

Article

COVID Crisis and Tourism Sustainability: An Insightful Bibliometric Analysis

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Abstract: The pernicious impact of COVID-19 on all the aspects of travel and tourism has posed a question of tourism sustainability before policymakers and researchers. This research aims to cast light on the bibliometric construct and knowledge structure of the contemporaneous research that evolved around tourism sustainability amid COVID-19. Bibliometric methods of performance analysis and science mapping were used to analyze a total of 440 bibliographic records retrieved from the Scopus database. The major findings showed sustainability as a trending area of tourism research amid COVID-19 and revealed the concentration of research in three prime domains: Management and sustainable development of tourism, environmental health, and mobility trends in the context of COVID-19 pandemic. These areas may be perceived as the recent domains, and they are imperative for future research.

Keywords: tourism; sustainability; COVID-19; bibliometric; knowledge structure



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1. Introduction

The tragic explosion of COVID-19 has brought travel and tourism to an abrupt standstill and thereby challenged the sustainability of tourist destinations worldwide. A sudden halt in the mobility and, consequently, the disappearance of tourists' activities worldwide has brutally affected the social, psychological, and economic well-being of tourists, local communities, organizations, and governments. Undoubtedly, tourism is among the most devastated sectors of the world economy during the pandemic [1–4]. COVID-19 has such a pernicious impact on the travel and tourism that the development of tourism in the twenty-first century will be studied in two phases: before COVID-19 and after COVID-19 [5].

The coronavirus epidemic has triggered many restrictions on international travel, confining tourism to proximity or local destinations [6–9]. This global pandemic is extensively recognized as a game-changer or a major challenge for the tourism sector [10] that has affected the sustainability of travel and tourism [2,4,11,12]. The term “tourism sustainability” refers to the situation wherein the tourism sector can sustain its positive impacts even in turbulent times and has the potential to smoothly recover from the negative impacts posed by major event crises [12]. The crises engendered by COVID-19 have crucial implications in terms of rethinking a sustainable future for tourism [13,14]. Moreover, the possibility of the more frequent occurrence of similar health crises in the near future challenges the sustainability of the tourism sector in the medium and long run [15]. Therefore, this is the time for taking lessons from the pandemic in order to rethink and reset the inept practices to build a more sustainable and resilient industry [16].

The intense effect of the coronavirus pandemic on all the levels of tourist activities and tourism businesses has presented researchers with novel challenges in terms of sustainable

development [3,17–19], as the epidemic has worsened the already existing sustainability challenges in the route of tourism development [20–22]. For that reason, COVID-19 can be perceived as a sustainability challenge for the tourism industry [19]. In essence, “*true sustainability will only occur when it is valued as a part of the taken-for-granted daily life of individuals and cultures across the globe*” [23] (p. 567).

Along these lines, the coronavirus pandemic can be envisaged as a major event crisis for the tourism industry that has posed a question of tourism sustainability before policymakers and contemporary researchers. That said, the present paper aims to decipher and map the scientific literature and evolutionary nuances in the area of COVID-19 and tourism sustainability by applying bibliometric techniques. The key objectives of the present study are [1] to examine the research trends of the underlying field; [2] to determine the scientific productions by authors, institutions, and counties; [3] to analyze the dissemination of scientific production by sources; [4] to classify and examine the content of publications based on keywords; [5] to analyze publications based on citations; and [6] to discover the conceptual, social, and intellectual structure of knowledge evolved in the area of tourism sustainability amid COVID-19.

2. Research Methodology

With the main goal of expanding knowledge, reviewing, appraising, and analyzing the recent scientific literature published on tourism sustainability amid COVID-19, the present study was carried out with the help of bibliographic data collected from the Scopus database. The methodology is based on four steps: research planning, data collection, data analysis with the help of bibliometrics, and dissemination of results. Bibliometrics, which includes a set of statistical and mathematical techniques, has been applied to the identified records [24] to summarize the bibliographic data and decipher the intellectual construct by analyzing the structural and social relationship between various research constituents, such as keywords, authors, nations, and institutions [25]. The two categories of analysis manifested across this study are performance analysis and science mapping.

(1) Performance analysis was conducted with the view to determine the contribution of different authors, sources, documents, and institutions to the research field [26]. These research constituents were examined through different metrics, such as the h-index, the g-index, the m-index, Bradford’s law, and Lotka’s law, to measure and comprehend the trajectories of the research field.

(2) Science mapping was carried out to discover the relationships between research constituents including keywords, authors, institutions, and countries [27]. Bibliometric methods, such as co-citation analysis, co-authorship analysis, co-word analysis, and Multiple Correspondence Analysis (MCA), were utilized for the purpose of science mapping. A blend of these methods with network analysis helps to derive the bibliometric structure of the research field [28]. To discover the knowledge structure of the research field, the conceptual, social, and intellectual structures were analyzed across the identified bibliographic records.

Consequently, the key research questions that the present study intends to answer are as follows: (1) Which are the main authors, publications, sources, and keywords in the research field? (2) What is the performance and influence of different sources and scientific productions in the research field? (3) What is the pattern of collaboration between different authors, institutions, and countries in the scientific community? (4) What are the emerging trends and themes in the field of research? (5) What is the knowledge structure of the given research field?

2.1. Data Collection and Search Strategy

The data for the present study were obtained from the Scopus database since it covers a larger number of tourism journals [29]. The suggestion of Donthu et al. [25] that bibliometric data should be collected from one appropriate database to alleviate human error in consolidation was followed. The process of data collection began with the identification of a search strategy, including the combination of keywords, sources,

time span, and subject area of the bibliographic records. The search strategy was designed and agreed upon by all the authors unanimously to effectively retrieve the bibliographic records [30].

The search query on the database was performed on 23 November 2021. The query initiated with the term “COVID and Tourism” searched in all fields of the records in the database. It resulted in a total of 10,767 records. Moreover, the query for the term “COVID and tourism and sustainability” resulted in 5150 documents. To refine the results, the authors decided to enter the search query by using the advanced search option available in the Scopus database. The search query was entered with the help of Boolean operators. While documents’ “title, Abstract, keywords” was selected as a field option to retrieve the most relevant records from the database. The proliferation of abstracts in the Scopus database allowed us to search for all relevant results across the title, abstract, and keywords [31]. The exact query entered in the advance search was as follows: TITLE-ABS-KEY ((COVID OR corona OR pandemic) AND (tourism OR destination OR travel OR tourist) AND (sustainab*)). This query resulted in a total of 614 documents. Before performing the keyword search in the database, researchers cooperatively decided on a combination of keywords that occur most frequently in the existing studies and are also likely to be general and common in all the documents [32].

To further refine the results for greater precision, the source type was limited to journal articles. This choice was dictated by the fact that the scientific literature available in journal articles is immensely representative of tourism knowledge [29]. In addition, the subject area of the records was limited to Social Sciences; Environmental Science; Business, Management and Accounting; Energy; Economics, Econometrics, and Finance; Arts and Humanities; and Multidisciplinary because these subject areas are most likely to contain scholarly work on tourism sustainability. The years of publication were defined from 2019 to 2021, and English was selected as the language of the records. This search strategy eventually led to the identification of 440 documents that were used for analysis in the present study.

2.2. Data Analysis and Network Visualization

This research has used the Biblioshiny version of the statistical R package to analyze the bibliographic records retrieved from the Scopus database. Bibliometric indicators such as analysis of authors, sources, citations, keywords, collaboration index, annual productivity, and publication growth were utilized, along with descriptive statistics to summarize the bibliographic data. Furthermore, the bibliometric techniques of factor analysis and visualizations were used to analyze the conceptual, intellectual, and social structure of the knowledge [33], wherein Multiple Correspondence Analysis (MCA), co-word analysis, co-citation networks, and collaboration networks of authors, institutions, and countries were employed. The application and interpretation of some of these techniques of performance appraisal and science mapping were followed [25].

Another software selected for producing a visualization of the networks in the present study is VOSviewer (version 1.6.17). VOSviewer is efficacious in exhibiting large bibliometric maps which can be easily interpreted [34]. Bibliographic mapping allows us to procure a comprehensive picture of the bibliographic networks [35]. The networks were used to probe different research constituents, such as authors, articles, keywords, journals, organizations, and countries. In network visualization, each node indicates an item or unit of analysis (e.g., author, keyword, journal, etc.), whereas the size of the node represents the occurrence or weight of the item in the network, and each color denotes a cluster, wherein nodes and links are representative of the relationship between the items manifested under a given cluster [25]. The link between the nodes specifies the co-occurrence of the item, while the thickness of the link reflects the strength of the connection between the items, and the distance between the nodes represents the related degree [33].

3. Results

3.1. Data Summary

Indexed in the Scopus database, a total of 440 records retrieved after applying the search criteria were published between 2019 to 2021. Accordingly, the rate of average annual scientific production was 146.67. Corresponding to the underlying search strategy, only one article (0.23%) was published in 2019. It is because of the obvious reason that the coronavirus pandemic broke out in December 2019 (see Reference [36]), when scholars began to look for COVID-19-related research possibilities in their domains, and it always takes a significant time to write and publish an article. The number of scientific productions became regular and grew substantially in the subsequent years. It was possible to observe a total of 107 publications (24.32%) in 2020 and 332 publications (75.45%) in 2021, representing a growth rate of 210.28%. It provides an insight that the area of COVID-19 and tourism sustainability research is a growing subject, with more scientific productions projected in the forthcoming years.

Figure 1 represents the classification of 440 publications according to the chosen categories of the subject area in the Scopus database. The category Social Sciences, with 351 documents (79.77%), has the highest number of publications, followed by Environmental Science, with 208 documents (47.27%); Business, Management, and Accounting, with 160 documents (36.36%); Energy, with 138 documents (31.36%); Economics, Econometrics, and Finance, with 31 documents (7.05%); “Arts and Humanities” with 16 documents (3.64% of 440), and “Multidisciplinary” with 6 documents (1.36%). It implies that Social Sciences; Environmental Science; and Business, Management and Accounting are the prime subject area categories for the given area of research.

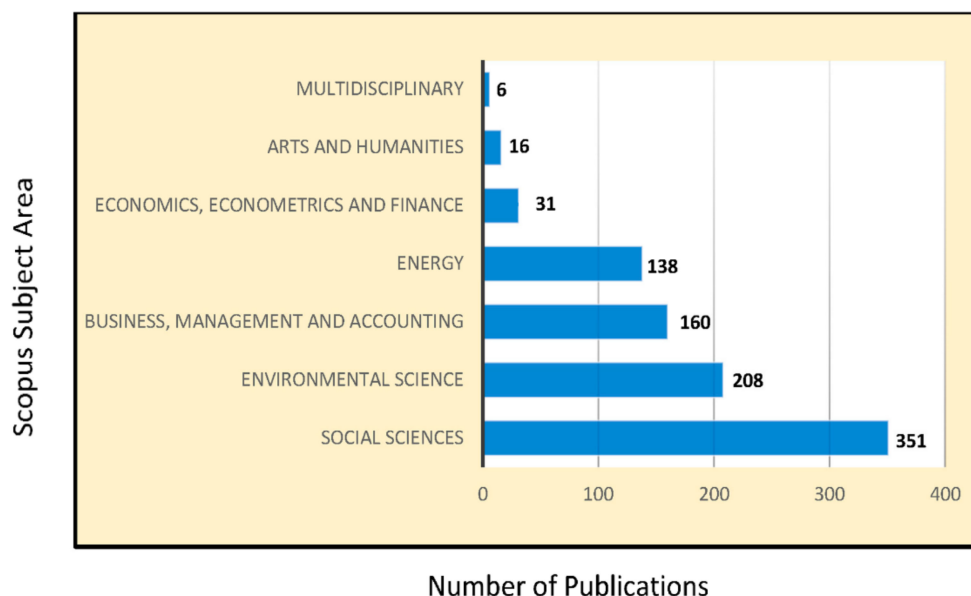


Figure 1. Number of Publications by Scopus Subject Areas. Source: own elaboration.

3.2. Authors' Productivity and Lotka's

The 440 documents retrieved from the Scopus database were authored by a total of 1351 authors while a total number of author appearances were recorded at 1437. It indicates that on average, there are 0.33 documents per author, 3.07 authors per document, and 3.27 co-authors per document. Like the data in a number of studies in in other disciplines, our data also depict that the number of multi-authored articles exceeded the single-authored ones (see Reference [37], p. 157). Out of 440 documents, 71 (16.14%) were single-authored, and the remaining 369 (83.86%) were multi-authored documents. It helps in the identification of 1280 authors in 369 publications, resulting in a collaboration index of 3.47 [38,39].

Lotka's Law [40], reflected in Figure 2, was used to analyze authors' productivity. The Inverse Square Law (x/n^2) of scientific productivity proposed by Alfred J. Lotka in 1926 correlates the contributors of scientific productions to their number of contributions [41,42]. We found that 1279 authors (94.7%) contributed merely with one document, 59 authors (4.4%) contributed with two documents, 12 authors (0.9%) contributed with three documents, and only 1 author (0.1%) contributed four documents. It reveals that Lotka's law in its primary form does not apply to the bibliographic data retrieved for the present study. The only author who has published four documents [43–46] is Prof. Joseph M. Cheer of Wakayama University, Japan. Whereas, Prof. Colin Michael Hall of the University of Canterbury, New Zealand, is the top-notch author in terms of total citations count. In Table 1, we can observe the impact of the top-10 authors. These authors are sequenced in descending order of their total citations, as the citation analysis evaluates the performance of an author and his/her contribution to the field of research [47].

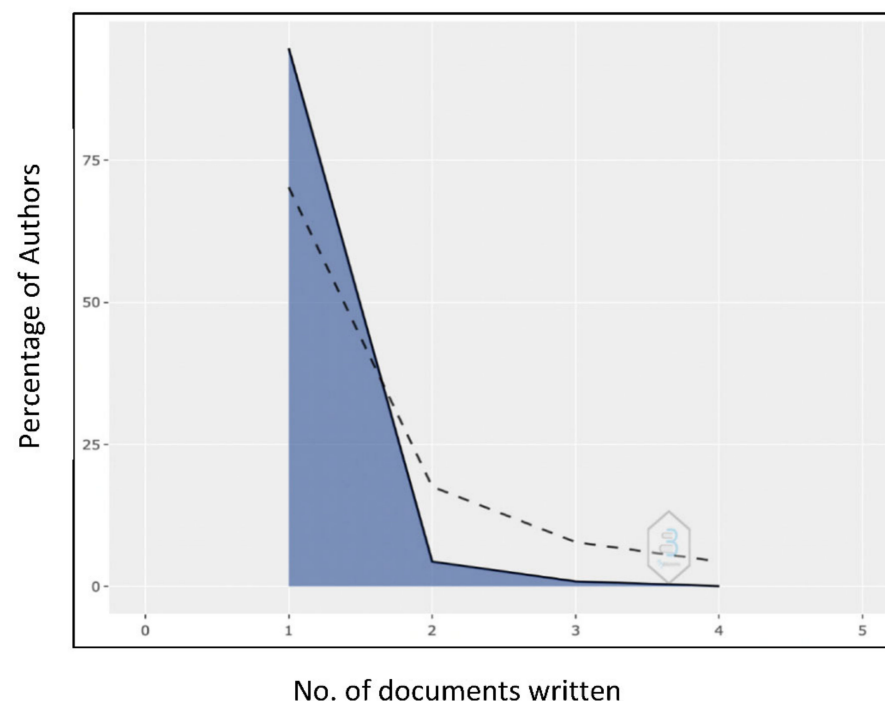


Figure 2. Frequency distribution of scientific productivity of authors. Source: own elaboration.

Table 1. Top 10 authors according to total citations.

Author	h-Index	g-Index	m-Index	TC	NP	PY Start
Hall, C.M.	2	3	0.67	268	3	2020
Gossling, S.	1	1	0.33	235	1	2020
Scott, D.	1	1	0.33	235	1	2020
Gyimthy, S.	1	1	0.33	108	1	2020
Ioannides, D.	1	1	0.33	108	1	2020
Choi, Tm.	1	1	0.33	102	1	2020
Naidoo, R	2	2	0.67	95	2	2020
Acquaye, A.	1	1	0.5	91	1	2021
Adamu, Z.	1	1	0.5	91	1	2021
Akintade, D.D.	1	1	0.5	91	1	2021

Source: own elaboration. Notes: PY Start—year of 1st publication; NP—no. of publications; TC—total citations.

3.3. Sources' Productivity and Bradford's Law

The aforesaid 440 documents were published in 180 distinct journals. Of these journals, 135 (75%) published only one document, 20 journals (11.11%) published only two documents, 9 journals (5%) published only three documents, and 16 journals (8.89%) published four or more documents. These 16 journals can be regarded as journals of tourism sustainability.

Bradford's Law [48] was employed to explore the publication of documents across different journals [42]. Bradford's law is a law of diminishing returns and scattering [49] which assumes that the number of journals in the intermediate and smaller zone will be n and n^2 times larger than the core zone, respectively [50]. As illustrated in Figure 3, it was possible to substantiate the existence of these three zones. The nucleus or core zone comprises three journals, namely *Sustainability*, *Journal of Sustainable Tourism*, and *Tourism Geographies*, which published a total of 154 documents (35%). The three journals in the nucleus account for 1481 citations, representing 49.61% of total citations. Meanwhile, there are 37 journals in the intermediate zone and 140 journals in the smaller zone that were found to publish 141 documents (32.04%) and 145 documents (32.96%), respectively. Table 2 presents the impact of the sources by h-index. These sources are sequenced in the descending order of their h-index because "... *h-index is a better citation-based metric for evaluating the quality and contribution of scholarly journals than other metrics such as the impact factor (IF) or the cites per paper (CPP)*" [51] (p. 240).

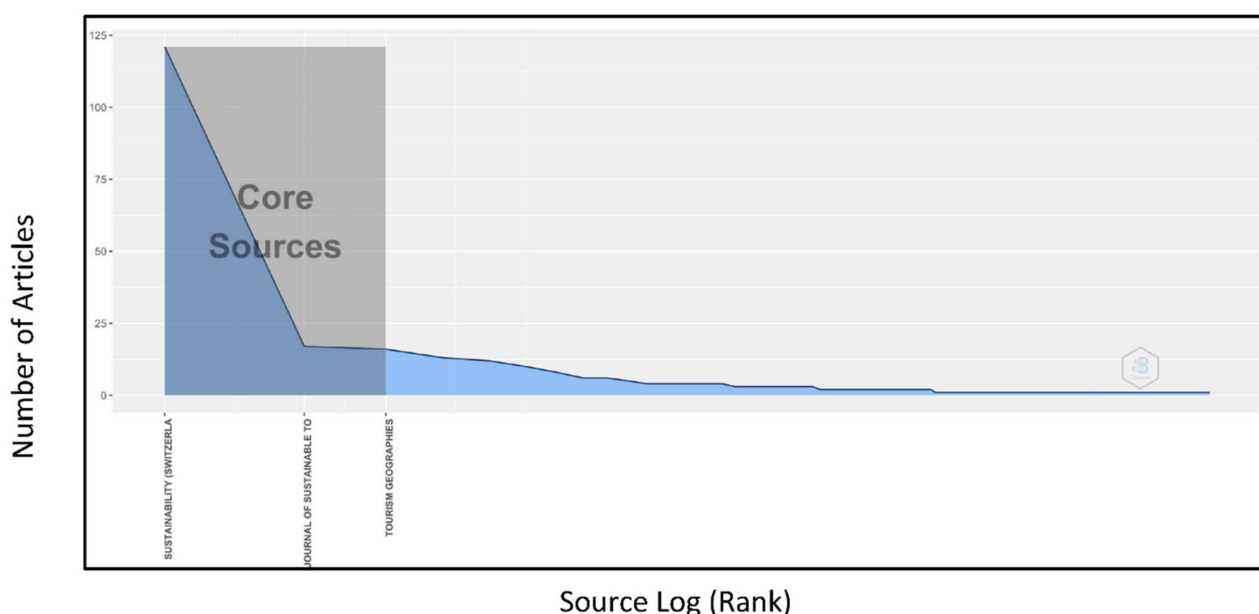


Figure 3. Bradford's law. Source: own elaboration.

3.4. Keywords' Analysis and Zipf's Law

The 440 documents were assigned by 1640 authors' keywords (DE) and 1321 keywords plus (ID). Authors' keywords are provided by authors themselves, while keywords plus are the words that pop up frequently in titles of article's references and are generated through an automatic computer algorithm [52]. Keywords are commonly used in bibliometric studies to effectively analyze the documents' content, trend topics, and research hotspots of a given field [53]. The keyword "COVID-19" was the pinnacle, with 179 authors' keywords (DE) occurrences and 131 keywords plus (ID) occurrences, followed by the keywords "sustainability" (70 DE and 80 ID), "sustainable tourism" (54 DE), and "sustainable development" (59 ID). Other frequently occurring keywords include "ecotourism", "travel behavior", "perception", "strategic approach", "climate change", "carbon footprint", "public transport", "resilience", "overtourism", "sustainable development goals (SDGs)", "new normal", "competitiveness", "responsible tourism", and "active travel". Figure 4 displays the word clouds of the top 50 authors' keywords and keywords plus to swiftly

scrutinize and compare the prominent terms in the field of tourism sustainability research amid COVID-19. A network of keywords shown in Figure 5 classifies the keywords into five different clusters. Cluster-wise dominant keywords are “COVID-19” (blue cluster), “sustainability” (yellow cluster), “sustainable development” (green cluster), “pandemic” (red cluster), and “public health” (purple cluster). The network also signifies that competitiveness, safety, innovations, sustainable mobility, crises management, governance approach, sustainable development goals (SDGs), carbon footprints, environmental protection, overtourism, virtual reality, and sustainable tourism development are some of the prominent areas where research opportunities are arising.

Table 2. Impact of sources by h-index.

Source	h-Index	g-Index	m-Index	TC	NP	PY Start
<i>Sustainability</i> (Switzerland)	12	20	3	583	77	2019
<i>Tourism Geographies</i>	12	15	4	769	15	2020
<i>Journal of Sustainable Tourism</i>	7	10	2.33	129	10	2020
<i>Transport Policy</i>	4	8	1.33	112	8	2020
<i>Transportation Research Interdisciplinary Perspectives</i>	4	4	1.33	92	4	2020
<i>Current Issues in Tourism</i>	3	8	1.5	69	9	2021
<i>European Transport Research Review</i>	3	3	1.5	20	3	2021
<i>International Journal of Environmental Research and Public Health</i>	3	4	1	27	4	2020
<i>International Journal of Hospitality Management</i>	3	3	1.5	45	3	2021
<i>Journal of Air Transport Management</i>	3	3	1	76	3	2020
<i>Science of the Total Environment</i>	3	4	1.5	58	4	2021
<i>Sustainable Cities and Society</i>	3	4	1.5	23	4	2021
<i>Worldwide Hospitality and Tourism Themes</i>	3	4	1	19	6	2020
<i>African Journal of Hospitality, Tourism and Leisure</i>	2	2	1	4	2	2021
<i>Energies</i>	2	2	0.67	14	2	2020

Source: own elaboration. Note: PY Start—year of 1st publication; NP—no. of publications; TC—total citations.

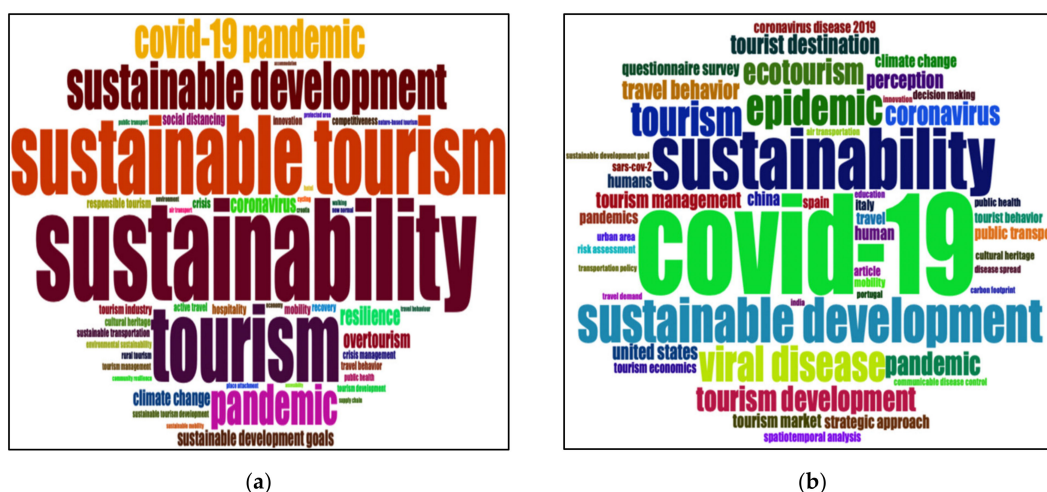


Figure 4. Word Clouds. Source: own elaboration. (a) Author's Keyword; (b) Keywords Plus.

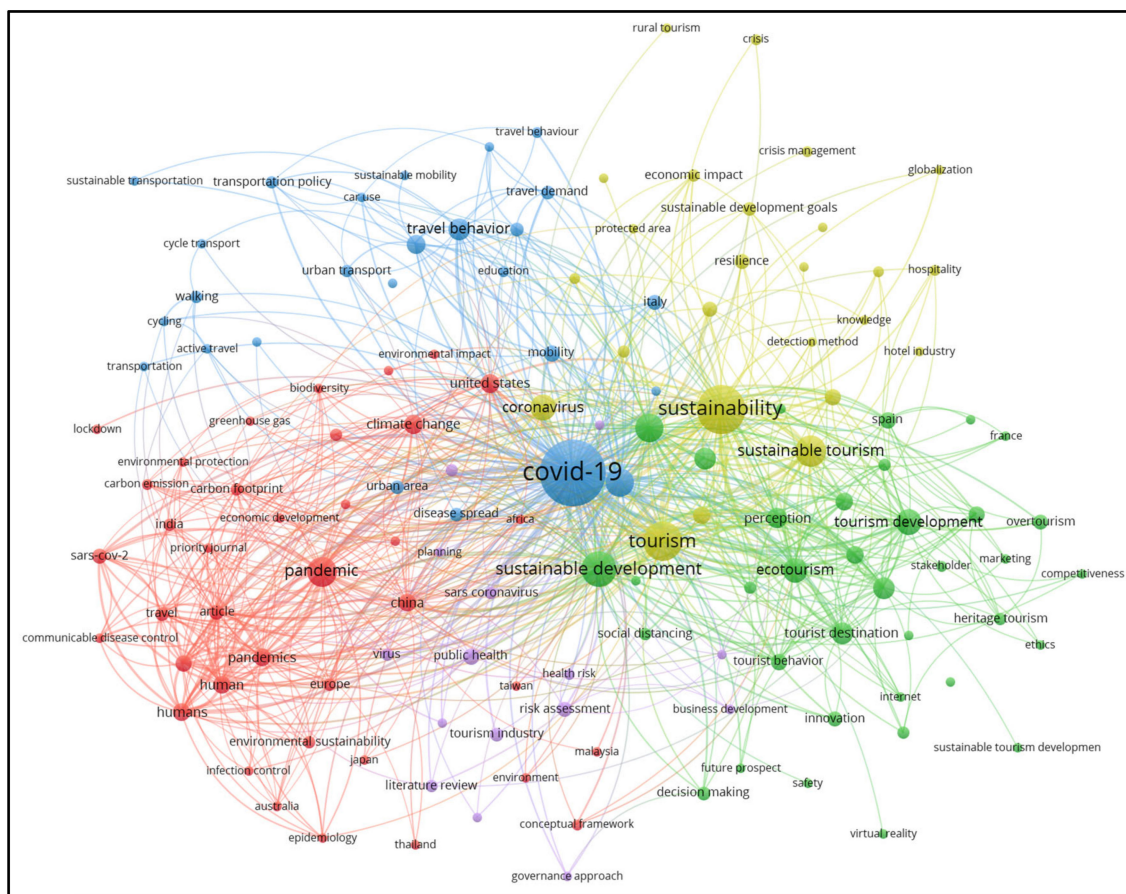


Figure 5. Keyword trends from using co-word analysis. Source: own elaboration.

Zipf's Law [54] of word occurrence was applied to check the frequency distribution of the most prominent keywords [55]. According to Zipf's Law, if keywords are ranked in the decreasing order of their frequency, where "r" is the rank of keyword and "f" is its frequency, then the product of "r" and "f" equals a constant [56]. The frequency distribution of the top 15 authors' keywords and keywords plus (see Table 3) reveals that Zipf's law in its original form ($r \cdot f = c$) is not applicable in current bibliographic records.

3.5. Citation Analysis

Citation analysis is one of the most frequently used methods of bibliometric analysis which helps in assaying the impact and quality of authors, sources, and documents based on their citation count [57,58]. A total of 2985 citations were received by the journals (n = 180) of identified documents (n = 440). Accordingly, the average number of citations per document is 6.784, and the average number of citations per journal is 16.583. Considering the timespan of COVID-19 and tourism sustainability research, these citation counts are expected to increase in the upcoming years. Table 1 shows the top 10 authors according to total citations, Table 2 represents the total citations received by top sources according to the h-index, and Table 4 represents the top 10 articles based on total citations. The article in the current data set which recorded the highest number of citations was “Pandemics, transformations and tourism: be careful what you wish for” [59], with a total of 235 citations and an average of 78.33 citations per year. Four out of the top ten cited articles were published in the journal *Tourism Geographies*. The most cited articles are identified in the areas of transformative opportunities for sustainable tourism [59–61], mobility and resilience [62], innovation [63], circular economy [64], sustainable development goals [65], travel behavior [66], impact assessment [67], and environmental effects [68].

Table 3. Frequency distribution of authors' keywords and keywords plus.

Authors' Keywords				Keywords Plus			
Keyword	Rank (r)	Frequency (f)	Product (r*f)	Keyword	Rank (r)	Frequency (f)	Product (r*f)
COVID-19	1	179	179	COVID-19	1	131	131
Sustainability	2	70	140	Sustainability	2	80	160
Sustainable Tourism	3	54	162	Sustainable Development	3	59	177
Tourism	4	53	212	Epidemic	4	47	188
Sustainable Development	5	33	165	Viral Disease	5	47	235
Pandemic	6	28	168	Tourism	6	46	276
COVID-19 Pandemic	7	27	189	Ecotourism	7	34	238
Resilience	8	13	104	Tourism Development	8	33	264
Coronavirus	9	12	108	Coronavirus	9	31	279
Overtourism	10	12	120	Pandemic	10	31	310
Climate Change	11	11	121	Tourist Destination	11	26	286
Sustainable Development Goals	12	11	132	Travel Behavior	12	25	300
Social Distancing	13	8	104	Perception	13	23	299
Crisis	14	7	98	Tourism Management	14	22	308
Hospitality	15	7	105	United States	15	21	315

Source: own elaboration.

3.6. Countries and Institutions

Based on the country of the corresponding author, the highest number of documents ($n = 35$) were published by the USA, followed by Spain ($n = 31$), Australia ($n = 22$), Italy ($n = 22$), UK ($n = 21$), China ($n = 21$), Poland ($n = 11$), Korea ($n = 10$), and Portugal ($n = 10$). Meanwhile, country-wise scientific production reflects that the USA occurred 105 times, Spain 92 times, China 82 times, Italy 63 times, Australia 62 times, UK 60 times, Portugal 44 times, India 37 times, Canada 26 times, and Malaysia 26 times in the identified records. A total of 81 nations were detected in 440 documents, with 61 countries having corresponding authors. Concerning citations, the USA received total citations (TCs) of 246 and average article citations (AAC) of 7.03, followed by the UK (TC = 244 and AAC = 11.62), Australia (TC = 227 and AAC = 10.32), Sweden (TC = 156 and AAC = 17.33), and Spain (TC = 152 and AAC = 4.903). Figure 6 represents the scientific productions by different countries on the world map. The deeper the color, the higher the country's productivity.

Table 4. Top 10 articles according to total citations.

Title	Authors	Source	PY	TC
"Pandemics, transformations and tourism: be careful what you wish for"	C. Michael Hall, Daniel Scott, and Stefan Gössling	<i>Tourism Geographies</i>	2020	235
"The COVID-19 crisis as an opportunity for escaping the unsustainable global tourism path"	Dimitri Ioannides and Szilvia Gyimóthy	<i>Tourism Geographies</i>	2020	108
"Innovative 'Bring-Service-Near-Your-Home' operations under Corona-Virus (COVID-19/SARS-CoV-2) outbreak: Can logistics become the Messiah?"	Tsan-Ming Choi	<i>Transportation Research Part E: Logistics and Transportation Review</i>	2020	102
"A critical analysis of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies"	T. Ibn-Mohammed, K.B. Mustapha, J. Godsell, Z. Adamu, K.A. Babatunde, D.D. Akintade, A. Acquaye, H. Fujii, M.M. Ndiaye, F.A. Yamoah, and S.C.L. Koh	<i>Resources, Conservation and Recycling</i>	2021	91
"Reset Sustainable Development Goals for a pandemic world"	Robin Naidoo and Brendan Fisher	<i>Nature</i>	2020	82
"How is COVID-19 reshaping activity-travel behavior? Evidence from a comprehensive survey in Chicago"	Ali Shamshiripour, Ehsan Rahimi, Ramin Shabanpour, and Abolfazl (Kouros) Mohammadian	<i>Transportation Research Interdisciplinary Perspectives</i>	2020	75
"COVID-19: from temporary de-globalisation to a re-discovery of tourism?"	Piotr Niewiadomski	<i>Tourism Geographies</i>	2020	71
"The COVID-19 crisis: Opportunities for sustainable and proximity tourism"	Francesc Romagosa	<i>Tourism Geographies</i>	2020	69
"Impact of COVID-19 on the travel and tourism industry"	Marinko Škare, Domingo Riberio Soriano, and Małgorzata Porada-Rochoń	<i>Technological Forecasting and Social Change</i>	2021	68
"Environmental effects of COVID-19 pandemic and potential strategies of sustainability"	Tanjena Rume and S.M. Didar-UI Islam	<i>Heliyon</i>	2020	65

Source: own elaboration. Note: PY—publication year; TC—total citations.

It was possible to observe a total of 793 institutions that produced the eligible 440 documents. Of these institutions, a maximum number of 11 documents were contributed by Griffith University. This was followed by Lund University, Massey University, University of Azores, and University of Johannesburg, which produced seven documents each. Meanwhile, the University of Brasov, University of Padova, and University of Surrey contributed six documents each. All other institutions produced five or fewer documents. Figure 7 presents a three-field plot of authors, countries, and institutions or affiliations.

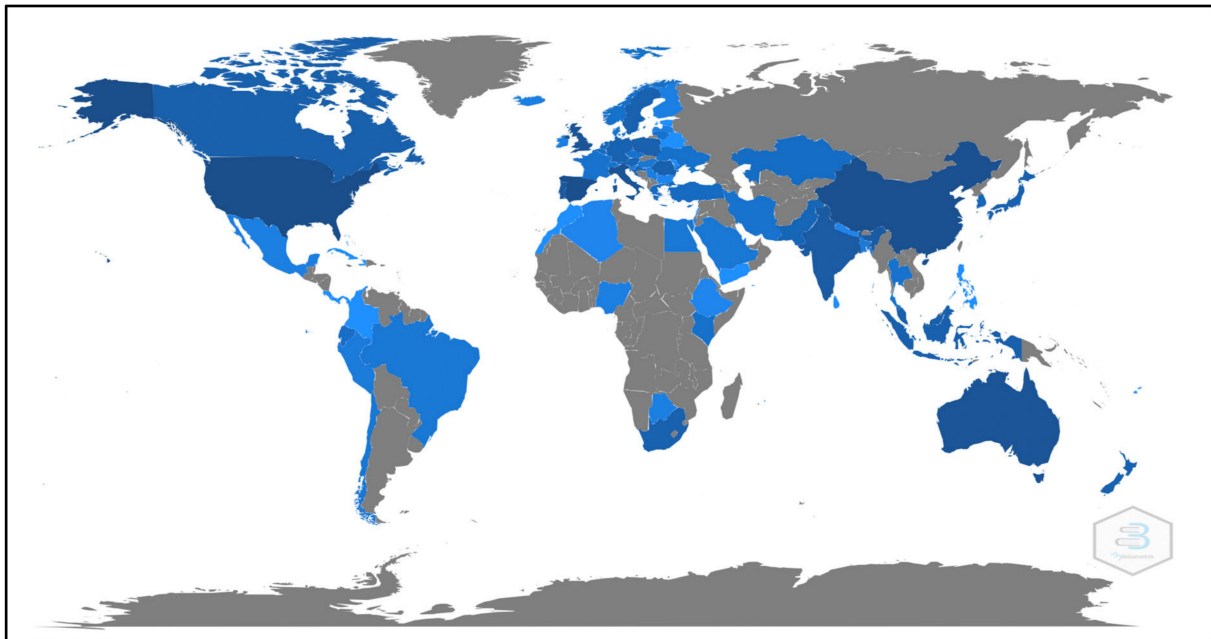


Figure 6. Scientific productions by different countries. Source: own elaboration.

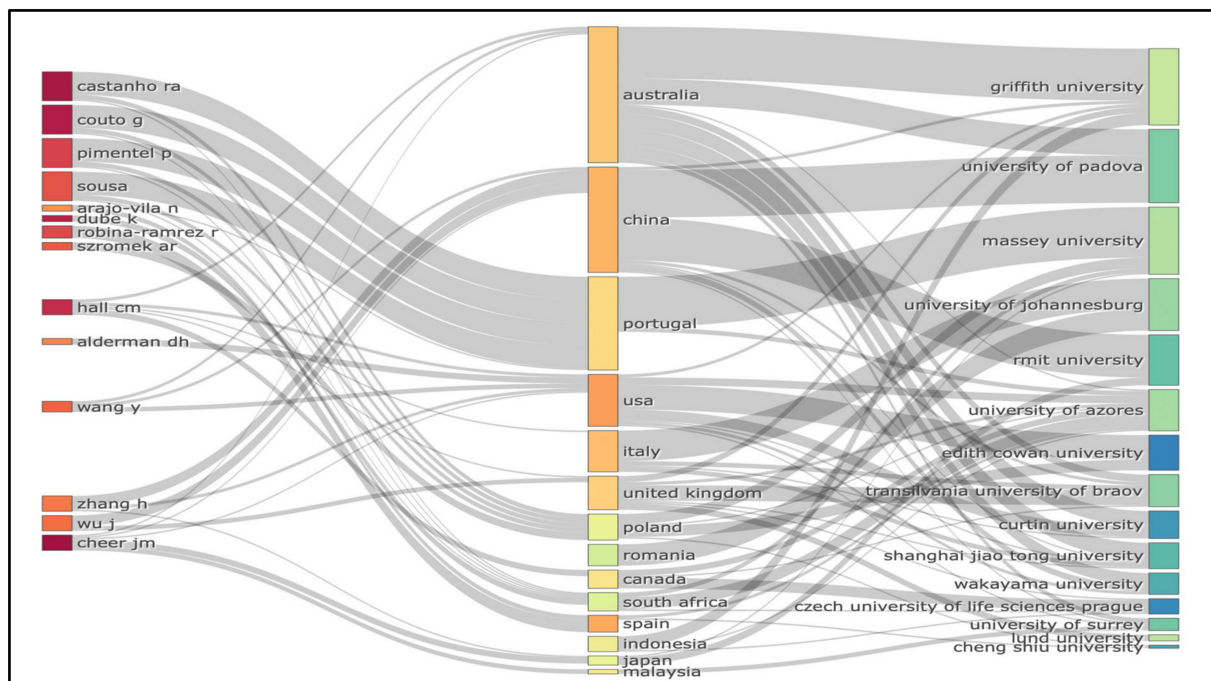


Figure 7. Three-field plot of author, countries, and affiliations. Source: own elaboration. Note: left field—authors; middle field—countries; and right field—affiliations.

3.7. Conceptual Structure of Knowledge

The conceptual structure of knowledge is analyzed to explore the key themes and trends that have been inquired and delineated in a given research field [69,70]. This analysis permits the scholars to highlight the relationships that exist between the terms that co-occur in the identified records [71]. To educate the research community about the conceptual structure of COVID-19 and tourism sustainability research, we applied two techniques: co-word analysis and Multiple Correspondence Analysis (MCA).

The VOSviewer technique of co-word analysis is used to uncover the most relevant concepts that co-occur in each document and are therefore conceptually related to each other [33]. The keyword trends depicted in Figure 5 were created by using co-occurrence of keywords through VOSviewer. It represents the five different clusters (red, green, blue, purple, and yellow) of keywords that generally co-occur and are subsequently related.

Multiple Correspondence Analysis, which is an extension of Correspondence Analysis (two-variable case), is used to represent the relationship between a set of categorical variables [72]. MCA is used to conduct the factor analysis of keywords to reduce the dimensionality of data [33]. The conceptual structure map derived through MCA is depicted in Figure 8. The map is divided into three clusters of keywords that are segregated by different colors. Each cluster represents a set of keywords that represents a particular theme. These clusters signify that the underlying keywords co-occur in the publications.

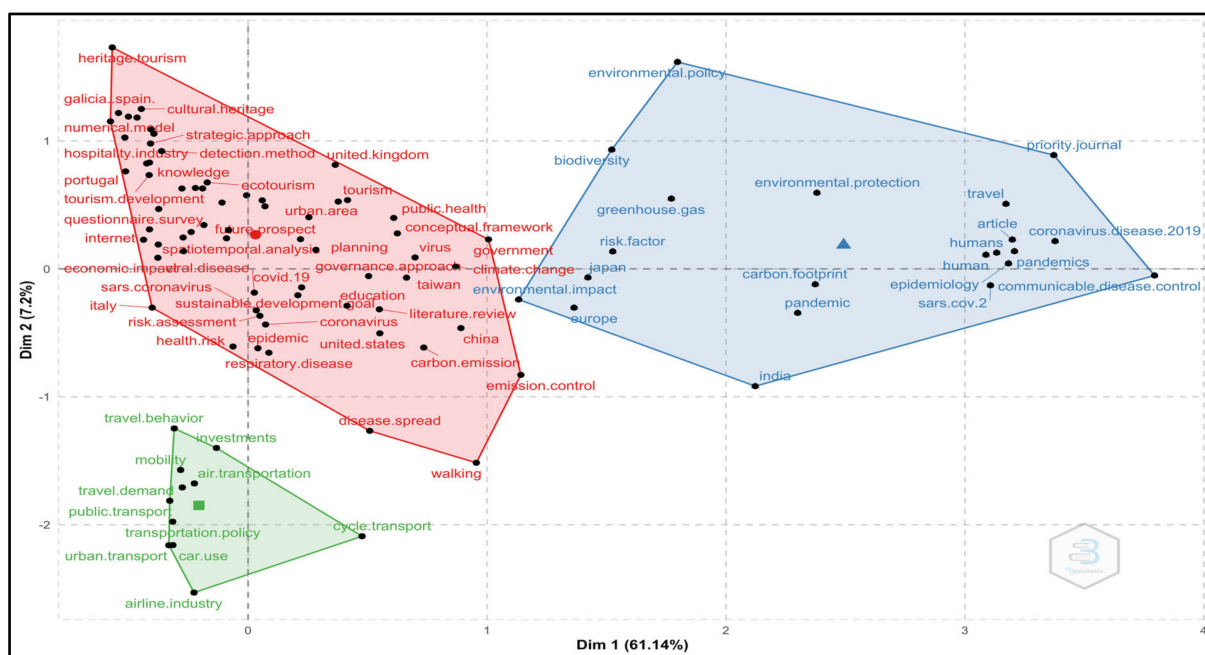


Figure 8. Conceptual structure map using Multiple Correspondence Analysis. Source: own elaboration.

Cluster 1 (red cluster) covers a wide range of keywords, such as “COVID-19”, “risk assessment”, “public health”, “disease spread”, “governance approach”, “strategic approach”, “planning”, “sustainable development”, “emission control”, “sustainable development goals”, “spatiotemporal analysis”, etc. These terms are related to the *management and sustainable development of tourism* (for example, see References [60,62,63,65]). Cluster 2 (blue cluster) includes terms such as “environmental protection”, “biodiversity”, “greenhouse gas”, “carbon footprints”, “pandemic”, etc. These keywords are related to *environmental health* (for example, see References [68,73–75]). Cluster 3 (green cluster) presents terms such as “cycle transport”, “car use”, “transportation policy”, “public transport”, “travel behavior”, etc. These keywords are related to *mobility trends* (for example, see References [76–79]).

3.8. Intellectual Structure of Knowledge

The intellectual structure of knowledge is assessed to determine the influence of authors’ work in the scientific community [70]. Co-citation analysis is the most widely used technique in bibliometrics to reveal intellectual linkages [79]. Co-citation analysis helps to identify the pairs of documents that are cited together in the third document [25]. It assumes that the publications which are often cited together are thematically similar [80] and thus concentrated in a cluster of visualization map [81]. The 440 documents analyzed in the present study have a total of 27,116 references. Figure 9 shows the three

clusters of the relationship between the authors in bibliographic references. Based on total citations and academic linkages, the most prominent authors in Cluster 1 (red) include Han, H.; Wang, Y.; and Li, Y. Their documents were related to “travel trends amid COVID-19” (see References [82–84]). In Cluster 2 (green), Gossling, S.; Hall, C.M.; Scott, D.; Higgins-Desbiolles, F.; Cheer, J.M.; and Higham, J., are among the most prolific authors. Their documents are related to “transformative opportunities for sustainability” (see References [13,43,59,85]). In Cluster 3 (Blue), Sigala, M.; Dolnicar, S.; and Xiang, Z., are among the key authors. These documents are related to “COVID-19 impacts and tourism response” (see References [16,86,87]).

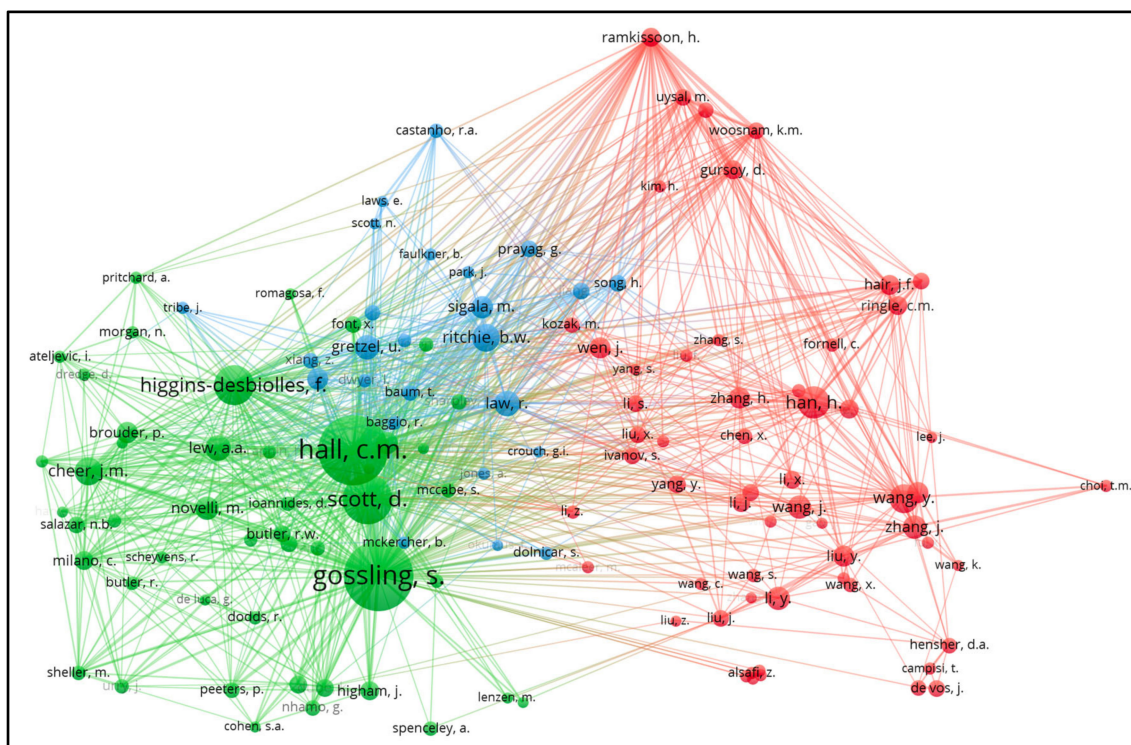


Figure 9. Co-citation network of authors. Source: own elaboration.

In Figure 10, we present a co-citation network of different journals that published documents on COVID-19 and tourism sustainability. There are three clusters identified by red, green, and blue colors. Journals in each cluster are generally co-cited. The journals with the most significant impact are *Sustainability* and *Journal of Sustainable Tourism* (red cluster); *Tourism Geographies* (green cluster); and *Transport Policy* (blue cluster).

3.9. Social Structure of Knowledge

The social structure of knowledge indicates how different authors, institutes, and countries collaborate in the research community [69]. Particularly, the collaboration networks allow us to identify the most relevant authors, institutions, and countries in the field of research and their relationships [70]. The co-authorship network is an increasingly used bibliometric technique to reveal the social-structure knowledge by analyzing the collaboration trends and identifying the leading authors, institutions, and countries [88].

Figure 12 represents a collaboration network of 20 organizations, determined on the basis of their co-authored publications. In all, 5 out of 20 organizations in the network are in the USA; 4 are in Canada; and 1 each is in Brazil, Indonesia, Australia, Germany, Ecuador, New Zealand, South Africa, Kenya, the UK, Costa Rica, and Croatia.

A co-authorship network of 37 countries is presented in Figure 13. There are four clusters of countries' collaboration: red cluster (12 countries), green cluster (10 countries), blue cluster (10 countries), and yellow cluster (5 countries). Based on co-authorship, the most important countries in the green cluster are the US, Italy, New Zealand, Germany, and Indonesia. Meanwhile, Spain, Poland, and Portugal are the key countries in the yellow cluster; the UK, Australia, India, and the Netherlands are in the red cluster; and China, South Korea, and the Russian Federation are in blue cluster. The strongest collaboration in the network was observed among China, Australia, UK, US, and Japan.

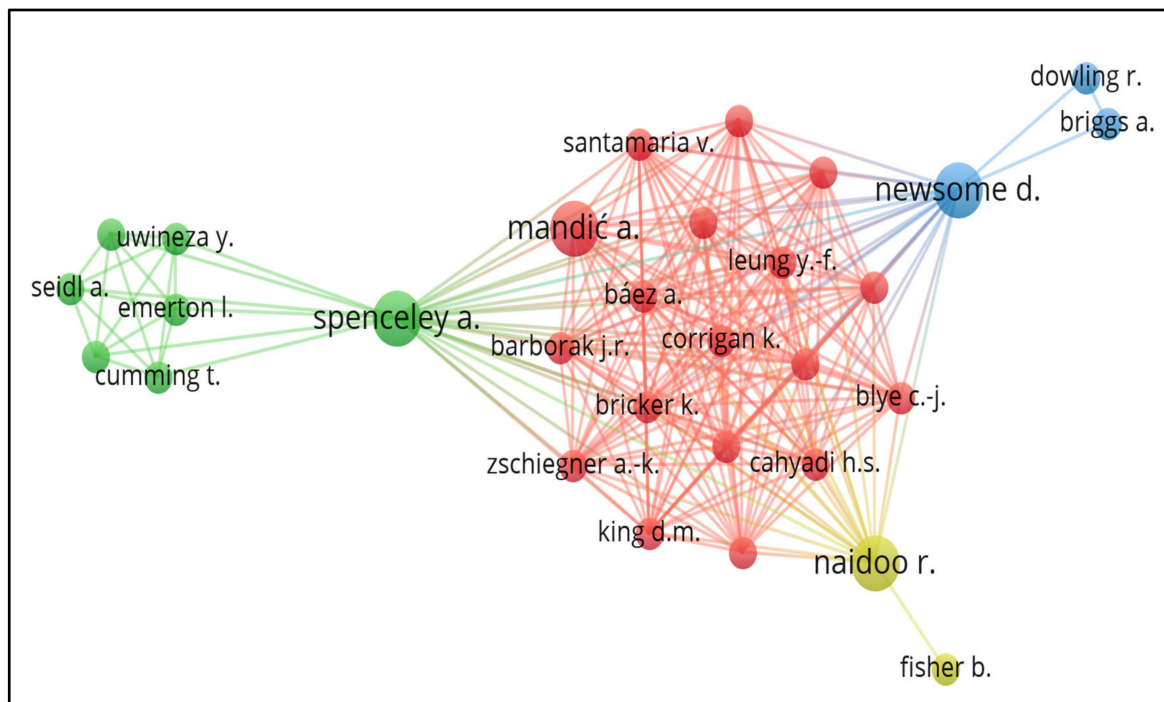


Figure 11. Co-authorship network of authors. Source: own elaboration.

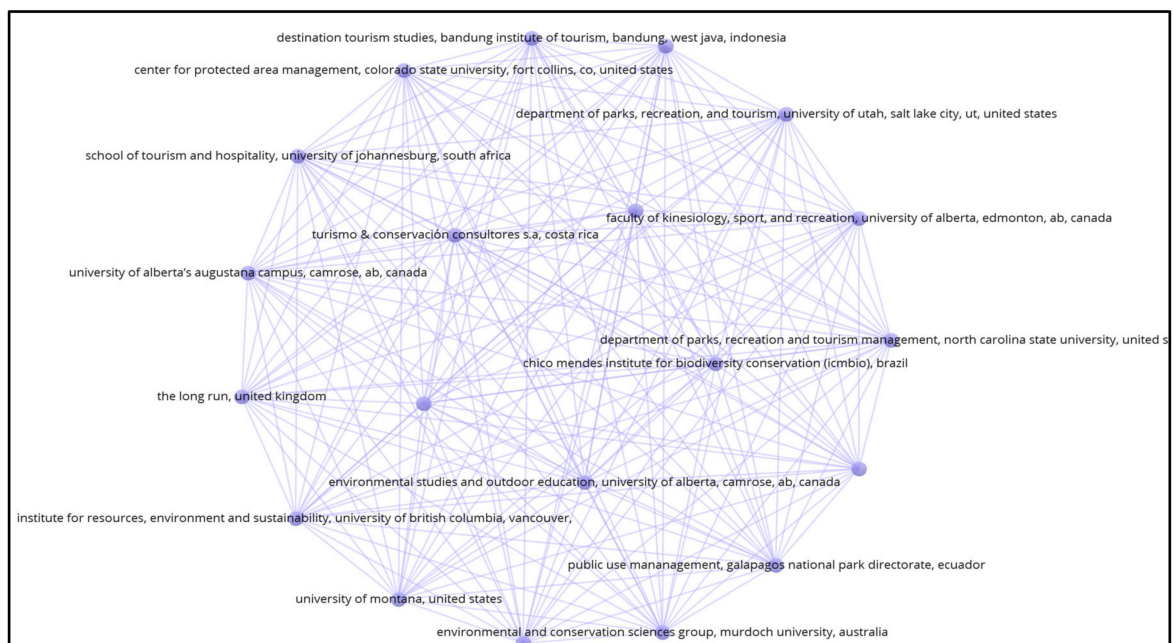


Figure 12. Co-authorship network of organizations. Source: own elaboration.

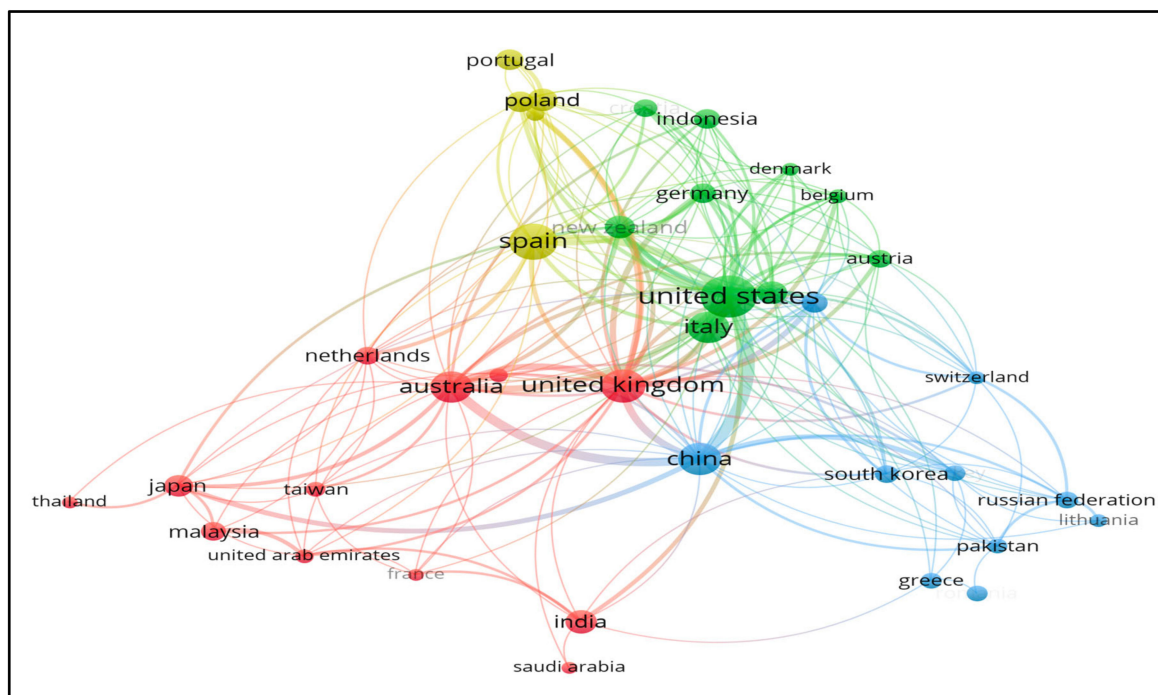


Figure 13. Co-authorship network of countries. Source: own elaboration.

4. Discussion

The present study aimed to decipher and map the scientific literature and evolutionary nuances of the research in “COVID-19 and tourism sustainability”. The researchers applied bibliometric techniques to analyze the 440 bibliographic records retrieved from the Scopus database. The findings reveal an apparent upsurge in the number of publications during 2021, with a growth rate of 210.28% over the previous year. The concentration of journals in the field of tourism sustainability to publish COVID-19-related articles between 2020 and 2021 could be one of the possible causes for this extensive increase in the number of publications. In terms of the authors’ productivity, we observed 0.33 documents per author and 3.07 authors per document. Out of 440 documents, 71 were single authored, and remaining 369 were multi-authored documents. A total number of 1280 authors were identified in the multi-authored documents, indicating a collaboration index (CI) of 3.47. This collaboration index is higher than the observations of Köseoglu and King [89], who found that collaboration networks in tourism journals generally consist of dual authors. However, the collaboration index of 3.47 roughly substantiates the findings of Marti-Parreño and Gómez-Calvet [90], who recorded the CI of 3.41 among the authors in the field of Social Media and Sustainable Tourism research. This high CI is probably an outcome of the increased interest of interdisciplinary and transdisciplinary researchers to publish in the area of sustainability during the pandemic. The growing interest of tourism researchers in sustainability [91,92], along with the guidelines of leading organizations such as UNWTO [93] and WTTC [94] on tourism sustainability can be another reason for the growth in the number of publications, as well as a higher CI.

As for the authors’ productivity, we found that 1279 authors published only one document, 59 authors published two documents, 12 authors published three documents, and only 1 author (Prof. Joseph M. Cheer) published four documents. It unveils that the Inverse Square Law of Scientific productivity [40] in its original form does not fit the present data set. One of the reasons is the presence of large number of authors who contributed only one document. Consequently, the more productive authors are found to have more collaborative studies [41]. In terms of sources’ productivity, the application of Bradford’s law [48] showed that, out of 180 journals that published 440 documents, only 3 are in core zones, i.e., *Sustainability*, *Journal of Sustainable Tourism*, and *Tourism Geographies*, which

published a total of 154 documents. It signifies that these three journals are of the highest interest to the researchers and are among the most cited journals in the literature of the subject under study [49]. The analysis of most-frequently appearing keywords (Table 3) through Zipf's Law [54] revealed that the law in its original form does not apply to the current data set. It could be because Zipf's law is more appropriate for middle ranks [56] instead of top ranks.

The findings on citations show that the 440 documents which were published in 180 journals received a total of 2985 citation, with an average of 6.784 citations per document and 2.651 citations per document per year. The average number of citations per document is higher than that of most of the journals publishing research in the area of tourism (see Reference [95]). The publication that received the highest number of citations was "Pandemics, transformations and tourism: be careful what you wish for" [59], with a total of 235 citations and an average of 78.33 citations per year. Of the top 10 articles in terms of number of citations, 4 were published in *Tourism Geographies* (Table 4). The co-citation analysis used to determine the intellectual structure of knowledge resulted into three clusters each of relationship between authors (Figure 9) and sources (Figure 10).

When analyzing the country of the corresponding author, the USA and Spain resulted in being the most productive nations, with a total of 35 (7.95%) and 31 (7.04%) documents, respectively. In terms of total citations, the USA received the highest amount of citations, at 246 citations, followed by the UK, with 244 citations. The results on country-wise productivity partly substantiate the findings of Güzeller and Celiker [96] on tourism research. Concerning the scientific productivity by institutions, Griffith University (Australia) and Lund University (Sweden) were deemed to be the most relevant institutions, roughly corroborating the results of most relevant countries (Figure 6). Moreover, the co-authorship analysis that was used to derive the social structure of knowledge uncovered a cluster of relationships between institutions (Figure 12) and four clusters each of relationships between authors (Figure 11) and countries (Figure 13) in the scientific community.

The technique of Multiple Correspondence Analysis applied to detect the conceptual structure of knowledge yielded three clusters of co-occurring keywords (see Figure 8). These clusters were related to management and sustainable development of tourism, environmental health, and mobility trends. The concepts of sustainable mobility and environmental health are closely linked with tourism sustainability [97,98] and are crucial for pandemic recovery [99]. Such concepts should be perceived as the recent domains that are imperative for future research on tourism sustainability in the face of major-event crises, such as COVID-19. The summary of findings is presented in Table 5.

Table 5. Summary of major findings.

S. No.	Objective	Findings
1	Research trend	Excluding one article that was published in 2019, all were published in 2020 (n = 107) and 2021 (332), showing a growth rate of 210.28%. A total of 440 documents were produced by authors of 793 institutions in 81 countries. The 1351 authors of 440 documents reveal there are 0.33 documents per author and 3.07 authors per document. Of 440 documents, 71 were single authored, representing a collaboration index of 3.47.
	Authors' productivity	Cheer JM (4), Castanho RA (3), Couto G (3), Dube K (3), Hall CM (3), Peters M (3), Pimentel P (3), Ronina-Ramrez R (3), Sousa (3), Szromek AR (3), Wang Y (3), Wu J (3), and Zhang H (3). All other authors produced two or one document.
2	Institutions' productivity	Griffith Univ. (11), Lund Univ. (7), Massey Univ. (7), Univ. of Azores (7), Univ. of Johannesburg (7), Univ. of Brasov (6), Univ. of Padova (6), and Univ. of Surrey (6). All other institutions produced five or less documents.
	Countries' productivity	USA (105), Spain (92), China (82), Italy (63), Australia (62), UK (60), Portugal (44), India (37), Canada (26), Malaysia (26), and Indonesia (25). All other countries produced less than 25 documents.

Table 5. Cont.

S. No.	Objective	Findings
3	Dissemination of scientific production by sources	<i>Sustainability</i> (121), <i>Journal of Sustainable Tourism</i> (17), <i>Tourism Geographies</i> (16), <i>Current Issues in Tourism</i> (13), <i>Transport Policy</i> (12), and <i>Worldwide Hospitality and Tourism Themes</i> (10). All other journals produced less than 10 documents.
	Sources dynamics	The only article in 2019 was published in the journal <i>Sustainability</i> . The most prolific journals in 2020 were <i>Sustainability</i> (33), <i>Tourism Geographies</i> (14), <i>Journal of Sustainable Tourism</i> (6), and <i>Worldwide Hospitality and Tourism Themes</i> (6). The sequence in 2021 was <i>Sustainability</i> (87), <i>Current Issues in Tourism</i> (13), <i>Journal of Sustainable Tourism</i> (11), and <i>Transport Policy</i> (11).
4	Content of publications according to authors' keywords	"COVID-19" (179), "Sustainability" (70), "Sustainable Tourism" (54), "Tourism" (53), and "Sustainable development" (33). Other important keywords include "Resilience" (13), "Overtourism" (12), "Climate Change" (12), and "SDGs" (11).
	Content of publications according to keywords plus	"COVID-19" (131), "Sustainability" (80), "Sustainable Development" (59), "Epidemic" (47), and "Viral Disease" (47). Other important keywords plus include "Ecotourism" (34), "Tourism Development" (33), "Travel Behavior" (25), "Perception" (23), and "Tourism Management" (22).
5	Top publications according to total citations	Hall et al., 2020 (DOI: 10.1080/14616688.2020.1759131); Ioannides and Gyimóthy, 2020 (DOI: 10.1080/14616688.2020.1763445); Ibn-Mohammed et al., 2021 (DOI: 10.1016/j.resconrec.2020.105169); Naidoo and Fisher, 2020 (DOI: 10.1038/d41586-020-01999-x); Shamshiripour et al., 2020 (DOI: 10.1016/j.trip.2020.100216)
6	Conceptual structure of knowledge	Cluster 1 includes keywords related to the management and sustainable development of tourism, such as "COVID-19", "risk assessment", "governance approach", "strategic approach", "emission control", "SDGs", etc.
		Cluster 2 includes keywords related to environmental health, such as "envi. Protection", "biodiversity", "greenhouse gas", "carbon footprints", etc.
		Cluster 3 includes keywords related to mobility trends, such as "cycle transport", "car use", "transportation policy", "public transport", "travel behavior", etc.
	Intellectual structure of knowledge	Cluster 1: Han, H.; Wang, Y.; and Li, Y., are the leading authors based on co-citations. Their documents were related to "travel trends amid COVID-19".
		Cluster 2: Gossling, S., Hall, C.M., Scott, D., Higgins-Desbiolles, F, Cheer, J.M., and Higham, J. are among the most prolific authors. Their documents are related to "transformative opportunities for sustainability".
		Cluster 3: Sigala, M.; Dolnicar, S.; and Xiang, Z., are among the key authors. These documents are related to "COVID-19 impacts and tourism response"
	Social structure of knowledge	Authors' collaboration: 4 clusters of authors' collaboration were resulted, and the most prolific authors per cluster are Mandić, A.; Newsome, D.; Naidoo, R.; and Spenceley, A.
		Institutions' collaboration: A collaboration network of 20 organizations resulted based on the co-authorship of documents. Most of these organizations are located in the USA (5) and Canada (4).
		Countries' collaboration: Based on the co-authorship network, the strongest collaboration was observed among China, Australia, the UK, the US, and Japan.

Source: own elaboration.

5. Conclusions

In light of the COVID-19 crisis, the UNWTO Secretary-General, on 5 June 2020, announced that sustainability should not only be accepted as a niche of tourism but the new norm for the entire sector. This was among the central elements of UNWTO's Global Guideline to Restart Tourism to secure better, more sustainable, and resilient growth, which would also contribute to the United Nation's Sustainable Development Goals [93]. The

World Travel and Tourism Council also reported on 19 August 2021 that “sustainability is our collective responsibility”, and it should be at the forefront of all the future policies to ensure a revival that benefits both people and the planet, especially now that COVID-19 has heightened the focus on sustainability [94]. Such proclamations of leading organizations in travel and tourism may be perceived as one of the major reasons to attract the interest of contemporary researchers toward tourism sustainability amid COVID-19.

The present study adopted bibliometric techniques to decipher and map the scientific literature and evolutionary nuances in the research field of COVID-19 and tourism sustainability. A total number of 440 documents published between 2019 and 2021 were retrieved from Scopus database for the purpose of analysis. While the performance of different research constituents was analyzed by using statistical techniques, the structure of knowledge was revealed through data exploration and network visualizations.

The growing number of publications, authors, sources, countries, institutions, citations, and collaborations between research constituents leads to the identification of *COVID-19 and tourism sustainability* as a significant and influential field of contemporary research. Based on the analysis of keywords, our findings reveal the concentration of research in three prime domains, namely management and sustainable development of tourism, environmental health, and mobility trends, in the context of COVID-19. These areas indicate the three clusters of trend research and evolutionary domains of research in the underlying field. The evolutionary research in the field reveals a rethinking of tourism sustainability, prompted by the COVID-19, which calls for transformative decisions of tourism practitioners and policymakers to reactivate tourism sustainably in the post-pandemic era [2,10,11].

This research contributes to our understanding of the bibliometric construct and knowledge structure of research that evolved around tourism sustainability amid COVID-19. The compilation of a growing number of documents led to the identification of trends and evolutions in the research field. Thus, aspiring researchers can recognize the most influential research areas, articles, authors, and sources. It would assist them in selecting a suitable and influential journal in which to publish their work, as well as deciding on possible international collaboration and collaborators in visualized countries and institutions.

To overcome the limitations of this study, future researchers may gather data from other prolific databases, such as the Web of Science. While the present bibliometric analysis is based on the three years of scientific literature in the given field, potential scholars may choose to expand the period of publications and combination of keywords. This will help to validate and extend the results of present analysis. As most of the findings rely on use of bibliographic software, a blend of manual and software processing can help refine the results.

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