

ANALYSIS OF SCIENTIFIC PRODUCTION IN THE FIELD OF SUSTAINABLE TOURISM: WEAVING NETWORKS OF KNOWLEDGE

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Abstract

The aim of this research was to investigate the dynamics of scientific production in the field of sustainable tourism, emphasizing the collaboration network, knowledge generated and the key authors and institutions that contribute to the advancement of knowledge. Information was collected from articles, books and proceeding papers using the Web of Science (WoS) platform from 1990 to 2018. A total of 7,051 documents were analyzed. Data were analyzed using network analysis and bibliometric indicators. Based on the information collected, scientific production linked on the economic pillar, particularly regarding terms such as sustainable tourism, tourism, management, sustainable development, sustainability, ecotourism and conservation. Thus, we found that the dynamics of collaboration in scientific production in sustainable tourism has a dense geographic network and proximity of themes as elements for structuring the knowledge network.

Keywords: Bibliometrics; Collaboration networks; Sustainability pillar.

1. Introduction

The annual growth of tourism activity generates income and employment, and it is often the main economic activity of a locality. This growth has positive and negative impacts, the latter being more frequent. Hence the need for alternatives that promote the sustainability of the location without devastating the physical and sociocultural space. In this conception, Körössy (2008) argues that the aspirations for sustainability come from academic, ideological and technological reflections on the current process of

social and economic development that lead to new ideas of thinking that address and act on the processes and phenomena of development.

From the perspective of tourism, it has been argued that sustainable tourism is a segment that seeks the balance of natural ecosystems, it is linked to local sustainability in which the visitor, who is open to new discoveries, understands the identity of the place and respects its customs (Hanai & Espíndola, 2011). The dynamics is in line with the definition of sustainable tourism established by the United Nations Environment Programme [UNEP] and World Tourism Organization [UNWTO] (2005) as one that “Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities.” (p. 12) Within this scenario, Niedziółka (2014) argues that sustainable tourism should also maintain a high level of tourism satisfaction and ensure a meaningful experience for tourists by raising awareness of sustainability issues and promoting sustainable tourism practices.

In the current scenario, research has endeavored to understand the dynamics of sustainable tourism. In this field, Buckley (2012) and Qian, Shen and Law (2018) argue that sustainable tourism are central elements in reflections in different fields of knowledge. Within this perspective, empirically studying the dynamics of scientific production is important to obtain a series of analyses that will provide a panoramic view and enable the understanding of the current state as well as visualize trends to understand the structure and dynamics of studies.

In this sense, the aim of the present study was to analyze how scientific production in the field of sustainable tourism is organized. Moreover, we intend to identify the authors, types of publications and fields of knowledge, analyze the themes adopted in the development of knowledge in the field of sustainable tourism and map the scientific collaboration network of institutions.

Among the studies on this theme, Buckley's work (2012) analyzed the scientific production of 250 selected articles on sustainable tourism with the following themes: population, peace, prosperity, pollution and protection, but found little adherence to these themes. Zolfani, Sedaghat, Maknoon and Zavadskas (2015) analyzed the scientific production on sustainable tourism in six databases from 1993 to 2013. Ruhanen, Weiler, Moyle and McLennan (2015) studied 492 papers from four journals, *Annals of Tourism*, *Journal Sustainable Tourism*, *Journal Research and Tourism Management*, and they concluded that the theoretical and methodological approaches have developed.

Adopting bibliometric techniques and having as the study object articles published in the *Journal of Sustainable Tourism (JST)*, the studies of Lu and Nepal (2009) analyzed articles published from 1993 to 2007; Mauleon-Mendez, Genovart-Balaguer, Merigo and Mulet-Forteza (2018) investigated publications over the last twenty years, and Qian et al. (2018) conducted a research from 2008 to 2017. Among these studies, Qian et al. (2018) propose that research be conducted to increase the database of journals in the fields of tourism and multidisciplinary fields to present a broader view of the status quo of research in sustainable tourism.

This is where this article aims to contribute. Thus, the present study is in agreement with the aforementioned studies and adds to knowledge by endeavoring to trace a profile and analyze the type of collaborative network on sustainable tourism from the data available on the Web of Science platform from 1990s to 2018.

To achieve the main purpose, the study is divided into three sections, in addition to the introduction. Next, in the second section, we present the methodological procedures. In section three we discuss the results, and in section four we present the concluding arguments of the study.

2. Data and Method

To meet the research objectives for the analysis of scientific production in the field of sustainable tourism, bibliometric indicators were chosen together with Social Network Analysis (SNA). The bibliometric indicators have been used for three purposes: to describe, monitor and evaluate scientific and technological activities (Santos, 2015). As for SNA, it was used to analyze the structure of scientific fields (Newman, 2001a, 2001b, 2004; Wagner & Leydesdorff, 2005; Corral, Kennan & Afzal, 2013) to understand behaviors and processes of the degree of connectivity of co-authors. Thus, the interaction between bibliometrics and SNA is an important instrument for analyzing the structure of science (Otte & Rousseau, 2002).

For information collection, we chose the Web of Science (WoS) platform, available on the Institute for Scientific Information (ISI) on the Web of Knowledge platform. The search for information took place on January 30, 2019. The search was restricted to articles, book reviews and proceeding papers published from 1990 to 2018. The decade of 1990 was chosen because it marks the beginning of discussions related to the term 'sustainability' after the United Nations Conference on Environment and Development (Eco-92), and the term 'tourism sustainable' began to be used in the scientific literature (Buckley, 2012).

The articles were located by using the term 'sustainable tourism'. After the articles were located, the data were extracted following two steps. The first step consisted of collecting files and exporting them to bib.excel, VOSviewer, Ucinet and Netdraw software. The information was then organized in tables and figures and submitted for analysis. The variables collected during this stage were: number of articles published, year of article publication, author and co-author affiliation, language, field of knowledge, journal title and citation frequency of the article.

To analyze the cooperation pattern among institutions, we adopted two SNA-specific metrics, measures of centrality and density. We chose these indicators because it is possible to verify how knowledge sharing takes place among the institutions with greater cooperation levels (Grácio, 2018).

The second step consisted of collecting keywords and abstracts. Considering the extensive number of keywords, we decided to select those with 50 or more co-occurrences. The choice was based on the understanding that when the authors choose the keywords, they acknowledge the association between certain terms, and thus it can be assumed that this relationship has a meaning within the field of study (Robredo & Cunha, 1998).

As for the abstracts, only those with 140 or more citations were analyzed. Thus, thirty-six articles composed the sample to identify on which pillars of sustainable tourism and themes knowledge was based on. The choice to work with the most cited articles was due to the understanding that by citing certain authors in the discussion section of an article demonstrates the proximity of issues between the cited authors from the perspective of citing authors (Grácio & Oliveira, 2013). Thus, the incidence of co-citation

may represent research foci with similar themes, but different approaches (Braam, Moed & Van Raan, 1991), which was a way of monitoring emerging themes in the study area.

To organize the process of collecting and systematizing information, the four pillars of sustainable tourism were adopted as reference, as proposed by Bruyn (2014), as they contain the “Framework for tourism sustainability” that establishes the corresponding terms to the four pillars of sustainable tourism and presents the dimensions and elements linked to these pillars. This document was chosen because it is in line with the twelve objectives and five pillars of sustainable tourism proposed by World Tourism Organization [UNWTO] (2013) and is in agreement with the studies by Janusz and Bajdor (2013). By using this document, it was also possible to relate the researched themes with the terms included in each pillar of sustainable tourism, as shown in Table 1.

In an endeavor to verify which pillar has been discussed in the scientific production, we decided to categorize the clusters based on keywords using those with a largest number of co-occurrences and the most cited articles. The latter took into account the approach of discussions based on what was seen in the abstracts of the thirty-nine most cited articles. Thus, to include the article within the pillar of sustainable tourism, content analysis was adopted as it enables the researcher to categorize, describe and interpret the content of documents and texts (Bardin, 2006; Mozzato & Grzybovski, 2011).

Due to the interdisciplinary nature of the research in the field of sustainable tourism and given the possibility of themes and studies that would allow them to be categorized into more than one pillar, we opted to include the article in a single pillar. This dynamic took into consideration the dynamics discussed in the abstract as well as the subjective view of the researchers during the reading.

Table 1 – Framerwok for tourism sustainably: Dimension, Element and goal assigned to “Pillar” of sustainability.

Sustainable tourism pillars	Dimension	Element	Goal
Economic Pillar	Tourism Satisfaction and Seasonality	Tourism Seasonality	Defined as the generation of prosperity at different levels of society and addresses the cost effectiveness of all economic activities.
		Tourism satisfaction	
	Supply chain	Leakages	
		Tourism Operations & Services	
	Business Development	Investment	
		Macro Economic	
		SMME Support	
	Marketing, Branding and Competitiveness	Positioning	
		Product Demand	
		Sustainability offer	
Community Participation	Community Participation	Based on the respect of human rights and equal opportunities	
	Community Satisfaction		Community Satisfaction

Socio-Cultural Pillar	Living Culture	Living Culture	for all members of society requiring an equitable distribution of benefits. The social and cultural heritage of the area plays an important role in tourism, particularly in areas with high cultural or artistic value, or in places where local traditions and values play a significant role.
	Socio Economic Employment	Socio- Economic	
		Employment	
Environmental Pillar	Natural Resources Management	Energy	Defined as the conservation and management of resources, including natural and cultural resources, bio-diversity and waste management.
		Water	
		Climate change	
	Waste Management (Limiting impact on tourism activity)	Solid Waste	
		Residual Water Waste	
	Bio- diversity Management	Habitat	
		Species	
	Cultural Resources Management	Protection	
		Preservation	
Historic Designation			
Transversal Pillar	Global governance	Funding	Provides support to the Economic, Socio-Cultural and Environmental pillars.
		Legislation	
		Monitoring	
	Safety and Security	Safety and Security	
	Destination Planning	Destination Planning and Control	
Infrastructure, Services and User Intensity	Transportation		

Source: Adapted from Janusz and Bajdor (2013), UNWTO (2013); Bruyn (2014).

The information was processed in the software as described below:

1) Bibexcel (Umeå University, Umeå, Sweden) was used for extracting scientometric data and create the frequency files; 2) VOSviewer version 1.6.9 was used to visualize clusters and co-occurrence networks; 3) Ucinet, version 6 (Borgatti, Everett & Freeman, 2002) was used to calculate of centrality and density measurements; 4) Netdraw version 2.09 (Borgatti, 2002) was used to build the co-authoring networks of the most collaborative institutions. Figure 1 systematizes the procedures adopted for data collection and analysis.

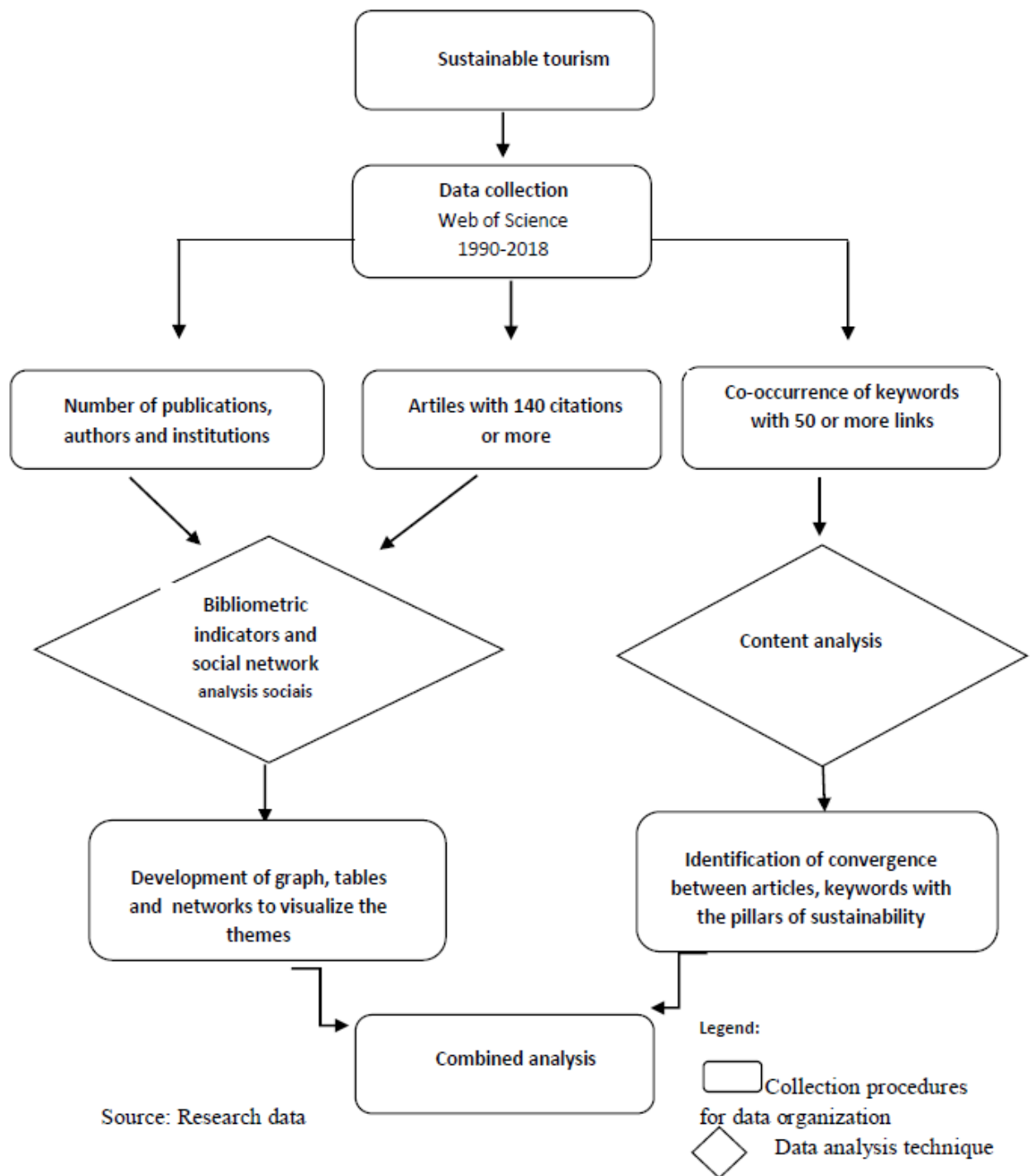


Figure 1 – Flowchart of the method used to collect and analyze data.

Based on the procedures described above, the following section is dedicated to discussing the analysis of the results related to scientific production in sustainable tourism.

3. Analysis of results

3.1 Outlining the profile of the scientific production network on sustainable tourism

The scientific production network in the field of sustainable tourism consists of 13,835 researchers in the category of authors (29.34%) and coauthors (70.66%) and 7,051 publications during the period under study. These professionals are affiliated to institutions in 150 countries.

The scientific production network has an average of 3.58 authors per publication and an average of 3.35 institutions. The largest number of coauthors was 24 from 5 different institutions. To disseminate the research results, researchers used different types of publications: articles (60.07%), proceedings papers (34.30%), book reviews (1.81%), and others (3.82). Regarding language, there was a prevalence of English (92.76%), followed by Spanish (3.52%), and other languages (3.72%).

Taking as a parameter the period from 1990 to 2018, we found that scientific production on sustainable tourism increased considerably in the 2000s (Figure 2), with emphasis on the periods between 2010 and 2018, which, in relation to the previous quadrennium periods, showed considerable increase (78.67%). Dynamics show a growing interest among researchers that enabled the dissemination of knowledge in this field of study.

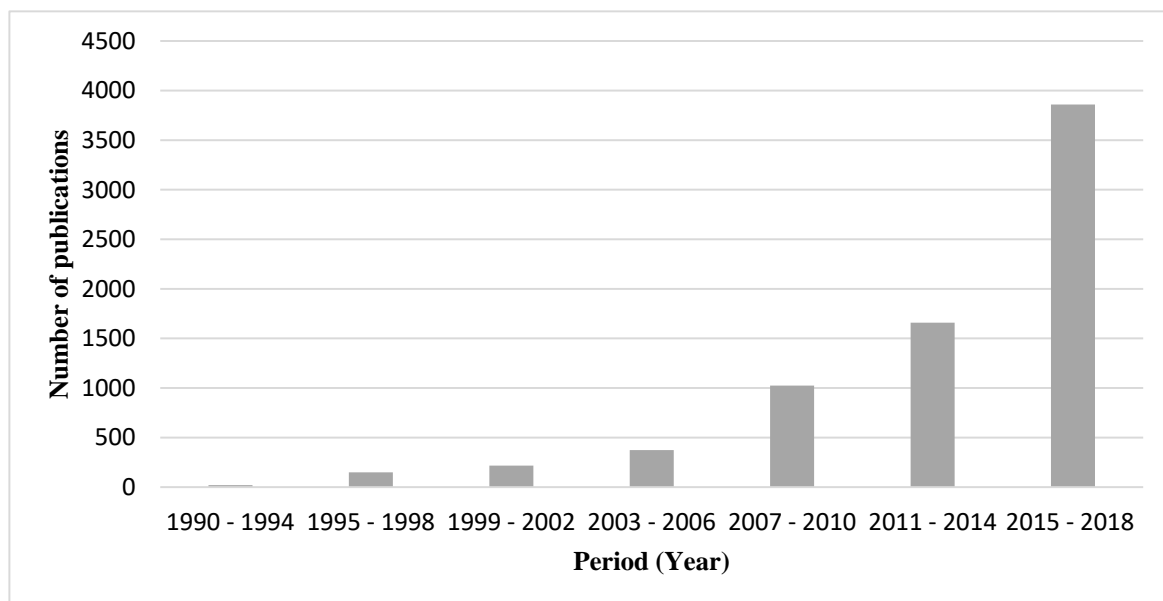


Figure 2. Evolution of scientific production in the field of sustainable tourism. Web of Science, 1990-2018.

Source: Research data

Regarding the articles available on WoS, we found that the researchers contributed to 918 journals, particularly in the Journal of Sustainable Tourism, which was the first journal created to promote critical and innovative thinking regarding the relationship between sustainability and tourism (Qian et al., 2018). As for the impact factor, the largest number of articles were published in journals with an index between 0.6 and 5.6 (Table 2).

Table 2. Journals with the largest number of articles published (frequency ≥ 30) and their impact factor. Web of Science, 1990-2018.

Journals	Number of articles	Impact factor
Journal of Sustainable Tourism	404	3,32
Sustainability	214	2,07
Tourism Management	209	5,92
Annals of Tourism Research	90	5,08
Journal of Cleaner Production	72	5,65
Current Issues in Tourism	65	3,46
Ocean Coastal Management	63	2,27
Journal of Environmental Protection And Ecology	57	0,67
Journal of Coastal Research	50	0,80
Asia Pacific Journal of Tourism Research	48	1,35
Tourism Geographies	48	2,06
International Journal of Sustainable Development And World Ecology	45	2,37
International Journal of Tourism Research	45	2,44
Journal of Travel Research	38	5,16
Marine Policy	38	2,10
Tourism Management Perspectives	38	1,77
Tourism Planning Development	35	-
Amfiteatru Economic	33	0,66
Worldwide Hospitality and Tourism Themes	32	-
Pasos Revista de Turismo y Patrimonio Cultural	30	-

Source: Research data

In a study conducted by Qian et al. (2018), the publications in the Journal of Sustainable Tourism, Tourism Management and Annals of Tourism Research appear among the most cited journals, which indicates that they are a reference in the field of sustainable tourism.

Analyzing the knowledge area of the published articles we found that knowledge in sustainable tourism is connected to the following areas: Social sciences or other topics, Environmental Sciences Ecology, and Science Technology or other Topics (Figure 3).

Social sciences other topics (36,97) Enviromental Sciences Ecology (20,29) Science Technology Other Topics(14,47) Engineering (7,04) Sociology (4,86) Geography (4,80) Geology (3,63) Water Resources (3,21) Computer Science (3,03) Urban Studies (2,82) Education Educational Research (2,42) Physical Geography (2,15) Agriculture (2,07) Biodiversity Conservation (1,89).

Figure 3. Cloud of words related to the knowledge area (percentage) of articles published in the field of

Sustainable Tourism. Web of Science, 1990-2018.

Source: Research data

Regarding the three areas with the highest percentage of articles, it can be seen that the nature of research in the field of studies called multi and interdisciplinary (Zolfani et al., 2015) consist of a set of disciplines that discuss various topics, as it can be seen in the keyword network analysis used by the researchers.

The list of keywords used in the articles published in the study area is shown in Table 3. The table makes it possible to visualize the terms that surround scientific production and, consequently one can see their correspondence with the pillars of sustainable tourism mentioned in Table 1.

Considering and analyzing the group of the keywords with more than 50 co-occurrences as reference, five groups were formed by the clusters, according to the similarity pattern of words used. It should be noted that the closer the keywords are, the more they complement knowledge generated and linked on the network.

Table 3. List of keywords with the highest co-occurrence in the field of sustainable tourism, organized by cluster and pillar. Web of science, 1990-2018.

Keywords	Cluster and pillar				
	1	2	3	4	5
Attitude		EC			
Behavior			EC		
Climate change					EM
Communities		EC		SC	
Conservation				EM	
Destinations	EC				
Economic	EC				
Ecotourism		EC		EM	
Environmental	EM				
Governance		EC			
Heritage			SC		
Impact	EC	SC			
Indicators		EC			
Industry	EC				
Management		EC		SC	
Model		EC			
Participations		SC			
Responsability	EC				
Rural tourism	EC				
Sustainability	EC	EC	SC		TR

Sustainable development	SC	EC			
Sustainable tourism	EM	EC			
Tourism	EC	TR	SC	EM	

Note: EC - Economic pillar, Socio-cultural pillar (SC), Environmental pillar (EM), and transverse pillar (TR)

When analyzing the keywords with the highest occurrence, we found the following: sustainable tourism, tourism, management, sustainable development, sustainability, ecotourism and conservation. Among the terms, “sustainable tourism”, “tourism” and “ecotourism” were among the most cited words in research by Mauleon-Mendez et al. (2018). The term ecotourism appears in the research conducted by Qian et al. (2018), which formed a cluster.

When relating the keywords with the pillars of sustainable tourism, the focus of studies is on the Economic (EC) pillar, and there are fewer studies on the socio-cultural (SC), environmental (EM), and transverse pillar (TR) perspective. A possible justification for this dynamic may be because seminal studies are linked to the themes on tourism, economics and environmental management (Buckley, 2012).

It is worth noting that among the themes in the scientific production, there are few discussions on the themes that address the terms “habitat” and “species” in the dimension of “Bio-diversity Management” listed on the Environmental pillar. When addressing these issues, the literature takes an interdisciplinary approach to address biodiversity management by using the term “ecological footprint” (Gossling, Hansson, Hörstmeier& Saggel, 2002), to understand tourism by focusing on conservation of endangered species and habitats (Kruger, 2005), and analyze the impact of commercial activity on the environment (Primavera, 2006).

As for the transverse pillar perspective, studies do not discuss the themes “funding” and “legislation”, included in the dimension of “Global governance”. A possible explanation for this situation may be because they have a more technical approach containing information from reports and documents, such as the studies by UNWTO (2013), Bruyn (2014), World Tourism Organization [UNWTO] (2017) and Organisation for Economic Co-operation and Development [OECD] (2018).

To understand what is being studied and proposed by the three most frequently occurring words and the thirty-nine most cited articles (Table 3), we found that studies using the term ‘sustainable tourism’ focused on the analysis of research developed in the field of sustainable tourism (Buckely, 2012), development of indicators (Miller, 2001), suggestions of tools to evaluate tourism sustainability (Gossling et al., 2002), studies on the experience of visitors and local consumers (Sims, 2009), and governance following a political economy approach (Bramwell, 2011). The term ‘tourism’ refers to studies that deal with environmental consequences (Gossling, 2002), eco-efficiency (Gossling et al., 2005), further understanding of the concept of tourism (Farrell& Twining-Ward, 2004) and mindful visitors (Moscardo, 1996).

Regarding the term ‘management’, we found studies that address the proposal of sustainability indicators for the study of management of community tourism (Choi& Sirakaya, 2006), tourist destination (Mihalic, 2000), heritage tourism (Garrod& Fyall, 2000), and they apply the stakeholder theory as a model for normative planning and relationship strategy (Sautter& Leisen, 1999).

The most frequently cited articles are those that adopt a theoretical discussion and point to definitions, such as the studies by Hunter (1997), Gossling (2002), Choi and Sirakaya (2006) and Saarinen (2006).

Table 4. Organization of the thirty-nine articles with the highest number of citations in the field of sustainable tourism by pillar of sustainable tourism. Web of Science, 1990-2018.

Pillar	Articles
Economic	(Mihalic, 2000); (Miller, 2001); (Font, 2002); (Gossling et al., 2002, 2005); (Wang & Fesenmaier, 2004); (Aguilo, Alegre & Sard, 2005); (Choi & Sirakaya, 2006); (Garrod, Wornell & Youell, 2006); (Okazaki, 2008); (Dwyer, Edwards, Mistilis & Roman, 2009); (Sims, 2009); (Miller, Rathouse, Scarles, Holmes & Tribe, 2010); (Bateman, Georgina, Fezzi, Atkinson & Turner, 2011); (Bramwell, 2011); (Nunkoo & Ramkissoon, 2011); (Gossling, Scott, Hall, Ceron & Dubois 2012).
Socio-Cultural	(Moscardo, 1996); (Garrod & Fyall, 2000); (Briassoulis, 2002); (Kiss, 2004); (Sims, 2009); (Barr, Shaw, Coles & Prillwitz, 2010); (Ballantyne, Packer & Sutherland, 2011); (Lee, 2013).
Environmental	(Reynolds & Braithwaite, 2001); (Gossling, 2002), (Loumou & Giourga, 2003), (Bejder et al., 2006); (Aburto-Oropeza, Ezcurra, Danemann, Valdez, Murray & Sala 2008).
Transverse	(Hunter, 1997); (Sautter & Leisen, 1999); (Hall, 2001, 2011); (Ryan, 2002); (Kruger, 2005); (Primavera, 2006).

Source: Research data

By analyzing the clusters generated through the co-occurrence of words and the most cited articles (Table 4), we found that studies generally focus on impacts, attitudes, perceptions, determinants, perspective, collaboration, climate change, governance, policy, biodiversity, and their study objects are: stakeholders, communities, national parks, protected areas and policies. These studies also seek to discuss models, indicators and theoretical frameworks.

This result leads us to infer that the practice of sustainable tourism requires planning, development and use of sustainability indicators to improve tourism management, participation of the local community in the planning and monitoring of activities, and partnerships that combine governments, private enterprises and communities (Ruhanen-Hunter, 2006; Graci & Dodds, 2010).

In this aspect, the term 'management' requires further explanation. The summary representation of content analysis shows that the studies are largely connected to research conducted by researchers residing in Oceania, particularly New Zealand and Australia. From this perspective, it must be pointed out that one third of New Zealand's territory is under protection including world heritage sites, national, maritime and forest parks and wilderness areas.

Tourism is a key component of New Zealand's economy, contributing 3.3% of gross domestic product (Simmons, 2013). In addition, New Zealand ranks second place, second only to Australia, among the top ten sustainable tourism reference economies, and it has an official quality warranty system for

assessing the level of environmental sustainability of businesses in the tourism sector.

It is noteworthy that some peripheral themes that have a lower number of link strengths (e.g. governance, perception, attitudes, climate change, heritage, communities, destinations) presented a high frequency and interact with the themes with the highest number of link strengths.

Another point to keep in mind is the geographical dimension that the authors adopted in the research. Among the countries studied, the largest number of studies were from Australia, New Zealand, Canada, South Africa and China.

When analyzing the geographical location of institutions where the researchers live, China is responsible for 17.86% of the articles published, ranking first, followed by the USA with 8.82%, and Australia (7.47%). The dynamism presented by China follows a world trend. According to data presented by Tollefson (2018), China ranked first in number of scientific publications, surpassing the United States in 2018. Among these results, except for China, the other countries included in the study conducted by Lu and Nepal (2009) indicate the significance of these countries, as well as the awakening of Chinese researchers to the study of sustainable tourism. It should be noted that China, together with the United States and Germany, are the countries that receive the largest number of tourists in the segment 'overnight visitors' (UNWTO, 2017).

3.2 Authors

Table 5. Authors by number of publications and number of citations in the field of Sustainable Tourism, 1990-2018.

Author	Number of publications	Number of citations	Average of citations	Total Strong links	University	Country
Gossling, S.	30	1782	59,4	36	Lund U.	Sweden
Hall, C.	21	844	40,19	23	U. of Canterbury	New Zeland
Scott, D	10	654	65,40	20	W. of Waterloo	Canada
Bramwell, B.	24	648	27	25	Sheffield Hallam U.	UK
Nunkoo, R.	13	512	39,38	9	W. of Waterloo	Canada
Ramkisson, H.	9	495	55	8	Curtin U.	Australia
Dolnicar, S.	14	484	34,57	3	U. of Queensland	Australia
Miller, G.	10	458	45,8	12	University of Surrey	UK
Hunter, C.	7	455	65	1	University of Aberdeen	UK
Saarinen, J	13	428	32,92	2	University of Oulu	Finlandia

Source: Research data

Regarding the most influential authors (Table 5), the largest number of publications and citations was for the author Gossling, S. In a detailed analysis of publications, scientific production was related to sustainability and focused on transport, mobility, energy and water. The main authors were Paul Peeters

(Peeters, P.), affiliated to the NHTV Breda University for Applied Sciences, and Daniel Scott (Scott, D.) from the University of Waterloo.

Among the most cited articles (195 citations), the theme “Consumer behavior and demand response of tourists to climate change” (Gossling et al., 2012) was the most frequent. The article has three coauthors, among which Gossling, S. is one of them, who has the largest number of articles, as mentioned above. This article is one of the ten most cited on the WoS platform related to the scientific production of sustainable tourism. It is important to highlight that these authors have been collaborating since 2008, and five articles focusing on discussions on climate change and tourism are the result of their partnership.

The data shown in Table 5 are similar to the research conducted by Qian et al. (2018), in which five authors are among the ten most cited. Their work is convergent with the studies by Mauleon-Mendez et al. (2018), which among the fifty most productive authors, four (Okazaki, 2008; Sims, 2009; Bramwell, 2011; Hall, 2011) appear in the present study. Another author who draws attention is Gossling, S., who was the most productive, which is in line with the present study. Given that the research was restricted to the Journal of Sustainable Tourism (JBS), and it is the only one in the Web of Science database, it is understood that, irrespective of the breadth of research, the above-mentioned authors are the most representative ones in the field of sustainable tourism.

By correlating the overall number of publications and citations, academic production has a low correlation with the number of citations. The correlation coefficient revealed a significant result ($R^2 = 0.47$ and $p = 0.05$). Within this scenario, one must draw attention to the author Garrod, B., who has 5 publications with 624 citations, an average of 124.8 citations for each article, while Gossling, S. has an average of 74.10 citations per publication. An analysis of the first author’s curriculum reveals that he is affiliated to Swansea University and his research focuses on the fields of destination marketing and management, heritage tourism, ecotourism, sustainable tourism and cultural marketing. The second author is a professor at Linnaeus University, and he conducts research on tourism and climate change, tourism and development, renewable energy, low-carbon tourism and climate policy.

3.3 Institutions

The scientific production in the field of sustainable tourism included 4,573 institutions. Among these, nine institutions stand out for having a larger number of publications (Table 6). From the data shown in Table 6, production from the Griffith University ranks first position in number of documents, followed by the Chinese Academy of Sciences. When analyzing the country of the institutions studied, Australia and China rank higher than other countries.

Table 6. Institutions with the greater number of publications on sustainable tourism, 1990-2018.

Institutions	Country	Number of publication
Griffith univ	Australia	110
Chinese acad sci	China	72
Univ queensland	Australia	69
Tianjin Univ Finance & Econ	China	56
Bucharest Univ Econ Studies	Romania	49
Hong Kong Polytech Univ	China	49
Univ Waterloo	Canada	49
Univ Johannesburg	South Africa	44
James Cook Univ	Australia	40

Source: Research data

As for the collaboration network, only the institutions with five or more partnerships were selected and the VOSviewer software combined 391 institutions. Regarding the sharing of knowledge, the institutions were grouped into 29 clusters. Due to the large number of institutions in the study, the analysis of institutional collaboration was conducted with the group of 13 institutions with the highest frequency of collaboration and the VOSviewer software identified the number of link strengths. After the institutions were identified, the institutional collaboration network was built using the NetDraw software, as shown in Figure 4.

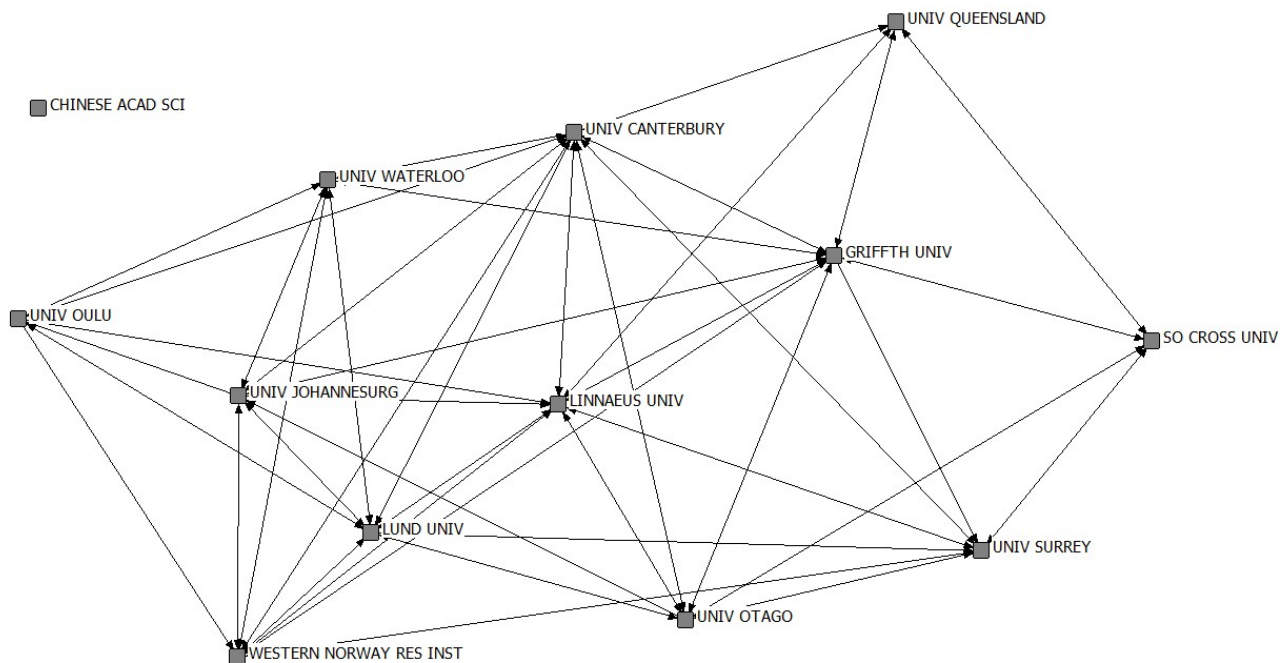


Figure 4. Institutional collaboration network in the field of sustainable tourism, 1990-2018.

Source: Research data

Geographic analysis of the most collaborative institutions revealed that they are located in the continents of Oceania (New Zealand and Australia), Europe (Sweden, Finland and England), East Asia

(China), and North America (Canada).

It is noteworthy that five institutions are located in two countries (Australia and New Zealand) in the continent of Oceania. This may be because Australia and New Zealand rank first and second position, respectively, among the economies that appear as a reference for sustainable tourism (Bruyn, 2014).

In an overview, the mentioned institutions offer graduate courses, master’s and PhD degree programs in the field of sustainable tourism.

In the analysis by institution, Griffith University has the highest number of link strengths and, consequently, it attracts the largest number of partnerships. This university was the first institution in Australia to offer courses in Tourism and Hotel Management and it has become a reference in the field. Currently, it offers a bachelor’s degree in International Tourism and Hotel Management and a master’s degree in International Tourism and Hospitality Management, which aim to train human resources in international tourism and hotel management.

Another institution with the highest number of link strengths is Canterbury University. It is located in New Zealand and the institution offers human resources training courses, particularly in Tourism Management, and the professors and students focus on developing different research studies on conservation and tourism.

Table 7. Centrality and density measurements of the scientific production network in Sustainable tourism, 1990-2018.

Network metric	Network of average	Featured institution
Intermediation centrality	-	Griffith Univ; Univ Canterburry
Centrality degree	11,76%	Griffiht Univ; Univ Canterbury
Flow of intermediation centrality	5.97%	Griffith Univ; Univ Canterburry;
Density	51%	-

Source: Research data

Based on the analysis of network metric, Griffith University and Canterbury University play a major role in the transmission of information, given that they have greater representativity in the intermediation centrality measure. It should be noted that these institutions are a bridge for peripheral actors in the network to connect to them.

Amid these discussions, the centrality degree index of the network (11.76%) shows that the probability of all institutions accessing all that is circulating in the network is low (Table 7).

When analyzing the centrality degree index, Griffith University and Canterbury University have the greatest number of ties and therefore play a key role in the collaboration network structure of Sustainable Tourism, as it is a link between the institutions. The flow of intermediation centrality shows that the importance of these institutions is not restricted to the number of direct contacts they maintain, but the number of contacts they intermediate. Thus, these institutions are important intermediary agents for the development of knowledge in the field of sustainable tourism. On the other hand, the Chinese Academy of Sciences has no ties with the other universities mentioned in this study. In a detailed analysis

of collaboration of the Chinese Academy of Sciences, this dynamic may be explained due to its greater cooperation with universities located in East Asia, which suggests that geographical proximity plays an important role in facilitating interaction among Chinese researchers.

The collaboration network under study has a density of 51%, indicating good connectivity (Carpenter, Baver & Erdogan, 2009).

In the analysis of the cluster, Griffith University maintains a cooperation pattern with other institutions located in the European continent. As for Canterbury University, a partnership pattern was observed with institutions in the Asian, European and African continents.

By correlating the institutions of the authors with the largest number of publications (Table 5) and the institutions with the largest number of publications (Table 6), we found that only the University of Waterloo and Queensland University belong to both scenarios. From this perspective, the dynamics of collaboration in the field of sustainable tourism is not due to the most prolific authors, but rather due to several authors who promote interaction in the co-authoring network. This perspective enables us to understand the importance of weak ties, which enable researchers with different characteristics (language, geographical location, etc.) to be connected to a theme and expand the knowledge network as well as create new research opportunities (Granovetter, 1973, 1983; Castells, 2018). Regarding the strong ties, most cited institutions and authors in this article are key elements for the development of scientific collaboration network in the field of sustainable tourism, as they assist the weak ties and provide theoretical support for research.

4. Conclusion

Based on what has been discussed, scientific production is based on the economic pillar, particularly regarding the terms of sustainable tourism, tourism, management, sustainable development, sustainability, ecotourism and conservation. On the other hand, there are gaps in the literature regarding the themes related to 'funding' and 'legislation' included in the transverse pillar.

Irrespective of the scope of the research, the most productive authors cited in this study are the most representative ones in the field of sustainable tourism. As for the most cited authors, studies that have adopted a theoretical framework and definitions are top on the list.

As for the collaboration network structure, Griffith University and Canterbury University are the ones that expedite the transmission of information and mediate knowledge in the network under study.

Among the institutions analyzed, the Chinese Academy of Sciences is noteworthy, although it is not among the most productive institutions, because it has an intense cooperation pattern among institutions in East Asia. However, no centrality index scores were found for the Chinese Academy of Sciences and, consequently, it does not cooperate with the other institutions in this study. Thus, it is interesting to note that this institution maintains almost exclusive partnerships with universities located in East Asia. This suggests that this institution relies on geographical proximity as an element for structuring knowledge.

The data allow us to conclude that the scientific collaboration network in the field of sustainable tourism is characterized by good connectivity (density) and geographical proximity.

We suggest further studies to investigate the collaboration network of the most cited authors to

better contextualize the development of scientific knowledge in the field as well as to verify the dynamics of scientific production in 'sustainable tourism' in countries located in the Asian continent, particularly China due to its increasing participation in scientific production, as we have discussed in this article.

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