Scientific literature on information and Communication technologies in ecotourism

Literatura científica sobre tecnologías de la información y la comunicación en ecoturismo

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Artículo de investigación científica y tecnológica

***Abstract*— The objective of this article is to identify the scientific production in the use of information and communication technologies (ICT) in the contribution and promotion of nature tourism. Its methodological development was built from a work of scientific bibliometric analysis under an exploratory-quantitative character, allowing the integration and application of statistical processes expressed from the technological tools used such as VosViewer, SciMat, and Bibliometrix of R. The indicators used emphasized academic activities (publications, dispersion, collaboration) and impact at the level of citation, co-citation, and impact factor, The scientific production extracted for the search period between 2011 and the first semester of 2020 was 356 documents. As a result, the analysis and graphs of the evolution of publications, geographical origin, and types of documents were obtained, as well as the themes and trends associated with technologies and the analysis of journals, authors, citations, and influential keywords, the large number of tourism proposals implemented in the world on natural environments and supported with digital technologies for their development, This reality is reflected in the documents generated in the last five years, where 212 articles in 129 journals have reflected this evolution. To conclude with a quantitative analysis of each of the categories studied and the examination of the inclusion of ICT in nature tourism, based on the publications in the Scopus database. The areas in which the publications are located are focused on environmental, social, agricultural, ICT, and biological sciences, where the context of the publications is based on the new tourism alternatives that seek the protection of natural resources, the low impact on the environment, the monitoring of sites and tourists and the control of the spaces in which this economic activity is carried out, supporting many countries, especially those of the emerging economies. A total of 216 journals were identified.**

***Index Terms*— Bibliometrics, Green tourism, Information technology, Scientific computing, Telecommunication.**

***Resumen*— El objetivo del artículo es identificar la producción científica en el uso de las tecnologías de la información y la comunicación (TIC) en el aporte e impulso del turismo de naturaleza. Su desarrollo metodológico se construyó a partir de un trabajo de análisis bibliométrico científico bajo un carácter exploratorio-cuantitativo, permitiendo integrar y aplicar procesos estadísticos expresados desde las herramientas tecnológicas usadas como VosViewer, SciMat y Bibliomterix de R. Los indicadores utilizados se enfatizaron en actividades académicas (publicaciones, dispersión, colaboración) y en impacto a nivel de citación, co-citacion, factor de impacto, La producción científica extraída para periodo de búsqueda comprendido entre el año 2011 y el primer semestre de 2020 fue de 356 documentos. Como resultados se obtuvieron los análisis de la evolución de publicaciones, procedencia geográfica y tipos de documentos, al igual las temáticas y tendencias tecnologías asociadas y el análisis de revistas, autores, citas y palabras claves influyentes, el gran numero propuestas turísticas implementadas en el mundo sobre los entornos naturales y apoyadas con tecnologías digitales para su desarrollo, esta realidad se refleja con los documentos generados en los últimos cinco años donde 212 artículos en 129 revistas han reflejado esta evolución . Para concluir con un análisis cuantitativo de cada una de las categorías estudiadas y el examen de la inclusión de las TIC en el turismo de naturaleza, basándose en las publicaciones en la base de datos de Scopus. Las áreas en las cuales las publicaciones están ubicadas se centran en las ciencias ambientales, sociales, agrícolas y biológicas en donde el contexto de las publicaciones se fundamenta alternativas turísticas que buscan la protección de los recursos naturales, el seguimiento de sitios, turistas y el control de espacios donde se desarrolla esta actividad sobre todo los de economías emergentes. Para ello se identificaron un total de 216 revistas.**

***Palabras claves*— Bibliometría, Computación científica, Tecnologías de la Información, Telecomunicaciones, Turismo verde.**

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I. INTRODUCTION

THE development of nature tourism seeks the establishment of the sustainable development goals proposed by the United Nations to incorporate the economic, social, and environmental dimensions that intercept the sustainability of alternative tourism models. Some proposals focus on sustainable tourism to improve regions and encourage visitors' spending while preserving the environment and the quality of life of the community [1]–[3]. In addition, others are responsible for identifying ecotourism development capabilities as one of the most important priorities of any country based on sustainable development [4],[5].

The high availability of georeferenced databases as well as the widespread use of GIS (Geographic Information Systems) is materializing in the proliferation of studies that analyze the distribution patterns of tourist territories, land use, identification of potential sites ecotourism, spatial restructuring, remote sensing, monitoring, and visitor occupation, among other actions, are used to strengthen nature tourism with the transversality of technologies [6]–[12]. As a result, ICTs are presented as strategies to support and promote sustainable tourism development in the territories [13]–[15].
This article contributes to the literature by identifying the inclusion of information and communication technologies (ICTs) in nature tourism by using scientific mapping to inform and synthesize research conducted between 2011 and the first half of 2020. The methodological design is built based on the exploratory method with a quantitative approach. The research questions were developed to achieve a bibliometric review of ICT and nature tourism. The following are the research questions: PI1: What are the characteristics of academic papers on the inclusion of information and communication technologies in nature tourism published between 2011 and 2020?; PI2: What is the intellectual structure of the knowledge base on the inclusion of information and communication technologies in nature tourism?; PI3: Which journals, authors, and documents on the inclusion of information and communication technologies in nature tourism have achieved the greatest academic impact?. This bibliometric review identified 427 documents exported from the Scopus database. R's Scopus, Excel, VOSviewer, SciMat, and Bibliometrix software are used to carry out a set of statistics, citations, analyses, and concurrency employed in scientific mapping studies [16]–[18].

The article is organized as follows: Section 3.1 is an analysis of the evolution of publications, their geographical origin, and types of documents. Scientific production is expressed for durations, their sources, and relationships to end with the types of documents extracted. Section 3.2 carried out the thematic analysis and trends in technologies associated with nature tourism. The purpose of this section is to visualize the evolution of motor themes, the relationships between them, and the few developed and marginalized. Section 3.3 deals with the analysis of influential journals, authors, quotations, and keywords. To do this, the frequencies of journals, citations, and keywords reflect the attention and impact of researchers on this scientific mapping.

The purpose of this article was to develop a significant reference on work carried out on the inclusion of ICTs to support nature tourism. Scopus is selected as a data source due to its large volume and high impact. For researchers in information and communication technologies in nature tourism, bibliometric methods provide a great deal of knowledge in trends, citations, journals, organizations, and authors, among other relationships. The strategies for the use of ICT in nature tourism are increasing, but the implementations are scarce. The article provides a valuable reference in this synergy. It is also a support to those interested in these review methods.

II. MATERIALS AND METHODS

The article does address a scientific bibliometric analysis under an exploratory-quantitative character. Allowing to integration and application of statistical processes expressed from the technological tools used for this mapping such as VosViewer, SciMat, and Bibliomterix of R. The indicators used were emphasized in academic activities (publication production, collaboration, thematic evolution, indexing, groupings, and coupling) and the impact at the citation level (co-citation, impact factor, analysis of titles, summaries, and keywords). In this way, the interpretation of academic productivity and international trends is clear.

His proposed methodology was based on the concepts presented by [20], reflected in Fig 1. The following are the activities: definition of the questions to be investigated, the structure of the search, review of the documents, classification according to the abstracts, and systematic mapping [20].

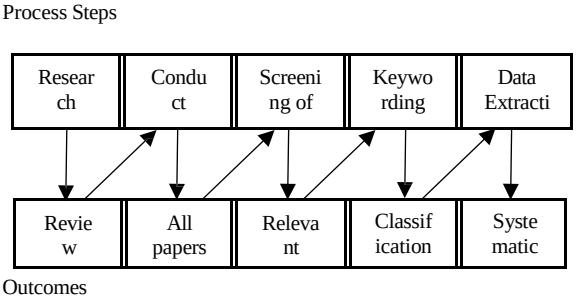


Fig. 1 Methodology of the scientific mapping study. Source: Scientific Mapping Study Methodology (SMS) [21].

A. *Research questions*

According to [21], within its theoretical framework, the initial approach must present a set of scientific questions. Three research questions were defined to establish the knowledge developed to date about the study. Seeks to implement a systematic mapping to identify scientific production in the use of ICT in the contribution and boost of tourism of nature.

- What is the evolution of publications, their geographical origin, and the types of research developed?
- What is the research carried out, its principal focuses, and topics of interest?
- What are the most cited authors and works, associated technologies, and commonly used keywords?

The purpose of the questions is to identify the technologies, components, and systems used in the promotion, implementation, and support of tourism of nature.

B. Search development

The Scopus database does use for the selection of primary studies. It is currently the largest multidisciplinary database of peer-reviewed citations and literature summaries [22]. Scopus was launched in 2004 and contains more than 70 million records published in more than 25,100 titles (5,500 open access) in nearly 5,000 international publishers, offering the most comprehensive picture of the production of world research in the fields of science, technology, medicine, social sciences, and the arts and humanities [23].

The choice of this database is justified by the indexation coverage of scientific journals related to tourism [24], [25] and the support of technological tools specialized in scientific mapping that make the reception of the files generated by Scopus.

As a strategy for finding scientific production associated with the use of technology in nature tourism, a search expression is defined based on the tools offered by Scopus for this task. This expression used connectors (“AND” and “OR”) and quotation marks for accuracy in scanning, a date limitation was made seeking to minimize results (between 2011 and the first half of 2020). The following was the expression used in court in July 2020 that generated a set of 427 documents.

TITLE-ABS-KEY (("ecotourism" OR "nature tourism" OR "eco-tourism" OR "rural tourism") AND ("ICT" OR "social networking" OR "virtual reality" OR "augmented reality" OR "Sensor" OR "IoT" OR "Big data" OR "NFC" OR "Li-fi" OR "WEB" OR "mobile" OR "GIS")) AND PUBYEAR > 2010.

For bibliometric analysis, records of the 427 documents were downloaded from the Scopus source. The exported file is in CSV format (comma-separated values). The download included metadata about citation information, bibliographic information, summary, keywords, and citation indices. This information was initially reviewed in the Microsoft Office Excel software, and VOSviewer, SciMat, Bibliometrix de R, and ultimately Mendeley used as manager of bibliographic references [26]–[28].

C. Filtering results

For this study of scientific mapping in the use of technology in nature tourism, the following inclusion and exclusion criteria were defined from the data obtained by the defined search expression.

Inclusion criteria:

- All articles, book chapters, and conferences are published in English follow a peer-review process, and have their full texts available.
- Nature tourism and technologies should be the focus of research, not a tangential issue.
- Research should include one of these words "ecotourism", "nature tourism", "eco-tourism" or "rural tourism" as an essential part and its conjunction with any of the following words that include the technologies present in this tourist activity "ICT", "social networking", "virtual reality", "augmented reality", "Sensor", "IoT", "Big data", "NFC", "Li-fi", "WEB", "mobile" or "GIS".

Exclusion criteria:

- All articles, book chapters, and conferences write before 2011.
- Documents that have not passed a peer-review process (prefaces, publishers).
- Works that do not have their full texts available.
- Works in languages other than English or Spanish.
- Research that does not include in the title, summary or keywords of a term that includes digital technologies applied in nature tourism “ICT", "social networking", "virtual reality", "augmented reality", "Sensor", "IoT", "Big data", "NFC", "Li-fi", "WEB", "mobile" o "GIS".

D. Classification of jobs

For the classification of the documents, the reading of the title, summary, and keywords was made after the filtering process. The Works were classified into three categories: focus, input, and research context. For work that was not sufficient with prior reading, the entire document was used to determine its classification.

The following criteria were used for the classification of documents, which provide structure at the level of technologies, type of tourism, and research contributions:

- Type of technology used
- Tourism intervention areas
- Research contributions

III. Results and Discussion

A summary of data extraction is presented in Table I, which shows the number of published documents on the use of digital technologies in nature tourism during the period 2011 to the first half of 2020. The disclosed manuscripts were taken from Scopus as a high-impact database [22]. The information covers 10 years, with an average of 3.95 documents per term and an average of 1.65 per source.

The scientific production for the period 2011 to 2015 is 34%, there is evidence of higher production in the last 5 years with more than 65% of this scientific mapping.

TABLE I
MAIN INFORMATION OF CLEANED DOCUMENTS

Description	Results		
Period	2011: 2015	2016: first semester 2020	2011: first semester 2020
Sources (Magazines, Books, etc.)	112	129	216
Documents	144	212	356

Annual average since publication	6,8	2,01	3,95
Average citations per document	10,84	4,25	6,916
Average citations per year per document	1.391	1.255	1,31

Source: own elaboration. Generated from Bibliometrix 3.0 (Aria y Cuccurullo, 2019)

The following are the research questions defined above that guide this systematic mapping study (SMS) [25], [29].

A. Evolution of publications, geographical origin, and types of documents

The evolution of scientific publications is presented in Fig.2 where a peak of scientific publications is evident in 2019.

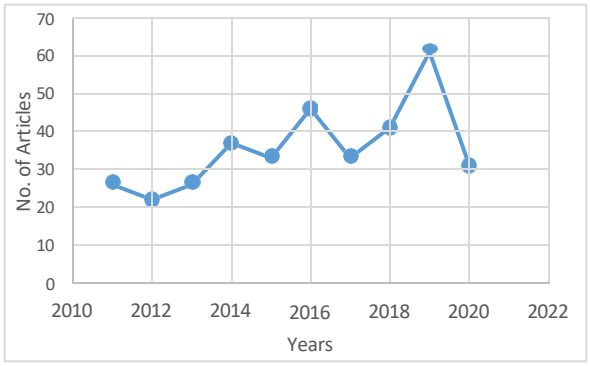


Fig. 1. Annual scientific production. Source: own elaboration based on Scopus information.

The Fig. 3 presents publications by the country where the color intensity is the largest participation. For Latin America, the nations of Brazil and Mexico represent the countries with the highest generation of publications. Many of Asia's countries are emerging economies and seek development processes by boosting nature's tourism for its high biodiversity and geographical location [30],[31].

The great Anglo-American and European contribution to this distribution is not surprising due to the general domain of both the publications of articles and in the publication of journals [27],[32]. Production has intensified in recent years due to the emergence of new tourist destinations and impacting remote communities [33]–[36]. Also, there is an increase in the community over the concern of sustainable development supported by the implementation of technologies [37],[38].

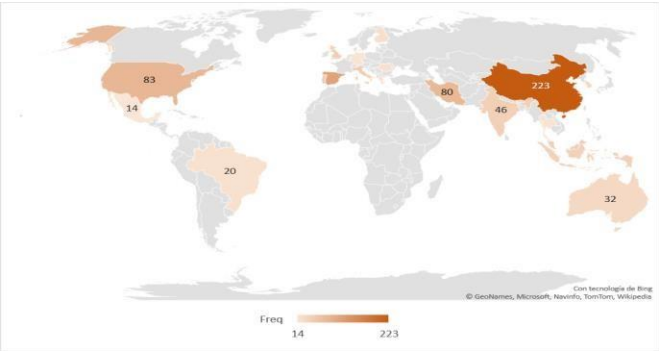


Fig. 2. Scientific production by country. Source: own elaboration. Generated from Bibliometrix.

Fig. 4 presents the different types of scientific production documents obtained from Scopus. This shows the number of tourism proposals implemented in the world on natural environments and supported by digital technologies for their development (scientific articles), with significant growth in the last five years, where 212 articles were produced in 129 journals.

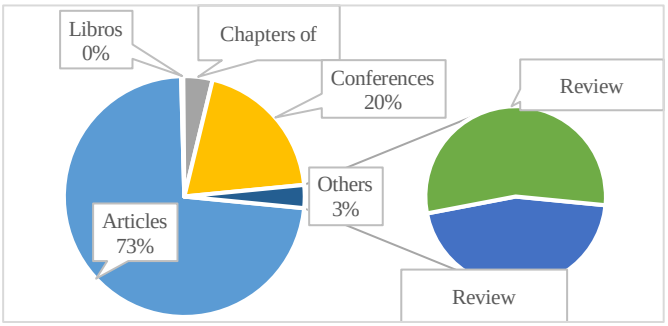


Fig. 3. Document types. Source: own elaboration based on Scopus information.

The collaboration between countries is presented with a link between them (red), which the thicker it means a greater relationship and the intensity of blue color in the geographical space of nations accredits the productivity of documents of the use of technologies in nature tourism (Fig. 5). China, the United States, the United Kingdom, Spain, Italy, and Australia are the countries with the highest number of projects reflected in the articles obtained, but the relations between them are headed by China, the United Kingdom, Spain, Italy, Greece, and Australia where nature tourism provides as a screed of the economy. European policy supports these rural sustainable development initiatives where communities are beneficiaries of these development funds [39].

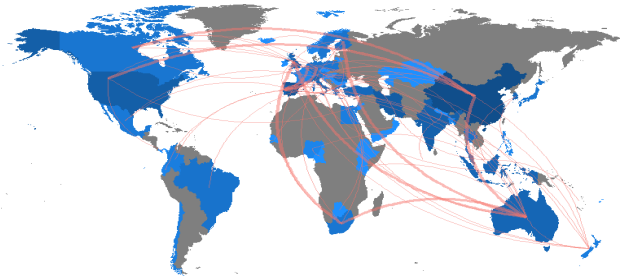


Fig. 5. Country collaboration map. Source: own elaboration based on Scopus information. Generated from Bibliometrix.

The countries with the highest academic production are China, Spain, the United States, Korea, and Portugal where collaboration rates are externalized (MCP y SCP). Although inter-country collaboration is not carried out in all documents of this scientific literature, 11 of the top 20 nations have a collaborative index between them in which China and Portugal lead these partnerships, see **¡Error! No se encuentra el origen de la referencia.**.

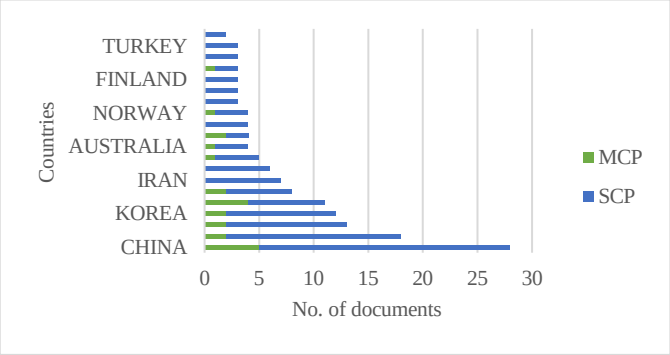


Fig. 6. Author of the country of the corresponding. Source: own elaboration.

B. Thematic evolution and trends associated technologies.

The Sankey diagram analyzes data visually see Fig. 7 [18], [40]. The chart visualizes the thematic evolution of the use of technologies in nature tourism throughout the established period. As a result, it was possible to analyze the flow conditions of the different topics and relationships in the field of research.

The thematic evolution map does use to analyze the development of the use of technologies in nature tourism throughout the research process and identify the path of the topic and its trend of change. The features in adjacent study time zones are connected to represent temporary continuity between research topics. The visual characteristics of the line are the width and color. Amplitude does use to indicate the number of keywords shared. The thicker the line, the greater the relevance of the topics. The topics studied are distinguished by color variation (see Fig. 7).

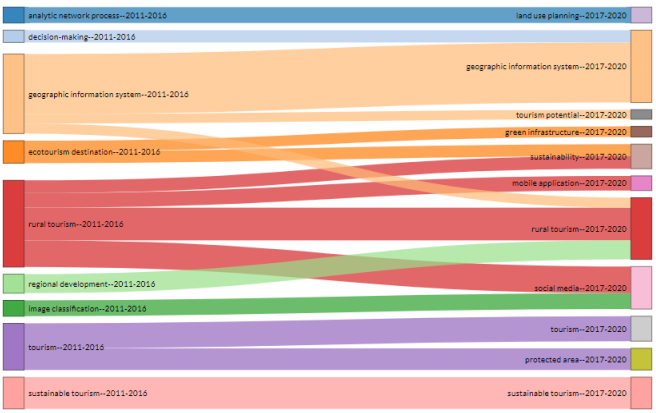


Fig. 7. Thematic evolution. Source: own elaboration. Generated from Bibliometrix.

The thematic evolution of this study presents two terms that mark a relevance, the first the Geographic Information Systems (GIS) these tend towards the definition of tourist potentials, as well as their implementation and use in rural tourism, their purpose is still present today. The second term rural tourism presents evolution towards sustainability, mobile applications, the use of social networks and continues to grow focused on regional development. In general, developments are present in the use of soils, green infrastructure, protected areas, sustainable tourism, and the support of technologies from their cross-cutting path.

The strategic diagram presented in Fig. 8 as expressed by [40] is a two-dimensional space where the themes are located according to their centrality (x-axis) and their density (y-axis) framed in the four quadrants. In each diagram, the size of the sphere is proportional to the number of records associated with each research topic.

In the first quadrant located at the top right are developed relevant topics in the context of research called motor topics [48]. In this case, the terms of environmental protection are reflected as the principal unity then multicriteria analysis, data, computers, digital and natural resources, these words are externally related to concepts applicable to other topics. In the quadrant located at the top left, they present terms such as interviews, and nitrate agents do very well-developed internal bonds, so they have marginal importance in the scientific field. These themes are characterized by being very specialized and being very peripheral (Highly developed and isolated topics). In the lower-left quadrant are the very underdeveloped and marginal themes. These themes have a low density and centrality, their most relevant feature is that they are emerging or disappearing issues. These words are the makeup of marketing, software, green technology, intelligence, and investment. The topics depicted in the lower right quadrant are relevant in the scientific field of work but are not well developed. These are the cross-cutting and generic topics, for this mapping we show the tourist destinations, ecotourism services, and wetlands i.e., they are essential points of the scientific field to be developed.

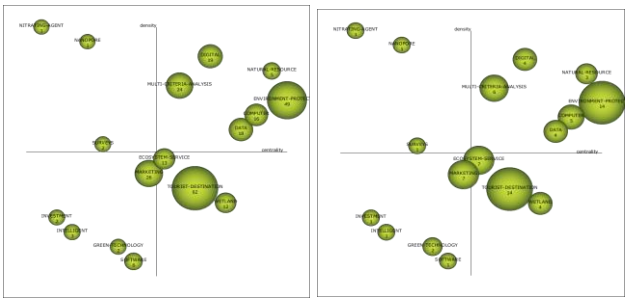
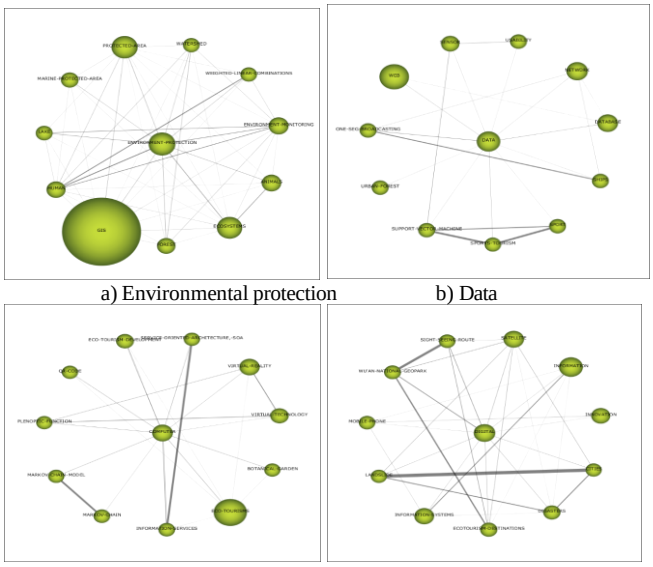


Fig. 8. Strategic diagram by documents and H Index. Source: own elaboration based on information from Scopus, through SciMat.

The theme network presented in Fig. 9 demonstrates the motor terms located in the right upper quadrant of a strategic diagnosis (Fig. 8). In the item (a) network presents the graph of the term environmental protection, which is the most important of this analysis, its relevant links are the protected geographic information systems, area, and ecosystems. In-network b) called data, its edges relate to the web, sensors, database, networks between other terms that represent the handling of information. The computer network c) presents relationships with words such as virtual reality, QR codes, information services, Markov chains, SOA, and the term Ecotourism as a larger node. The digital network (d) consists of nodes such as mobile telephony, information system, innovation, tourist destinations, sites, and soil use, the latter two have a stable relationship that is evidenced by the thickener of the edge.

These sets of terms presented on the networks represent the influence of digital technologies on the tourism of nature. The

related categories from GIS are the use of soils, the definition of tourist destined, tourist projections, and other follow-up and control actions. New technological trends such as virtual reality, augmented reality, mobile telephony, mobile and web applications, databases, and the general use of the internet, project a groove and innovation in the development of tourist alternatives.



a) Environmental protection b) Data

c) Computer d) Digital

Fig.9. Cluster Network. Source: own elaboration based on information from Scopus, though.

Cluster analysis in Bibliometry did based on the frequency of occurrence of two keywords some hierarchical grouping method of the Bibliometrix library did use in R. These words are grouped together and then combined with other groups of a greater degree of similarity, of this form, a new cluster did construct, this fusion is valid until the individuals do group [18]. Multiple Correspondence Analysis (MCA) is an approach to compressing big data with many variables in a low-dimension space. That generates a two-dimensional or three-dimensional intuitive graph using the flat distance to reflect the similarity between keywords. As words approach the center position, they indicate great attention in recent years. The closer to the edge, the narrower the subject of study or the transition to other topics [18].

Fig. 10 shows two red conglomerates that present research into technologies in nature tourism. This cluster has as keywords "internet" and "social networks" these are the closest to the center and of great request. This evidence: web-supported technologies project the evolution of nature tourism. The edges of the cluster consist of telemetry, ecotourism, virtual reality, rural development, and information and communication technologies to the general child [35], [41]–[47].

Cluster two reflects Geographic Information Systems (GIS) as the most relevant keyword. The word relates to environmental monitoring and the search for tourist environments and the quality of soil use, how natural resources are conserved [12], [48]–[50].

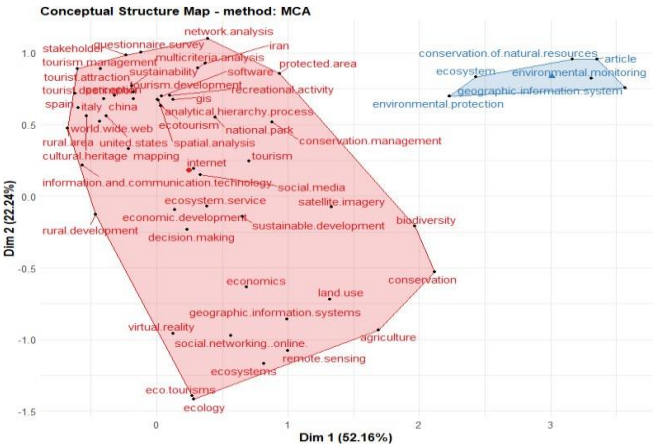


Fig. 10. Thematic groupings. Source: own elaboration based on information from Scopus, through Bibliometrix.

C. Analysis of influential journals, authors, citations, and keywords

The following analysis focuses on the identification and production of major journals, organizations, authors, quotations, and keywords that contribute to the use of technologies in nature tourism. This can be seen in table II.

TABLE II.
CLASSIFICATION OF THE MOST PRODUCTIVE JOURNALS

No.	Journal	Area	Country	H_index	G_index	TC	NP	Q
1	Sustainability (switzerland)	Social Sciences	Switzerland	5	8	113	28	2
2	Journal of sustainable tourism	Agricultural and biological sciences	United Kingdom	8	12	220	12	1
3	Tourism management	Social Sciences	United Kingdom	6	9	185	9	1
4	Lecture notes in computer science	Computer science	Germany	2	3	11	8	2
5	Land use policy	Agricultural and biological sciences	Holland	6	7	111	7	1
6	Shengtai xuebao/ acta ecológica sinica	Agricultural and biological sciences	China	2	4	23	7	3
7	Environmental monitoring and assessment	Environmental sciences	Holland	4	6	98	6	2
8	Advances in intelligent systems and computing	Computer science	Germany	1	1	4	5	2
9	Journal of ecotourism	Business, Management and Accounting	United Kingdom	2	4	20	5	1

10	Journal of mountain science	Earth and Planet Sciences	China	4	5	29	5	2
11	Tourism geographies	Environmental sciences	United States	2	4	67	4	1

Source: own elaboration

The highest percentage of high-production magazines are of European, Chinese, and North American origin. Of the set of sources (216 journals), 164 have published only one article that is about 76% of this set. At the quartile level, a high inference assessment of the quality of documents produced within the thematic approach does show. While Q1 and Q2 each with five journals and one in Q3. This distribution suggests that the thematic approach is DOIng published in high-impact and quality resources. The above are approximate variables for measuring the quality of research (Fig. 11).

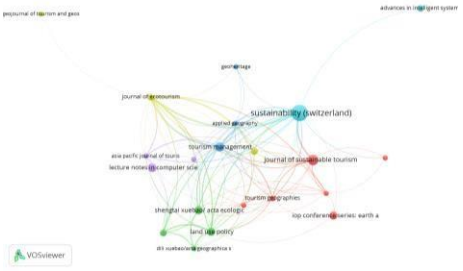


Fig. 11. Bibliographic coupling of journals. Source: own elaboration based on information from Scopus, through VosViewer.

Table III reflects the productivity of authors who have researched the subject. More than three authors do evidence per document on average too of 97% of scientific production is carried out by multi-authorship.

TABLE III
RESULTS OF AUTHORS BY DOCUMENTS

Description	Results
Authors	1316
Authors of individually authored documents	40
Authors of multi-authorship documents	1276
Individual authorship documents	57
Documents by author	0,324
Authors by documents	3,08
Co-Authors by documents	3,51
Collaboration Index	3,45

Source: own elaboration

Table IV presents the principal authors with the most significant impact by the H index, it indicates the minimum number of times an author or journal has been cited. Jeong JS has the highest H index and the highest number of articles. In general, this table exhibits the most productive authors in this field during the period 2011- the first half of 2020.

TABLE IV
IMPACT OF THE AUTHORS

Authors	Index H	Index G	Index M	TC	NP	PY_start
Jeong js	4	6	0,571	42	6	2014
Cherrett t	3	4	0,375	44	4	2013
Davies n	3	4	0,375	44	4	2013
Deng j	3	4	0,429	42	4	2014
Dickinson je	3	4	0,375	44	4	2013
Filimonau v	3	4	0,375	44	4	2013
Garcia-moruno l	3	4	0,429	24	4	2014
Hernandez jm	3	4	0,3	54	4	2011
Norgate s	3	4	0,375	44	4	2013
Santana-Jimenez y	3	4	0,3	54	4	2011
Speed c	3	4	0,375	44	4	2013
Suarez-vega r	3	4	0,3	54	4	2011
Wang x	3	4	0,3	32	4	2011
Cetin m	3	3	1	140	3	2018

Source: own elaboration

The map depicted in Fig. 12 shows two groups of thought determined by the size, dispersion, and coherence of the sets. These schools of thought are about: rural tourism, multicriteria decisions, geographic information systems (GIS), mobile applications, social networks, and the web. The formation of these groupings of authors based on the analysis of the subpoena. It also reveals the evolution of research lines to define a knowledge base of the use of technologies in the construction of new tourism alternatives in the world. The red group of six authors, they focus on the work of tourist communities, the use of social networks and mobile applications, and ways to generate sustainable practices during visits to destinations [51], [52].

The currents of thoughts represented in the green cluster, led by Jeong JS presents in its studies the implementation of technologies to determine the use of soils in ecotourist geographical spaces and thereby establish the possibilities and potentials of this activity based on natural resources in these areas [53], [54].

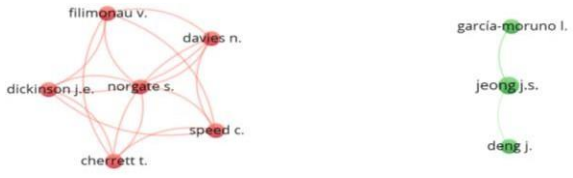


Fig. 12. Author citation analysis network. Source: own elaboration based on information from Scopus, through VosViewer.

With the use of VosViewer was made in the analysis of the co-citation of authors, the visual-spatial representation of this intellectual structure presents the similarities between authors united in groups that interpret a field of thinking. The interpretation of the co-citation map begins with the author's notes where the bubble size reflects the relative volume of the

author's co-citations [55]. The proximity of the nodes to each other represents the degree of intellectual affinity of the authors based on the number of their co-citations. The links between specific authors represent the citations of the authors by other academics. This is presented in Fig. 13 shows a network of seven clusters where Saaty (90 subpoenas) and Malczewski (69 subpoenas) lead the red group by their node size and the number of relationships with their group and external groups.

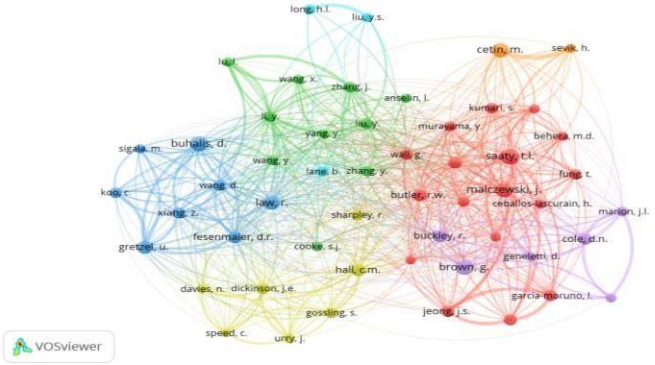


Fig. 13. Network of co-citations by authors. Source: own elaboration based on information from Scopus, through VosViewer

On the left side of the network is the dark blue cluster in which Buhalis with 75, Law with 64, and Gretzel with 53 subpoenas generate the axis of this graph of co-citation relationships most important of this conglomerate.

The purple cluster located on the right side of the network, although small, has relationships with six (6) of the seven (7) groups. The authors with the highest number of citations are Brow (79) and Buckley (47). The groups defined by the yellow and green color are very similar in their dimensions, where a very homogeneous number of citations is evident by each author. These citations are in a range of 32 to 48. Its most prominent exponent is Hall (48), Liu (35), and Li (32), which has a high coupling. In general, the network expresses high coherence and coupling by exhibiting an evolution and use of new or continuous thoughts over time. Technologies are reflected as cross-cutting and relevant in tourism development by some concepts as evolutionary axes in their progress.

Titles and summaries did use for scientific mapping. Using a minimum number of occurrences of 10 times per term, this determined three groups of words. That did reflect in Fig. 14 with the three red, green, and blue clusters. The red group demonstrates the terms of tourist destination, technology, and their implementation through the internet, rural, and community tourism. In the blue cluster, the axis is on the word China as a reference for tourism strategies, and in the green group with the term, Geographic Information System (GIS) is the most successful. GIS did use for assessments, criteria, maps, and methodologies for implementing tourist sites.

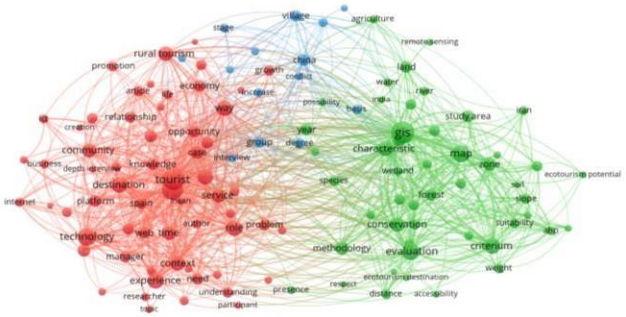


Fig. 14. Bibliographic map of titles and Abstracts. Source: own elaboration based on information from Scopus, through VosViewer.

Despite the current relevance of keyword use in various analyses, 41 documents that do not have this section did identify during the review. The rest of the documents apply keyword co-occurrence analysis. The most matched terms are geographic information system (94), ecotourism (64), rural tourism (42), and sustainable tourism (14). Words with a minimum level of occurrence such as augmented reality, virtual reality, fuzzy logic, smart tourism, social networks but are technological trends that are coexisting in tourism development according to innovate and be implemented. The above container did see in the word cloud reflected in Fig. 15. Criteria associated with the search for economic development, smart tourism, and actions related to ICT-mediated tourism options [2], [56]–[63].

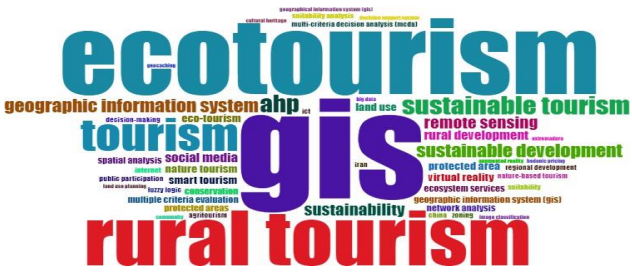


Fig. 4. Keyword cloud. Source: own elaboration based on information from Scopus. Through Bibliometrix.

Ecotourism and rural tourism are the main tourist alternatives implemented in the world. Technologies always accompany tourism. Within the analysis, the relevant word is GIS for its wide range of work. That did reflect in the high performance of this technology in different fields related to tourism. Also, new technologies such as augmented and virtual reality, social networks, mobile devices, telemetry, the Internet of Things, among others, are contributing to the evolution of nature tourism from sustainable aspects and seeking to minimize environmental impacts.

IV. CONCLUSIONS

This study examined the inclusion of information and communication technologies in nature tourism in the period 2011 to the first half of 2020, based on publications in the Scopus database. Although this study is not the first attempt at a comprehensive and systematic review of academic research in nature tourism, it is a study to build an orderly conceptual structure by applying bibliometric techniques. Also, the brief

offers researchers the opportunity to position their research within this evolving field, allowing the identification of new avenues of research.

The Scientific production of 356 documents did extract in the search period from 2011 to the first half of 2020. In the last three years, about 37% of scientific production did locate. Regarding geographical production by continent, Asia and Europe did see as the leaders with 85%, and the remaining 15% makes helping by America and Oceania. 49% of publications from geographical sources did consolidate in four countries. The largest share is from China with 22%, followed by Spain with 11% and then the United States and Iran with 8% each. Finally, scientific articles did find to represent 73%, conferences 20%, book chapters 4%, review articles 2%, and review conferences 1%. This shows the large number of tourist proposals implemented in the world on natural environments supported by digital technologies for their development. This reality did reflect in the documents generated in the last five years where 212 articles in 129 journals have manifested this evolution.

The highest percentage of high-production journals are of European, Chinese, and North American origin. Of the set of sources (216 journals) only 164 have published an article, this is about 76% of this group. At the quartile level, a good inference assessment is shown on the quality of documents produced within the thematic approach where Q1 and Q2 each with five journals and one in Q3. This distribution talks about the thematic approach being published in high-impact and quality resources. Where these variables are used to measure the quality of research.

The nine (9) evolutionary processes expressed in the diagram "fy" as different paths, but the most representative is the GIS group, which was consolidated by the decision-making, remote sensing, and sustainable tourism group. The second group at the level of relevance did makeup of rural tourism has contributions from regional development and the emergence of new technologies such as virtual reality, fuzzy logic without being far from green infrastructure is evident.

The publications analyzed did locate in the environmental, social, agricultural, and biological sciences. A total of 216 journals did identify for this purpose. The most productive are Sustainability (Switzerland) with 28 articles and the Journal of Sustainable Tourism with 12 articles each. At the level of quartiles within the thematic approach, a good inference evaluation of the quality of the documents produced is shown.

The means Q1 and Q2 present five magazines each and one in Q3. The context of the articles based on new tourist alternatives that seek the protection of natural resources, the low impact on the environment, the monitoring of sites, tourists, and the control of the spaces. The above to develop the economic activity generated by tourism and support emerging economies.

In this area of research on the use of ICT in nature tourism, terms such as augmented reality, virtual reality, social networks, internet, big data, fuzzy logic, mobile applications, and smart tourism appear in a minimum percentage as keywords in publications articles. That establishes the ICT areas where the work will implement to increase the results of the use of the technologies included in the development of nature tourism. The lines are established and require research to expand the indicators to improve the effects of sustainable development of sustainable tourism or supported by technologies.

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