

Sustainable Development in the Age of Demographic Trends: A European Financing Perspective

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Abstract

This research employs a bibliometric approach to analyze the evolution of concerns surrounding global and local sustainable development amidst demographic trends, drawing upon the Scopus international database. The study aims to address questions regarding the distribution of published works and evaluative metrics, as well as to identify emerging research trends. Through meticulous examination of articles indexed in Scopus and utilizing the VOSviewer software, the study offers insights into the distribution of works by year, authors, institutions, countries, and journals. Additionally, it delves into the network of co-authors, co-citations, and keyword co-occurrence within the literature. This analysis sheds light on key research trends in sustainable development financing from 2014 to 2024. The originality of this research lies in its comprehensive examination of the landscape of sustainable development research, providing valuable insights for policymakers, researchers, and practitioners. By understanding the distribution and trends within this literature, stakeholders can make informed decisions to promote sustainable development practices globally and locally. This study serves as a valuable resource for shaping future research directions and strategic initiatives aimed at addressing pressing sustainability challenges.

Keywords

Sustainable development, financing, global, demographic trends

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Introduction

The burgeoning field of green and sustainable finance stands at the forefront of contemporary economic discourse, offering innovative financial tools aimed at fostering sustainable development while addressing pressing environmental concerns. In this paper, the authors embark on a comprehensive exploration of the landscape surrounding environmentally friendly financial instruments such as sustainable bonds and sustainable debt, delving into their significance and the rationale driving the paradigm shift towards finance.

Existing research has noted reductions in companies' market worth after the disclosure of environmental transgressions (Capelle-Blancard and Laguna, 2010). Due to the adverse market response to environmental malfeasance, companies pivoted towards eco-conscious methodologies to capitalize on enhanced social standing, rallying community and governmental backing, thereby alleviating friction with regulatory bodies and mitigating adherence expenses. They leverage eco-friendly financial tools to fund these sustainable initiatives. However, stakeholders in green finance markets require established norms and benchmarks to delineate which endeavors merit the *green* designation, along with frameworks to oversee issuers' divulgence of bond utilization and the environmental, social, and governance performance of invested projects. For instance, the Royal Bank of Canada advocates for transparent standards, taxonomy, and parameters in sustainable finance (Akomea-Frimpong et al., 2021). As part of its initiative to achieve \$100 billion in sustainable financing by 2025, RBC launched its inaugural V500 million (\$752 million) green bonds in 2019, directed towards financing renewable-energy projects and sustainable infrastructure.

High-tech innovation serves as a significant driver for promoting sustainable economic growth. However, the substantial financial requirements, along with unpredictable outcomes, pose challenges for investors, and financial constraints hinder the allocation of resources to HI. The emergence of sustainable finance addresses these challenges, facilitating a symbiotic relationship between HI and GF to foster sustainable economic development (Aman et al., 2022; Bai et al., 2022; Wang et al., 2022). Therefore, the imperative for sustainable practices in finance is underscored by the escalating need for corporate disclosure of environmental performance, catering to the exigencies of both capital markets and other stakeholders. The integration of high-tech innovation into sustainable economic development is not devoid of challenges, necessitating the symbiotic relationship between sustainable finance and high-tech innovation to overcome financial constraints and propel sustainable growth.

1. Review of the scientific literature

Within this paper, initially, the authors present background and context surrounding environmentally friendly financial tools, along with an exploration of the rationale behind green finance. Vital to sustainable development is the corporate divulgence of environmental performance to both the capital market and other stakeholders. Consequently, we proceed to examine existing literature on sustainability disclosure, aiming to encapsulate its trajectory, catalysts, and significance. Coinciding with the ascendance of financial tools channeling resources toward eco-friendly enterprises and projects, research indicates a substantial surge in corporate sustainability reporting globally over recent decades. According to many research papers, green finance holds promise in supporting high-tech innovation (HI) and effectively addressing climate change risks (Bai et al., 2023; Li et al., 2023; Wan et al., 2022). Knowledge input and assets are crucial indicators for assessing a country's future core competitiveness (Ahamed et al., 2023; Sun et al., 2021).

Amidst heightened global and regional environmental directives, there's an uptick in sustainable finance initiatives and the uptake of eco-friendly financial tools, driven by investors' escalating concern for climate-related issues. Particularly, the push on governments, financial entities, and businesses to enact environmental safeguards and address climate change has intensified post the 2015 Paris Climate Agreement (Tolliver et al., 2020). Entities like the United Nations, World Bank, International Monetary Fund (IMF), European Union, and G20 are increasingly exerting pressure on their constituents and trade allies to embed sustainable finance policies within their financial frameworks (Bhandary; Gallagher; and Zhang, 2021).

Current research illuminates the distinct characteristics of green financial instruments and Park (2019) delved into the allocation process for green bonds and scrutinized both public regulations and private governance of the green bond sector concerning the establishment of standards and directives for defining green bonds and overseeing issuers' utilization of funds. Aman et al (2022) examined the primary set of voluntary guidelines for green bonds established by the International Capital Market Association (ICMA), along with similar guidelines formulated by various countries. While disclosure regarding project selection and fund allocation typically occurs at the outset and is likely one-off, ongoing reporting on the environmental outcomes of fund utilization is paramount to safeguarding the integrity of the financial instrument.

2. Research methodology

This analysis is based on articles indexed in the prestigious Scopus international database. Therefore, the research aims to find responses to the following questions:

1. What is the distribution of descriptive information (years, authors, institutions, countries and journals) of published works on global and local sustainable development in the age of demographic trends through a European financing perspective in the scientific database Scopus?
2. What is the distribution of evaluative information (network of co-authors, co-citations, co-occurrence of keywords) of published research on global and local sustainable development in the age of demographic trends through a European financing perspective in the scientific database Scopus?
3. What are the main research trends regarding on global and local sustainable development in the age of demographic trends from the published works?

For the analysis in this study, a bibliometric approach was employed. Both the Scopus scientific database and the VOSviewer software were utilized to thoroughly examine the content of the articles.

During the literature review process, the keywords were searched in the "Title," "Abstract," and "Keywords" sections of the Scopus database. A search string was developed consisting of three main keywords: 1) sustainable, 2) development, 3) financing, during 2014-2024 period. Therefore, following this

filtering process, 4.144 articles were obtained. In the second stage, documents written in English were selected. Thus, the number of the documents decreased to 3.977.

Table no.1. Stages of the literature review process regarding inclusion and exclusion criteria

Stage	Content	Description
Stage 1	Scientific database	Scopus
	Indexation	All
	Date	02.03.2024
	Period	1 January 2014 - 29 February 2024
	Searched keywords	TITLE-ABS-KEY (sustainable AND development AND financing) AND PUBYEAR > 2014 AND PUBYEAR < 2024
	Initial result	⇒ 4.144 documents
Refining stages		
Stage 2	Language	English ⇒ 3.977 documents
	Final result	⇒ 3.977 documents

Source: Authors after Scopus (2024)

3. Results and discussion

In this chapter are presented the evaluative outcomes derived from 3,977 articles obtained through the filters applied in the Scopus scientific database. In a graphical representation of network visualization, the line thickness signifies the strength of collaboration, the circle size indicates the volume of articles, and the colors represent collaboration groups (Van Eck and Waltman, 2017).

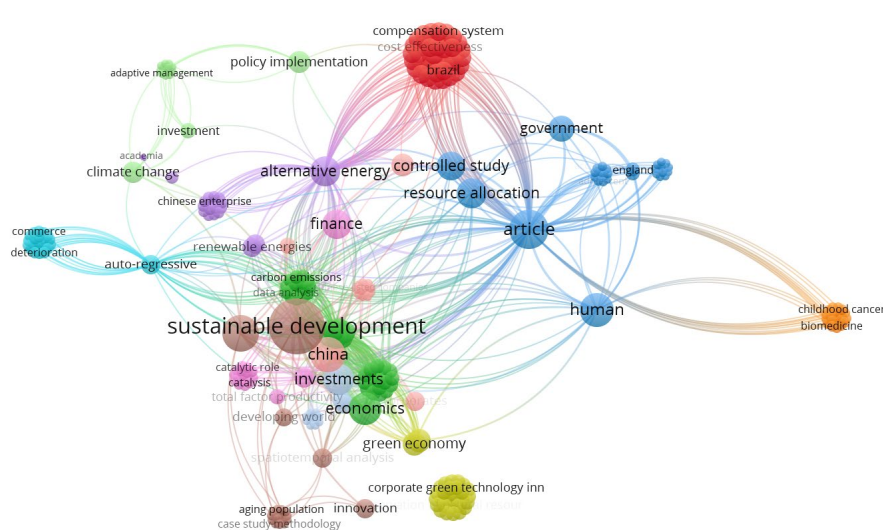


Figure no. 1. Network visualization map of co-occurrence of keywords

Source: Authors after VOS Viewer (2024)

Figure 1 depicts the co-occurrence of key words on the network visualization map. Out of the 3.977 research papers identified in the analyzed reference period, 320 keywords reached the analysis threshold (304 results). The results indicate that the co-occurring keywords were classified into 12 clusters.

This visualization highlights the interconnectivity of keywords within the research field, indicating the thematic concentration and diversity. The size of the circles reflects the frequency of keyword occurrence, while the thickness of the lines shows the strength of the relationship between keywords. This map suggests a strong focus on terms directly related to sustainable development, financing mechanisms, and demographic trends. The clusters formed by these keywords can be interpreted as the main thematic areas of interest, with larger clusters signifying more developed research areas within the field.

Thus, we obtained a number of 12 clusters, as following:

- Cluster 1 (red) is built around the key words: "energy", "ecosystems", "power markets", "ecosystem", "compensation fund", "environment", "restoration", "electric industry", "institutional arrangement".
- Cluster 2 (green) is built around the key word: "economics" and creates interconnections between the following addressed topics: "stakeholder", "carbon emission", "developing countries", "energy quality", "financial expansion", "data analysis", "quality control", "panel data", "information analysis", "comparative approach", "foreign direct investment", "resource management".
- Cluster 3 (blue) concentrates around the key word "resource allocation" and revolves around the key words "controlled study", "human", "government", "financial management", "development financing", "accelerators", "cost effectiveness analysis", "productivity", "decision-making", "economic evaluation", "research to policy", "sustainable development goal".
- Cluster 4 (green) is built around the key word "green economy", with the following interconnections: "R&D investments", "technology innovation", "environmental protection", "taxation", "corporate green technology innovation", "personnel human capital", "conservation of natural resources".
- Cluster 5 (purple) is built around the key word "alternative energy" and realizes the following interconnections: "financing", "academia", "inter-organizational deal", "development planning", "financial systems", "strategic investment", "crowding out", "renewable energy sector".
- Cluster 6 (turquoise) is built around the key word "auto-regressive", "cost", "financial markets", "sustainable", "policy reform", "policy recommendations", "commerce", "green horizons".
- Cluster 7 (orange) focuses on the key words "middle-income country", "biomedicine", "medicine financing and coverage", "health systems strengthening".
- Cluster 8 (brown) focuses on the key word "sustainable development", creating the following links: "developing world", "spatiotemporal analysis", "innovation", "family business", "health management", "sustainability-oriented innovating population", "sustainable business models", "case study methodology", "rural entrepreneurship".
- Cluster 9 (pink) is constructed around the key word "finance", on which basis the following connections are made: "green finance", "total factor productivity", "machine learning", "development strategy", "sustainable growth", "state-owned enterprise", "state-owned enterprise".
- Cluster 10 (coral) is constructed around the word "artificial intelligence" and contains the following elements: "corporates", "supply chains", "environmental governance", "potential pathway analysis".
- Cluster 11 (light green) focuses on the key word "policy implementation" and contains the following elements: "investment", "adaptive management", "insurance system", "framework", "multinomial logit regression", "climate-smart", "bivariate probit regression".
- Cluster 12 (light blue) is built around the key word "investments" and contains the next key words: "environmental performance", "environmental management", "structural optimization", "fixed effect models", "factor input structure", "theoretical modeling", "enterprise environmental performance".

Based on the detailed description provided, the clusters in Figure 1 reveal a comprehensive and multifaceted landscape of research in sustainable development, highlighting the diversity of topics and the interconnections between them. Therefore, **clusters 1, 4, 5, 6, 10, and 12** focus on technological and environmental aspects, including energy ecosystems, green economy, alternative energy, policy implications of financial markets, artificial intelligence's role, and investment strategies for enhancing environmental performance.

Clusters 2, 3, 9, and 11 delve into economic, financial, and policy dimensions, emphasizing economics, resource allocation, finance, and policy implementation. They highlight the pivotal role of economic analysis, financial management, green finance, and policy frameworks in achieving sustainable development goals in addressing carbon emissions, financial expansion, and policy effectiveness. While **cluster 7** focuses on the intersection of sustainable development with biomedicine and health systems, illustrating the link between environmental sustainability and health outcomes in middle-income countries.

Cluster 8 bridges sustainable development with social and business innovation, indicating the importance of spatiotemporal analysis, sustainable business models, and rural entrepreneurship in fostering sustainability in the developing world.

The interconnectivity indicates a rich tapestry of research that spans technological, environmental, financial, health, and social dimensions. It underscores the complexity of sustainable development challenges and the need for integrated solutions that consider technological, economic, and social factors. The analysis provides insights into current research trends, highlights areas of robust inquiry, and suggests potential directions for future research to address gaps and emerging challenges in sustainable development.

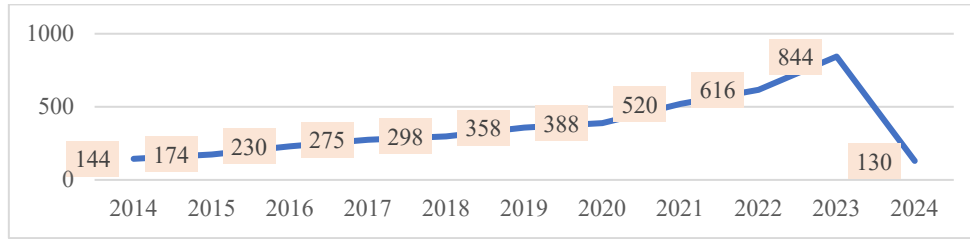


Figure no. 2. Number of articles published by year

Source: Authors after Scopus (2024)

This figure shows a clear upward trend in the number of articles published over the analyzed period, indicating growing academic interest and research output in the field of sustainable development, especially in relation to demographic trends and financing. The sharp increase in publications could reflect an increasing recognition of the importance of sustainability issues, possibly driven by policy developments, environmental challenges, and the availability of funding for such research. The decrease of the number of articles in 2024 is just because we have only analyzed the first two months of this year; indeed the world nowadays is trying to shift from a net zero approach to a more holistic view of the sustainability challenge.

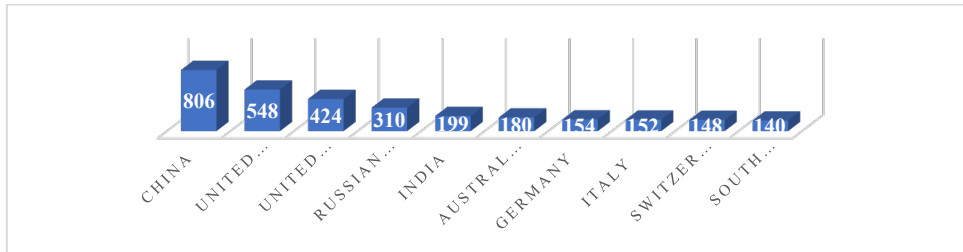


Figure no. 3. Number of articles published by country

Source: Authors after Scopus (2024)

This graphic illustrates the geographical distribution of research output, with certain countries leading in terms of the number of publications (highlights China, the United States, and the United Kingdom as the top contributors, indicating the global interest and collaborative nature of research in sustainable development). The first finding is that China leads with the highest number of articles published, followed by the United States and the United Kingdom and this indicates a significant contribution to the global pool of academic articles. However, there's a notable drop in the number of articles published from the top three countries to the rest in the top 10, illustrating a concentration of research output in a few countries.

The diversity in geographic representation among the top 10 countries, including nations from Asia, North America, Europe, and other regions, reflects a global spread of academic contributions, albeit with significant variances in volume. Finally, the prominence of specific countries can be attributed to their research capacities, policy interest in sustainable development, and availability of funding for research in this area.

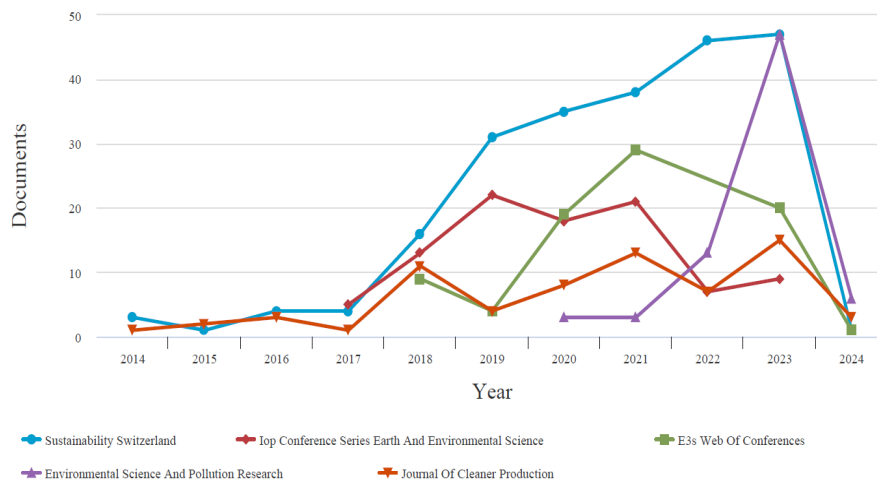


Figure no. 4. Distribution of articles in journals

Source: Authors after Scopus (2024)

The distribution across journals showcases the interdisciplinary nature of sustainable development research, spanning environmental sciences, policy studies, economics, and more. Journals with a higher number of publications in this field likely have a focus on sustainability issues, indicating their importance as platforms for disseminating research findings. As a spike, we can see that “Environmental Science And Pollution Research (ESPR)” journal has attracted a large number of authors between 2020 and 2022, overlapping the pandemic period where sustainability was a debated subject among the academic researchers.

Table no.2. Distribution of articles in journals

Position	Journal name	Number of documents
1	Sustainability Switzerland	226
2	Iop Conference Series Earth And Environmental Science	95
3	E3s Web Of Conferences	82
4	Environmental Science And Pollution Research	72
5	Journal Of Cleaner Production	68
6	Resources Policy	55
7	Lancet	46
8	Energies	38
9	Lecture Notes In Networks And Systems	37
10	Renewable Energy	34

Source: Authors after Scopus (2024)

This table ranks journals based on the number of documents published, highlighting those with significant contributions to the field. The leading journals, such as "Sustainability Switzerland" and others listed, serve as key outlets for research dissemination in sustainable development, reflecting the journals' thematic focus and influence in the academic community. The distribution of publications across journals is skewed, with a few journals dominating the publication space.

Table no. 3. Top 10 authors and institutions with significant contributions in the studied field

Authors			Position	Institution		
Author name	Document	Percent		Institution name	Documents	Percent
Taghizadeh-Hesary	20	0,503%	1	Organisation Mondiale de la Santé	88	2,213%
Sarker, T.	9	0,226%	2	London School of Hygiene & Tropical Medicine	45	1,132%
Umar, M.	9	0,226%	3	Harvard T.H. Chan School of Public Health	41	1,031%
Jakovljevic, M.	8	0,201%	4	University of Cape Town	36	0,905%
Mirza, N.	8	0,201%	5	University of Oxford	36	0,905%
Bhutta, Z.A.	7	0,176%	6	The World Bank, USA	34	0,855%
Chirambo, D.	7	0,176%	7	University College London	30	0,754%
Ng, A.W.	7	0,176%	8	Bucharest University of Economic Studies	28	0,704%
Chisholm, D.	6	0,151%	9	Plekhanov Russian University of Economics	27	0,679%
Daelmans, B.	6	0,151%	10	Financial University under the Government of the Russian Federation	25	0,629%

Source: Authors after Scopus (2024)

This table identifies leading authors and institutions by their contributions to the field, indicating centers of excellence and influential researchers. The presence of diverse institutions from different countries underscores the global and collaborative nature of research in sustainable development. Therefore, the 3 institutions which are leading the research in sustainable development highlights the importance of health and environmental issues within the sustainable development discourse. The presence of global health

organizations and renowned universities underscores the interdisciplinary nature of sustainable development, involving environmental, health, and policy research.

We have decided to do an analysis in the following way: by comparing the contributions of authors and institutions, we can explore the impact of institutional support on research output, potentially identifying if certain institutions are particularly supportive or influential in the research fields of these top authors.

Based on the contributions of the top authors and institutions, here are the key findings:

- **Total Contributions by 10 Top Authors:** the authors together contributed a total of 87 documents.
- **Average Contributions per Author:** the top 10 authors contributed approximately 8.7 documents.
- **Total Contributions by Top Institutions:** the 10 institutions contributed a total of 390 documents.
- **Average Contributions per Institution:** approximately 39.0 documents.

Implications

The institutional impact implies a significantly higher average contribution from institutions (39.0 documents) compared to individual authors (8.7 documents) highlights the substantial impact of institutional support on research output. Institutions likely provide resources, funding, and an environment that facilitates higher volumes of research. While the data suggests that while top authors make significant contributions, the collective capacity of an institution to produce research output far exceeds that of individual researchers. This underscores the importance of institutional backing in advancing research fields.

The potential for collaboration is given by the high output from both top authors and institutions. While the dataset does not specify affiliations, it's plausible that top authors are associated with or collaborate with high-contributing institutions, leveraging resources and networks to amplify their research impact.

In the end, the dynamics between individual researchers and institutions play a crucial role in shaping the research ecosystem. High-contributing authors and institutions likely drive innovation and advancements within their fields, setting research agendas and influencing future research directions.

Conclusions

The analysis reveals a significant and growing interest in sustainable development research, particularly in relation to demographic trends and European financing, as evidenced by the increasing volume of publications, the diversity of contributing countries, and the range of journals disseminating this research.

In conclusion, the emergence of green finance represents a paradigm shift towards sustainable economic development, driven by the imperative to mitigate climate change risks and foster high-tech innovation. By aligning financial incentives with environmental objectives, green finance holds the key to unlocking sustainable growth pathways, thereby laying the foundation for a resilient and prosperous future.

Distribution of Descriptive Information: The research spans from 2014 to 2024, with a total of 3,977 documents after refinement for language. This body of work comes from a diverse range of countries, institutions, and journals. China, the United States, and the United Kingdom are the top contributors by country. The leading journals include "Sustainability Switzerland," "Iop Conference Series Earth And Environmental Science," and "E3s Web Of Conferences," indicating the interdisciplinary nature of the research.

Distribution of Evaluative Information: The network visualization maps and tables highlight the collaboration among authors and institutions, and the co-occurrence of keywords. There are 12 clusters identified, showing a wide range of interconnected themes such as "energy," "economics," "resource allocation," and "green economy". This indicates strong collaborative ties and thematic concentrations within the sustainable development research community.

Main Research Trends: The document identifies key research trends, including technological and environmental aspects (energy, ecosystems, green economy), economic, financial, and policy dimensions (economics, resource allocation, green finance), and the intersection of sustainable development with health systems and social and business innovation. The analysis underscores the importance of interdisciplinary approaches to address the complex challenges of sustainable development.

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