An exploration of trends and future directions in sustainability performance: A bibliometric analysis of Scopus database [version 1; peer review: awaiting peer review]

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Abstract

Background: Current global economic activities are increasingly being perceived as unsustainable. With the Sustainable Development Goals (SDGs) statement in 2015, sustainability performance has received significant attention. Thus, it is necessary to better understand the topics of interest and expand cooperation networks to advance studies in integrated efforts. The present bibliometric research intends to assess worldwide research tendency in sustainability performance.

Methods: We conducted an extensive bibliometric analysis of published academic articles on sustainability performance (SP) from 1997 to 2021. We reviewed, retrieved, and analysed 3680 papers published in Scopus. Specifically, VOSviewer software was used to conduct document co-authorship and co-occurrence analyses and burst detection analyses.

Results: The outcomes reveal that since 1997, the sum of publications has been on the rise steadily. About a third of all global papers on sustainability performance were produced by researchers from the United States and Australia, outnumbering the remaining 138 countries/territories. Furthermore, the ten most prolific authors of sustainability performance are all from universities. Haapala, Karl R. and Murat Kucukvar were the most influential authors found, based on the total publication number of sustainability performance.

Conclusions: The bibliometric analysis was conducted to identify the trends in the area of sustainability performance. Therefore, this study identified a significant research gap for future study of practitioners and researchers. The social sustainability and the relationship between the material flow analysis and sustainability performance should be noted. In addition, only the Scopus database has been considered due to its academic prestige. The database includes a large number of articles on sustainability performance. Therefore, the analysis was limited to the Scopus database only. However, other databases, such as Web of Science, Google Scholar, and MedLine, can...
be used for future research. These can also be used in combination.

**Keywords**
Sustainability performance, Scopus database, bibliometric analysis, co-citation analysis, co-occurrence analysis

This article is included in the Climate Action gateway.

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- **Yang KH:** Data Curation, Formal Analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing – Original Draft Preparation
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Introduction

According to the World Meteorological Organization, the period 2015–2020 was the warmest on record, with global climate change increasing by 0.2 percent compared to 2011–2015. The 20% increase in global carbon emissions was among the factors contributing to this change, which was also higher than 410 parts per million (ppm) at the end of 2020. However, the concentration of the major greenhouse gases showed a continuous increase in 2020. A similar trend showed through carbon dioxide (CO2) concentration as in previous years could amount to 414 ppm or higher in 2021. In 2018, across the world, an overall US$166 billion economy loss and 55.3 Giga tera (Gt) of carbon dioxide (CO2) equivalent emissions were attributed to 831 critical phenomena associated with climate. Sustainable development has become a universal concern across countries following the increasing socio-environmental issues, including climate change, pollution, and multiple health issues due to pollution.

In 2015, all United Nations (U.N.) member states implemented Sustainable Development Goals (S.D.G.s) to eradicate poverty, provide protection to the earth, and achieve prosperity by 2030. In the period of sustainable development, all organisations are recommended to enhance perceptiveness in achieving sustainable development objectives associated with social well-being, economic prosperity, and environmental preservation. Notably, sustainability performance helps organisations obtain a competitive advantage in the market that is progressing towards a greener economy, achieve significant financial gains, and attract customers to assure long-term profitability.

Therefore, sustainability performance has been under close attention by researchers, scholars, and practitioners. Furthermore, a considerable number of papers and special journal issues are available, covering a wide range of themes related to sustainability performance. However, very few studies concerning the bibliometric analysis of sustainability performance form global perspective using VOSviewer. VOSviewer is a tool to carry out bibliometric analysis, which is helpful to comprehend the research topic status. Additionally, this study used Scopus as a source of data mining. Scopus is the biggest database of abstracts and citations, with 1.4 billion citations and 16 million researcher information. The Web of Science (WoS) and Scopus databases are remarkably overlapped in terms of journal indexing. As a result, employing Scopus aims to cover a broader range of topics.

In conclusion, this study aims to conduct a bibliometric analysis of sustainability performance from 1997 to 2021. It intends to identify the trend of publication of papers in the said area, identify the prolific contributors in sustainability performance, analyze co-authorship of different researchers and nations, and analyze the co-occurrence of author keywords. This study will help scholars, policymakers, and industry grasp the research tendency in sustainability performance and identify the orientations for their research.

Sustainability performance

The concept of sustainable development has aroused more and more academic interest over the past decade due to the increasing environmental crises, inclusive of climatic variations, contamination and substantial health crises derived from contamination. The concept of sustainable development denotes the present generation’s capability of fulfilling necessities without jeopardizing the development of our offspring. Such a concept has three pivotal elements (society, environment, and economy) when it comes to producing commodities. The leading research focus currently emphasizes sustainability performance. According to, sustainability performance benefits from economic, social, and environmental coordination. Eventually, it fulfils stakeholders’ necessities, enhances profit, competitiveness, and organizations’ resilience in the short and long term. Numerous research (e.g. 17,19–21) has identified sustainability performance dimensions, such as environmental, economic, and society-level performances, called triple bottom line (TBL). The TBL, including economic benefit, ecological environment, and social responsibility, do not exist independently as a link to associate them. For example, argued that organizations highlighting TBL could achieve better economy-wise performances in contrast to those highlighting 1 or 2 aspects. Higher economic gains encourage organisations to adopt better social responsibility. Organisations with robust economic strength can splurge additional money on treating pollution, offer advantages to the society and enhance the employees’ well-being. Hence, sustainable development performance can be evaluated as per the economy, society, and environmental influences.

The performance of sustainable development herein primarily denotes that corporations should manufacture on the foundation of the entire TBL. Furthermore, enterprises should minimize the expenditure, uplift consumers’ contentment, decrease discontentment, focus on developing green packaging, diminish unnecessary deliveries, and use environmentally friendly materials to minimize environmental impacts. Hence, sustainable development performance can be evaluated as per the economy, society, and environmental influences.

Methods

In this study, bibliometric analysis was used as a research method. Bibliometric analyses are a quantification method assisting in identifying and analysing data correlated with keywords, their associations, the number of papers published within a certain time limit and their citations. employed this strategy, and other studies have used a similar methodology, such as 32–34, with Gaur and Kumar providing an in-depth assessment (2018).

Figure 1 depicts how to collect the articles for bibliometric analysis. The subsections that follow explain each of the stages shown in Figure 1.
Figure 1. Steps for selecting articles.

Data source and search strategy
First, the research theme of sustainability performance was defined. Furthermore, this study aims to explore worldwide research tendency in sustainability performance to identify gaps and make research recommendations. Based on the research question and objectives, the article searching keywords were established. The full search strategy, retrieved by topic = “sustainability performance” or “triple bottom line” or “TBL”. The timespan is 1997–2021, and the retrieval time was 13 October 2021.

The present paper was based on the Scopus database core collection to guarantee the data’s scientific and completeness. Scopus is the largest database of abstracts and citations, with 1.4 billion citations and 16 million author data\textsuperscript{35}. The Scopus database is superior to similar alternatives since it indexes approximately 70\% more sources\textsuperscript{36}. It gives more thorough coverage of the newest literature, according to \textsuperscript{37}.

After the research searching keywords were chosen, the inclusion criteria (IC) were constructed. There were four criteria for inclusion:

- **IC1**: To include papers containing the research subject, which was “sustainability performance”, and the research premises/objective should match the paper’s objective.
- **IC2**: To include papers that eliminated letters, duplications, book reviews, editorials, conference proceedings and unpublished research.
- **IC3**: To include only papers within the analysis time (1997 – 2021).
- **IC4**: To include papers that limited the research fields (called “subject area” in databases) to environmental science, engineering, commercial activities, economy and society-wise research, and decision-making sciences.

The inclusion criteria contributed to the selection of articles, with only those that met all of them being chosen.

Process of selecting articles
Posterior to the initial search, we completed screening practically and methodologically to guarantee the correlation of literature, during which it needed to involve $\geq 1$ keyword aforementioned in the topics, abstracts, keywords. Our team completed the initial selection for approximately 5428 literature and afterwards discussed the outcomes to generate consensus. Subsequently, we reviewed the entire databases and checked associations via reading the abstracts when necessary. As a result, the 3687 articles were identified through Search Filters 1 (SF1), which read the title, abstract, and keywords. Only articles that demonstrated potential for achieving the four inclusion criteria cleared SF1 (IC1, IC2, IC3 and IC4). Afterwards, there were 3680 articles retrieved after full reading (SF2). The procedure of study inclusion and record exclusion was presented in \textit{Table 1}. Please note that the full list of included studies is available in \textit{Underlying data}.

Data analysis method
After data selection, there were a total of 3680 articles extracted for analysis. Furthermore, with the fast advancement of data mining, informational analyses and graphics rendering techniques, it’s probable to utilise computers to study substantial literature data and complete data expression via
visualising data results\textsuperscript{18}. This research will use this kind of bibliometric analysis tool, VOSviewer, to perform a quantitative analysis of the relevant literature\textsuperscript{19}.

Van Eck and Waltman of Leiden University in the Netherlands created VOSviewer, a program for constructing and visualizing econometrical networks. It’s capable of creating a corresponding knowledge map, identifying the research area’s knowledge base, and providing the most up-to-date progress in related research, as well as frontier hotspots, evolution paths, and future development trends in sustainability performance research, all of which are intended to serve as references and a foundation for future research\textsuperscript{18}.

### Results and discussion

**Literature development trends**

As presented by Figure 2, for the period of almost 24 years, 3680 papers were published, given the limitations in the search string. The results obtained from the preliminary analysis revealed that the oldest publication was dated 1997. The trends of the quantity of the literature witnessed relatively low before the year 2001. However, it increased gradually from then on, which showed there would be more documents to pour into the literature on sustainability performance. It may have been due to the increasing environmental crises, climatic variations, contamination and substantial health problems derived from environmental contamination and sustainable development. The fact that the concept of sustainable development had been widely accepted among the industries\textsuperscript{1}. In addition, almost 400 publications were published in each of the last three years. It reflects that this trend will also grow by the rapidly increasing rate, which shows the importance of the topic of sustainability performance.

### Most influential authors

Table 2 presents the top ten most productive authors in sustainability performance from five nations: the United States (4 authors), Canada (3 authors), China (1 author), Norway (1 author), and Qatar (1 author). The first publications ranged between 2009–2015, where five authors were the first authors, three were co-authors, and two were the last authors. Although there isn’t any rule pertaining to author sequence, the first author is often related to the most contribution. Also, the affiliations of authors displayed that sustainability performance studies were mainly conducted in the university.

As shown in Table 2, Haapala, Karl R. can be seen as the most prolific researcher in the field of sustainable performance, having produced the most papers, which is 25. Also, this study checked the hottest research topic of the ten most prolific authors in the last five years. The research of Haapala mainly focuses on sustainable manufacturing issues in recent years. Conversely, only Haapala focuses on sustainable manufacturing areas among the top ten prominent researchers. At the same time, material flow analysis is the most popular research topic among the top ten contributing authors, including Kuçukvar, Tatari, Shen and Egilmez. The second most popular research topic is the green supply chain, which was investigated by three authors, involving Searcy, Svensson and Badurdeen. Authors Hewage and Sadiq, with the identical study field of life cycle assessment, co-authored a report entitled “Sustainability assessment of flooring systems in the city of Tehran: An AHP-based life cycle analysis”.

### The most productive journal

The literature review should be a valid approach to identify the conceptual content of the research area and guide further studies\textsuperscript{40}, whereas identifying the most tightly associated and essential research is pivotal for the bibliography. The top 10 sustainability performance-associated journals are presented in Table 3. As shown in Table 3, the top 10 most prolific journals are owned by five publishers. Four of the top ten journals were published by Elsevier. The most prolific journal was the Journal of Cleaner Production, with 9658 papers covering 29.9% of the overall publications. The Journal of Cleaner Production has been cited in many papers, which can explain why the CiteScore is remarkably high. As is known to all, the CiteScore can impact authors’ decision-making in selecting journals suiting their original and note-worthy works. Also, after investigation, the Journal of Cleaner Production strongly connects to clean manufacturing, environmental challenges, and sustainable development.

In addition, as shown in Table 3, the top ten journals are nearly all of excellent quality (as they are all SCI or SCIE), such as the social science citation index or science citation index expanded, except for the Sustainability Switzerland. Also, the CiteScore of Sustainability Switzerland is low. But the Sustainability Switzerland is still among the top two most productive journals. That might be because the authors consider the CiteScore and take into account if the journal

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**Table 1. The Process of Review.**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Procedure</th>
<th>Data systematization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article searching</td>
<td>Searched articles in Scopus databases with keywords. “Sustainability performance” or “sustainability” or “triple bottom line”</td>
<td>5428</td>
</tr>
<tr>
<td>Inclusion</td>
<td>Articles selected after reading title, abstract, and keywords (SF1)</td>
<td>3687</td>
</tr>
<tr>
<td>Articles identification</td>
<td>Articles selected after full reading (SF2)</td>
<td>3680</td>
</tr>
</tbody>
</table>
Table 2. Ten most productive researchers in sustainability performance study field.

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Scopus author I.D.</th>
<th>Year of 1st publication</th>
<th>T.P.</th>
<th>h-index</th>
<th>TC</th>
<th>Current affiliation</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Haapala, Karl R.</td>
<td>13005255100</td>
<td>2013</td>
<td>25</td>
<td>20</td>
<td>132</td>
<td>Oregon State University, Corvallis, United States</td>
<td>United States</td>
</tr>
<tr>
<td>2</td>
<td>Murat Kucukvar</td>
<td>36661159000</td>
<td>2011</td>
<td>24</td>
<td>35</td>
<td>995</td>
<td>Qatar University</td>
<td>Qatar</td>
</tr>
<tr>
<td>3</td>
<td>Badurdeen, Fazleena F.</td>
<td>14520479800</td>
<td>2009</td>
<td>17</td>
<td>20</td>
<td>500</td>
<td>The University of Kentucky, Lexington, United States</td>
<td>United States</td>
</tr>
<tr>
<td>4</td>
<td>Hewage, Kasun N.</td>
<td>8384286700</td>
<td>2011</td>
<td>17</td>
<td>34</td>
<td>473</td>
<td>University of British Columbia Okanagan, Kelowna, Canada</td>
<td>Canada</td>
</tr>
<tr>
<td>5</td>
<td>Tatari, Omer</td>
<td>14627876500</td>
<td>2011</td>
<td>17</td>
<td>36</td>
<td>842</td>
<td>The University of Central Florida, Orlando, United States</td>
<td>United States</td>
</tr>
<tr>
<td>6</td>
<td>Shen, Liyin</td>
<td>7005091994</td>
<td>2009</td>
<td>15</td>
<td>59</td>
<td>713</td>
<td>Chongqing University, Chongqing, China</td>
<td>China</td>
</tr>
<tr>
<td>7</td>
<td>Svensson, Göran</td>
<td>57202411507</td>
<td>2015</td>
<td>14</td>
<td>18</td>
<td>178</td>
<td>Kristiania University College, Oslo, Norway</td>
<td>Norway</td>
</tr>
<tr>
<td>8</td>
<td>Sadiq, Rehan</td>
<td>7003604679</td>
<td>2011</td>
<td>12</td>
<td>54</td>
<td>461</td>
<td>University of British Columbia Okanagan, Kelowna, Canada</td>
<td>Canada</td>
</tr>
<tr>
<td>9</td>
<td>Egilmez, Gokhan</td>
<td>55248346200</td>
<td>2014</td>
<td>11</td>
<td>24</td>
<td>595</td>
<td>University of New Haven, West Haven, United States</td>
<td>United States</td>
</tr>
<tr>
<td>10</td>
<td>Searcy, Cory</td>
<td>8453354600</td>
<td>2009</td>
<td>11</td>
<td>31</td>
<td>277</td>
<td>Ryerson University, Toronto Canada</td>
<td>Canada</td>
</tr>
</tbody>
</table>

*Note = TP: Total Publication/ TC: Total Citation

Figure 2. Number of annual publications in sustainability performance research.
can deliver research to appropriate readers and facilitate the development of the research area. Sustainability Switzerland is mainly related to sustainability and sustainable development. Therefore, CiteScore ought not to be considered the only measure. Aside from CiteScore, researchers should consider whether the publication can convey research to the appropriate academics and accelerate the relevant research field development.

Country and research institute analysis

Table 4 presents the top 15 most prolific nations facilitating the increase of sustainability performance studies across the globe. Approximately 38% of the international research were from the United States and Australia, revealing that both nations are pivotal for developing sustainability performance studies. The United States was the leading nation with 867 articles, covering 26% of the overall articles across the world. With one-half of the United States’ overall articles, Australia was the second most prolific nation. However, Oregon State University’s total publication (TPi) was comparable to that of the University of Queensland, albeit slightly lower than that of Universiti Teknologi Malaysia. As a result, having the most productive academic institution may not be synonymous with being the most productive country.

Besides, only India (73.2%) had over 2/3 single-country publications (S.C.P.) among the 15 countries. This indicated that India has a more vital intra-country collaboration than...
Table 4. The top 15 most prolific nations and academic institutions in sustainability performance publications.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>TPc</th>
<th>S.C.P. (%)</th>
<th>The most prolific academic institution</th>
<th>TPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>867</td>
<td>68.9</td>
<td>Oregon State University</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Australia</td>
<td>398</td>
<td>65.6</td>
<td>The University of Queensland</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>United Kingdom</td>
<td>373</td>
<td>48.5</td>
<td>University College London</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>China</td>
<td>273</td>
<td>37.0</td>
<td>Sichuan University</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Malaysia</td>
<td>187</td>
<td>66.3</td>
<td>Universiti Teknologi Malaysia</td>
<td>26</td>
</tr>
<tr>
<td>6</td>
<td>Canada</td>
<td>173</td>
<td>61.9</td>
<td>University of British Columbia Okanagan</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Germany</td>
<td>172</td>
<td>49.4</td>
<td>Technical University of Berlin</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>India</td>
<td>164</td>
<td>73.2</td>
<td>National Institute of Technology Tiruchirappalli</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Brazil</td>
<td>160</td>
<td>61.9</td>
<td>Universidade de São Paulo</td>
<td>24</td>
</tr>
<tr>
<td>10</td>
<td>Italy</td>
<td>156</td>
<td>58.3</td>
<td>Politecnico di Milano</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>Netherlands</td>
<td>123</td>
<td>43.9</td>
<td>Wageningen University &amp; Research</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>Spain</td>
<td>114</td>
<td>51.8</td>
<td>Universidad de Zaragoza</td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>France</td>
<td>106</td>
<td>31.1</td>
<td>AgroParisTech</td>
<td>5</td>
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<tr>
<td>14</td>
<td>Sweden</td>
<td>86</td>
<td>50.0</td>
<td>Chalmers University of Technology</td>
<td>14</td>
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<td>15</td>
<td>Turkey</td>
<td>85</td>
<td>65.9</td>
<td>‘Istanbul Teknik Universitesi’</td>
<td>8</td>
</tr>
</tbody>
</table>


other countries. Additionally, China was the nation with the least S.C.P. with 37.0%, in which 101 out of 273 articles were associated with several affiliations from 43 diverse nations. Furthermore, China has more total publications than India, which indicates that international collaboration should be a focus. As shown in Figure 3, outcomes of co-authorship revealed that America was the most affiliated nation, linked to 53 nations/territories. Moreover, the United States produced the most publications, with the total number of publications ranking first. Therefore, international collaboration might contribute to producing more publications. The government needs to formulate flexible and steady policies to sustain transnational collaborations.

Co-occurrence (author keywords)

The analyses of the knowledge development track in the study field can assist scholars in comprehensively capturing the development trend of the study field, forecasting the developmental tendency, and offering scholars more research targets. In past research, certain scholars utilized quantitative computation on the foundation of the occurrence frequency or co-occurrence frequency of words or phrases, which delineate the study. As per the association strength between topic words, they clustered them and drew a net of subject topics in diverse periods’ atlases to identify the development path of the study field40.

As shown in Figure 4, there are 7634 author keywords documented, amongst which 6006 (78.7%) were merely utilized once, 782 essential words (10.2%) were utilized twice, and 276 (3.6%) were utilized three times. After re-labelling synonymical single words and congenerical phrases, 420 keywords reached the liminal value of minimal five occurrences for VOSviewer. In the map, the term ‘sustainability’ was the most popular keyword with 878 occurrences and 337 associations with other keywords. In addition, our team discovered the utilization of general terms like “organizational sustainability” (8 occurrences, 12 links), “corporate sustainability” (129 occurrences, 112 links) and ‘triple bottom line’ (22 occurrences, 29 links).

The critical concept of sustainable development includes three pivotal components, including society, environment, and economic development41. In Figure 4, keywords associated with ‘social sustainability’, ‘economic sustainability’ and ‘environmental sustainability’ were repeated 31, 69 and 70 times, respectively. This result suggests that the researchers overlooked the social sustainability aspect. Although, some researchers indicated that corporations and commercial activities shouldn’t merely highlight the economy-wise sustainable development. The other aspects should be taken into consideration as well because they are equally essential42,43.
Figure 3. A screenshot of a bibliometric map produced on the foundation of co-authorships via net visualization mode. The URL below can be utilized to open Figure 3 in VOSviewer: https://bit.ly/3vZdPU7.

Figure 4. A screenshot of the bibliometric map produced on the foundation of author keywords co-occurrence with overlay visualization mode. The URL below can be utilized to open Figure 4 in VOSviewer: https://bit.ly/3bsitk4.
Keywords that address challenges within sustainability performance by inner or outer factors were discovered as well, e.g., ‘green supply chain’ was reported 21 times and often cooccurred with ‘reverse logistics’. Furthermore, green manufacturing, green purchasing and green packaging, three elements of the green supply chain, were identified as the factor for influencing reverse logistics. But there have been no academics researching the effect of other elements of the green supply chain on reverse logistics, which provided a research gap for future study. On the other hand, material flow analysis is the most popular research topic among the top ten contributing authors. Nevertheless, no streams of keyword occurrence were observed in the review, which linked material flow analysis and sustainable development performance.

**Distribution of sustainability performance based on major applications**

As per the number of research and author keyword occurrences, positive associations were discovered between the outputs of the subtheme search and the centric theme search. For example, it is shown that the manufacturing industry was the most commonly seen application with 1149 papers in Scopus and 28 occurrences in VOSviewer. This was followed by the construction industry (700 papers and 21 occurrences), food industry (593 papers and 11 occurrences), automotive industry (371 papers and 7 occurrences), agriculture industry (362 papers and 7 occurrences), and oil and gas industry (246 papers and 6 occurrences).

In fact, the manufacturing sector is a cornerstone of economic development, which is pivotal for economy-wise sustainability, and it serves as a major contributor to the Gross Domestic Product (G.D.P.), employment rates and export percentage of countries around the world. However, the rapid development of manufacturing has caused substantial waste, overuse of various resources and overconsumption of energy. Also, achieving sustainability performance helps manufacturing organizations to attain a competitive advantage in the market that is moving towards a greener economy and achieving significant financial gains while attracting customers to assure long term profitability. As a result, an increasing number of academics and practitioners are incorporating sustainability into the manufacturing industry, and the manufacturing industry has become the focus of research.

Furthermore, Figure 5 showed that most publications related to the manufacturing industry, construction industry, food industry, automotive industry and agriculture industry came from the U.S.A except on the agriculture industry. Australia is the primary focus of research into the agriculture industry’s sustainability performance. The reason for it could be linked to Australia’s economy and culture. The agricultural sector is vital for Australia’s economic and cultural development. In this country, about 65% of overall production is exported, which accounts for about 14% of the overall exportation value in Australia. Also, in general, the U.K. was amongst the top five nations that publish research on all sustainability

![Figure 5](image-url)

**Figure 5.** Five nations with the most publications on the selected sustainability performance major applications.
performance applications. Other nations like China, Australia, Malaysia, India, Netherlands and Italy were listed in diverse applications of sustainability performance and merely once.

Limitations of the study
The outcome may not cover all sustainability performance-associated research on Scopus by restricting the search of “sustainability performance” within titles, abstracts, and content. That’s because certain scholars didn’t refer to their systems as sustainability performance but instead utilized diverse terms. Research in the future should contrast the outputs from several databases like Scopus and Web of Sciences. The search outcomes from Web of Science, for example, automatically demonstrate the most popular research via the ‘hot paper’ function, which remains absent in Scopus. Such a function demonstrates that pivotal research was recognized quickly after publication, which is reflected via a fast and remarkable citation number. Utilizing bibliometric analyses via several data sources will facilitate more systematic research.

Conclusions
The present paper aims to help researchers and practitioners grasp the research tendency in sustainability performance and find the underlying orientations for further studies. As per academic database outputs, bibliometric analyses are a mechanical method to grasp the international research tendency in certain study fields. Such a method can distinguish a bibliometric analysis report from a review study mainly aimed at summarizing the latest development, problems, and future orientations of specific topics. Although there are certain limitations, this research is still vital for sustainability performance researchers.

Firstly, the outcomes herein reveal that the sustainability performance field has witnessed remarkable advancement recently. Publications have been increasing over the past ten years and are anticipated to increase progressively. Secondly, according to the findings of this study, the academics who focus on sustainability performance-related research are all university professors. Moreover, when publishing the article, the authors should not only consider the CiteScore but also take into account if the journal can deliver research to appropriate readers and facilitate the development of the research area. Furthermore, the study identified countries and academic institutions with solid international and internal cooperation (e.g., U.S.A. and India). Those international and internal collaborations are a treasure for scholars to expand their studies. However, the fact that some countries and regions lack international collaboration and specialized policies to support collaboration should be noted.

Finally, this paper found the research trend for academics. There are three elements of sustainability performance, however, social sustainability has been somewhat overlooked, and this should be noted. Likewise, the association of material flow with sustainable development performance, which offers future orientations for scholars, practitioners and investigators in future studies on sustainability performance, ought to be extensively researched. Moreover, merely co-authorship and cooccurrence analyses were completed via the VOSviewer. Thereby, more tools, like co-citation and bibliographical coupling of the program, can be utilized. Because sustainability performance is important across the globe, the sustainability performance research boundaries are expected to expand progressively, and more thrilling topics will definitely emerge.

Data availability
Underlying data

This project contains the following underlying data:

- Scopus.csv (articles from 1997–2010).

[insert license statement].

References

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