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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

EXPLORING TRENDS AND THEMES IN SUSTAINABILITY AND GREEN GROWTH THROUGH BIBLIOMETRIC ANALYSIS

SÜRDÜRÜLEBİLİRLİK VE YEŞİL BÜYÜME KAVRAMLARINA İLİŞKİN TREND VE TEMALARIN BİBLİYOMETRİK ANALİZLE ARAŞTIRILMASI

Esra ERARSLAN[*]
Çağın ERBEK[**]

Abstract

Sustainability is a general concept that covers economic, environmental, and social dimensions. Green growth is a particular strategy of economic development that prioritizes environmental sustainability. The main objective of this study is to determine the most significant publications regarding sustainability and green growth, to visually analyze publications, and to provide a comprehensive framework for the most recent trends. In this research, 1161 publications are retrieved from the Scopus Database with the mentioned keywords published in English since 1990. It was found that 67.8% of the studies were articles, 12.9% of the research were book chapters, and 8.1% were conference papers. It was discovered that China (689), the UK (185), and South Korea (157) had the most publications overall. Whereas, France and the Netherlands have the most cited publications on average.

Keywords: Bibliometric Analysis, Sustainability, Green Growth, Bibliometrics
Jel Classification: Q01, Q56

Öz

Sürdürülebilirlik ekonomik, çevresel ve sosyal boyutları kapsayan genel bir kavramdır. Yeşil büyüme ise çevresel sürdürülebilirliğe öncelik veren özel bir ekonomik kalkınma stratejisidir. Bu çalışmanın

* PhD student, İstanbul University, Department of Numerical Methods, İstanbul. Email: esra.erarslan@ogr.iu.edu.tr, https://orcid.org/0000-0003-1509-8330

** Asst. Prof., Haliç University, Department of Business Administration, İstanbul. Email: caginerbek@halic.edu.tr, https://orcid.org/0000-0002-7230-1182

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temel amacı, sürdürülebilirlik ve yeşil büyüme ile ilgili en önemli yayınları belirlemek, yayınları görsel olarak analiz etmek ve en son trendler için kapsamlı bir çerçeve sunmaktır. Bu araştırmada, Scopus Veri Tabanı'ndan 1990'dan bu yana İngilizce olarak yayınlanmış 1161 yayına, belirtilen anahtar kelimelerle ulaşılmıştır. Çalışmaların %67,8'inin makale, %12,9'unun kitap bölümü ve %8,1'inin konferans bildirisi olduğu tespit edilmiştir. Çin (689), Birleşik Krallık (185) ve Güney Kore'nin (157) toplamda en fazla yayına sahip ülkeler olduğu ortaya çıkmıştır. Fransa ve Hollanda ise ortalama olarak en çok atıf alan yayınlara sahiptir.
Anahtar Kelimeler: Bibliyometrik Analiz, Sürdürülebilirlik, Yeşil Büyüme, Bibliometri
Jel Kodları: Q01, Q56

1. Introduction

Our main objective is to shed light into the intersection area of sustainability and green economics by retrospective search since 1990. This inquiry systematically examines the evolution and patterns over a span of three decades using bibliometric analysis, thus addressing several pivotal research questions: What is the current trend of publication and citation regarding the selected themes? Which journals, authors, articles contributed to this themes? What are the main keywords that beed studied on? What is the future research direction of the sustainability and green growth?

This paper provides a brief summary of recent works aiming to present a holistic picture of researches conducted in both areas. In section 2 the overview of methodology and data collection methods, and filtering criteria will be given. In section 3 the results of the study will be provided and lastly, section 4 concludes the paper with the short-term future direction of these domains (Donthu et al., 2021).

2. Historical background of the concept of development

As the world's population and human needs increase, we see that labour, means of production and nature are used more intensively in production. The path chosen by the capitalist mode of production for progress, for growth, for satisfying the needs of societies, and which is defined as development, involves an intense process of industrialisation (Sen, 1988). Industrialisation is therefore legitimised by the desire to achieve more prosperous societies. The industrialisation policies of states aim to produce more by using existing resources as efficiently as possible and to create more employment opportunities in order to increase welfare. However, the problem of scarcity faced by societies from the past to the present has reached a point that contradicts the goal of unlimited growth. As the ecological crisis, highlighted by scientists with data, became an issue on the political and economic agenda of societies, policies began to be developed on how to make the system sustainable (Meadows et al., 1972). The concepts of sustainable development and green growth are the products of these discussions. In this sense, the debate on how to make social production ecological and sustainable has emerged as an important issue (European Commission, 2019, p. 2).

In order to explain why the concepts of sustainable development and green growth are widely used today, it is important to understand the historical context in which the concept of development was shaped. Development analyses in the 1950s focused on industrialised countries. Discussions

on development have evolved through two fundamental divisions. The first is the rejection of monoeconomics. Orthodox economics adopts a single economic approach that is universally valid and the market is considered under conditions of full employment. The second is the idea of mutual benefit, according to which the market economy brings benefits to all parties involved in the economic relationship at the individual or national level. Contrary to the claims of orthodox economics, the underemployment equilibrium of Keynesian economics has shaken the understanding of monoeconomics. According to this view, there may be different economies in different regions, but the economy does not have a single linear path of development. The phenomenon of underemployment and urban unemployment has been used to justify interventionist public policies along with Keynesian economics (Hirschman, 2014, pp. 51–55). With such a theoretical division, early development economists such as Paul Rosenstein Rodan and Ragnar Nurkse considered underemployment as the fundamental feature of underdevelopment. Walt W. Rostow adopted the mono-economic approach and divided the development process of countries into five stages, emphasising the importance of achieving the "take-off" stage. This is the stage where all obstacles to development are removed (Rostow, 1960, p. 7). The 'take off' phase has been called the 'big push' by Rodan and the 'great spurt' by Alexandre Gerschenkron. In general, however, all three approaches emphasise that government and external intervention is essential for underdeveloped countries that cannot reach this stage with their resources.

The dominance of Keynesian economics, the scarcity of labour supply after the Second World War and the effects of the Cold War have all played a significant role in the creation of interventionist public policies in underdeveloped countries. Since there is no source of capital to realise the industrialisation movement on its own, it can be said that nation-states, as the founding economic subject, were the main actors of the early industrialisation process. Therefore, the phenomenon of industrialisation and the ideology of development allowed societies where pre-capitalist relations were dominant to be drawn into capitalist relations. Both the increase in the volume of production and the geographical spread of production have brought the role of nature to the centre of the relations of production. The geographical spread of industrialisation also means that nature and natural resources are drawn into more production processes. At this point, scarcity as the main problem that economists have been trying to solve from the very beginning, has led to the problem of how to preserve natural resources at a level that ensures the continuity of the production process.

The optimal use of nature, which is directly used in the production process, indirectly provides an important service in the reproduction of labour such as clean air, water, agricultural production, and finally absorbs production waste, has become one of the main topics of economists and policy makers, especially since the middle of the 20th century. The concepts of growth and development, which are discussed around the questions of how developed countries grow, how underdeveloped countries develop and how growth can be made sustainable, have required in-depth analysis of the relationship between the individual, society and nature. The concepts of sustainable development and green growth should therefore be considered in the light of these developments.

3. Methodology

Bibliometrics focuses on a quantitative assessment of research within a certain area (Martínez-López et al., 2018). Pritchard (1969) coined the term "bibliometrics" to refer to using mathematics and statistical methods on books and other forms of communication. The primary advantage of this technique is the establishment of a retrospective examination that identifies the most notable patterns in the literature from the past and current. This method provides a general summary of the studies in the literature, as well as the development of the subject over time, the contributions of the authors to the topic, the collaborations of the authors, and the frequency of the journals related to the given search terms. With the improvement of technology and the availability of softwares such as Gephi and VOSviewer, as well as their integration with Scopus and WoS databeses, bibliometric analysis has gained popularity (Donthu et al., 2021).

A great number of studies have undertaken bibliometric analysis in many fields including econometrics (Zapata & Mukhopadhyay, 2022), economics (Bonilla et al., 2015), green economics (Alsmadi & Alzoubi, 2022), sustainability (Farrukh et al., 2020), and entrepreneurship (Block et al., 2020). This technique simplifies the process for academics to identify trends and uncover literature gaps, thereby enhancing research quality. Its ease of application extends its utility to practitioners as well, facilitating the examination of large data sets and providing comprehensive insights. Due to its wide range of applications, bibliometric analysis is a crucial tool in scholarly research. In this study, Bibliometrix package in R utilized to conduct bibliometric analysis.

Scopus database was chosen for conducting this analysis. While there are other available sources to retrieve data, such as Web of Science and Google Scholar, Scopus's coverage is more extensive and it allows more detailed study (Baker et al., 2023; Mukherjee et al., 2022). Merging several sources were also possible but data cleaning may result in some complications (Corbet et al., 2019) as the attributes of studies saved in different formats. In this research, using the keywords 'sustainab*' and 'green economy,' 1161 publications in English from the social sciences area, covering the period from 1990 to 2023, were retrieved in order to evaluate citation records, highly cited articles, publishing patterns, and subject clusters through the following query:

TITLE-ABS-KEY (sustainab* AND "green economy") AND PUBYEAR > 1990 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (LANGUAGE , "English"))

4. Findings

The findings were examined through detailed performance and science mapping analyses. Performance analysis, as outlined by (Cobo et al., 2011), focuses on the contributions of study participants. It reviews the database comprehensively, revealing the status of average annual citations, the most cited journals, the most relevant affiliations, leading authors, the most productive countries, and the most cited documents. On the other hand, science mapping, as described by (Donthu et al., 2021), emphasizes the relationships between these contributors i.e. co-occurences of keywords, topics, areas.

Table 1 shows the general information about the findings. Overall, 787 articles – account for 67.79% of total documents – from 583 sources were examined in this research. 2901 authors contributed by writing 1161 documents and each document citated 18.4 times in average. Annual growth rate of the area is around 17.3% and while the number of single-authored document is 254, the ratio of international co-authored document is 31.27%. Over the last 33 years, these 1,161 documents have accumulated 59,163 citations.

Table 1: General Information on Retrieved Data

Description	Results
Timespan	1990:2023 (October)
Sources (Journals, Books, etc)	583
Documents	1161
Annual Growth Rate %	17.29
Document Average Age	4.13
Average citations per doc	18.4
References	59163
Document Contents	
Keywords Plus (ID)	3365
Author's Keywords (DE)	2860
Authors	
Authors	2901
Authors of single-authored docs	233
Authors Collaboration	
Single-authored docs	254
Co-Authors per Doc	3.05
International co-authorships %	31.27
Document Types	
Article	787
Book	47
book chapter	150
conference paper	94
conference review	9

In Figure 1, the graph depicting annual scientific productivity clearly shows the number of articles published from 1990 to 2023. Overall, the number of studies increased steadily over the period, except the years of 2011 and 2016. After 2020 the number of articles rose. The highest number of articles published reached almost 200 in 2023. This rise is parallel with the European Green Deal. Additionally, Sustainable Development Goals were adopted in 2015 by 179 countries aiming the improvement on 17 different goals by 2030. This agreement also impacted the rise in the number of articles. The European Green Deal provides a roadmap for integrating climate and environmental challenges into all policy areas. It aims to make the EU economy sustainable by making the transition fair and inclusive for all (https://www.switchtogreen.eu). The European Green Deal proposes production processes that aim to increase the efficient use of resources, prevent climate change,

protect biodiversity, and reduce pollution by moving towards a circular economy. It explains what kind of transformation will be achieved on a sectoral basis, across Europe and specifically in the countries with which it has economic relations. It can be thought that political developments, such as the European Green Deal and the adoption of the Sustainable Development Goals, are also influencing the number of academic studies.

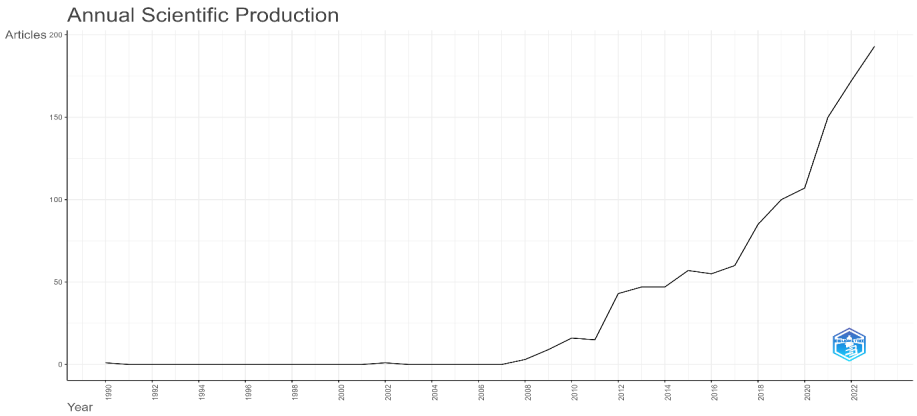

Figure 1: Annual Scientific Production

The sankey diagram in Figure 2 presents three interconnected columns: authors on the left, keywords in the middle, and sources on the right. Through this visual representation, relationship and flow of information among the aspects of the reseach area are given. The most used search terms are green growth, sustainable development, sustainabilty, green economy and renewable energy. The direct flows between the columns can be seen. It can be concluded that the majority of articles related to green growth published in the Sustainability journal.

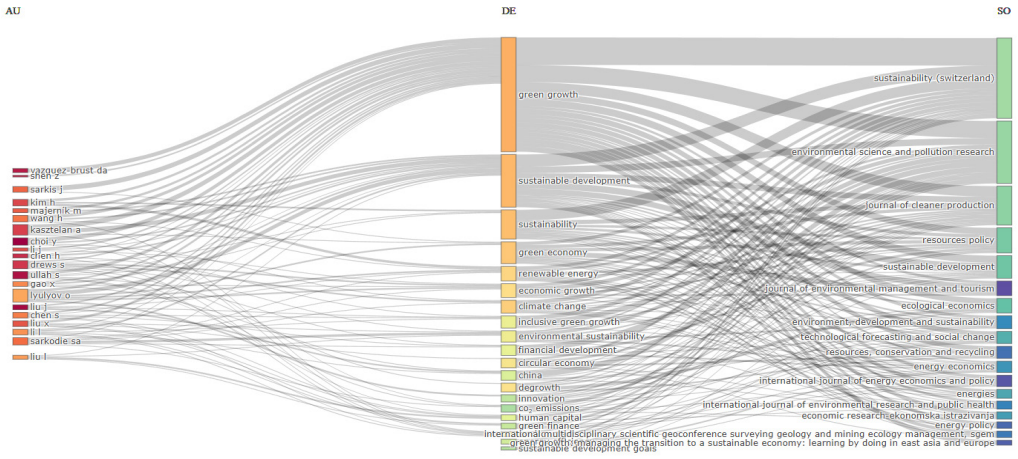

Figure 2: Three-Fields Plot

Table 2 shows the trend of sources. Dominating the list of sources, the journal 'Sustainability' leads with a contribution of 76 articles. This is closely followed by 'Environmental Science and Pollution Research' and 'Journal of Cleaner Production,' with 55 and 34 articles, respectively. Among these sources, it's interesting to note that only the 4th and 8th lines are conferences, with the remainder being journals. Following on to the affiliations which is given in Table 3, China's Dalian University of Technology ranked first in the area with 26 publications, followed by University of Turku in Finland with 20 articles. Cardiff University and the Technical University of Denmark are contributed 18 articles each. This distribution indicates the top academic institutions influencing these studies in addition to highlighting the regional variation in research.

Table 2: Trend Journals

Rank	Sources	Articles
1	Sustainability (Switzerland)	76
2	Environmental Science and Pollution Research	55
3	Journal of Cleaner Production	34
4	IOP Conference Series: Earth and Environmental Science	22
5	Resources Policy	21
6	Sustainable Development	16
7	Ecological Economics	14
8	E3S Web of Conferences	13
9	Technological Forecasting and Social Change	13
10	Energies	11

Table 3: Affiliations

Affiliation	Articles
Dalian University of Technology	26
University of Turku	20
Cardiff University	18
Technical University of Denmark	18
Nanjing University of Information Science and Technology	16
School Of Management and Economics	16
Beijing	15
Universitat Autònoma De Barcelona	14
Xi'an Jiaotong University	14
Jiangsu University	13

Top authors and top authors' production since 2012 graphically illustrated in Figure 3. Each horizontal line represents an author. While the size of the nodes shows the frequency of publications, the darkness of nodes gives the information about the total citations (TC) for each year. According to the figure, Ullah S. has shown notable productivity since 2022. Liu J.'s publications in 2020 has received a great number of citations.

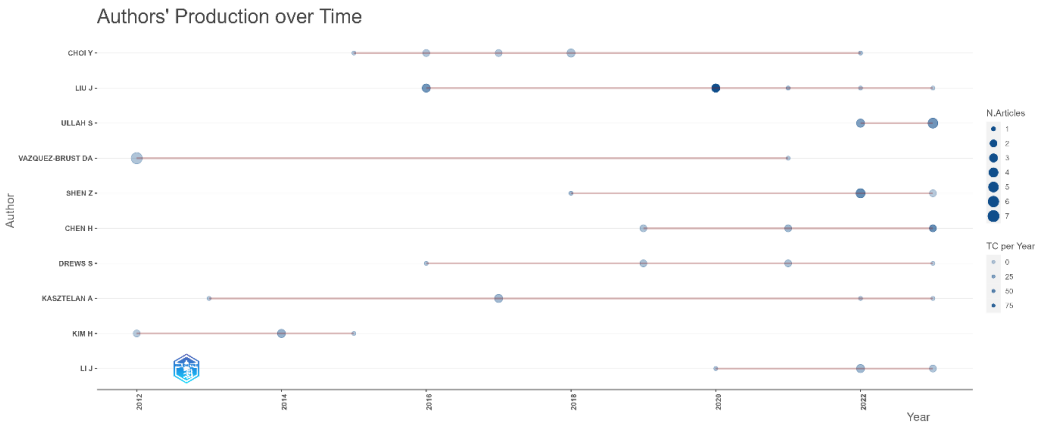

Figure 3: Top 10 Authors' Production Over Time

Table 4 states both top 10 countries' scientific production and top 10 most cited countries over time. On the left, top 10 countries' scientific production is given. China dominates with the number of publications at 689. The UK and South Korea follow with 185 and 157 articles respectively. On the right, the top 10 most cited countries are shown. This table represents the ranks of countries based on TC and the average number of citations per publication. China ranked 1st with 3,653 citations yet the average number of citations is less than other countries. Considering average article citation, France and Netherlands are shown higher influence per article.

Table 4: Top 10 Countries Based on Scientific Production and Number of Citations

Top 10 countries' scientific production		Top 10 most cited countries		
Country	**Frequency**	**Country**	**TC**	**Average Article Citations**
China	689	China	3653	19.10
UK	185	UK	2140	41.20
South Korea	157	USA	1182	43.80
USA	150	Germany	1078	32.70
Germany	135	South Korea	835	15.80
India	129	Turkey	776	38.80
Malaysia	95	France	658	50.60
Pakistan	93	Netherlands	658	43.90
Finland	87	Japan	551	39.40
Italy	84	Spain	518	24.70

Figure 4 and Figure 5 illustrate the frequency of keywords used in the literature and trend words by years. According to Figure 4, 'sustainable development' appears most frequently, with 463 occurrences. This is followed by 'economic development' and 'China,' which are mentioned 192 and 187 times respectively. The term 'economic growth' also features prominently with 177 instances. 'Sustainability' is noted 168 times, reflecting its significant relevance. The terms 'green growths' and 'climate change' show a notable occurrence as well, with frequencies of 140 and 129. The Figure

5 depicts a comprehensive timeline of trending topics from 2010 onwards, revealing the dynamic landscape of discourse frequency over the years. In the most recent year depicted, the terms 'investment,' 'finance,' and 'Africa' have emerged prominently, each being referenced approximately 100 times, as indicated by the uniform size of the dots on the chart. Looking back to 2022, a separate set of topics dominated the conversation; 'economic development,' 'China,' and 'green economy' were among the most frequently mentioned terms, each cited around 300 times.

Figure 4: Word Cloud

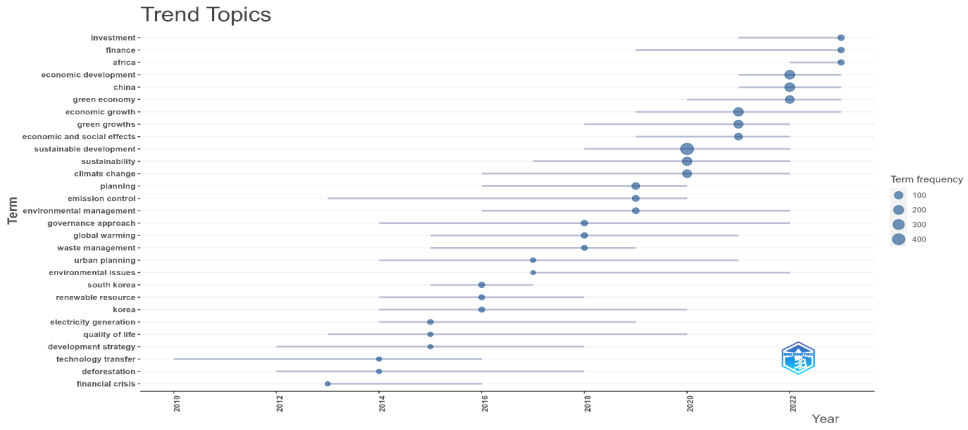

Figure 5: Timeline Chart of Trend Topics by Years

Citation analysis reflects the intellectual connections between publications (Appio et al., 2014) and presents most influential works in the area. Co-citation analysis is another technique for mapping the publications which are cited mutually (Rossetto et al., 2018). Analysis of most cited articles given in the Table 5 which reveals that the recent study by Hickel and Kallis (2020) has quickly garnered high attention, indicating a strong interest in critical assessments of green growth feasibility with 590 citations. Interestingly, another novel study by Hao et al. (2021) has also a high citation rate of 117.67 per year, reflecting urgent interest in the relationship between green growth and carbon emission reduction in developed countries. The significant citation rate suggests that the findings are considered valuable and timely for policy makers.

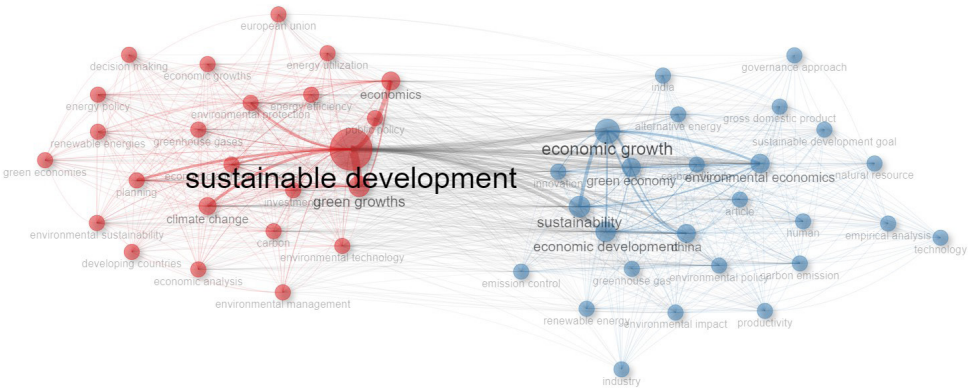

Figure 6: Co-occurence of Keywords

Keywords co-occurence analysis also one of the key indicators determining the hot topics in the research area. In the Figure 6, the layout suggest that the distance between the terms and the lines connecting them indicate the strength of the relationship among themes: the closer the terms and thicker the lines, the more powerful association. In the center, 'sustainable development' highligted as the core term. Some of the intriguing terms connected to sustainable developments are 'green growth', 'climate change', 'energy', 'economic growth', 'environmental sustainabiliy' and 'green growth'.

Table 5: Most Cited Articles

Author/s	Article	Findings	Total Citations	TC per Year
(Hickel & Kallis, 2020)	Is Green Growth Possible?	The paper challenges the green growth theory, which posits that economic growth can coexist with ecological sustainability, by presenting empirical evidence and studies indicating that absolute decoupling of GDP growth from resource use and carbon emissions is unlikely, suggesting a need for policymakers to consider alternative strategies.	590	147.50
(van Vuuren et al., 2017)	Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm	This paper explores the SSP1 green growth paradigm's potential impact on global energy, land use, and emissions through the IMAGE 3.0 model, suggesting that sustainable practices and human development investment could significantly reduce emissions and land use by 2100, although climate policies remain crucial for further reductions to meet global temperature targets.	436	62.29
(Lorek & Spangenberg, 2014)	Sustainable consumption within a sustainable economy – beyond green growth and green economies	The paper revisits the shift from the 1992 UNCED's focus on changing consumption and production patterns to the 2012 UNCSD's emphasis on the green economy, questioning whether this represents progress or a diversion from essential goals. It argues that while sustainable development remains a valid concept, the current green growth approach, akin to ecological modernisation, lacks the necessary focus on strong sustainable consumption.	379	37.90

(Hao et al., 2021)	Green growth and low carbon emission in G7 countries: How critical the network of environmental taxes, renewable energy and human capital is?	This study examines the impact of green growth on CO2 emissions in G7 countries from 1991 to 2017, using advanced panel data methods, and finds that green growth, along with environmental taxes, human capital, and renewable energy use, effectively reduces emissions, supporting the theory that green growth is beneficial for environmental quality.	353	117.67
(Adedoyin et al., 2020)	Modelling coal rent, economic growth and CO2 emissions: Does regulatory quality matter in BRICS economies?	This study investigates the relationship between economic growth, pollutant emissions, and coal rents in BRICS countries from 1990 to 2014, finding that while coal rents negatively impact CO2 emissions, surprisingly, regulations on coal rents have a positive impact on emissions, suggesting the need for more stringent environmental regulations and a shift towards renewable energy sources for sustainable development.	346	86.50
(Fernando et al., 2019)	Pursuing green growth in technology firms through the connections between environmental innovation and sustainable business performance: Does service capability matter?	This study explores the mediating role of service innovation capability in the relationship between eco-innovation and sustainable organizational performance, using data from 95 Malaysian firms employing green technology. The findings reveal that eco-innovation leads to better sustainability performance, with service innovation capability enhancing this effect and providing competitive advantages.	304	60.80
(Lombardi & Laybourn, 2012)	Redefining Industrial Symbiosis	This article revisits and updates the definition of industrial symbiosis (IS) to reflect its evolution in research and practice, proposing a broader perspective that emphasizes eco-innovation and cultural change in networks of diverse organizations, moving beyond the traditional focus on geographic proximity and physical resource exchange.	283	23.58
(Dai et al., 2016)	Green growth: The economic impacts of large-scale renewable energy development in China	This study uses a dynamic CGE model to demonstrate that large-scale renewable energy development in China by 2050, while economically feasible and not significantly costly, could lead to substantial green growth, reshape the energy structure, provide major environmental benefits, and significantly contribute to GDP, comparable to major industries.	257	32.13
(Kallis et al., 2018)	Research On Degrowth	Scholars and activists are increasingly using the term 'degrowth' to advocate for a radical socio-economic transformation towards reduced resource and energy use, with research reinvigorating debates on growth limits and exploring the feasibility, desirability, and possible pathways for such a transition, posing critical questions for sustainability sciences.	255	42.50
(Jänicke, 2012)	"Green growth": From a growing eco-industry to economic sustainability	This paper scrutinizes prevalent assumptions in economic growth discourse, debating the efficacy of government-led high growth policies versus the necessity of a paradigm shift towards environmental sustainability, showcasing best practices in 'green growth,' and critically analyzing the conceptual evolution and strategic implementations as per OECD and other prominent institutions.	246	20.50

5. Conclusion and discussion

This bibliometric analysis has provided a comprehensive overview of the research trends within the scope of sustainability and green growth from over the past three decades. The analysis reveals that a significant amount of documents were articles. The annual growth rate of 17.3% indicated a rapidly expanding interest in addressing these research areas. Also, the analysis highlights the international collaboration by the 31.3% of documents, which affirms the importance of subjects and increasing engagement in this field.

China is at the top of the sustainability area in terms of the number of publications and citations; it is followed by the UK and South Korea. Nonetheless, when assessing the impact of research through average citations per article, France and the Netherlands appear foremost. This highlights the need for encouraging research that not only contributes to the quantity but also improves its quality and depth overall.

The steady rise in scientific output and collaborative nature of this research area are encouraging evidence of a responsive academic environment as we look towards the future. The global community's involvement in sustainability and green growth research is encouraging since it holds the promise of creative solutions to current environmental issues. Leveraging the collective insights from leading nations will be pivotal in shaping sustainable policies and practices, steering international efforts towards achieving a harmonious balance between development and the environment.

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