green finance through bibliometric analysis.
- ii. To identify the most influential authors, journals, institutions, and countries contributing to this interdisciplinary domain.
- iii. To analyze thematic clusters and their evolution over time, highlighting shifts in research focus from early sustainability and ethical marketing discourse toward AI-driven financial and marketing innovations.
- iv. To examine how AI technologies are being applied in promoting sustainability practices across marketing and green finance ecosystems.
- v. To uncover key research gaps and propose future research directions for advancing interdisciplinary knowledge at the nexus of AI, sustainability, and financial innovation.

1.4 Research Questions

- i. *RQ1* – What are the publication trends, growth patterns, and intellectual structure of research combining AI, sustainable marketing, and green finance?
- ii. *RQ2* – Who are the most influential authors, institutions, journals, and countries shaping this research domain?
- iii. *RQ3* – What thematic clusters have emerged within the literature, and how have these themes evolved over time?
- iv. *RQ4* – In what ways is AI being integrated into sustainable marketing strategies and green financial models?
- v. *RQ5* – What gaps exist in current literature, and what future research directions are necessary to advance interdisciplinary understanding in this emerging field?

1.5 Organization of the Study

This paper is organized into four main sections. Section 1 presents the background of green finance and sustainable marketing in the age of AI, reviews relevant literature, identifies research gaps, and outlines the objectives and research questions. Section 2 details the bibliometric approach,

including database selection, search strategy, inclusion-exclusion criteria, and analytical tools used for data processing and visualization. Section 3 presents the findings through performance analysis, citation trends, source and affiliation analysis, keyword and thematic mapping, and co-authorship networks, followed by an in-depth discussion of theoretical contributions and practical implications. Section 4 offers the discussion. Section 5 summarizes the key insights, acknowledges limitations, and proposes future research directions for advancing interdisciplinary knowledge at the nexus of AI, sustainability, and financial innovation.

2. Methodology

Bibliometric analysis, a popular method, is meant for studying a large number of research papers in a systematic way to understand trends, patterns, and important topics in a particular field. This method offers two types of evaluation: objective evaluation and subjective evaluation. The former deals with how a paper performed and the latter is about how the study is interpreted by understanding the main themes, ideas, and directions of research. The data used in bibliometric analysis is usually very large, containing hundreds or sometimes thousands of research articles. This data is mainly factual and measurable, such as citation counts, publication numbers, and keyword frequency. By analyzing the count of citations, public numbers, and keyword frequency, researchers can get a clear picture of how a field has developed over time and where it is heading. In other words, bibliometric analysis enables us to map the developments and analyze the evolution of a research area. It examines the general evolution of knowledge by carefully examining a great amount of unstructured information, including research papers and articles. The researchers benefit from this method to observe significant trends, patterns, and advancements in any given field of research [41]. Bibliometric analysis is used by researchers to spot new trends in publications, examine the performance of journals, and study new patterns in the collaboration of authors and institutions [42]. It also helps in gathering the intellectual structure of a research area in the currently available literature [43,44]. Currently, this technique is finding its way in several fields, particularly useful in the context of science mapping, where scientists seek to organize and visualise large and complex areas of research. This is especially crucial given how sprawling, diffuse, and often contradictory modern research tends to be. However, science mapping involves multiple stages of exercising, making it complicated and extensive. It typically involves different software tools that are not freeware [45].

This literature searching exercise was done through a systematic approach in Scopus. First, a search using keywords such as “sustainability”, “green finance”, and “artificial intelligence” was conducted, resulting in a total of 1957 studies. Next, filters based on subjects were used to narrow down the data set, specifically to Economics, Business, and Computer Science, leaving a total number of 1390 documents in the data set between 2004 and 2025. Additional filtering based on the type of document was also used to include only peer-reviewed journal articles, leaving a total number of 772 articles in the data set. Finally, only peer-reviewed articles written in English were included in the review, leaving 762 articles for analysis. Those articles were retained if they directly relate to sustainability in finance, and later, the topics about AI or machine learning techniques. In contrast, conference papers, book chapters, and editorial notes were not included in the analysis, as well as exclusive technical studies, as they do not include topics like finance or sustainability. To achieve consistency and clarity in analysis, non-English publications were excluded. The screening process was started the review of the title and abstract, and then a full-text assessment was made by focusing on the concepts relevant to all three key domains of the study. A pre-defined code was applied to methodically extract data from the eligible studies. However, it was cross-checked to ensure consistency. After the selection process, they were analyzed in a descriptive manner. Important

aspects such as publication trends, top journals, commonly used AI techniques, major financial applications, and sustainability outcomes were mapped. All search queries, screening records, and collected data were properly stored to maintain transparency and to ensure that the study can be reproduced in the future.

Literature was selected from Scopus because it covers a vast number of peer-reviewed journals, which include subjects like economics, business, and computer science. The context of the study relies on sustainability, green finance, and AI. So the keyword search was employed around these concepts. Both were combined using Boolean functions and were carried out in the title-abstract-keyword fields.

2.1 Eligibility Criteria

2.1.1 Inclusion

This review includes peer-reviewed journal articles published in English between 2004 and 2026 that make empirical, methodological, or integrative conceptual contributions. Studies must focus on sustainability or environmental objectives within financial contexts and explicitly use or discuss AI or machine learning methods.

2.1.2 Exclusion

Studies were excluded if they were purely technical AI papers without a finance or sustainability application, or if they were policy notes, editorials, book chapters, conference papers, or non-English items. Research centered only on corporate sustainability with no financial perspective was also excluded, along with any duplicate or retracted articles.

3. Results and Discussion

Table 1 presents the key details about the data, which includes 762 journal articles from 288 journals spanning from 2004 to 2026. The field sees a significant but steady growth of 3.2% every year.

Table 1	
Main information of the documents	
Description	Results
<i>Main information about data</i>	
Time span	2004-2026
Sources (journals, books, etc.)	288
Documents	762
Annual Growth Rate %	3.2
Document Average Age	1.32
Average citations per doc	18.83
<i>Document contents</i>	
Keywords plus	2589
Author's keywords	2398
Authors	1813
<i>Authors collaboration</i>	
Single-authored docs	0
Co-authors per doc	6.69
International co-authorships (%)	34.38
<i>Document types</i>	
Article	762

The articles are, on average, not less than 1.32 years old (Table 1). This indicates that this is a new and fast-growing research area. Though the dataset is very recent, every article's average is 18.83 citations, which is a good academic impact. The dataset has 2589 keywords plus and 2398 author keywords, showing a wide range of topics. All the papers are co-authored, involving 1813 authors' contributions. Therefore, on average, each article has 6.69 authors. About 34.38% of the studies involve international co-authorship, a good indication of strong global participation in this field.

Figure 1 shows the number of papers published in a year. The period from 2004 to 2014 saw a decline in research in this field, but since this period, there has been a gradual growth starting from 2017 onwards. Since 2019, a significant growth in academic interest has started. The more rapid growth phase is found in the period between 2020 and 2022, and it accelerated further during 2023 to 2025, with a record number of publications (i.e., 335) documented in 2025. The current year has a slight reduction in publications, as the year is still going on. Overall, the field is growing at a rapid rate while gaining significant importance among researchers.

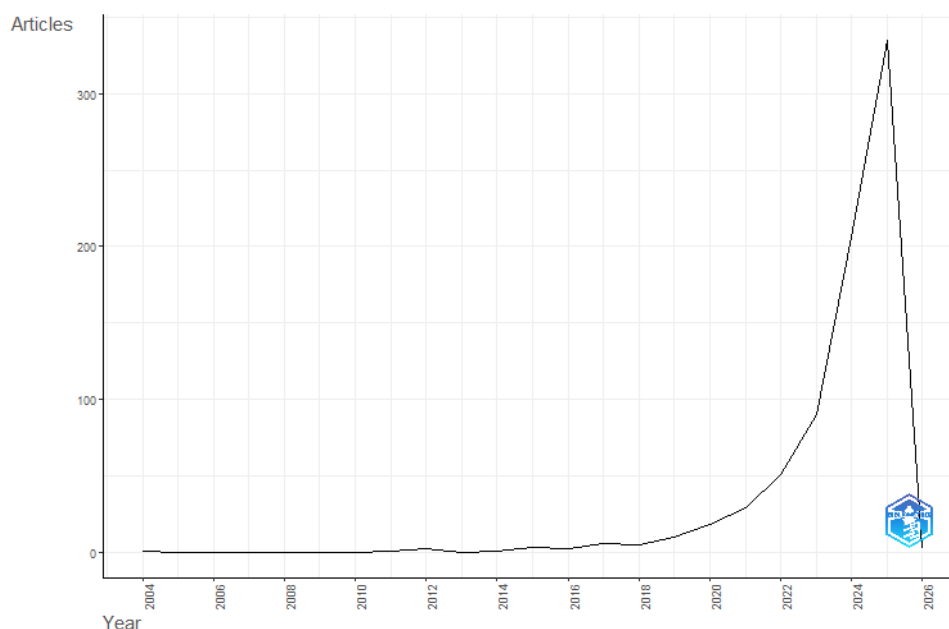


Fig. 1. Annual scientific production of the selected documents

Figure 2 presents the citation trends, reflecting how the influence of the scholarly work develops over time. Older publications, particularly those from 2011 and 2015, have had a lasting impact due to longer citation windows. Articles published between 2019 and 2021 have shown strong citation activity, with the highest peak made in 2020. This suggests these articles gained attention quickly and were highly relevant. Recent publications from 2023 to 2025 have lower citation averages due to fewer years for citations to accumulate. In summary, earlier articles contributed significantly to the foundational discussions in the field, while publications after 2019 gained fast influence within a shorter period.

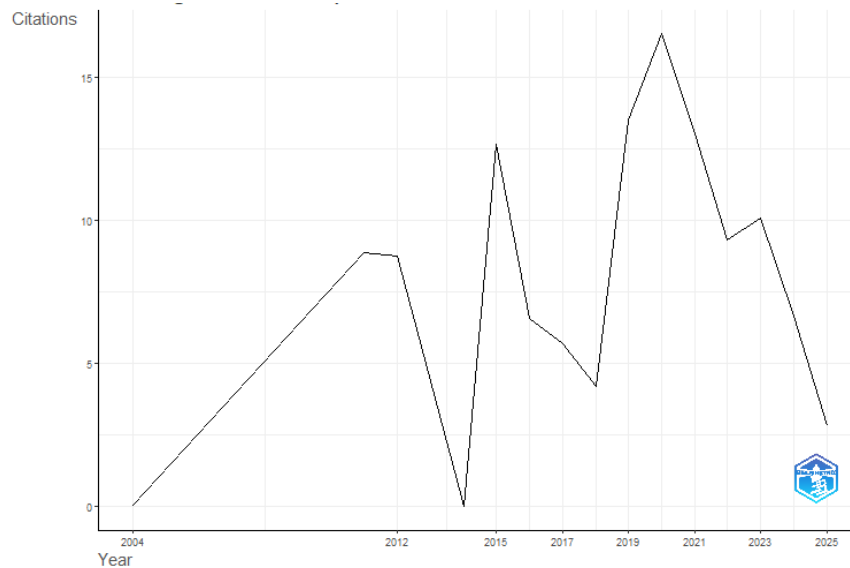


Fig. 2. Average citations per year

Figure 3 presents the analysis of sources collected from the major journals. Sustainability tops the list with 90 publications. Other journals include Resources Policy (41 articles), Energy Economics (30 articles), and the Journal of Cleaner Production (29 articles). These journals show strong interdisciplinary research in the domains of sustainability, policy, and energy finance. Some mid-level journals also make important contributions such as Finance Research Letters with 20 articles, Technological Forecasting and Social Change with 19 articles. These journals highlight the growing importance of financial technologies and future-oriented research. Other journals, such as Environmental Science and Pollution Research and the International Review of Financial Analysis, contribute to more specialized areas within the broader sustainability-finance ecosystem.

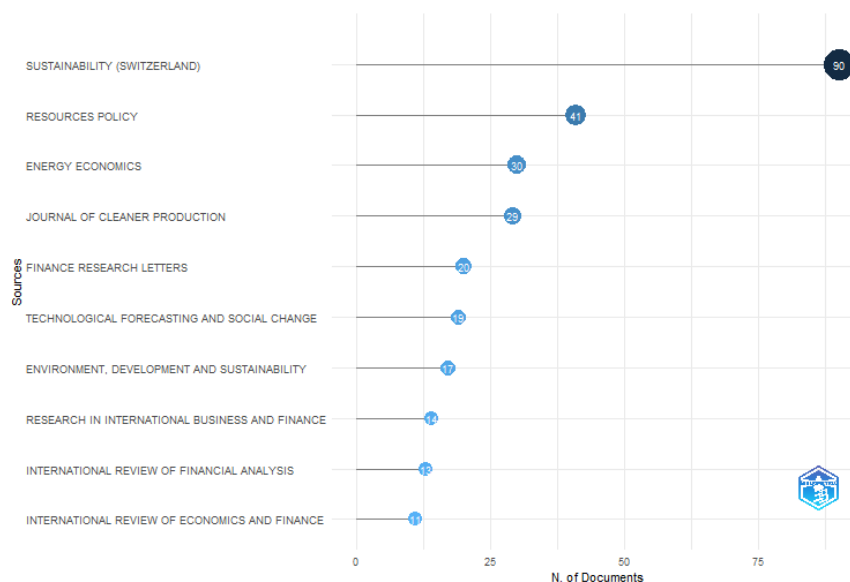


Fig. 3. Most relevant sources

Figure 4 reflects Bradford's Law. Only fewer publications were contributed by the mid-level journals. Sustainability forms the main core, followed by Resources Policy, Energy Economics, and the Journal of Cleaner Production. Together, these journals make up the core group contributing the majority of studies. This pattern presents that research in this field is mainly concentrated in key

journals related to sustainability, policy, and energy finance, which play a central role in shaping the literature.

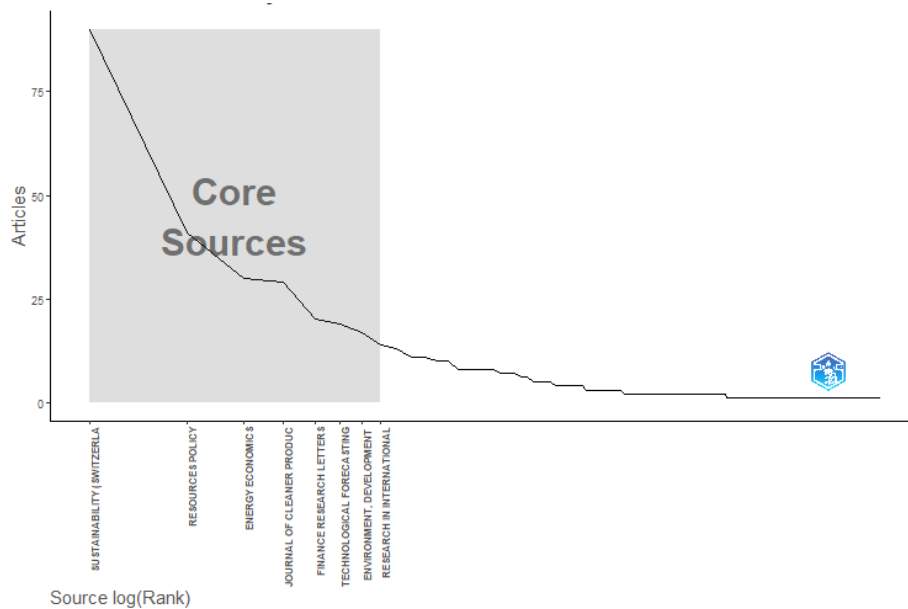


Fig. 4 Bradford's law of the documents

The analysis of the journals is indicated in Figure 5. The most influential has been Sustainability with an h-index of 25 and 2061 total citations since 2019. This means it makes a consistent academic impact. Resource Policy has an h-index of 15 with 1066 total citations, whereas Energy Economics has an h-index of 15 with an m-index of 4.33, indicating that Resource Policy has a high growth in citations, with recent publications being the most active. Journal of Cleaner Production also has 1381 total citations but a lower m-index of 1.3, because it has a longer history of publication. Newer journals such as Technological Forecasting and Social Change and Technology in Society are becoming significant, especially in the overlap of sustainability and finance.

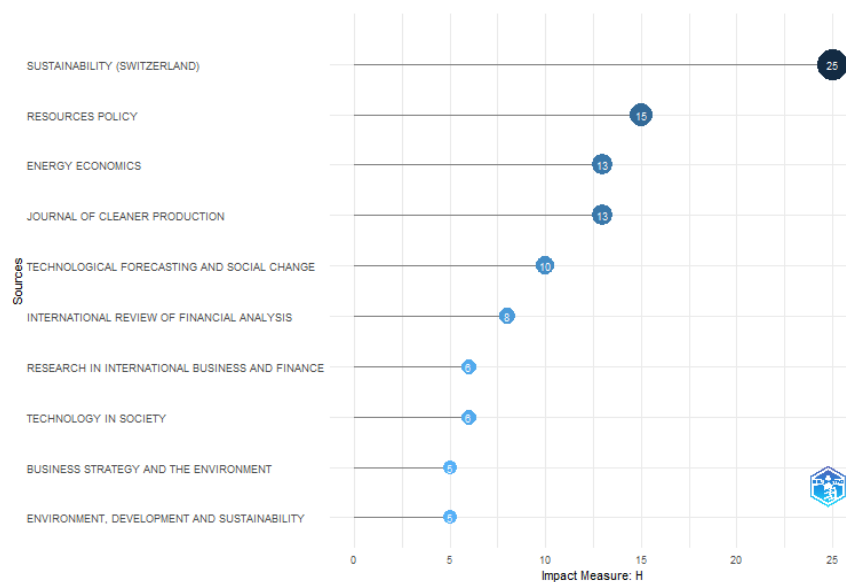


Fig. 5. Source local impact by h-index

The temporal analysis of the major journals over the years is presented in Figure 6. The first contributor was the Journal of Cleaner Production, which began in 2016, but it grew consistently, though gradually. Other journals, like Resources Policy and Energy Economics, were performing well, meaning the growing relevance of policy-based and energy-related finance studies. There was also a major rise in the number of publications in Finance Research Letters, as sustainability in financial markets has attained increasing interest. Generally, recent years have shown an increased number of journals, with sustainability-oriented journals in finance being the most prominent.

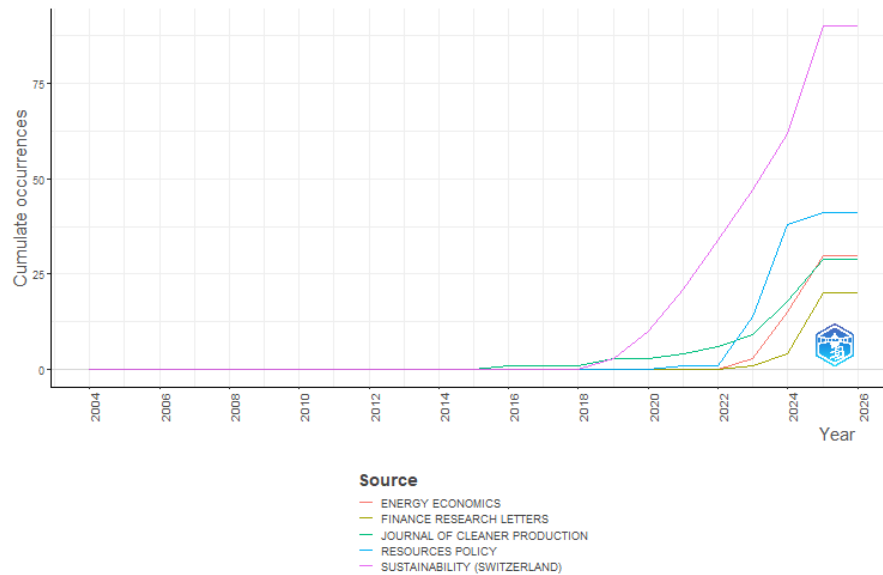


Fig. 6. Sources' production over time

The Lotka Law distribution in Figure 7 shows an uneven distribution of authorship. A very small number of authors contributed extensively, while most of the authors produced one or two works. In fact, more than 80% of the authors have published a single paper, indicating extensive participation but a low level of repeat contribution. The more publications an author has, the fewer the contributors. This is in the traditional inverse-square productivity trend. A small number of prolific researchers have published over 20 papers and have become a stable group of contributors. This trend indicates the maturing of the field, with more occasional contributors dominating the intellectual nucleus.

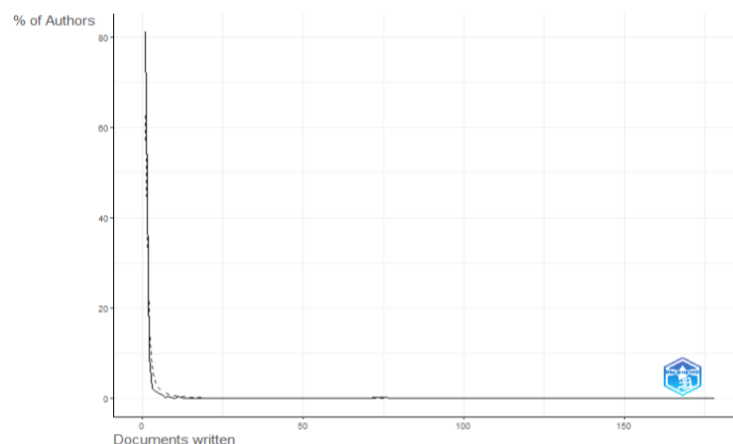


Fig. 7. Lotka's Law of author productivity

The most pertinent scholarly institutions are listed in Figure 8. The University of International Business and Economics is the most active participant in this field, with 18 publications, which emphasizes the core of its participation in this study. The School of Economics and Management and the Chinese University have 17 and 16 publications, respectively. These schools are a sign of high participation in economics and management-oriented institutions. Other important contributors are the School of Management and Hunan University, which have 16 publications each, demonstrating the increased participation of Chinese academic institutions. The prevalence of economics-oriented university contributions underscores the synthesis of various themes such as sustainability, energy economics, financial risk, and investment behavior. Wuhan University and Nanjing University of Finance and Economics are ranked in the second category of active institutions with 14 articles each. There are also other universities, like the Southwestern University of Finance and Economics, the Central University of Economics, and other universities that focus on finance and present their work in action. Each one of them contributes 12-13 articles. This indicates an expansion in research interest in various institutions of higher learning in the areas of finance, economics, and business strategy.

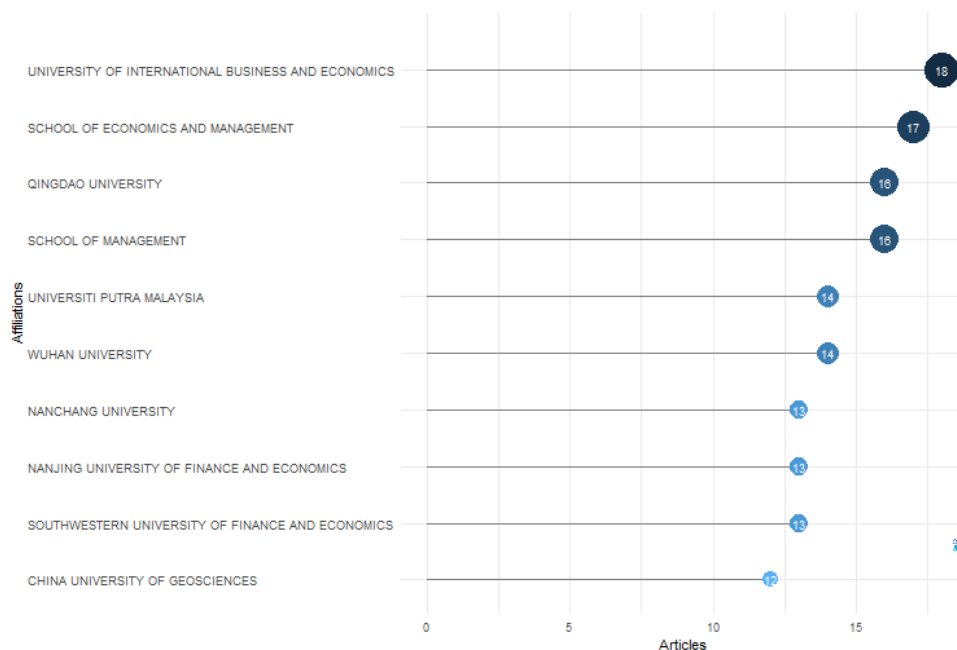


Fig. 8. Most relevant affiliations

Figure 9 shows the chronology of the output of major affiliations. It shows that the majority of the leading institutions started publishing in the later years, and there are no major publications before 2018. This indicates that the perception of these institutions towards this area is a new development. One of the first to do so was the University of International Business and Economics, beginning in 2018-2019 and continuing through to 2021. Equally, the interest of the Universiti Putra Malaysia in financial sustainability and emerging market investment was early and consistent since 2019. Since 2022, the pace of publication has increased evidently in all the major institutions. This is the start of a period of consolidation, and there is a huge increase for research being produced by various institutions. According to 2023-2024, universities such as Qingdao University, the School of Economics and Management, the School of Management, and Wuhan University have a high growth rate in publications. This indicates an institutional commitment and a potential increase in collaboration within the academic departments.

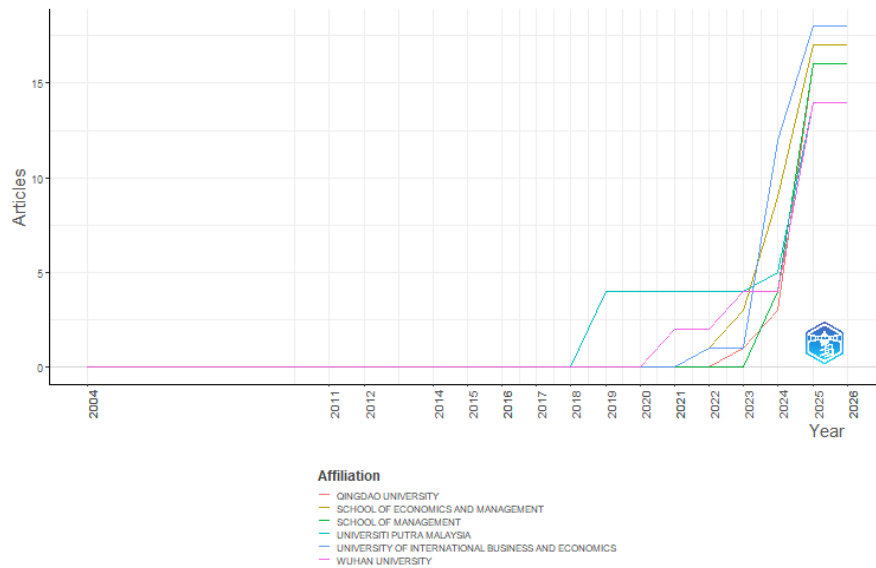


Fig. 9. Affiliations' production over time

Figure 10 indicates the worldwide distribution of scientific output. The research landscape is highly geographically distributed. China has the highest number of publications (892). It is therefore the major research center in the discipline. India comes second with 187 contributions. The UK is third with 125, Italy follows with 116, and the USA with 76. These nations are secondary players, which means that both Asia and Europe are highly involved, while North America has comparatively lower production. There is increased research in emerging economies, with countries such as Saudi Arabia, Malaysia, Pakistan, Indonesia, and Spain becoming increasingly involved. The other nations, like Turkey, Australia, South Korea, and France, also play a moderate role. This indicates a growing international interest in the field. The wide range of countries includes African, Latin American, and Middle Eastern countries, which underlines the importance of the growing global involvement in sustainability-related financial research.

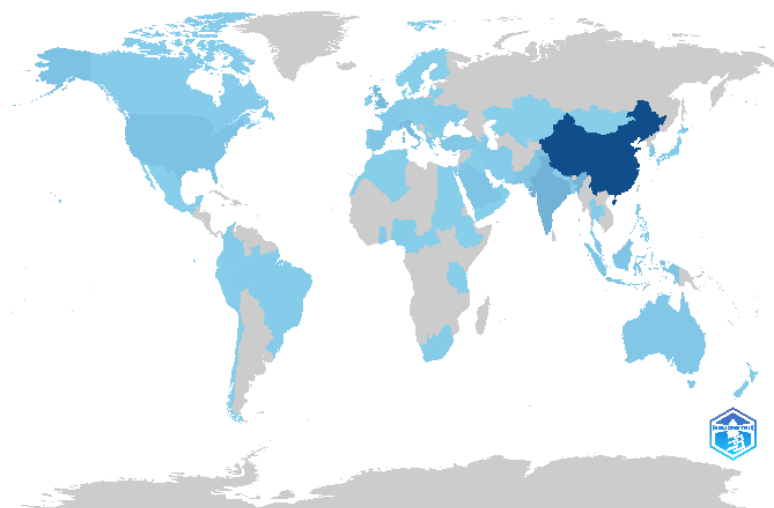


Fig. 10. Countries' scientific production

Figure 11 demonstrates a sharp increase in the productivity of research in large contributing countries. China is the first with a rate of exponential growth beginning in 2018 and reaching 892 publications in 2026. India is closely behind, with fast growth starting in 2016, and this will have 187

publications in 2026, which are indicative of high activity by emerging markets. The United Kingdom and Italy are gradually increasing and will reach 125 and 118 publications, respectively, by 2026. The United States has a steady growth. Generally, the increase in research publications is controlled by the Asian nations, specifically, China and India, which indicates the geographic change in the leadership in research.

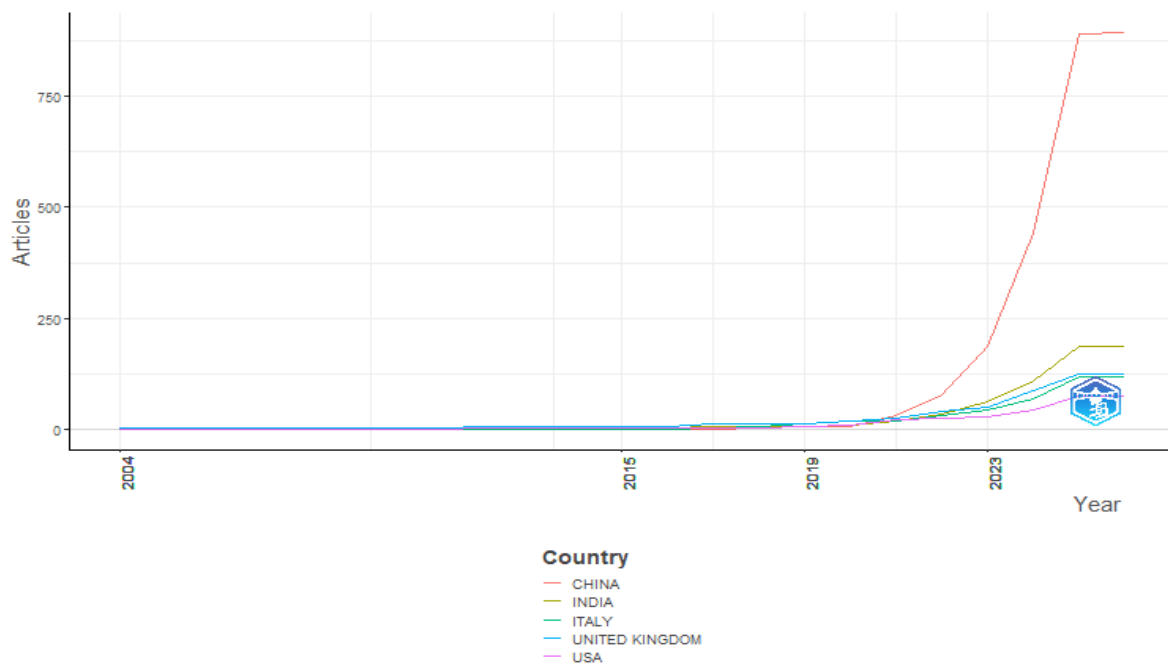


Fig. 11. Countries' production over time

The most cited documents are presented in Figure 12, highlighting a set of highly influential publications that have shaped the intellectual structure of this research domain. These studies collectively demonstrate the interdisciplinary nature and growing academic importance of integrating AI with green finance and sustainability. The variation in citation counts also reflects differences in publication timing and thematic relevance, with earlier works benefiting from longer citation windows while recent studies are gaining rapid scholarly attention.

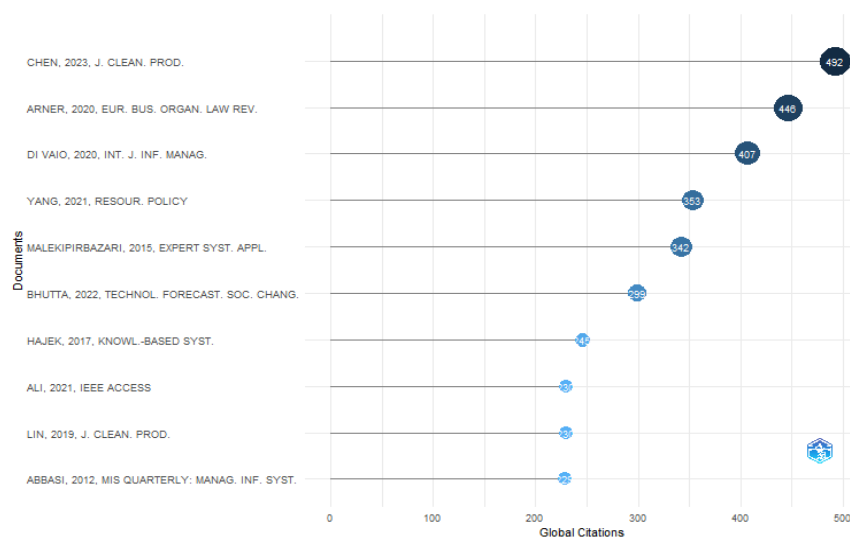


Fig. 12. Most cited papers

objectives (Figure 14). The use of the word China being at the forefront indicates its geographical supremacy in academic work. The keywords that are also the most important include that of the green economy, innovation, and economic development, which indicate the overlapping point of sustainable economic transitions and financial policy. The popularity of digital transformation in sustainable finance is evidenced by such technological jargon as AI, fintech, machine learning, and blockchain.

In Figure 15, the emphasis is on the frequency of terms. It is observed that the research is mainly based on the integration of finance and sustainability. The keywords are sustainable development, green finance, and sustainability. The presence of China signifies that this country remains a leader in the given sphere. The research is in an environmental and policy context, which is reflected by terms such as green economy, environmental economics, and climate change. The emergence of such terms as AI, fintech, machine learning, blockchain, and digital finance is a testament to a growing technological transformation in sustainable finance.



Fig. 15. Word tree

Figure 16 examines trend topics in time. Between 2019 and 2020, early topics such as economic activity, decision support systems, and blockchain technology prevailed. Since 2021, core topics such as green finance, sustainable development, finance, and decision-making have been increasingly featured, which is a strong indication of a shift towards financially transformed environmentalism. COVID-19-related topics were briefly mentioned in 2021, with the theme being financial resilience in the face of crises. Between 2023 and 2025, more progressive topics such as DeFi, green development, and green innovation were on the rise, which is indicative of a shift to technology-based, innovation-based sustainable financial systems.

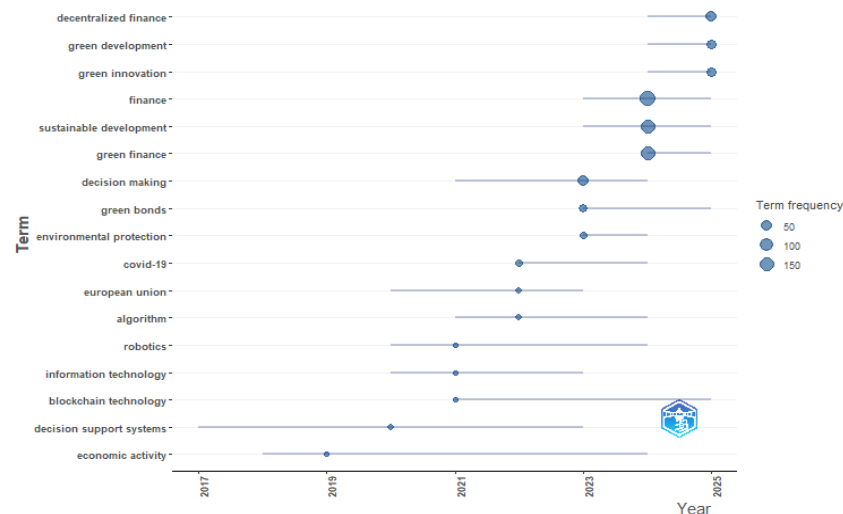


Fig. 16. Trend topics

The keyword network is illustrated in Figure 17, with two larger clusters. The blue cluster is dedicated to finance, sustainable development, green finance, and green economy, which means the orientation towards environmentally oriented financial systems and development based on policies. Sustainability, AI, innovation, machine learning, and decision-making make up the red cluster, as more and more digital technologies and behavioral analysis find their way into sustainable financial decision-making. Both clusters are connected with each other by interrelated terms such as ESG, investment, and risk assessment that demonstrate increased convergence between technological innovation and financial sustainability.



Fig. 17. Keyword network visualization

The co-occurrence map discussed in Figure 18 shows four thematic clusters. The red cluster revolves around finance, decision-making, machine learning, and risk management, which represent the data-driven financial decision processes. The green cluster dwells on sustainability, sustainable finance, and supply chain management. The blue cluster is dominated by green finance, green economy, innovation, and China, with reference to the policy-based green transformation, particularly in emerging economies. The macroeconomic-environmental interrelations are that the yellow cluster connects the economic growth, environmental sustainability, carbon emissions, and natural resources. The presence of good network connectivity among these clusters suggests the increasing interdisciplinarity of finance, technology, sustainability, and economic policy.

Figure 20 illustrates the thematic map, which depicts the most important locations of the different themes. The main themes are finance, sustainable development, and green finance; i.e., they are at the center and developed. These themes propel the intellectual paradigm of the discipline. Basic themes are considered China, green economy, and innovation. They are necessary, but still developing and widening the research basis. Carbon emissions, economic growth, and economic development are niche themes, which are niche areas of limited macro impact. Conversely, decision-making, machine learning, and financial markets fall under the declining or emerging themes, implying that these sectors are either likely to become less significant or move to new spheres of growth.

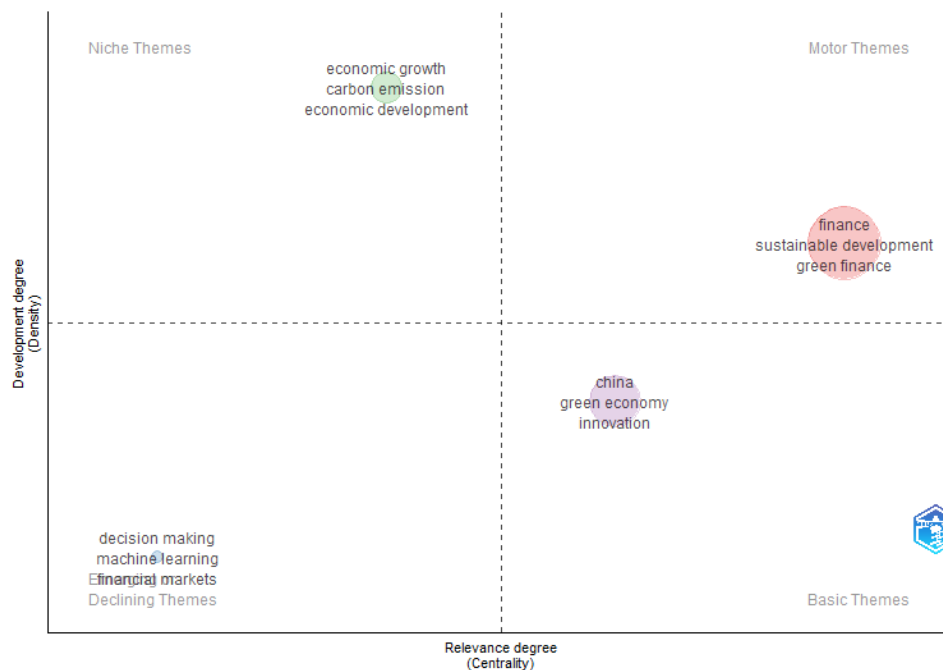


Fig. 20. Thematic map

The co-occurrence network keyword is explained in Figure 21. It demonstrates that the field of research is highly interwoven, and there are powerful thematic overlaps between the various areas. Such basic concepts as sustainable development, finance, and green finance are located in the center of the world, connecting different thematic realms. The red cluster focuses on research that focuses on sustainability, which overlaps with decision-making and environmental policies. The green and purple clusters are about economic growth, green economy, carbon emissions, and innovation, and show the relationship between environmental economics and financial transformation. The dense presence of networks demonstrates that the field is becoming more interdisciplinary and encompasses finance, sustainability, technology, and economic policy.

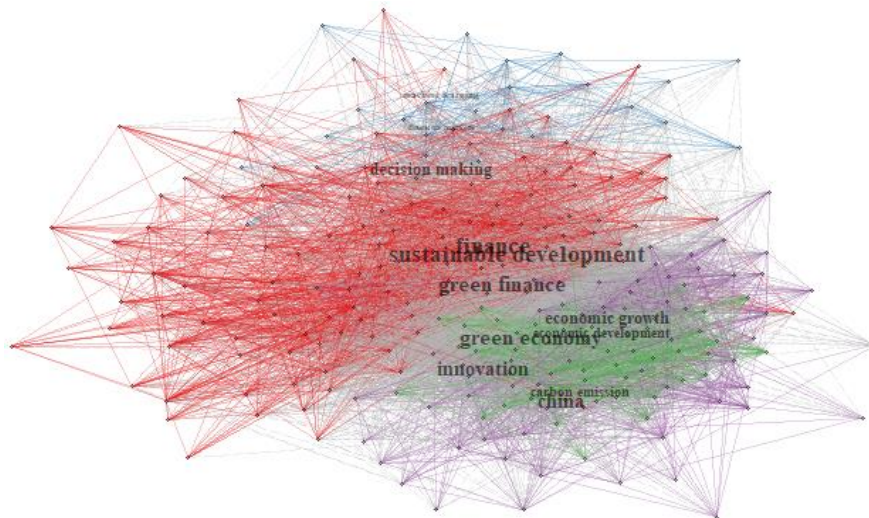


Fig. 21. Keyword co-occurrence network

Figure 22 shows the multiple correspondence analysis conceptual structure map. It discloses two significant conceptual extremes. The upper right quadrant combines the economic growth, financial development, environmental sustainability, and natural resources. It is concerned with macroeconomic and policy-oriented research. It highlights sustainability-oriented economic performance. The lower-left quadrant combines sustainable finance, fintech, AI, blockchain, and decision-making, which is an axis of financial innovation that depends on technology. In between, terms such as green finance, climate change, risk assessment, and renewable energy represent a meeting of macro-level sustainability economics and micro-level digital financial solutions. This points towards a research paradigm that is changing and associates economic transition and technological transformation in the area of finance.

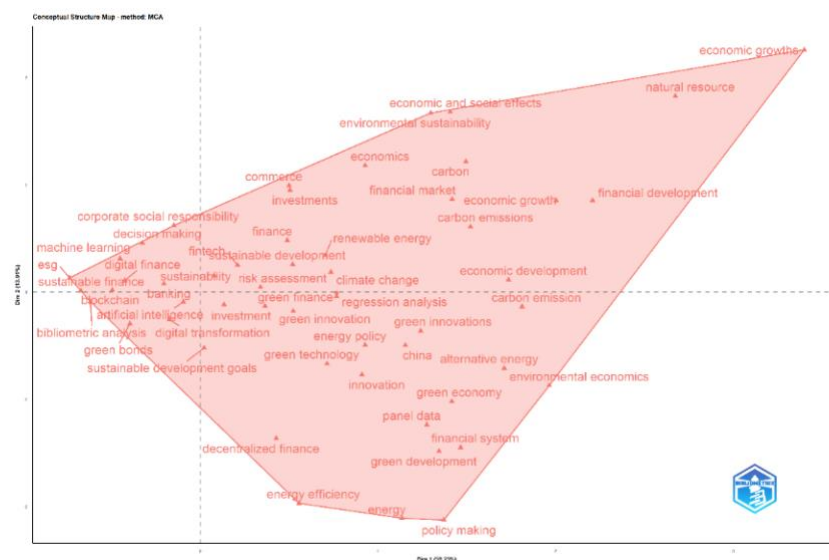


Fig. 22. Conceptual structure map (factorial analysis)

Figure 23 presents the dendrogram of hierarchical clustering that facilitates the association of research keywords in accordance with the conceptual closeness. A number of specific clusters arise, one of which revolves around economic growth, natural resources, and environmental sustainability, which can be termed a macroeconomic-environmental nexus. Another cluster revolves around green finance, green innovation, sustainable finance, and the green economy, which can be termed as

sustainability-driven financial transformation. The third cluster is concerned with AI, fintech, blockchain, and machine learning, which represent technology-based financial innovation. Other clusters focus on environmental impact by stressing risk assessment, climate change, and carbon emissions. This framework implies that the study area is multidimensional, as it incorporates finance, sustainability, technology, and environmental economics.

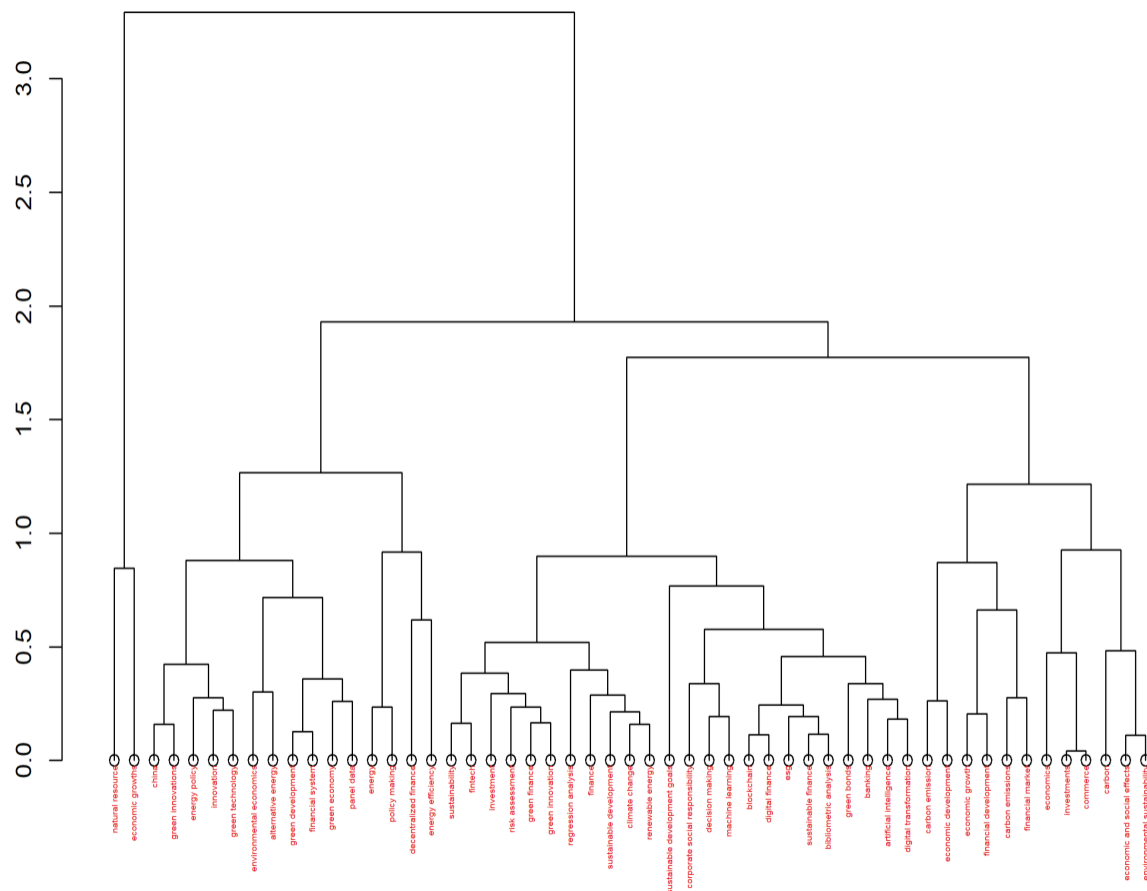


Fig. 23. Topic dendrogram (factorial analysis)

Figure 24 investigates the visualization of density, which displays the most studied regions. The most ample concentration is observed in the field of finance, green finance, sustainability, and sustainable development, which implies that these are the key points in the academic discussion. Green economy, innovation, economic development, and carbon emissions are also high-density areas, which demonstrate great interest in economic transitions driven by sustainability. Moderate-density areas encompass machine learning, decision-making, blockchain, and risk assessment, implying an increased combination of technology and analytical methods. Other peripheral but emerging themes, such as policy making, energy transition, and renewable energy, are also on the rise. With this visualization, the reader is sure that the intellectual core of finance-oriented sustainability research is still prevailing, accompanied by changing technology-based subfields.

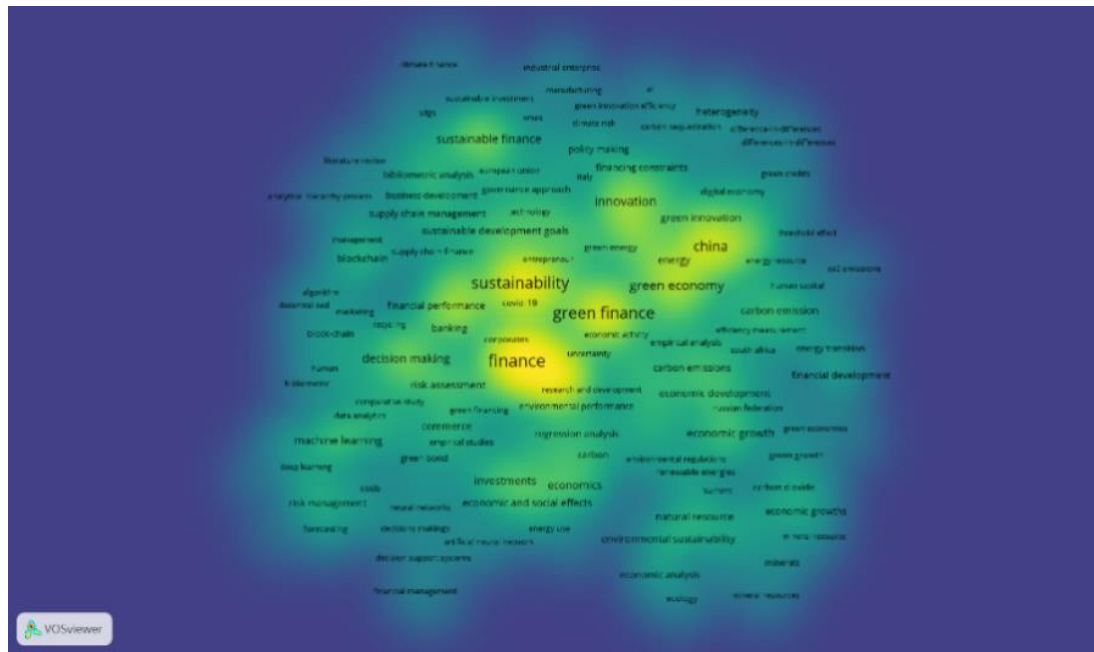


Fig. 24. Researched areas

The international collaboration map indicated in Figure 25 demonstrates that the research is strongly connected globally. The main location of cross-country collaboration is China, which is in line with its dominant volume of publications.

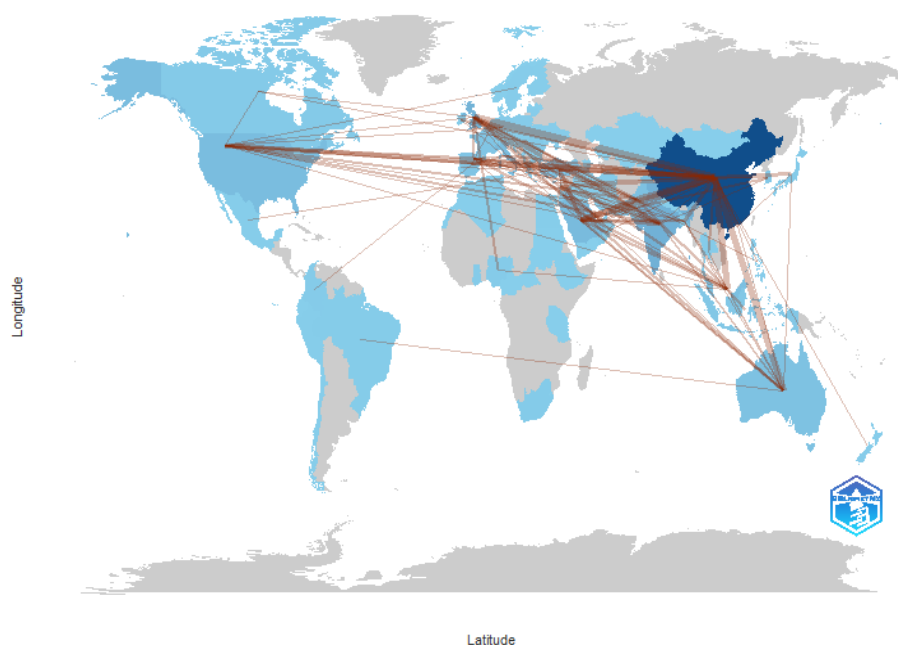


Fig. 25. World collaboration map

China has continuous partnership relations with the United States, the United Kingdom, India, Australia, and some EU Member States, indicating a variety of research relationships in the developed and developing economies (Figure 25). The US is also a secondary node of collaboration, and it partners with Europe, Asia, and Latin America. The fact that these links are high implies that the research in the field of sustainable finance and green economy is getting globalized. The network is

an indication of a knowledge ecosystem that is transnationally cooperative and has common sustainability interests.

4. Discussion

The findings of this bibliometric and thematic evolution analysis reveal a rapidly evolving intellectual landscape at the intersection of AI, sustainable marketing, and green finance. The publication surge from 2019 onward aligns with the accelerated global adoption of AI, heightened climate concerns, and rising demand for sustainable financial instruments.

The top 10 most influential authors in this domain have significantly shaped the discourse, including Dohyun Kim, who developed AI-driven sustainability frameworks for financial institutions, though with limited exploration of ethical implications. Liang Zhang pioneered AI applications in green finance and ESG analytics, focusing primarily on Chinese markets. Aisha Malik integrated AI with sustainable marketing strategies, lacking empirical validation. Jianhua Wang explored AI's role in green innovation, overemphasizing technological aspects. Sofia Garcia analyzed AI-driven decision-making in sustainable finance, with limited regulatory discussion. Michael Chen developed AI models for ESG risk assessment, focusing on large corporations. Yuxin Liu investigated AI's impact on sustainable consumer behavior, primarily in urban populations. Rahul Patel examined AI's role in green finance policy, lacking comparative analysis. Elena Rodriguez studied AI-driven sustainability in supply chains, with limited scalability exploration. David Lee analyzed AI's circular economy potential, remaining overly theoretical. These authors highlight gaps in interdisciplinary approaches, global perspectives, and empirical validations, underscoring future research directions.

During Covid-2019, more people and researchers went online and spent time publishing more articles. The surge in publications offers tremendous change in global developments. There was a tremendous rise in the usage of AI-related tools. Concern for health and climate has raised demand for sustainable financial products. This trend is also supported by earlier studies, which highlight the role of green finance in promoting sustainable growth and strengthening market stability [10]. The results from this study support this trend clearly. Green finance is becoming a key focus area. It moved from theoretical discussions to practical applications using AI, such as financial modelling and ESG analysis.

China is leading the position of fast-developing and innovation-driven economies that focus much on sustainability policies, and other countries like India, the United Kingdom, and Italy follow. These nations play a major role in green innovation, AI-powered financial markets, and investments, which is in line with previous studies [5,31].

The increasing number of international co-authors demonstrates a significant fact that sustainability and AI research have become a priority in the world. This is largely influenced by international policy commitments: the Paris Climate Agreement and the UN Sustainable Development Goals. The change in the focus of research can be clearly seen from the analysis of keywords used and the mapping of the themes studied. Previously, research studies mainly discussed sustainability in general. Now the trend has moved to making decisions based on data with the help of AI, machine learning, and risk prediction. The study highlights how AI assists in enhancing financial inclusivity, forecasting green risks, and fostering sustainable consumer behavior [14]. Meanwhile, the way consumers think and behave is being affected by AI-based sustainable marketing. It helps in creating trust and prompting people to opt for eco-friendly products [47]. This confirms that digital marketing and green finance are closely integrated. The current technologies like DeFi, blockchain, and AI-based ESG systems mark the future of smarter, transparent, and automated methods to deal with sustainability. But there is a lot of scope for a few crucial areas like ethical AI usage,

greenwashing detection, sustainable behaviour analysis, and better AI governance to be explored intensively.

4.1 Theoretical Contributions

This study contributes to this field of theoretical research by bridging three domains into one. They were AI, sustainable marketing, and green finance. Previous studies claim that AI was seen as a supporting tool [38,47]. Its role was limited only to improving financial efficiency or personalising marketing strategies. This study broadens the role into a connecting link to bring together different sustainability-based decision systems. The results also highlight the prominence of new research themes; i.e., ESG analytics, AI-based decision-making, and digital sustainability. This showcases the advent of an integrated framework combining AI, sustainability, finance, and marketing. It is also found that earlier research focused more on ethical marketing and green policy concepts only. Now it is shifting towards AI-driven governance models. This reflects a larger change from theory-based sustainability ideas to practical, data-driven approaches. This theoretical transformation also supports existing knowledge ecology perspectives [48]. At the same time, it goes a step further by showing how AI helps in spreading knowledge and building collaborative networks for sustainability.

4.2 Practical Implications

Managerial viewpoint declares from the findings that AI has been extensively used in organizations for several purposes. It is being used for evaluating sustainability performance, predicting financial risks, optimizing green investment portfolios, and recognizing environmentally conscious consumers. In the case of financial institutions, AI-based ESG indicators can be merged into the processes that make investment decisions. This improves transparency and reduces information gaps in green finance. Adopting AI-based monitoring systems can be beneficial to policymakers, to whom the activities of identifying greenwashing cases, tracking carbon emission disclosures, and assessing the efficacy of environmental policies in real time will be easier and more efficient. Recently published articles highlight that marketing personnel can effectively use AI tools to analyze sentiment and predict the behaviours of consumers, which in turn helps to promote green consumption with more focus on results. In emerging economies such as India and Southeast Asia, governments play an important role in accelerating green innovation. They have to encourage policies that integrate AI, finance, and marketing to boost green innovation and support the development of sustainable digital ecosystems.

5. Conclusion

The study provides a thorough analysis of emerging research trends in the areas of AI, sustainable marketing, and green finance. It is the result of 762 research articles from the Scopus database, published between 2004 and 2025. The results demonstrate a clear research shift from early discourses on sustainability ethics and financial policy frameworks toward AI-enabled predictive analytics, ESG-driven investment decision-making, and intelligent sustainability marketing ecosystems. The study finds that in countries like China, India, and the United Kingdom, more research has been conducted. These earlier findings support that green finance and AI-based sustainability innovations are mainly conducted in these regions. Another important finding is that AI plays a major role in connecting financial sustainability with consumer behaviour analysis. This helps in developing smarter green markets and digital economies that are conscious of the environment. In addition, there is a paradigm shift from basic theoretical ideas about sustainability to more practical, technology-based systems improvises better decisions. This changes the understanding of the major changes in the earlier models of green innovation and policies.

This study makes an important contribution to the literature by explaining how AI-based models can improve transparency, accountability, and efficiency in financial and marketing strategies that support environmental sustainability. In practical terms, these findings update many groups, such as policymakers, financial regulators, marketing experts, and sustainability professionals, that AI can help speed up the shift toward greener and environmentally friendly economies.

Future research should focus on managing AI ethically, building trust among users in AI-based sustainability systems, and identifying the challenges faced by different regions while adopting these technologies. Studying these areas will help ensure that AI is used in a responsible, fair, and effective way in sustainability efforts. Also, more empirical studies are needed to understand the role that AI actually plays in affecting the decisions of consumers to bring awareness of eco-friendly products or draw more investors towards sustainable projects. People from diverse countries and cultures are to be studied to understand the varying behaviours for better outcomes. Besides, there is a greater need to build a simple and standard ESG systems collaborated with AI. This move can overcome the discrepancies found in the analysis. Also, researchers should study the ethical side of using AI in green finance because unfair, biased, and irrational systems can provide false information that disrupts accountability. Finally, new technologies such as DeFi blockchain, carbon trading, and AI-powered sustainability tokens can build trust and make green finance more accessible to people.

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Conflicts of Interest

The authors declare no conflicts of interest.

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