

Remote Working and Sustainability: A Bibliometric Mapping Analysis

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Abstract

This bibliometric analysis explores 214 peer-reviewed studies on Remote working and Sustainability that are accessible in the Web of Science database between 1997 and 2023. The study methodically investigates important aspects, such as primary publications, scientific information sources, authors, citations, co-occurrences, geographical origin, nation distribution, and authors' research output, using the R programming language for mapping. Apart from showcasing the existing status of research, the analysis seeks to identify gaps in the literature, forecast future directions, and identify recent hotspots and trends in the subject. The analysis highlights a notable absence of publications from Arab and less developed nations. Consequently, the study promotes greater understanding among academics in these areas, stressing the need to carry out excellent theoretical and empirical research on sustainability and remote working. Additionally, the study suggests promoting international scientific cooperation to incorporate these nations into the academic debate and increase the overall depth and breadth of findings on the subject.

Keywords: E Remote Working, Sustainability, Bibliometric, Web of Science, Research articles.

Introduction

A bibliometric analysis is a statistical method allowing the assessment of the qualitative and quantitative coverage of a given area of interest, Rodrigues et al. (2020). In the 1960s, Bibliometric examination was developed as a technique to accurately assess the historical state of a particular field of study and anticipate future development trends, investigations, and connections (Moral-Munoz et al. 2019; Tlili et al. 2021; Rojas-Lamorena et al. 2022). Bibliometric methods allow researchers to base their findings on aggregate bibliographic data produced by other scientists working in the field who express their opinions through citation, collaboration, and writing (Zupic & Čater 2015). On this context, and as remote working and sustainability is an increasingly important area, comes this bibliometric study.

As the concept of sustainability has grown, people and organizations have been working to lessen their adverse effects on the environment and promote social responsibility. Sustainability as it is defined by the Brundtland Commission, (1987) “the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs”, considering its three dimensions Economic, Social, and Environmental. On the other side, recently, there has been renewed interest in remote working by many institutions worldwide. Remote working has transformed the traditional workplace by enabling people to carry out their duties away from the typical office setting, Abdulrahim & Yousif, (2023).

This trend toward remote working has benefited workers greatly in terms of flexibility and work-life balance and has had unanticipatedly positive effects on sustainability. The issue has grown in importance considering recent development of digitalization and high concern of countries to achieve the sustainable goals.

There is an urgent need to address the literature concerning remote working and sustainability using bibliometric analysis. However, it provides constructive suggestions for better future literature, and promoting scientific writing in the field. It is now well established from a variety of studies, that there is strong association between remote working and sustainability, from economic, social, and environmental perspectives.

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This study intends to investigate the relationship between remote working and sustainability, illuminating the advantages, difficulties, and opportunities brought about by this shifting evolving paradigm. We focused our search on research articles, as Rojas et al.(2022), denote that the academic community considers them the most up-to-date source of knowledge in each field. It attempts to provide a systematic view of the major publications, sources of scientific knowledge, authors, citations, co-occurrence, geographical origin, country, and authors' scientific production of the studies addressed remote working and sustainability.

The study sheds light on the connection between remote working and sustainability by conducting a comprehensive bibliometric analysis of remote working and sustainability of 214 research articles published on the Web of Science throughout 26 years. This study is unable to encompass the research articles published in other sources rather than WOS.

It adds to the body of existing literature by mapping the research articles on remote working and sustainability which is not adequately covered by systematic literature review and bibliometric studies. So far, very little attention has been paid to the role of remote working and sustainability.

The study gives new insights into the linkage of remote working and sustainability. It examines the evolution of remote working and the dynamic growth of the related theoretical and empirical research linking it to sustainability with its three dimensions (Economic, Social, and Environment). It also reveals the most influential authors and articles in the field.

The overall structure of the study takes the form of six sections, including the introduction in the first section, the literature review in the second, the methodology, the results and analysis in the third and fourth section. In section five is the discussion, and in the last section is the conclusion and recommendations.

Literature Review

Remote working has emerged as a prevalent and transformative trend in recent years, driven by advancements in technology and the need for flexible work arrangements. (Grant et al., 2013; Wang et al., 2021), define remote working as a term used to describe working from home or another location outside an office at any time, which involves the increasing use of technology enabling workers to communicate with their workplace and supporting flexible working practices. Remote working, also known as telecommuting, telework, or work from home (WFH), describes the “organization and/or performance of work, whereby an employee can carry out work that could also be carried out at the employer’s premises regularly out of these premises through the use of information technology” (Leščevica & Kreituze, 2018). Remote working has become increasingly popular in recent years, especially due to the COVID-19 pandemic, which forced many organizations to adopt remote working policies to ensure business continuity and employee safety. According to a survey by FlexJobs, 91% of remote employees would like to continue their hybrid or remote working, and 76% say their employer will allow them to work remotely going forward (Shreedhar et al. 2022). Remote working when examined within a sustainability context; provides several benefits from an economic, environmental, and social perspective, mainly due to the elimination of the need to commute to the workplace, if working from home, or the reduced time and distance traveled to a co-working space.

Remote working can have positive or negative impacts on each of the three dimensions of sustainability, depending on various factors such as employee behaviors, home infrastructure, local context, and organizational policies, (Kuhlman & Farrington, 2010). Several previous studies have explored the interrelation between remote working and sustainability. On the environmental dimension of sustainability (Adams & Rau, 2022; Baker & Johnson, 2021), discuss the reduction of commuting emissions, energy consumption, and carbon footprint. The environmental impact in the form of the reduction of electricity consumption by large office buildings and the reduction of the emission of harmful substances contained in car exhaust fumes are the most frequently mentioned environmental advantages Orzel & Wolniak (2022). Thereby, remote working contributes to the tackling of alarming environmental issues and the transition toward the establishment of smart cities and communities. In a smart city, digital and telecommunication technologies are used to make traditional networks and services more efficient for the benefit of its

inhabitants and businesses (EC, 2020). Similarly, the economic dimension of remote working and sustainability has been addressed. (Smith & Johnson, 2023; Wilkins & Patel, 2022), examine cost savings and productivity, and economic development. Moreover, employees and owners of projects prefer remote working due to the flexibility of working time, time savings, work comfort, safety, and savings. Remote working has been associated with various benefits for both employers and employees, such as improved productivity, reduced costs, increased flexibility, better work-life balance, and higher job satisfaction, Green Business Bureau, (2021). Likewise, the social dimension of sustainability which refers to the promotion and protection of human rights, well-being, diversity, and equity, has been linked to remote working. (Carter & Thompson, 2023; Brown & Green, 2021; Turner & Collins, 2023; Garcia & Lee, 2022) point out Work-Life Balance and Well-being, Inclusivity and Diversity, Technological Infrastructure and Connectivity, and Social Isolation and Collaboration. Furthermore, Chafe et al. (2021), mention the main benefits of remote working were increased flexibility, autonomy, work-life balance, and individual performance, while major challenges were social aspects such as lost colleagues and isolation. This can be consistent with the results of Moglia et al. (2021), who indicate that increased remote working presents an important opportunity to improve sustainability outcomes. However, remote working also poses some challenges, such as communication difficulties, isolation, cyber-security risks, and blurred boundaries between work and personal life Contreras et al. (2020).

In terms of bibliometric literature review studies on remote working and sustainability, there are very few articles that address it partially. Tavares-Lehmann, A. T., & Varum, C. (2021), reviewed 393 articles that link the concepts of Industry 4.0, Sustainability, and the Circular Economy. The authors provide an overview of the main themes, authors, journals, countries, and keywords in this field. Also, they identify some research gaps and future directions for this topic. Another bibliometric study conducted by Ganga et al. (2022) discusses the mixed effects of working from home on energy use, travel, technology, and waste. It argues that the authors mention that work is not a clear win for the environment, as it depends on several employee behaviors and situational factors. They also suggest some ways that companies can account for remote working in their sustainability goals and policies. Further, Ellili, N. O. D. (2023), analyzes 997 papers published in the journal Environment, Development, and Sustainability from 1999 to 2022. The author examines the growth, impact, collaboration, citation, and keyword patterns of these papers. Also, the author identifies the most productive and influential authors, institutions, countries, and regions in this field. Based on the limited bibliometric studies in this field, this study tries to bridge the literature gap in this context, focusing on high quality research published in Web of Science.

Methodology

This study conducts a bibliometric analysis on remote working and sustainability, reviewing high-quality research articles published in the Web of Science database for the period (1997-2023). R program version 4.3.1 (2023) is employed to analyze quantitative data collected from the WOS. It is an ecosystem software that operates in an integrated environment consisting of open libraries, an open algorithm, and open-graphical software (Aria & Cuccurullo, 2017). The Bibliophagy interface, which offers a web interface for the bibliometrics package, is used to perform this analysis. The sequence of the study starts with definition of the research scope, then selection of the keywords and terms to retrieve the relevant publications from the Web of Science database (Remote Working* And Sustainability*). These steps were followed by exporting the bibliographic data of the publications in BibTex format. Then, import the bibliographic data into the R-studio, using the Bibloshiny interface to perform the analysis. Consequently, was the generation and interpretation of the diagrams based on the analysis results. Lastly, is the reporting and discussion of findings and conclusions based on the diagrams.

This bibliometric analysis was carried out using descriptive and scientific mapping. The database used is Web of Science (Saudi Digital Library). First, the author filtered 736 results from the Web of Science Core Collection consisting of articles, book chapters, review papers, proceeding papers, early access, and editorial material. After filtering, 214 research articles are selected from 101 sources, by 919 authors, covering the period (1997-2023). The selected articles comprised of articles 203, early Access 8, and 3 proceeding papers, written in English, Portuguese, and Spanish. The selected documents covered the different categories, such

as environmental sciences, management, economics, business, education scientific discipline, educational research, and social sciences. Table 1 displays the reliability and accuracy of data, it reveals the missing values and scores for each item of information needed to carry out this bibliometric analysis to confirm the accuracy and completeness of the data used. The table demonstrates that the metadata that was taken from WOS has all the data required to perform the bibliometric analysis. With no missing values in around 80% of the records, the data quality is very high. This suggests that the data are reliable, and that the analysis will probably result in accurate findings.

Table 1: Reliability and Accuracy of Data

Item	Missing	Missing percentage	Score
Author	0	0.00	Excellent
Corresponding Author	0	0.00	Excellent
Document Type	0	0.00	Excellent
Journal	0	0.00	Excellent
Language	0	0.00	Excellent
Number of Cited References	0	0.00	Excellent
Publication Year	0	0.00	Excellent
Title	0	0.00	Excellent
Total Citation	0	0.00	Excellent
Cited References	1	0.47	Good
DOI	4	1.87	Good
Keywords	8	3.74	Good
Keywords Plus	29	13.55	Acceptable

Source: Authors' Calculation using R program

Results and Analysis

Bibliometric Main Information

The bibliometric analysis covers 26 years of research on remote working and sustainability, from 1997 to 2023. The main sources of the analysis are 101 journals or databases that are indexed in the Web of Science (WOS), which is a comprehensive and authoritative database of scientific publications. The analysis includes 214 research articles on the topic, with an average age of 3 years. Table 2 summarizes some of the key indicators of the analysis. The annual growth rate shows how fast the research on the topic is expanding over time. The co-authorship indicators reflect the degree of collaboration and diversity among the researchers. The author's keywords represent the main themes and subtopics of the research. The references and citations indicate the sources and impact of the research.

Table 2 Key Indicators

Indicator	Value
Annual growth rate	14.53%
Number of authors	919
Single-authored publications	12
International co-authorship	38.79%
Co-authors per document	4.36
Author keywords	1006

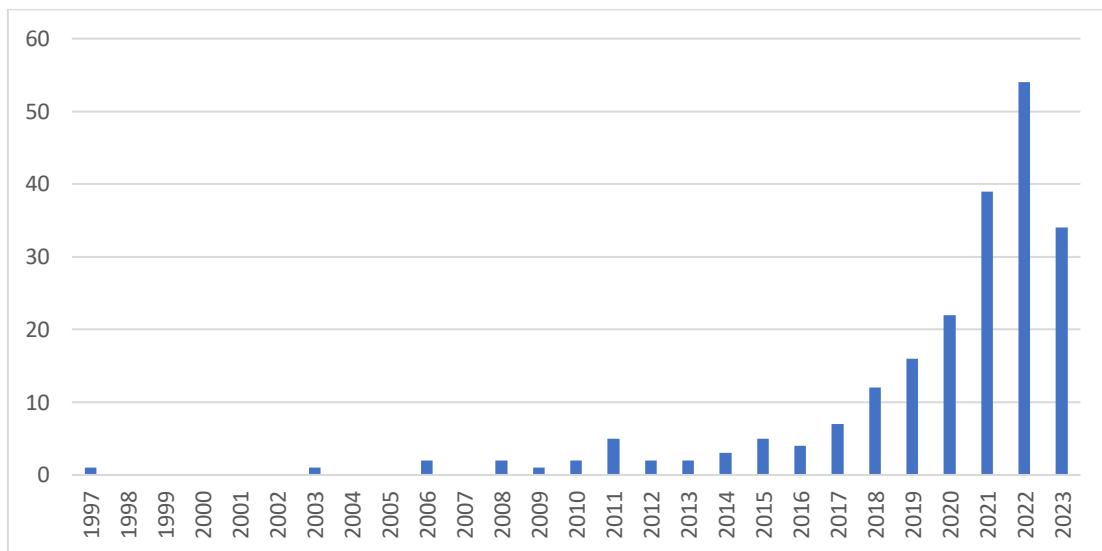
References	14341
Citations per document	15%

Source: Authors' Calculation using R program

Scientific Production

To identify the trend of scientific production on remote working and sustainability, based on the articles published in WOS, figure 1 show that the number of articles increased slowly and fluctuated from 2000 to 2015, and then it sharply increased from 2015 to 2022. However, it decreased in 2023. The peak years of scientific production were 2021 and 2022, with 39 and 54 documents respectively. The sudden increase in 2015 could be attributed to the growing awareness and interest in the topic, especially in the context of the COVID-19 pandemic and its impact on work arrangements and environmental sustainability. The decrease in 2023 could be due to the saturation of the topic or the emergence of new research directions.

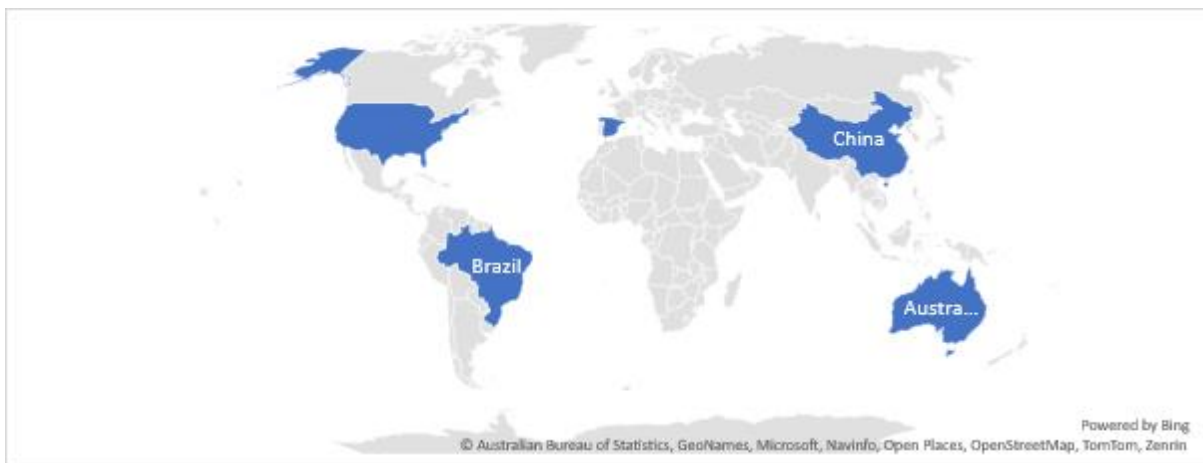
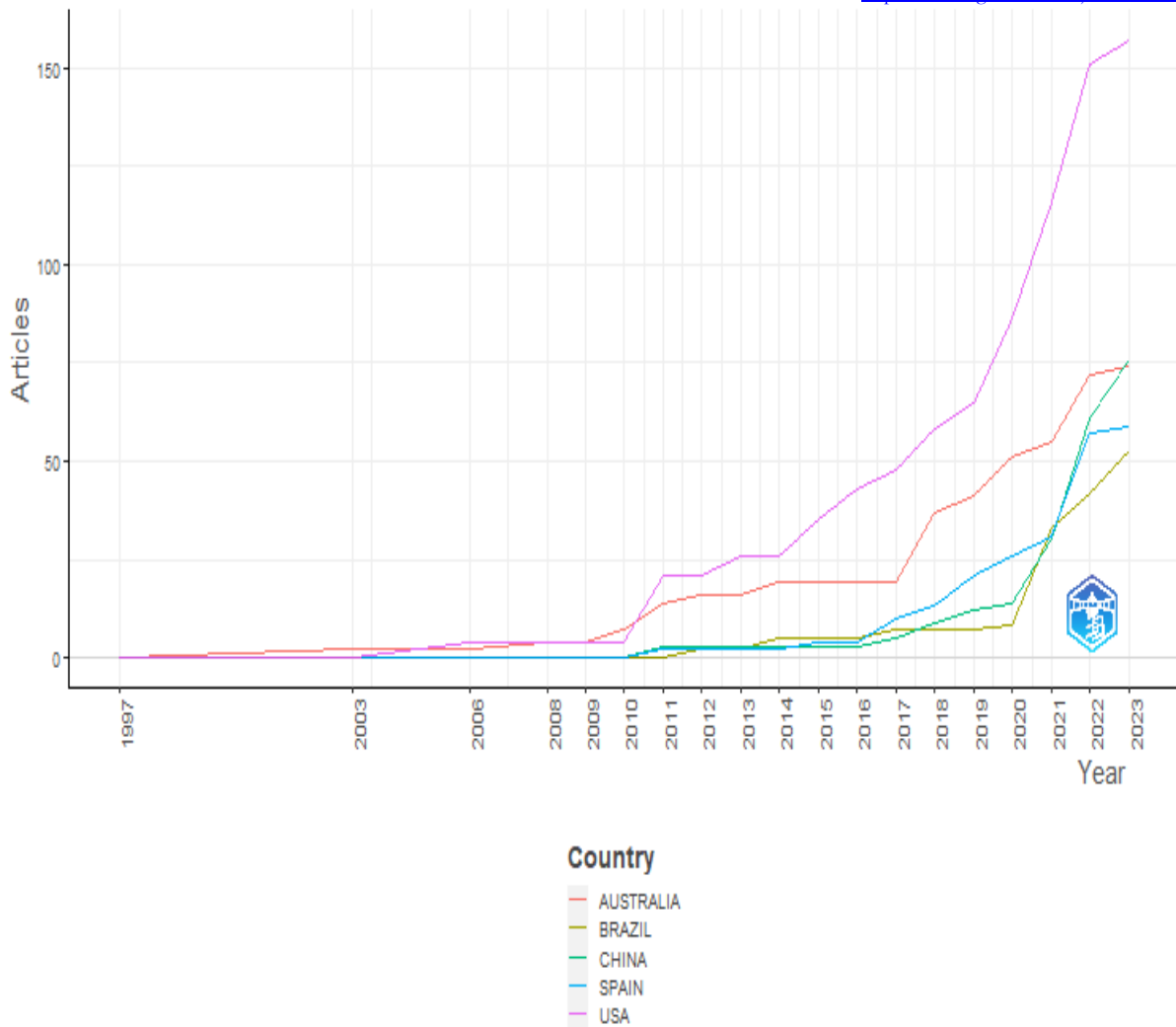
Figure 1 Annual Scientific Production



Source: Authors' presentation

Emphasizing the trend of publications on remote working and sustainability on WOS from 1997 to 2023, for the top five countries, Figure 3 shows that there were very few publications in the period from 1997 to 2010. It indicates that the USA and Australia were the leading countries in this period, followed by Canada, China, and Germany. The USA had a dramatic rise in publications in 2022 and 2023, surpassing all other countries.

Figure 2 Country Production Over Time



Source: Authors’ Presentation Using R Program Results

From the perspective of the countries’ scientific production, Figure 3 presents the top 20 countries that publish the most on the topic of WOS. It emphasizes that the USA has 157 documents, which account for 58% of global production. It also names China, Australia, Spain, and Brazil as the following four countries in the ranking. It points out that Saudi Arabia is the sole Arab country in the top 20.

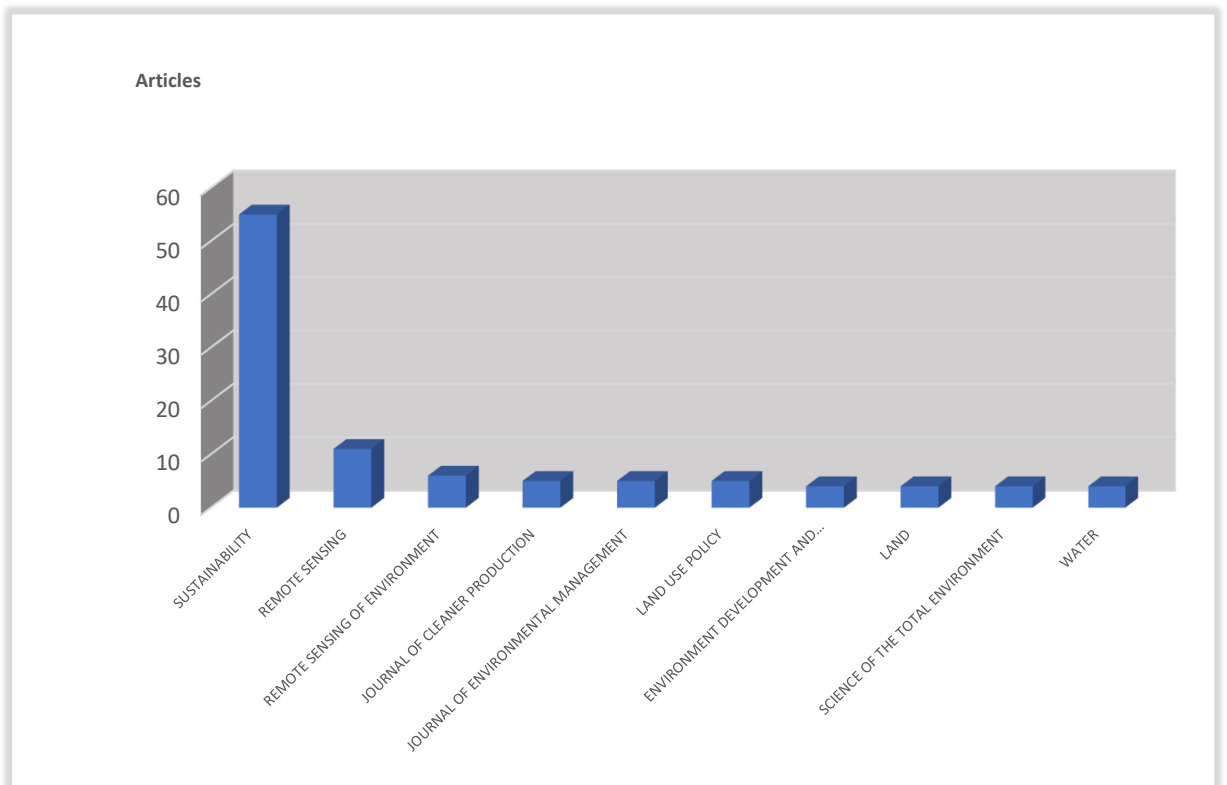
Figure 3 Countries Scientific Production



Source: Authors' presentation using R program

Based on an analysis of 101 sources that publish the most on remote working and sustainability in WOS, figure 4 discloses that (Sustainability) is the leading source with about 26% of the articles on the topic. It also indicates that the top ten sources published 103 articles, which accounts for 48% of the total publications on the topic in WOS.

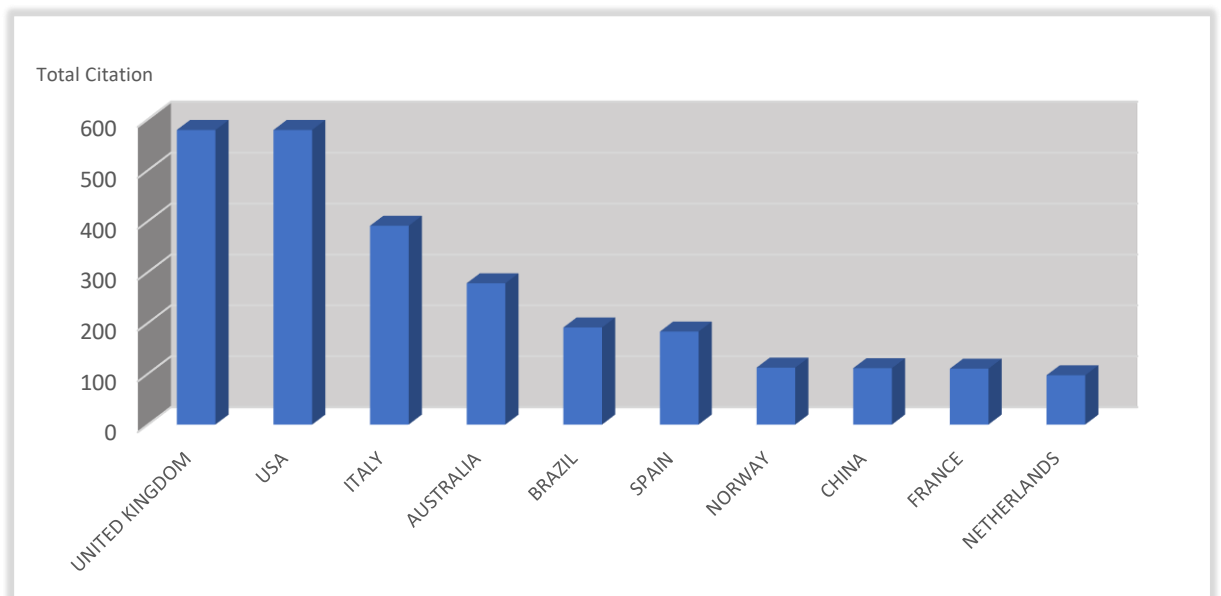
Figure 4 Most Relevant Sources



Source: Authors' presentation

To label the countries that have the highest citations on remote working and sustainability, Figure 5 shows the ranking of the countries based on citations. It highlights that the United Kingdom and the USA are the top countries with the most citations, followed by Italy, Australia, Brazil, and Spain. It also notes that the United Kingdom and the USA are the most cited countries, despite the United Kingdom being number 8 in production with only 43 articles. It contrasts this with China, which is number 2 in production after the USA, but has low citations with 111 and 6.5% per article.

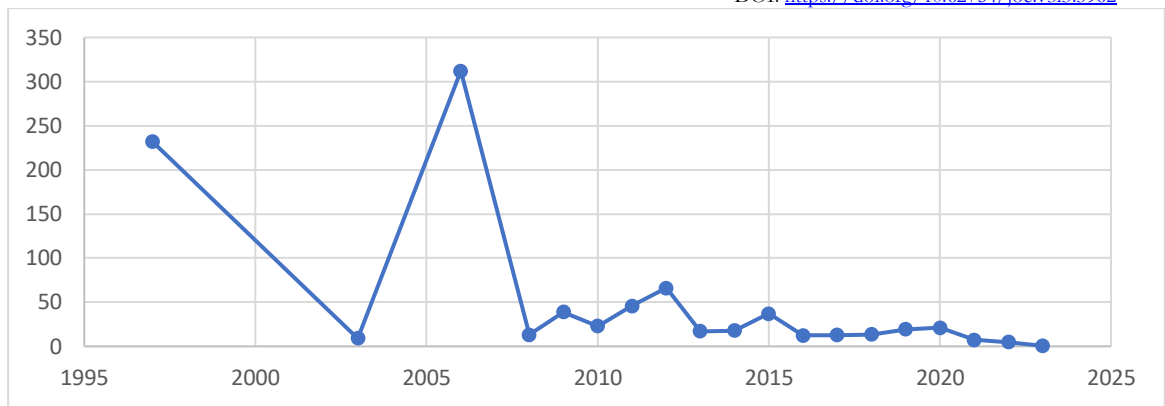
Figure 5 Most Cited Countries



Source: Authors' presentation

Figure 6 presents the average citations per year on remote working and sustainability, which illustrates the trend of citations from 1997 to 2023. It states that the highest average citation per year was in 2006, then it dropped sharply in 2007 and 2008 and varied throughout the period from 2009 to 2023. The peak in 2006 could be related to some influential publications on the topic that received high attention and recognition. The drop in 2007 and 2008 could be due to the global financial crisis that affected research funding and output. The variation in the later years could reflect the diversity and complexity of the topic and its subtopics.

Figure 6 Average Citation Per Year

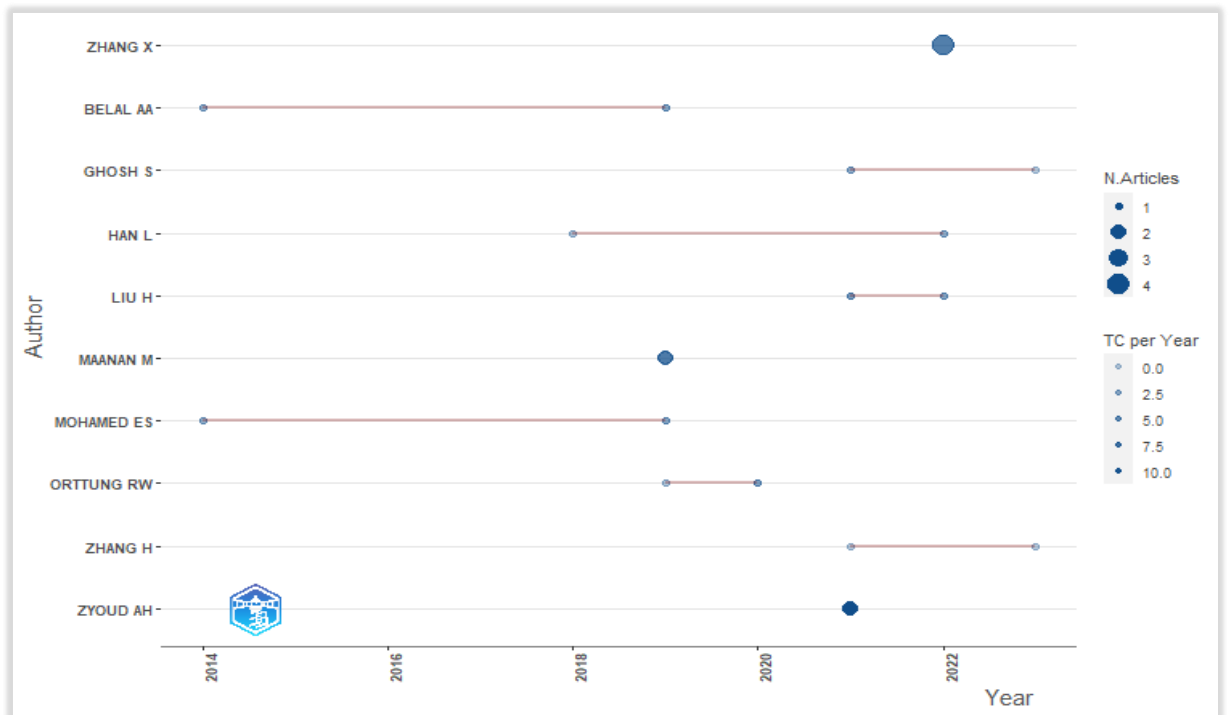


Source: Authors' Presentation

Authors Production

Considering the authors' production on the topic of remote working and sustainability, Figure 7 illustrates the number of articles published by each author from 2014 to 2023. It reveals that most of the authors published between 1 and 4 articles in this period, out of a total of 919 authors and 214 publications. It highlights that ZHANG X is the author with the most publications in 2022, with 9 articles, while BELAL AA and Mohamed ES have the highest average citation per year, with 25.5 and 23.5 citations respectively.

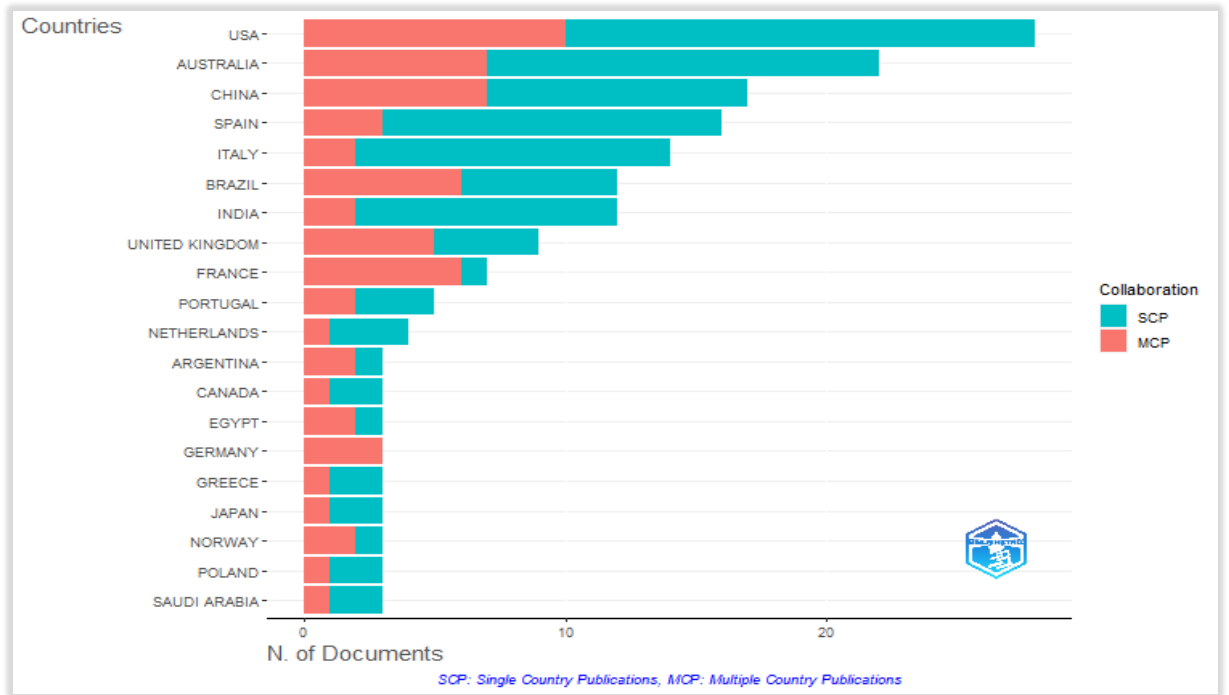
Figure 7 Authors' Production Over Time



Source: Authors' presentation using R program

Figure 8 identifies the number of documents published by corresponding authors from different countries on the topic of remote working and sustainability. It points out that the USA has the largest percentage of multi-country publications. It also reports that there are only two Arab countries that have corresponding authors, Egypt, and Saudi Arabia, with only one article each.

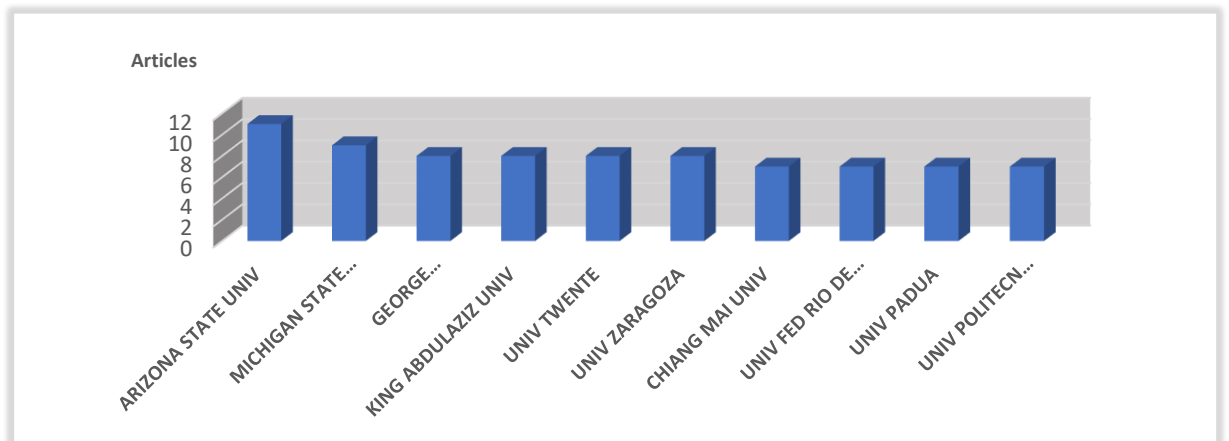
Figure 8 Corresponding Author's Countries



Source: Authors' presentation using R program

The affiliation of authors as displayed in Figure 9, shows that Arizona State University is the highest with 11 authors followed by Michigan State University's 9 authors. King Abdulaziz University in Saudi Arabia is the only Arab university on the 10 top affiliations with 8 authors.

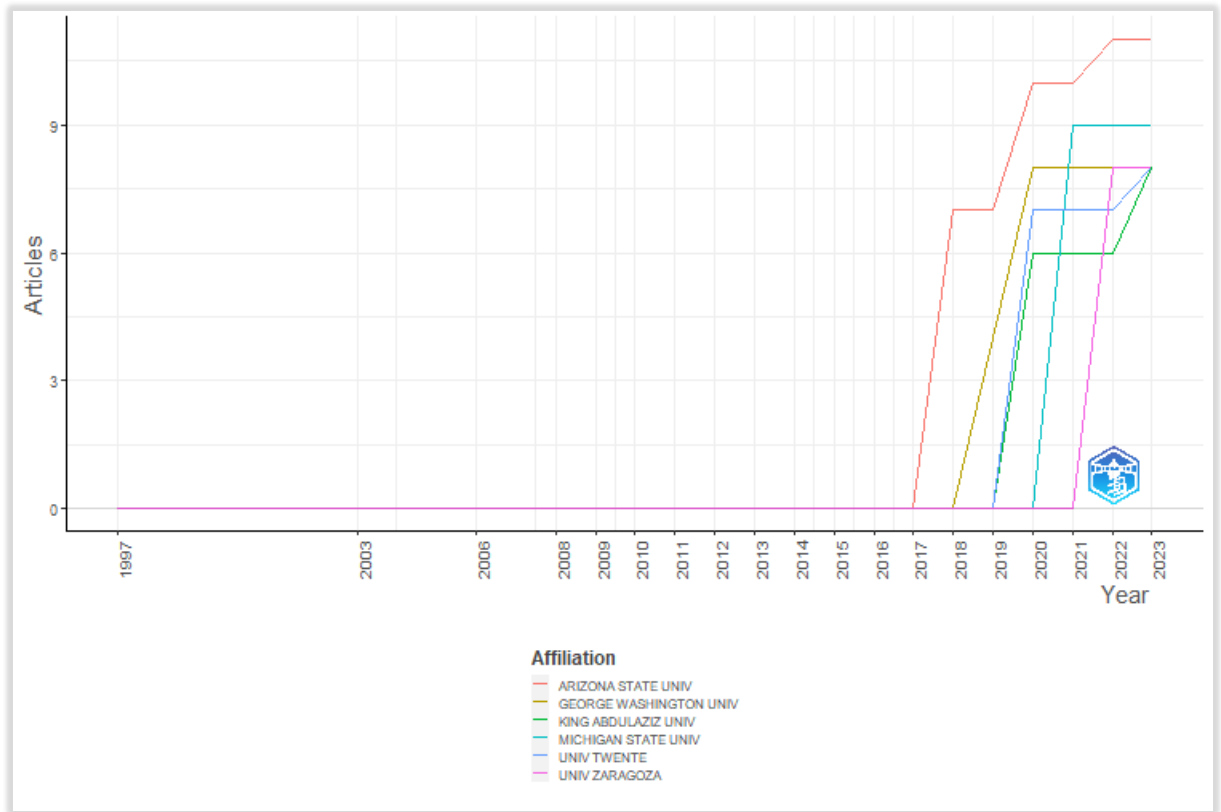
Figure 9 Most Relevant Affiliation



Source: Authors' presentation using R program

The affiliation production over time as stated in Figure 10, reveals that publications on the topic of remote work are recent, hence Arizona State University started in 2017 and continued till 2023. Similarly, the other five universities started late in 2018, 2019, 2020, and 2021.

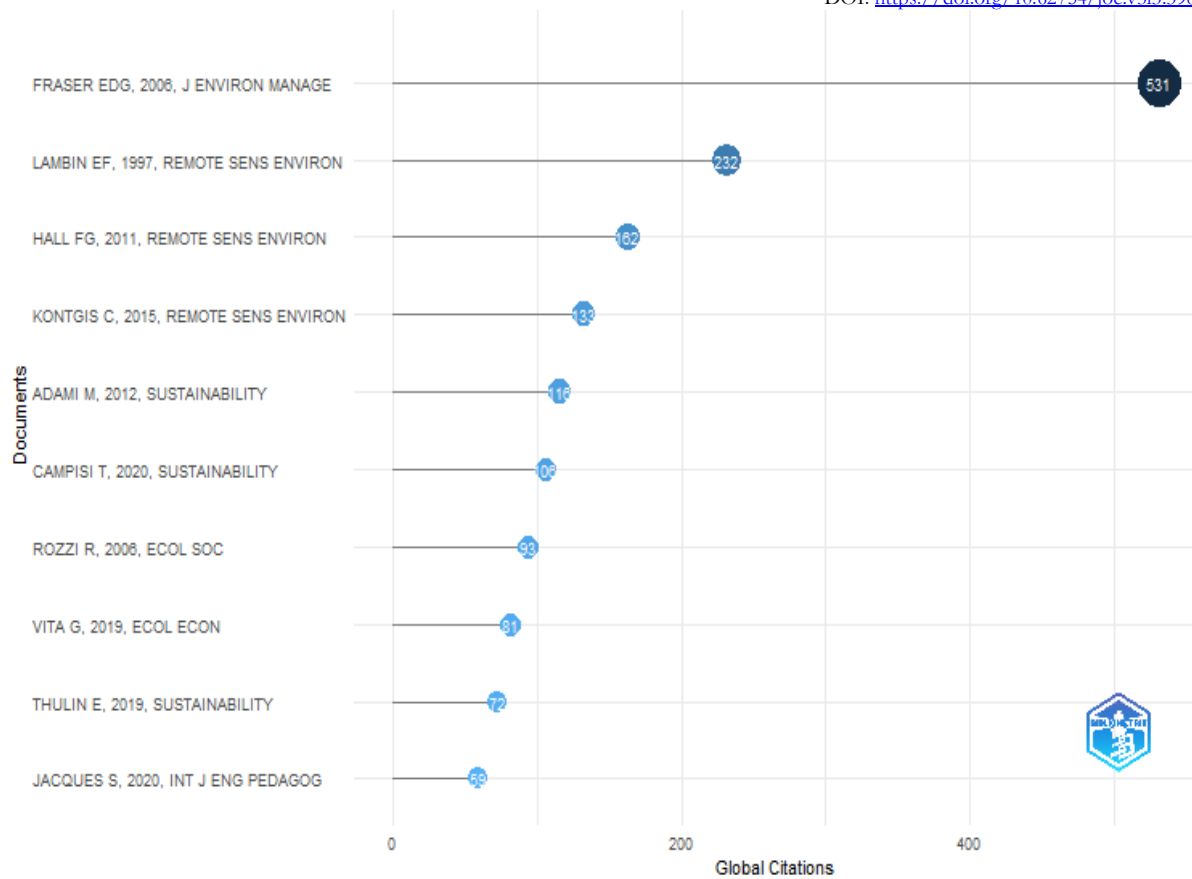
Figure 10 Affiliation Production Over Time



Source: Authors' presentation using R program

In terms of the highest cited documents, Figure 11 shows FRASER EDG's document, which was published in the Journal of Environment Management in 2006 and has 531 citations. It is followed by Lambin EF's document, which was published in Remote Sensing Environment in 1997, and gets 232 citations. Based on the metadata analysis, there is a concentration of high global citations on documents published in the Remote Sensing Environment and Sustainability source.

Figure 11 Most Global Cited Documents

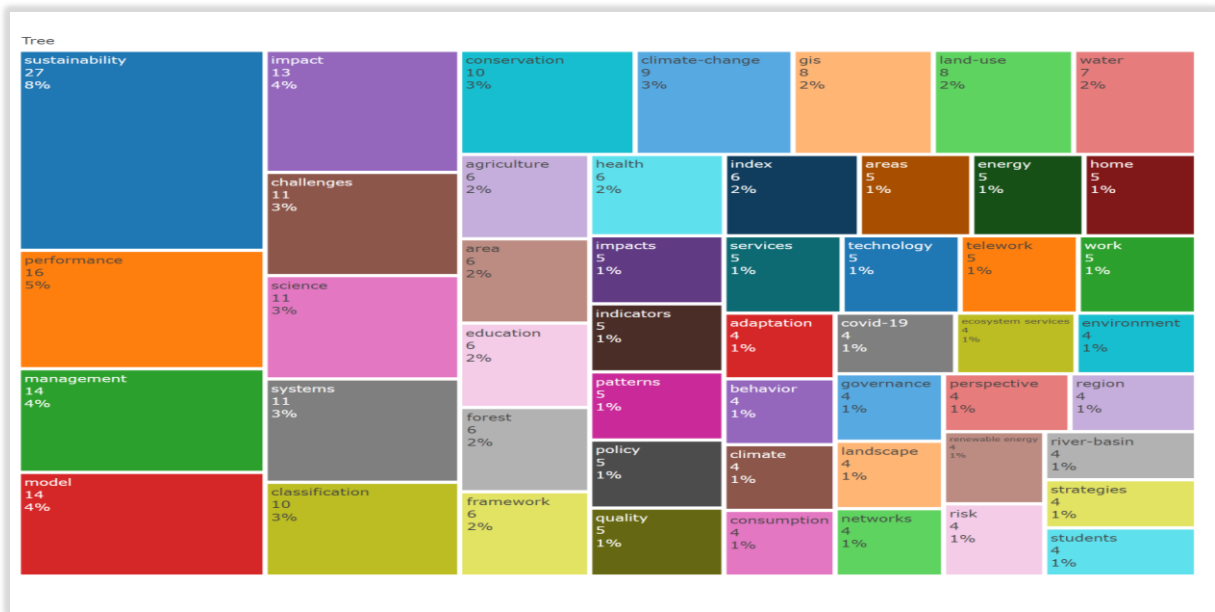


Source: Authors' presentation using R program

Keywords and Trend Topics

Based on the bibliometric data analysis on remote working and sustainability, displayed in Figure 12, the most relevant Keyword occurrences are; Sustainability, Performance, Management, Model, and Impact, which occurred 27, 16, 14, and 13 times respectively in the year 2023. Other related words that occurred with less frequency are Challenges, Science, System, Classification Conservation, and Climate Change. These words are close to the scope of remote working and sustainability topics.

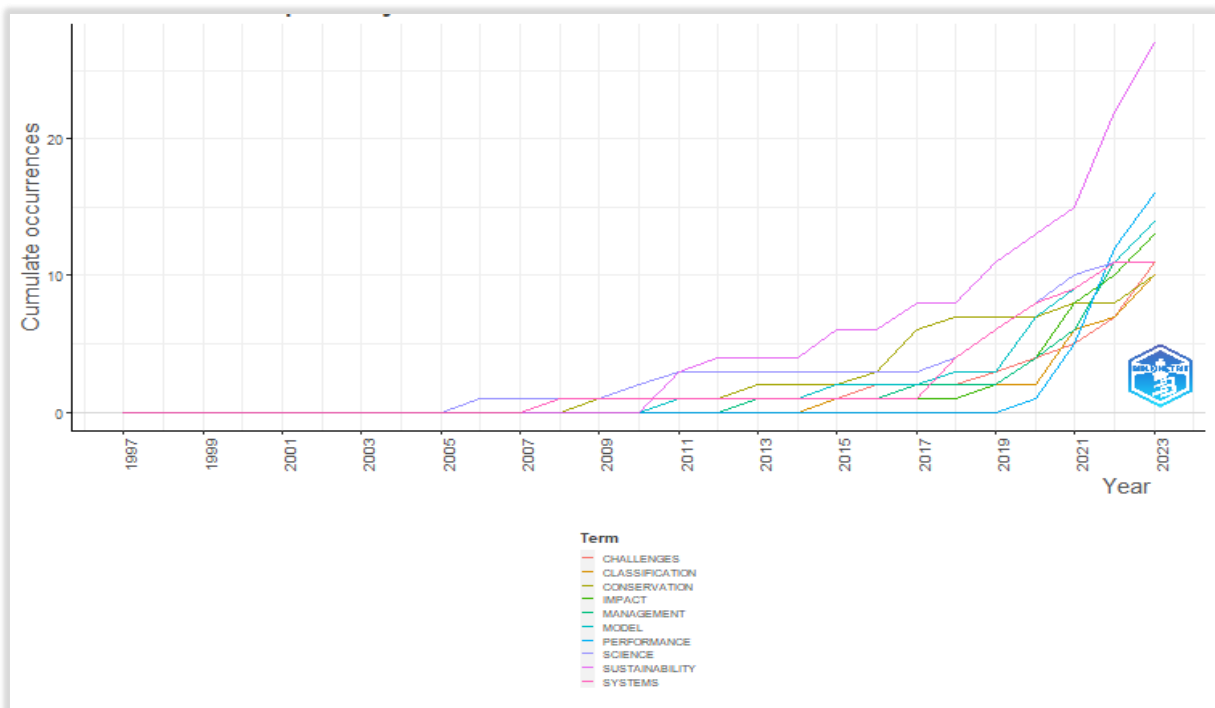
Figure 12 Keywords Occurrence



Source: Authors’ presentation using R program

Regarding the word frequency over time on the topic, figure 13 points that sustainability comes at the top 131 times, starting from 2011, followed by science 77 times, since 2006, and conservation 66 times, starting from 2009. The word performance was relatively recently used in 2020, compared to the other related words; management, model, and impact.

Figure 13 Words Frequency Over Time

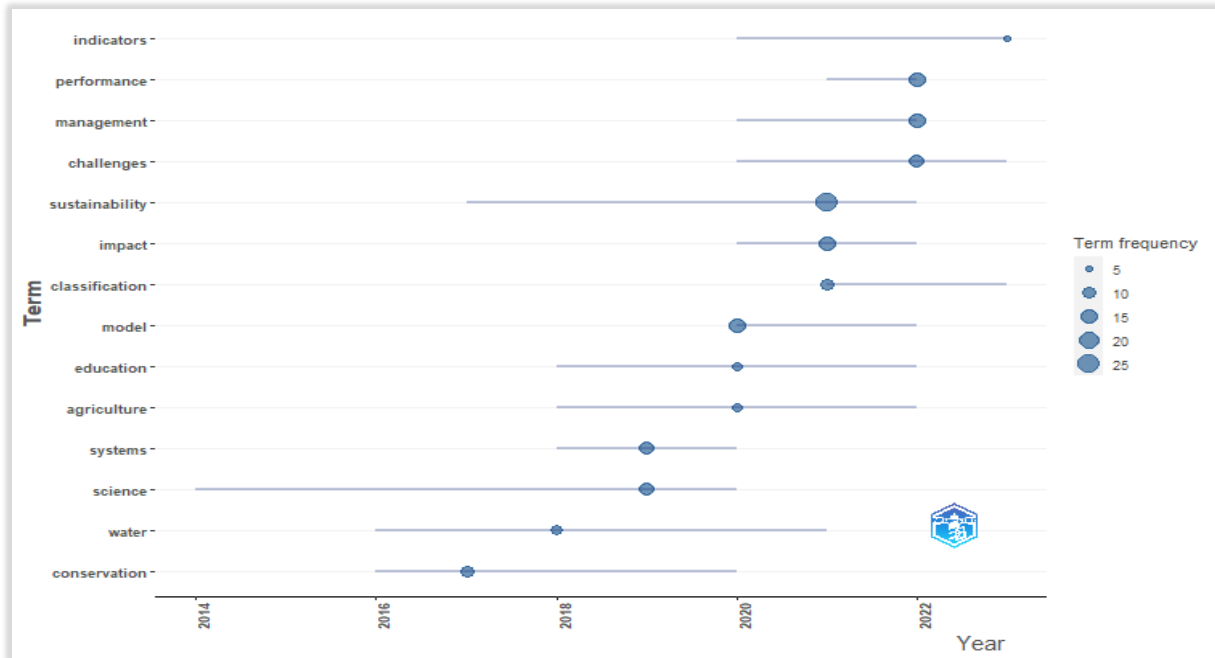


Source: Authors’ presentation using R program

Based on the bibliometric analysis of the trending topic illustrated in Figure 14, the term Sustainability tops the list of terms, particularly in 2021. The terms; Indicators, Challenges, and Classifications are relatively

moderate trend terms in the recent years from 2020 to 2023 in the publications of remote working and sustainability topics on WOS.

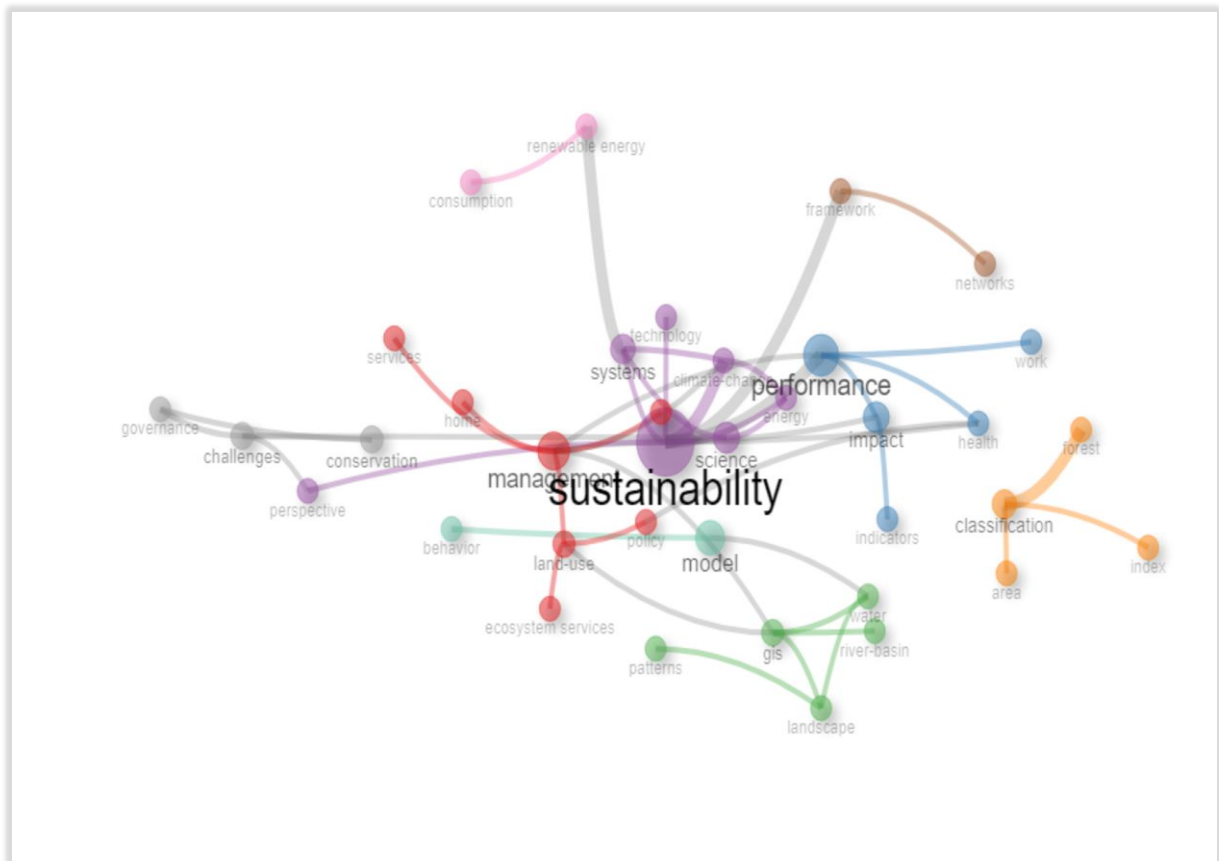
Figure 14 Trend Topics



Source: Authors' presentation using R program

Figure 15 represents the occurrence and the co-word network on remote working and sustainability published on WOS. To identify the focus and trends of remote working and sustainability research, the co-occurrence of terms in both abstracts and titles was analyzed using binary counting. The threshold for including a term in the analysis was a minimum of 5 occurrences. Out of 1006 terms, only 37 terms met this threshold. The resulting co-occurrence network map is shown in Figure 15, where four final clusters are presented in different colors. The sizes of the labels and circles depend on the number of occurrences. Lines identify major links between terms, and their thickness and the distance between the terms represent the association's strength. It reveals that the term sustainability has the largest co-word network, followed by management, system, performance, and land use.

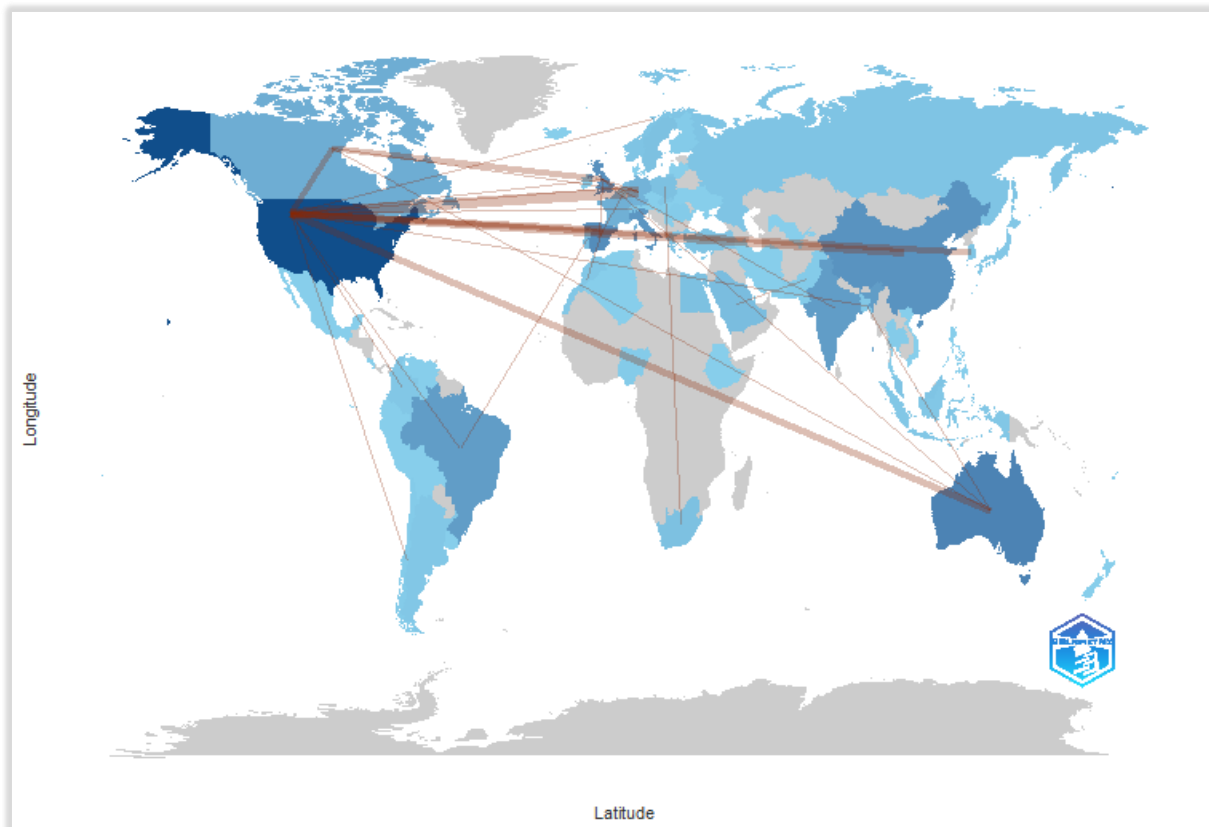
Figure 15-Co-word Network



Source: Authors' presentation using R program

The map displays the global scientific collaboration on remote working and sustainability on WOS. It reveals the intensive collaboration among countries, particularly, the USA, Australia, the UK, China, Spain, Brazil, Argentina and Canada. Additionally, from the Arab world, Saudi Arabia, Morocco, and Egypt have significant global collaborations. The darkness level of the blue regions indicates the intensity level of the country's collaboration.

Figure 16 World Map Collaboration



Source: Authors' presentation using R program

Discussion

A strong relationship between remote working and sustainability has been reported in the literature. The current study presents some significant findings produced by the bibliometric analysis of the metadata gathered from the research articles published on remote working and sustainability in the WOS database. The period of remote working and sustainability publications covered by this analysis demonstrates that it is a relatively new but expanding research area that has grown in importance and attention over time, particularly in the context of the COVID-19 pandemic. One interesting finding of the study, it explored that {Sustainability} is the leading source with about a third of the articles on the topic. Despite the relatively few publications in 26 years, that have been published on the subject in the WOS database, the huge number of references cited demonstrates that the field of remote working and sustainability study builds on a substantial body of prior knowledge and literature. The rapid advancement of information technology and the high level of familiarity among academics and institutions with the sustainability concept have also had an impact on the scientific production of articles about remote working and sustainability. This can be explained by the fact that industrialized nations with high levels of scientific production, such as the USA, China, Australia, Spain, and Canada, have more publications than underdeveloped countries. What is surprising is that Saudi Arabia is the only Arab nation among the top 20 indicates the ongoing advancement of research and the substantial funding devoted to it.

Additionally, the most frequently cited nations are ones with a wealth of publications on the subject but with varied structures. However, despite the relatively smaller publishing, the United Kingdom is at the top of the list of referenced countries. This demonstrates the high standard of research conducted in the UK, as well as other elements like researchers' access to the papers. According to the co-author percentages, remote working and sustainability are diverse research areas that draw researchers from different nations, fields, and disciplines. It is a collaborative study area with numerous researchers from various specialties and backgrounds. The fact that King Abdulaziz University in Saudi Arabia is the only Arab institution with authors affiliated with the top 10 colleges speaks highly of the quality of the research that is produced at

this Saudi institution. According to the research on keyword occurrence and trend topics, there is a transforming inclination toward new terms that have become popular in recent years.

Comparison of the findings with those of other studies, (Ellili, N. O. D. ,2023; Ganga et al. 2022) confirms the concentration of studies in specific groups of countries, while studies are very limited in developing countries. The most often used terms, however, are sustainability, performance, impact, challenges, classification, and management. A possible explanation for this might be, the rapid changes in work patterns and the growing awareness of sustainability, that is intimately tied to performance and the issues that management systems encounter. The corresponding scientific output shows that there are significant discrepancies in the research output and cross-national collaboration on the topic of sustainability and remote working. One of the issues that emerges from these findings that is African and Arab countries make up the smallest proportion of corresponding authors globally, which suggests a lack of visibility or international cooperation. This can be a result of the different institutional elements that affect the use of remote labor and its effects in varied social, economic, and environmental contexts.

Conclusion And Recommendations for Future Research

The main goal of the current study was to determine trends and patterns of scientific publications on remote working and sustainability in WOS during the period 1997 to 2023. This study sets out to better understand and guide future research on remote working and sustainability using a bibliometric mapping analysis. This study provides a significant addition to understanding the body of prior research on the subject. The most obvious finding to emerge from this study is that the primary source for articles on the subject is Sustainability, with very inadequate contribution from other sources. The evidence from this study reveals that there is a high concentration of scholarly publications, citations, and collaboration on this topic in specific industrialized countries, like the United States of America, the United Kingdom, and China. However, there is virtually little contribution from the Arab, African, and other developing nations. To address the issues related to remote working and sustainability specifically in their societies, scholars from Arab and other underdeveloped countries must be encouraged to focus on this important topic, to enrich scientific knowledge, and to develop workable solutions based on empirical findings.

A limitation of this study is that it did not include all sources of publications like Scopus, due to technical constraints. Notwithstanding these limitations, the study recommends that future biometric research expand on these findings by incorporating additional publishing sources and delving deeply into the three pillars of sustainable development and remote working. Further work is needed to fully understand the implications to raise awareness in these countries about the magnitude of conducting more theoretical and empirical high-quality research on remote working and sustainability. In addition to expanding the global scientific collaboration to include these countries. Given how recent remote working and sustainability topics are, future studies can be conducted to examine the literature independently for each of the three sustainability pillars (Environmental, Social and Economic) and remote working. Future studies can be done to address the sustainability issues in these regions and how remote work helps to improve performance in these nations through flexible-resourcing model, sensitivity analysis, decision analysis, and optimization analysis. Since sustainability and remote working are issues that relate to the global or regional levels of economies, future studies on these levels may be conducted.

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