Journal of Business, Social and Technology (Bustechno)
http://bustechno.ridwaninstitute.co.id/index.php/jbt/issue/current

WHAT ABOUT RELATIONSHIPS BETWEEN GREEN INNOVATION AND SUSTAINABLE DEVELOPMENT? A BIBLIOMETRIC ANALYSIS REVIEW

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Article Information:
Received:
January 4 2023
Revised:
January 11 2023
Accepted:
January 18 2023

Keywords:
Green Innovation;
Sustainable Development;
Bibliometric analysis;
Web of Science (WoS).

Abstract

This research analyzed the relationship between green innovation and sustainable development. The method used in this research is bibliometric. The bibliometric analysis conveys the journal's authors, provides past, present, and future capabilities of this particular theme, and serves as a goal and guide for current researchers to understand the themes of green innovation and sustainable development. The research aims to empirically capture the intellectual form, capacity, and direction of knowledge development. Achieve the goal using the VOSViewer software and the Web of Science (WoS) scientific database. VOSviewer software was adopted as a bibliometric analysis tool to visualize author, country, journal and keyword networks. The analysis conducted on 4 November 2022 cites 2043 documents from 2015 to 2022. The results prove that the number of green and sustainable innovation publications has grown relevantly in the last eight years. Ranked first in China as the most productive country in green innovation and sustainable development research and ranked second in the USA with the involvement of lead authors and research institutes. Keyword analysis shows that studies on green innovation and sustainable development in the last eight years have focused on environmental, economic, and technological themes. The bibliometric analysis provides data relevant to the main themes studied regarding green innovation and sustainable development.

Introduction

The Intergovernmental Panel on Climate Change (IPCC) presented part III of its Sixth Assessment Report on 4 April 2022, entitled "Mitigation of Climate Change." The report concludes that human emissions of greenhouse gases must be reduced by 43% by 2030 and

How to cite: Bianca Tiffani S, Melinda Malau, (2023), What About Relationships Green Innovation and Sustainable Development? A Bibliometric Analysis Review, 4(1) *Journal of Business, Social and Technology (Bustechno)* https://doi.org/10.46799/jbt.v4i1.110
E-ISSN: 2807-6362
Published by: CV. Syntax Corporation Indonesia

achieve carbon neutrality by 2050 to limit temperature increases to 1.5°C, an action agreed upon by nearly 200 countries in the Paris Agreement since 2015.

Environmental degradation and climate transformation have increased stakeholder anxiety about the prevalence of ecological challenges, leading to higher rates of global warming. Various efforts have been made to address conflicts between environmental issues and long-term strategic development (Fang et al., 2022).

Green innovation is a promising path to increase sustainability. It is full of complexity stemming from the difficulties and uncertainties surrounding adaptation activities within and across companies to enable green innovation (Afeltra et al., 2021).

Sustainable development aims to improve the quality of human life around the world, both for the present and future generations, without taking advantage of using natural resources that exceed energy sources. The goal of Sustainable development (SDGs) is to grab the attention of researchers around the world because of their role in economic growth, employment, environmental security (Opoku 2019; Van Zanten & Van Tulder, 2021).

The concept of green innovation (GI) makes it easier for companies to create environmentally friendly products and services to achieve sustainable development goals. (Duan et al., 2019). The Sustainable Development Goals (SDGs), known as the Global Goals, were adopted by all member states of the United Nations (UN) in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity in 2030 (UNDP, 2022).

Therefore, this study intends to examine and identify the literature on green innovation and sustainable development using a bibliometric methodology in the aspects of green innovation and sustainable development. As a result of the publication of researchers or the scientific community recognises past, current and future research. This research adds knowledge and can serve as a recommendation for future research.

Using a combination of bibliometric analysis, text mining, and visualization, the Objective of the Study is as follows:

RQ1. How is the annual research publication on green innovation and sustainable development for 2005-2022?

RQ2. What is the most productive organizational affiliation in green innovation research and sustainable development?

RQ3. What is the publication of green innovation and sustainable development research in the a country that has contributed the most to conducting research?

RQ4. How to analyze research keywords green innovation and sustainable development using co-occurrence unit analysis author keyword analysis?

RQ5. How to cite green innovation and sustainable development using a Co-citation analysis unit authors?

RQ6. How to analyze the Bibliographic coupling of countries?

A. Green Innovation

Green innovation has recently piqued the attention of the government, business sector and academia. (Zeng et al., 2022). Green innovation creates primary use and knowledge of human and financial energy based on evaluating the protection of energy quantities and natural areas to achieve economic, environmental, and social benefits. This income method is Green innovation (Guzzo et al., 2022).

Green innovation directs innovation in a product design and production method by taking into account environmental factors and energy consumption in the manufacture and use of products to achieve the mission of reducing environmental pollution and increasing

the use of energy sources and sustainable development (Li et al., 2020, 2022a, 2022b; Ling & Long, 2020).

Green corporate culture can be beneficial for companies dealing with environmental issues (Al-Swidi et al., 2021). Green corporate culture can be beneficial for companies dealing with environmental issues (Naqshbandi & Jasimuddin, 2022).

B. Sustainable Development

Sustainable Development is a long-term economic growth model (Chowdhury, et al., 2022). The ideal state is to fulfil current interests without affecting the sustainable development of future generations. This is an idea that people get after knowing the seriousness and then contemplating ecological damage (Jayaratne et al., 2022).

Green development refers to economic and social development techniques that aim at efficiency, balance, and sustainability, reflecting the organic unity of green subjects, green economy, and green governance arrangements (Mingwan Wu et al., 2021).

Green development can be understood as sustainable development, transformation, low carbon economy, and growth (Wang et al., 2018).

C. Bibliometric

The bibliometric analysis combines two critical methods: knowledge mapping and analysis and potential analysis. Science mapping analysis is another bibliometric method and describes a spatial representation of how the goals of different actors relate to one another (Gaviria et al., 2019). Bibliometrics is consistent with organized literature reviews. The bibliometric analysis relies on quantitative methods that avoid and reduce bias. Bibliometric analysis is also of interest here because, unlike the category of meta-analysis, which focuses on summarizing empirical reality, it first unravels the structure of intellectual perspectives by examining social and systemic relations within the corpus (Donthu et al., 2021).

This analysis considers various bibliometric outputs, such as the category searched for, year and title of publication, earning authors, institution and country, and sample and citation figures.

Method

This research adopts the Bibliometric study method. Bibliometric analysis is a research procedure to illustrate the relationship between green innovation and sustainable development.

Most bibliometric analyses have shared data sources: Thomson Reuters' Web of Science (WoS) and Elsevier's Scopus. (Mongeon & Paul-Hus, 2016). All literature information for analysis, such as authors, citations, journals, countries or regions, and alliances, can fulfil the interests of solving problems and helping achieve research missions. In addition, it also follows the bibliometric literature review procedure (Hosseini et al., 2018).

This study retrieved data from the database (WOS). The data mining date is November 4, 2022. The concept of this analysis is to use several keywords to find research articles that are published internationally. The keywords used in this analysis are green innovation and sustainable development. The years of publication taken were 2015 to 2022. This research was divided into 3 phases, as shown in Figure 1.

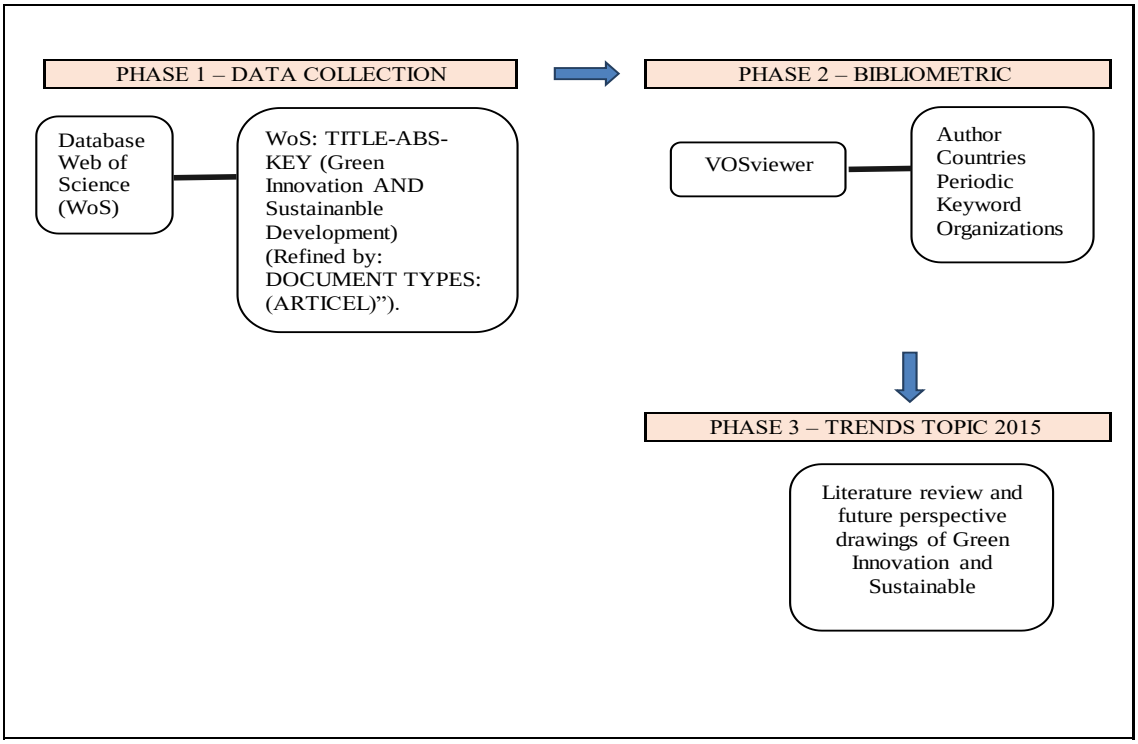

Figure 1 Methodology Phases

In the first stage, collecting data from the Scopus database uses the application of search keywords: TITLE-ABS-KEY "green innovation and sustainable development," which produces 2043 articles. In the second stage, Documents in TXT format are exported to VOS viewer software for bibliometric analysis of publications, authors, countries, institutions, journals, organizations, and regions (data visualization stage). The third stage is data analysis to identify the main themes discussed in the research on "green innovation and sustainable development."

Results and Discussion

A. Annual Number of Publications

Figure 2 shows the trend of annual publications related to green innovation and sustainable development research, starting in 2005 (40 publications) and ending in 2022 with 688 articles that can be accessed online. The increase in publications occurred in 2018 – 2022, with over 100 article documents.

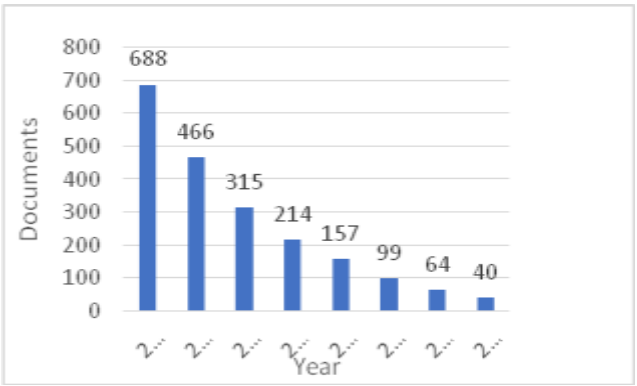

Figure 2. The annual number of publications

B. The Most Productive Organizations

Based on figure 3, 2318 organizations research green innovation and sustainable development. Organization. 10 Main organizations with the largest published documents on green innovation and sustainable development. Size and color represent separate numeric dimensions of data. The two organizations that published the most were the Chinese Academy of Sciences 28 documents (1.37%) and the China University of Mining Technology 26 documents (1.27%). The Chinese state leads the most productive organizations studying green innovation and sustainable development. China is a country that supports the development and research of green innovation and sustainable development.

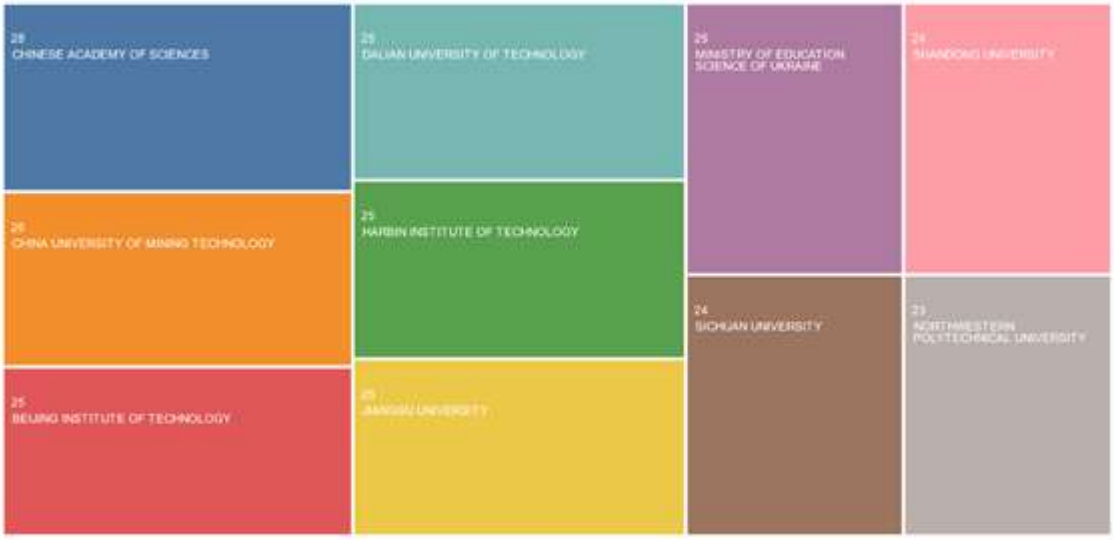

Figure 3. The Most Productive Organizations

C. The Most Contributing Countries

One hundred seven countries have been identified as researching green innovation and sustainable development. The ten most productive countries are listed in Figure 4. The top 10 countries include developed and developing countries, focusing on the relationship between green innovation and sustainable development, which has become a global problem.

Figure 4. The Most Contributing Countries
Source: This map was created by the authors via mapchart.net

China ranks first with 926 publications because Chinese companies, as important players in emerging markets, are pursuing a sustainable development strategy. The company focuses on adhering to the intrinsic requirements of green economic development and actively takes responsibility for addressing environmental challenges.

The USA is ranked second with 139 publications, England is third with 133 publications, Italy is fourth with 127 publications, Spain is fifth with 109 publications, Pakistan is sixth with 101 publications, India is seventh with 96 publications, Malaysia is eighth with 84 publications.

D. Co-occurrence of Author Keywords

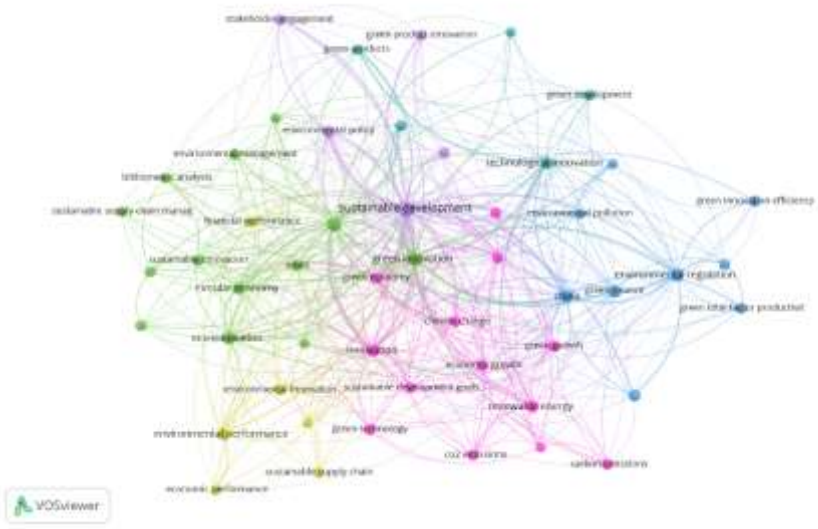

Figure 5. Co-occurrence of Author Keywords

Analysis of the appearance of the author's keywords is given in illustration 5. It is determined that 5677 keywords are applied to the publications examined with 15 iterations, resulting from the 5667 keywords fulfilling criteria 51. According to illustration 5, the map represents grouping keywords into six groups.

E. Bibliographic coupling of countries

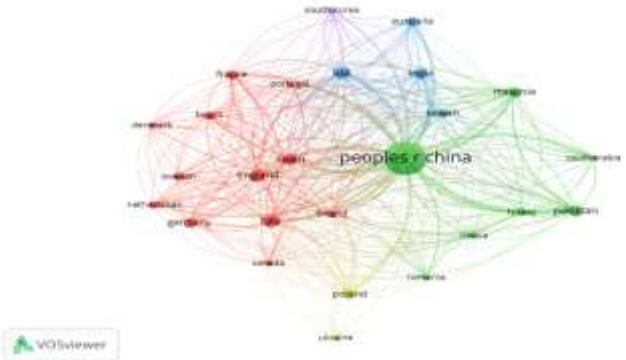

Figure 6. Bibliographic coupling of countries

Bibliographic coupling analysis of countries illustration 6 shows country bibliographic coupling with a threshold of 25 documents. This analysis found 5 clusters

with red, green, blue, yellow, and purple colors. Spain, England, Italy, Canada, Germany, Netherlands, Sweden, Denmark, Brazil, France, Finland, and Portugal are in red. China, Russia, Romania, Turkey, Pakistan, Saudi Arabia, and Malaysia are grouped in green, the United States, India, Australia, and Taiwan in blue, Poland, and Ukraine in yellow, and South Korea in purple. As shown in Figure 6, China has the most networks on the map nodes. That is, it is a very productive country. In addition, England and Italy have an important position.

Discussion and Implication

This research provides a bibliometric analysis of references on green innovation and sustainable development between 2015–2022 by analyzing 2043 articles, according to publications in the web of science (WoS). Studies have been conducted to evaluate the relationship between green innovation and sustainable development. They are using the conceptual and intellectual framework of the topic. There are two techniques which it contributes to the theoretical development of the topic under study. Summarize the section using highly critical citations, shared citations, thematic mapping, shared keyword occurrences, and objective and technical document groupings. It provides academics with a compass to guide their future research with this technique. Second, selecting and plotting the most common patterns shows how the topic is increasing. In short, this study offers guidance for those exploring aspects of green innovation and sustainable development, providing information about the field's past, present, and future to create compelling empirical models or generate sufficient literature reviews.

Conclusion

Conclusions and limitations of the study Initially, it was found that bibliometrics is an appropriate method for an inductive approach to the semantic separation of the conceptual structure of the newly created field. This aspect of insight in research related to green innovation and sustainable development demonstrates the multi-dimensional and interdisciplinary character. As in other objective aspects, we are applying bibliometrics can increase our knowledge and support researchers in mastering green innovation and sustainable conceptual frameworks. This study intends to investigate the relationship between green innovation and sustainable development and describe its growth over the last eight years. To account for scientific developments, the researchers conducted a global bibliometric analysis of 2043 posts published between 2015–2022. To answer a predetermined research mission, bibliometric research included how to analyze citations, analyze snippets with events and the author's keywords and group technical and scientific documents.

In conclusion, green innovation and sustainable development are recently developed topics relevant to academics and practitioners. Although green innovation and sustainable development are primarily used as constrained variables and the abstract framework surrounding these designs is still in architecture, there needs to be more heterogeneity regarding the drivers or antecedent variables of green innovation and sustainable development. In conclusion, green innovation and sustainable development are recently developed topics relevant to academics and practitioners. Although green innovation and sustainable development are primarily used as constrained variables and the abstract framework surrounding these designs is still in architecture, there needs to be more heterogeneity regarding the drivers or antecedent variables of green innovation and sustainable development. Explained by a consensus of scholars approaching the problem (management, economics, engineering, and environment). China is ranked first as the most productive country in green innovation and sustainable development research. The second level is the USA by linking primary authors and

research institutes. Keyword analysis proves that research on green innovation and sustainable development in the last eight years has focused on environmental, economic, and technological themes. The bibliometric analysis provides information relevant to the essential themes studied regarding green innovation and sustainable development.

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