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Relational analysis of publications on the use of geographic information systems in tourism - Recreation planning and management

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ABSTRACT

This study aims to comprehensively examine the use of geographic information systems (GIS) in tourism planning and management. The role of GIS in the tourism sector is becoming increasingly important, especially in areas such as spatial data analysis, decision support systems, and sustainable tourism planning. In this study, a bibliometric analysis of academic studies was conducted, examining current trends, thematic clusters, international collaborations, and citation networks in detail. The methodology of the study is based on bibliometric analysis using VOSviewer software. These analyses reveal the methods and areas in which GIS is utilized in tourism planning, as well as the prominent topics and countries that have collaborated more in this field. Based on articles in the Scopus database, the research visualized and analyzed the issues on which publications focus, the collaboration networks between authors, and the most cited studies. The findings demonstrate that GIS is effectively utilized in tourism planning, particularly in areas such as sustainable tourism, infrastructure planning, and environmental impact assessments. However, topics such as big data analytics and intelligent city planning have not yet been sufficiently explored. In addition, international collaborations are concentrated among countries such as the United States, China, the United Kingdom, and Türkiye. The most frequently cited authors and studies were those related to sustainable tourism and its environmental impacts. In conclusion, this study offers a deeper understanding of the versatile applications of GIS in the tourism sector and provides important insights for future research. In particular, it is emphasized that issues such as integrating GIS with big data and artificial intelligence should be further explored.

KEYWORDS

Geographic information systems (GIS), tourism planning, recreation planning, bibliometric analysis, academic collaboration

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INTRODUCTION

The tourism sector continues to proliferate as one of the main drivers of economic, cultural, and environmental development worldwide (Anis et al., 2023; Jeong et al., 2023). For sustainable growth, aligning with shifting tourism alternatives in response to environmental challenges (Borysova et al., 2020), the integration of modern technologies in planning and management processes plays a crucial role. In this context, GIS has become an essential tool for spatial data analysis, suitability assessment, impact identification, decision-making, and achieving sustainable development goals in tourism planning and management. GIS provides powerful tools for planning and managing tourism destinations, leveraging its advanced capabilities in spatial data collection, analysis, and visualization (Magige et al., 2020).

Recent studies have highlighted the use of GIS in various areas, including monitoring the environmental impacts of tourism destinations, infrastructure planning, site selection, and enhancing tourist experiences (Vukovic, 2022). Particularly, tourism planning requires a comprehensive understanding and analysis of geospatial data, which is complex and dependent on a diversity of factors (Allheeib et al., 2022). Still, proper and effective adoption of GIS technologies in the tourism sector remains limited compared to their strong potential and significant role (Chen, 2007; Lepetiuk et al., 2023). Research in the literature provides examples of GIS-based implementations and focuses on reviewing previous studies, while a comprehensive and holistic analysis of the current state of the scientific field is lacking.

From this perspective, the primary objective of the research is to gain a deeper understanding of the current impacts and future potential of GIS technology on tourism planning. To achieve this goal, the study undertakes a comprehensive review of publications on GIS and tourism planning, conducted through a bibliometric analysis using VOSviewer software. In this context, inter-author collaborations and citation networks are determined by the analyses and spatial distribution of factors such as the country, language, and journal of the study. The results have been organized into clusters and maps, showing the popular research topics and their relationships to each other, which helps identify the contribution of GIS to the tourism sector and the research gaps (i.e., areas that are insufficiently explored or left unexplored) in this field. The results of the study provide an important data source, especially for academics working on the use of GIS in tourism planning. Citation analyses, which identify the most influential studies and authors in the field, offer valuable guidance for future studies and provide essential resources for researchers seeking to understand the impact of GIS on the tourism sector.

The novelty of this study lies in its comprehensive and systematic bibliometric analysis of the scientific literature on the use of GIS in tourism planning and management. While previous studies have generally examined specific applications of GIS and recommended fields to benefit from GIS capabilities, this study approaches the literature from a broader perspective. It systematically analyzes the multifaceted use of GIS in the tourism sector. The bibliometric analysis, performed using VOSviewer software, identifies the main trends and existing knowledge gaps in the field, revealing thematic clustering, international collaborations, citation analysis, and research gaps. Furthermore, the geographical distribution of international collaborations, along with a detailed analysis of the most cited authors and studies, makes this study distinct from other literature reviews.

LITERATURE REVIEW

The bibliometric analysis is a commonly used method for determining particular studies and their context, focusing on selected areas or topics. Different software and methodologies are utilized to perform bibliometric analysis, while some researchers develop new tools to perform the process. Among these is the Bibliometrix tool, developed using the R programming language by Aria and Cuccurullo (2017), which provides comprehensive science mapping analyses across various scientific fields. VOSviewer, on the other hand, is one of the most preferred tools. Shah et al. (2019) analyzed the issue of presumption using tools such as HistCite and VOSviewer. The findings of this study are considered an example of VOSviewer's capacity to visualize research themes in the literature. Moral-Muñoz et al. (2020) evaluated software tools used in scientific

research from an up-to-date perspective. This study considered the advantages and limitations of various software tools and provided guidance on which software is more effective in which situations.

Bibliometric analyses are conducted in a broad range of fields. For example, in their bibliometric analysis of international competitiveness, Capobianco-Uriarte et al. (2019a, 2019b) analyzed the distribution and thematic trends of publications in this field. Guo et al. (2019) conducted a bibliometric analysis focusing on smart city research and identified the general trends in publications in this field. The study by Kokol et al. (2020) examined the historical development of bibliometric analysis in the medical field. These methods used in medical research provide general analysis methods that can be extended to other scientific fields. Tomaszewska and Florea (2018) evaluated the themes and trends in the scientific literature on urban smart transportation through a bibliometric analysis. Similarly, Winkowska et al. (2019) examined the literature on the smart city concept and mapped its place in scientific research using bibliometric methods. Finally, Yeung et al. (2021) analyzed the applications of virtual and augmented reality in the medical field, while Zyoud and Al-Jabi (2020) examined scientific developments in the early phase of COVID-19 research through bibliometric analysis. These studies offer valuable insights into analyzing the literature in rapidly evolving fields, such as emerging technologies and pandemics.

Bibliometric analyses on tourism and GIS-related studies are relatively uncommon. Bibliometric analyses in the field of tourism focus on studies in tourism management, gastronomy, tourism, and accommodation management. These studies provide a systematic review of the body of knowledge in this field by revealing different aspects and research trends in the tourism sector. For example, Dahiya et al. (2022) analyzed research trends in the tourism and hospitality sector in India and presented a bibliometric analysis of studies conducted between 2000 and 2021. The research revealed the increase and central themes of publications in the industry during this period. Del Río-Rama et al. (2020) emphasized the importance of cultural and natural resources in island tourism and analyzed this issue with the bibliometric mapping method. The research by García-Lillo et al. (2018) mapped the "intellectual structure" of academic research on human resource management and tourism. By analyzing key authors and themes in this field, the study illustrated the impact of human resources on tourism management. Jiang et al. (2017) analyzed research on tourism crises and disaster management using bibliometric visualization techniques, revealing scientific developments in this field. Kim and So (2022) examined the last two decades of customer experience research, evaluating the main trends and thematic developments in the field of hospitality and tourism through a bibliometric analysis. Koseoglu et al. (2016) systematically analyzed bibliometric studies in the field of tourism, examining the methods and themes of these studies.

In addition to the aforementioned studies, bibliometric analyses have been extensively applied to various subfields within tourism research, revealing key trends and thematic developments. For instance, Koseoglu, Sehitoglu, and Parnell (2014) conducted a bibliometric analysis of academic studies published in leading tourism and hospitality journals in Turkey, shedding light on the evolution of research trends in this region. Similarly, Leong et al. (2020a, 2020b) explored the advancements in tourism research by assessing the growth of academic publications over time and identifying the primary research areas that have shaped the field. Mulet-Forteza et al. (2019) provided a comprehensive bibliometric analysis of publications in tourism, leisure, and hospitality, highlighting the dominant themes and their contributions to the broader literature.

Focusing on niche areas, Naruetharadhol and Gebsombut (2020) examined food tourism studies in Southeast Asia, uncovering emerging trends and key themes through bibliometric methods. In the context of cultural and religious tourism, Suban et al. (2021) analyzed the growth of halal and Islamic tourism research, identifying significant trends and contributions in this specialized field. Furthermore, Szpilko (2017) investigated the tourism supply chain literature, mapping out the primary studies and trends that have influenced this area of research. These studies collectively demonstrate the versatility of bibliometric analysis in uncovering the

intellectual structure and thematic evolution of diverse tourism subfields, providing valuable insights for future research directions.

METHOD

This study employs bibliometric analysis to examine the literature encompassing the fields of GIS and tourism planning. The analysis encompasses studies retrieved from the Scopus database. The keywords "tourism planning," "recreation planning," and "GIS" were used as keywords. In the first stage, 133 studies were listed in the review without time limitation. In addition, a table was created for all the articles included in the evaluation. In this table, the name of the article, purpose, method, authors, and the analysis method used were compiled. Only the articles written in English were then filtered, and the remaining 83 articles were used for further analysis. The articles used in the study, along with information about these articles, are provided in Appendix 1. A previous study (Çalış & Duman, 2023) was utilized in the implementation of the procedures of the method, and the details of the preliminary research are presented in Table 1.

Table 1.

Preliminary research procedures (Source: Scopus.com)

Database researched	Scopus
Content explored	Article
Language	English
Date Range	All times
Search fields	Title, abstract, and keywords
Search categories by field	There are no field limitations.
Keywords	"tourism planning" or "recreation planning" and "GIS"

Additionally, a systematic literature review (SLR) was conducted on the articles in Appendix 1, following the procedures outlined in Table 1. The SLR method is a rigorous and structured approach used to synthesize existing research on a particular topic. This methodology is characterized by transparent, repeatable, and scientific processes that aim to minimize bias and increase the reliability of findings. According to Kitchenham's (2004) guidelines, the SLR process can be divided into several phases: planning, conducting, and reporting. The planning phase involves defining a straightforward research question and selecting appropriate databases and keywords for the literature review (Sevgi, 2021; Faisal et al., 2021). Following this, the conducting phase involves applying systematic review methods and identifying relevant studies, which may include both practical and methodological considerations (Sevgi, 2021; Sulistyowati & Ahmar, 2023; Samara et al., 2020). Ultimately, the reporting phase facilitates evidence-based decision-making by synthesizing findings in a clear and reproducible manner (Choo, 2023; Jacobs et al., 2019).

Within the scope of the systematic literature review, all 83 studies on the subject were examined and classified to answer the following questions.

- Question 1: Write the purpose of the study in one sentence.
- Question 2: What are the method(s) used in the study?
- Question 3: What are the analyses and techniques used in the study?

The VOSviewer application was used for these analyses. VOSviewer is a crucial software for visualizing and analyzing bibliometric data, including scientific research, authors, and keywords. One of the most remarkable features of this software is that it allows the creation of clusters based on the relationships between data. Clustering involves grouping items with the same theme, and these items are typically closer to each other than to items in other clusters. VOSviewer uses an advanced algorithm to analyze data. By examining the relationships between items, this algorithm identifies groups with dense connections. For example, in a keyword network, words that are frequently used together are included in the same cluster. In a co-authorship network, researchers who frequently publish together are grouped. Citation networks cluster articles that cite similar sources. In co-citation analysis, studies that are frequently cited

together are brought together. Similarly, bibliographic match analysis clusters articles that use the same sources. In this process, clusters are formed around particular themes or keywords. In the analysis, clusters are typically represented in different colors, allowing each group to be easily distinguished visually. Items within clusters are usually close to each other, while items in different clusters have more distance between them. The size of the items in the network is also important; larger circles usually indicate that an item is used more frequently in the analysis or is centrally located. These clusters often reflect a particular topic or theme. For example, when conducting research in the field of tourism and GIS, terms related to "sustainable tourism" may be clustered in one cluster, while terms related to "recreation planning" may be in another. Similarly, collaborating authors or articles on the same topics may be included in the same cluster.

Clustering facilitates a deeper understanding of the primary themes and research trends within a field. This provides researchers with the opportunity to examine the overall structure of the existing literature and understand the connections between different topics. Furthermore, the level of granularity of the cluster can be adjusted through the VOSviewer software, allowing analyses to be carried out more in-depth or more generally. In conclusion, cluster analysis with VOSviewer software is a highly effective method for uncovering hidden structures in the scientific literature. In this way, researchers can visually analyze which topics are related to one another and identify which authors tend to collaborate more frequently. This type of analysis is beneficial for understanding general trends and subtopics in the research field.

The analyses in this study were conducted using VOSviewer software, and the relationships between publications, keyword co-occurrences, and collaborations between authors were examined. First, keyword clustering was performed. VOSviewer revealed that frequently used keywords, such as "GIS," "sustainable tourism," and "recreation planning," were clustered together. This reveals that these topics are often discussed together in research. Author clustering was based on the collaboration of authors working in the field of tourism planning and GIS. Authors who frequently work together in the same research area formed a separate cluster, revealing the collaboration networks in this field. In the study, the clustering feature of VOSviewer was utilized to identify the primary patterns and relationships within the data. This analysis helped us understand which themes are prominent in the research field and which topics scientific publications are concentrated on. Finally, the level of detail of the clusters was adjusted by changing the resolution settings in VOSviewer. By using high resolution, more clusters were created with finer details, while low resolution resulted in fewer but more comprehensive clusters. In this way, the basic structure and sub-areas in the analyzed data were revealed. This method enabled the visualization and examination of scientific relationships, prominent trends, and sub-themes in the fields of GIS and tourism planning through bibliometric analysis.

In the final stage of the study, spatial distribution maps were prepared to present the findings obtained with the support of geographic information systems. The findings obtained with the help of these maps were visualized. These maps were created based on the countries of the authors of the publications and the number of citations for each publication. All maps produced in this framework were created according to countries and continents. Produced maps are;

- Distribution of publications by country
- Distribution of publications by contributing authors
- Distribution of publications according to the number of citations
- Distribution of publications by continent
- Distribution of authors contributing to publications by continent
- Distribution of publications on a continental basis according to the number of citations.

FINDINGS

The findings of this study are presented under two main headings. First, the bibliometric analysis outlines the primary trends in the literature on the application of GIS in tourism planning, identifies the most cited authors, and examines research collaborations. This analysis contributes to the body of knowledge in the field by identifying prominent topics and under-explored research areas. Second, spatial distribution analyses examine the geographical distribution of studies using

GIS worldwide. These findings enable us to understand which regions utilize GIS more intensively and the spatial implications of this technology in tourism planning.

Findings based on bibliometric analysis

The distribution of studies by year and field category, the distribution of articles by country, and the ranking of authors by the number of articles were obtained from the Scopus database. Figure 1 illustrates the distribution of studies by year using a line graph. It is noteworthy that the number of studies has increased, especially since 2012. When the distribution of published studies by field category is analyzed, it is evident that Environmental Science (22%) and Social Sciences (22%) carry a significant weight. This duo is followed by Business, Management, and Accounting (15.5%). Earth and Planetary Science (10.1%), Computer Science (5.4%), and Agricultural and Biological Sciences (5.4%) are the three other fields with the highest weight. There are also studies in other fields, such as Engineering, Energy, Materials Science, etc., although with less weight. There are also other fields classified under the "other" category, but with very low weights. A pie chart summarizing the field category is presented in Figure 2.

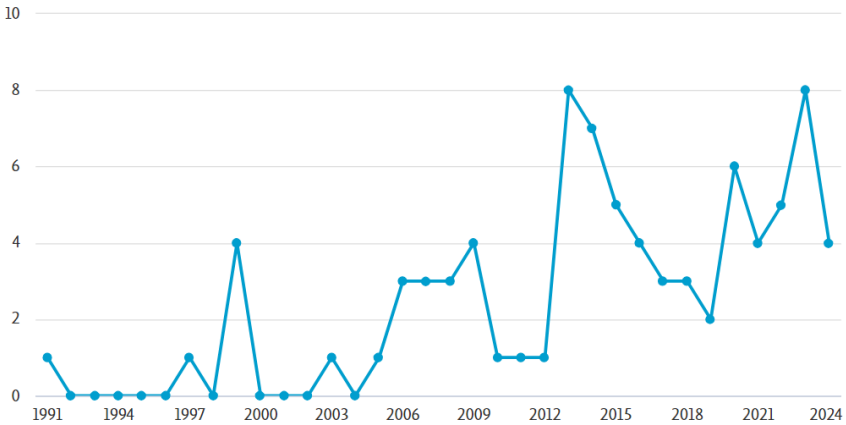

Figure 1. Distribution of studies by years (Source: Scopus.com)

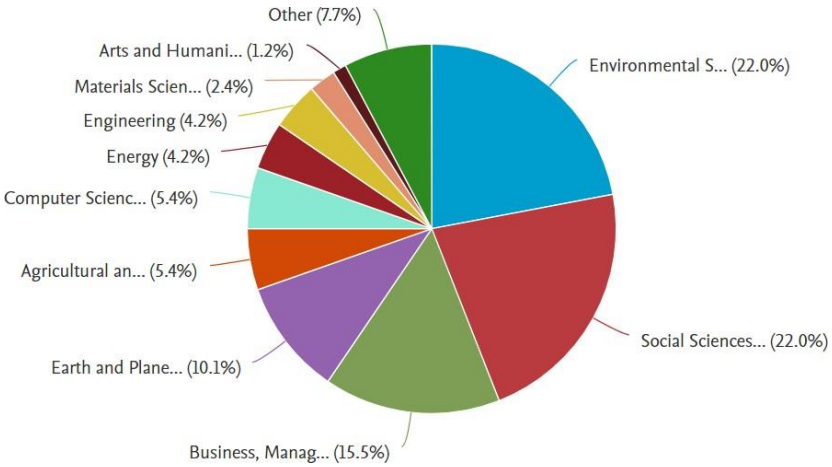

Figure 2. Distribution by field categories (Source: Scopus.com)

The distribution of articles by country is presented in Figure 3. China and the United States lead the way, followed by Turkey, Iran, Malaysia, and the United Kingdom.

In Figure 4, where the authors are ranked according to the number of articles, it is seen that Aminu and Matori are in first place with four articles each, followed by Yusuf and Zainol with three articles each.

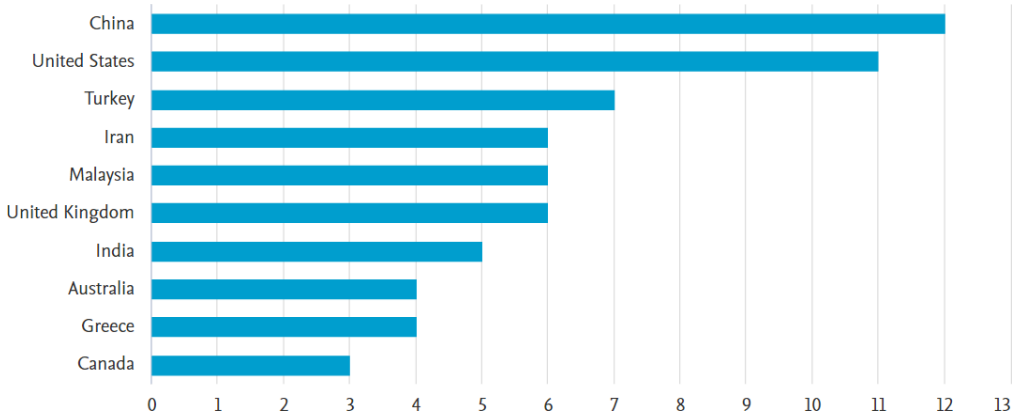

Figure 3. Ranking of the number of articles by country (Source: Scopus.com)

Figure 5 shows the network visualization of the publications in the Scopus database, illustrating the relationships between keywords (minimum of 2) that the authors use most frequently together. The circle of the keywords most frequently used by authors is shown as larger.

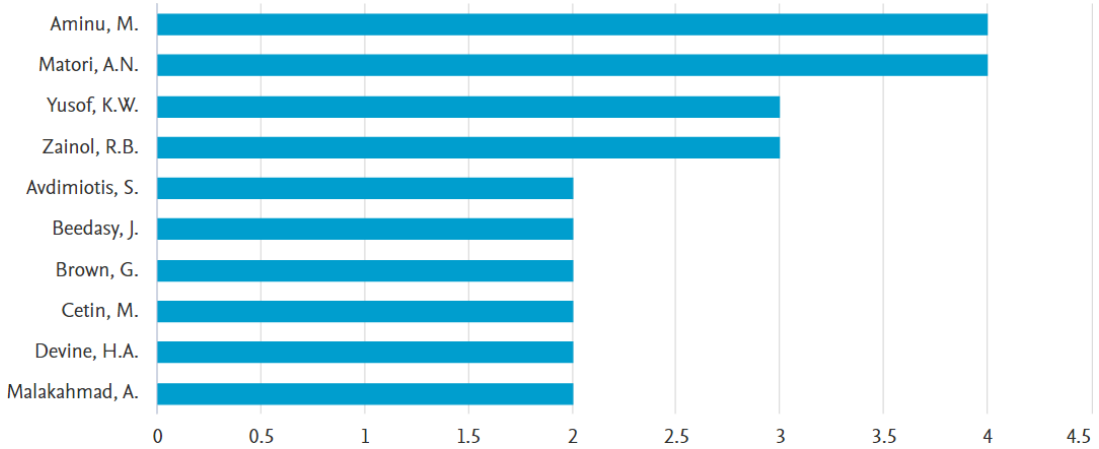

Figure 4. Ranking of authors according to the number of articles (Source: Scopus.com)

The VOSviewer program grouped the keywords that the authors used together most frequently (a minimum of two words used together) and created five clusters. Table 2 shows these clusters.

Table 2.
Keyword clusters (Source: Authors)

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
Carrying capacity	Big data	Ecotourism	Social media	AHP	Nature conservation	Multiple criteria evaluation
Outdoor recreation planning	GIS	MCE	Tourism	Sustainable tourism	Protected area	Spatial planning
SDSS	Open source	Recreation planning	Tourism planning			
Sustainable development	Recreation opportunity spectrum	Suitability analysis				
Trail planning						

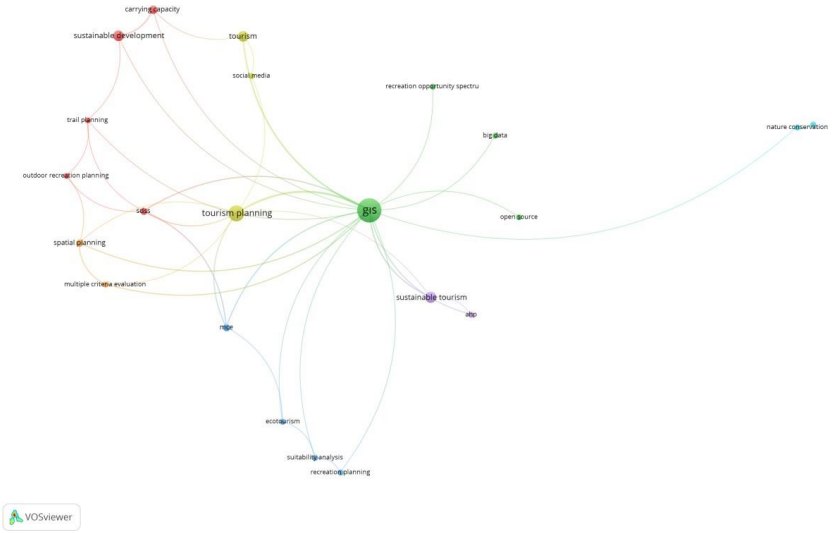

Figure 5. Network Visualization of Publications in Scopus Database Showing the Associations of the Words (Min 2) Mostly Used Together by the Authors (Types of Analysis: Co-Occurrence/Unit of Analysis: Author Keywords) (Source: Vosviewer)

The list of authors of the studies with over 100 citations is given in Table 3.

Table 3.
Authors of the most cited studies (Source: Authors)

Id	Author	Citations
1	Bahaire, T., Elliot-Wite, M.	403
2	Cetin, M., Sevik, H.	232
3	Lee, S. H., Choi, J. Y., Yoo, S. H., Oh, Y. G.	200
4	Raymond, C., Brown, G.	189
5	McAdam, D.	164
6	McIntyre, N., Moore, J., Yuan, M.	155
7	Beedasyl, J., Whyatt, D.	135
8	Gül, A., Örücü, M.K., Karaca, Ö.	114

The sources where the most cited articles were published are listed in Table 4, with at least 1 document and at least 100 citations in the Vosviewer program. Journal of Sustainable Tourism ranked first with three publications and 756 citations.

Table 4
Sources where the most cited articles were published (Source: Authors)

Id	Source	Documents	Citations
1	Journal of Sustainable Tourism	3	756
2	Environmental Monitoring and Assessment	1	232
3	Tourism Management	1	200
4	Society and Natural Resources	1	155
5	International Journal of Applied Earth Observation and Geoinformation	1	135
6	Environmental Management	1	114

The institutions where the authors of the most cited articles work are listed in Table 5, with at least 1 document and at least 100 citations. It was observed that all seven institutions listed consisted of different departments.

Table 5.
Institutions where the authors of the most cited articles work (Source: Authors)

Id	Organization	Documents	Citations
1	Department of Tourism and Environment, University of Lincolnshire, and Humberside	1	403
2	Department of Landscape Architecture, Faculty of Architecture and Engineering, Kastamonu University	1	232
3	Department of Rural Systems Engineering, Seoul National University	1	200
4	Research Institute for Agriculture & Life Sciences, Seoul National University	1	200
5	School of Natural and Built Environments, University of South Australia	1	189
6	Natural Resource Management, Green Mountain College	1	189
7	Department of Finance & Business Information Systems, Nottingham Business School, Nottingham Trent University	1	164
8	Center for Tourism and Community Development, Lakehead University	1	155
9	Faculty of Engineering, University of Mauritius	1	135
10	Department of Geography, Lancaster University	1	135
11	Department of Landscape Architecture, Süleyman Demirel University	1	114
12	Department of Eğirdir Vocational College, Süleyman Demirel University	2	114

The countries with the highest number of citations are listed in Table 6, which includes at least one document and a minimum of 100 citations. With 11 documents and 319 citations, the USA ranked first. The United Kingdom and Turkey followed the USA.

Table 6.
Countries with the highest number of citations (number of articles/number of citations) (Source: Authors)

Id	Country	Documents	Citations
1	United Kingdom	2	567
2	Turkey	2	346
3	Korea	1	200
4	Australia	1	189
5	Canada	1	155
6	Mauritius	1	135

Findings based on GIS analysis according to spatial distributions

This section presents the findings obtained through GIS-based spatial distributions and geographical analysis. Figure 6 presents a world map illustrating the spatial distribution of studies on GIS and tourism planning across various countries. This map illustrates the countries that utilize GIS more extensively and visualizes the geographical distribution of studies on GIS. Fig. 2

shows that China is the leader among the countries using GIS in tourism planning, with nine studies. Turkey follows this with seven studies, Iran with 6, Malaysia with six, and India with 5. Although they are developed countries, the United Kingdom, with four studies, the United States, with four, Greece, with four, Australia, with four, and New Zealand, with three, are the countries with the fewest publications. However, another striking factor is that Egypt, Jordan, Italy, Spain, Canada, Japan, and South Africa, which are among the most popular countries in the world in terms of historical, natural, and cultural tourism, each have two publications. Another striking result is that New Zealand 1,

Mexico, Nepal, Portugal, Iceland, Denmark, Romania, Serbia, and Korea have the fewest publications. In addition to all this, it is a significant finding that there are no publications in the vast majority of the rest of the world.

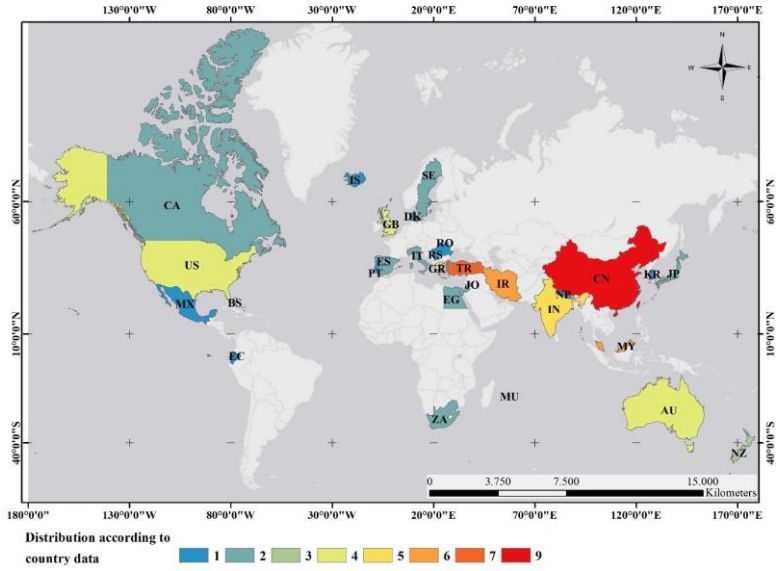

Figure 6. Distribution of publications by country (Source: Authors)

Figure 7 illustrates a world map showing the spatial distribution of authors who have contributed to studies on GIS and tourism planning across various countries. Fig. 3, China, a country rich in history, culture, and nature, ranks first with 38 authors, followed by Malaysia with 27, the United States with 23, India with 22, Turkey with 19, Iran with 18, Italy with 11, Australia with 10, Greece 9, Romania 8, United Kingdom 8, Spain 7, Canada 6, New Zealand 6, Portugal 6, Jordan 5, South Africa 5, South Korea 4, Sweden 4, Ecuador 4, Japan 3, Bahamas 2, Denmark 2, Mauritius 2, Mexico 2, Serbia 2. Germany and Iceland maintained their presence with 1 and 1 author, respectively. Many other countries, which constitute a significant part of the world, do not have an author who meets the criteria. Fig. The spatial map obtained in Fig. 3 was also evaluated within the scope of international cooperation networks. Spatial data on which countries are more frequently involved in academic collaboration were analyzed. The striking factor in the joint studies is that authors from the same country mostly worked together. China 7, Portugal 1, Jordan 1, Sweden 2, Turkey 7, New Zealand 2, United Kingdom 3, Spain 1, Iran 3, South Africa 2, India 4, Greece 4, Malaysia 5, Australia 4, United States 3, Spain 1, Denmark 1, Korea 1, Mauritius 1, Egypt 2, Serbia 1, New Zealand 1, Italy 2, Canada 1, Iran 2, Mexico 1, Canada 1, Japan 1, Romania 1. Studies conducted with the cooperation of different countries: Mauritius- United Kingdom 2, India- Saudi Arabia- United States 1, Ecuador-Canada-Spain 1, Malaysia-Nigeria 1, Jordan-Germany 1, Nepal-Thailand-Japan 1, Iceland-Sweden 1, United Kingdom-United States 1, Japan-China 1, China-Belgium 1, China-United States 1, United States-Greece 1, the Bahamas-United States 1, Iran-Italy 1. As a result, this study shows that the number of publications on the use of GIS in tourism planning and the number of collaborations between countries on this issue are significantly low.

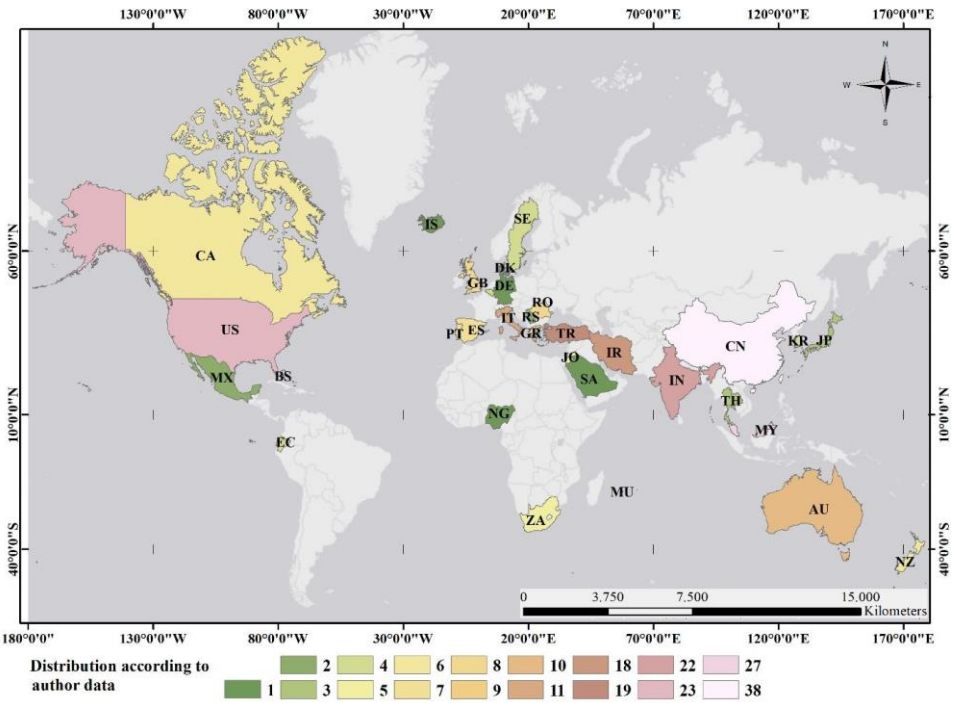

Figure 7. Distribution of publications by contributing authors (Source: Authors)

Figure 8 shows a scatter map showing the distribution of citations across countries. This map shows which countries produce the most cited research on GIS and tourism planning. Considering the number of citations, the United Kingdom leads the list of countries using GIS in tourism planning with 575 citations, while Turkey ranks second with 492 citations. Mauritius follows with 270 citations, New Zealand with 233, South Korea with 200, and Australia with 213. Canada 195, Malaysia 186, Iran 129, China 116, United States 99, Iceland 82, India 63, Sweden 62, Italy 60, Nepal 59, Greece 57, South Africa 53, Bahamas 44, Denmark 31, Jordan 31, Ecuador 16, Serbia 14, Portugal 9, Mexico 9, Spain 6, Romania 5, Japan 1. Very few publications from other countries were not cited at all. Figure 9 illustrates the distribution map of regions where studies are concentrated on a continental basis within the scope of the reviewed literature. This map reveals which continents use GIS more in research on tourism planning. According to Figure 9, Asia ranks first among the continents, with 32 publications. Europe ranks second, with 26 publications. North America ranks third, with eight publications. Australia ranks fourth, with seven publications. Africa ranks fifth, with six publications. South America ranks sixth, with one publication. There are no publications on the Antarctic continent. In terms of the number of countries publishing in this field by continent, it has been determined that Asia is the most influential continent. Europe and North America follow this.

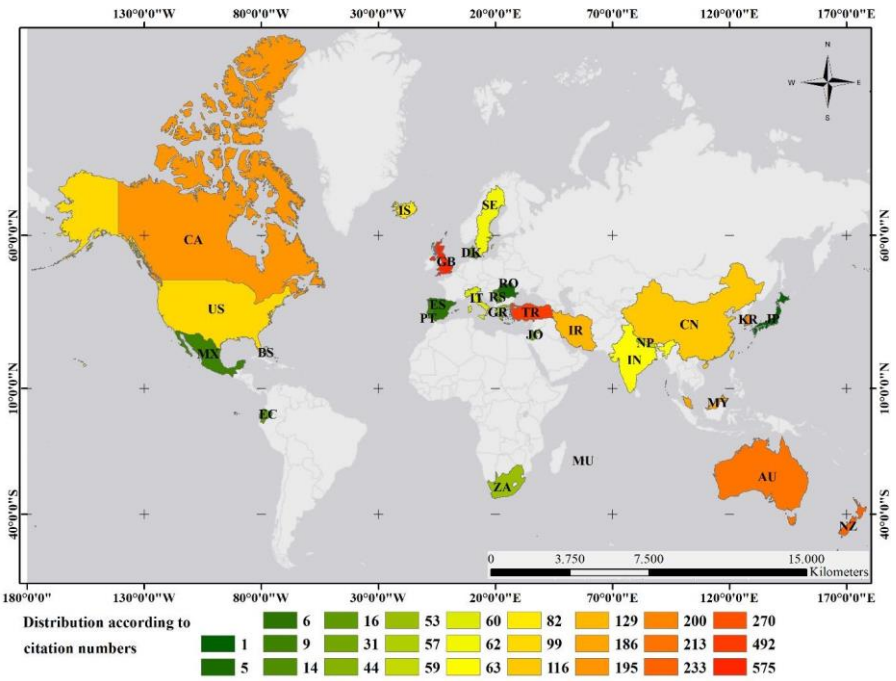

Figure 8. Distribution of publications according to the number of citations (Source: Authors)

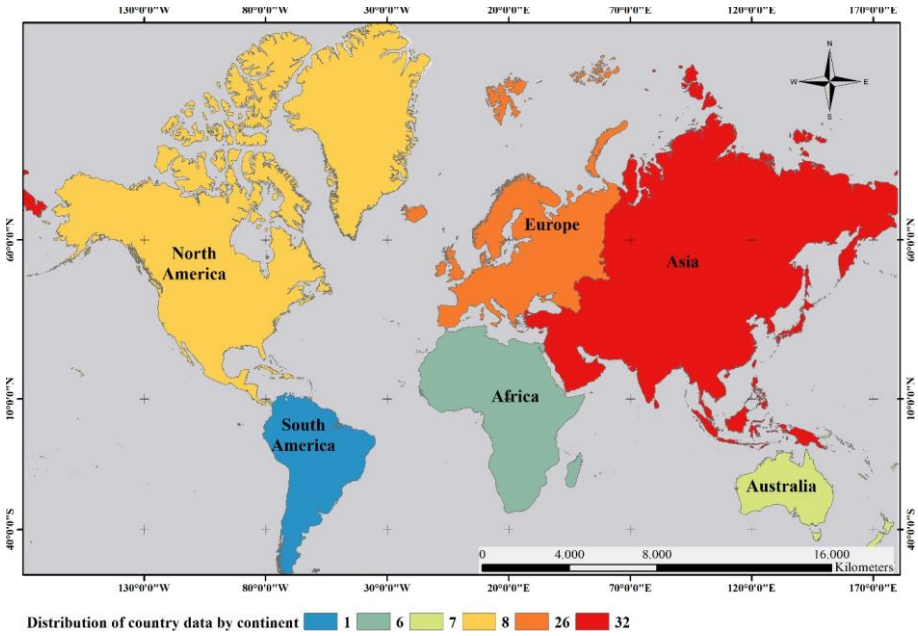

Figure 9. Distribution of publications by continent (Source: Authors)

Figure 10 shows the distribution of the authors who contributed to the publications within the scope of the reviewed literature. In this context, Asia stands out as the continent that has worked the most on the research topic, with 121 authors. Europe ranks second, with 82 authors; North America ranks third, with 33 authors; Australia ranks fourth, with 16 authors; Africa ranks fifth, with eight authors; and South America ranks sixth, with four authors. Examining the distribution of authors by continent, it is evident that Asia is the most influential continent in terms of the number of authors. Europe and North America follow this. Figure 11 shows a map of the distribution of citations to publications within the scope of the analyzed literature. According to Figure 11, Europe ranks first with 1393 citations, Asia ranks second with 785 citations, Australia ranks third with 446 citations, North America ranks fourth with 347 citations, Africa ranks fifth with 323 citations, and South America ranks sixth with 16 citations. When the number

of authors and the number of citations are compared, it is found that authors and publications from the European continent are much more influential. This is followed by Asia and Australia, respectively.

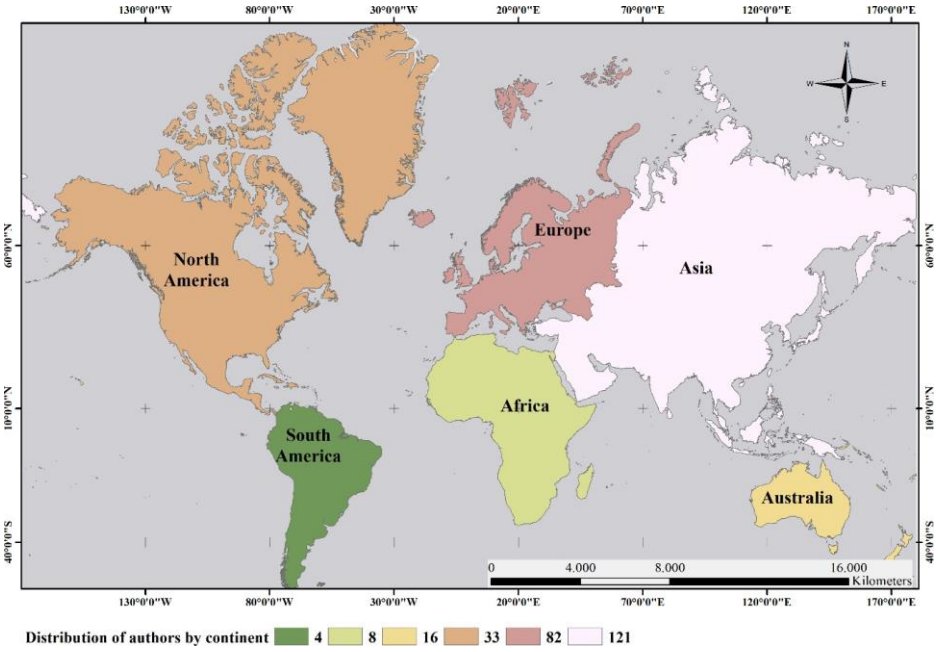

Figure 10. Distribution of authors contributing to publications by continent (Source: Authors)

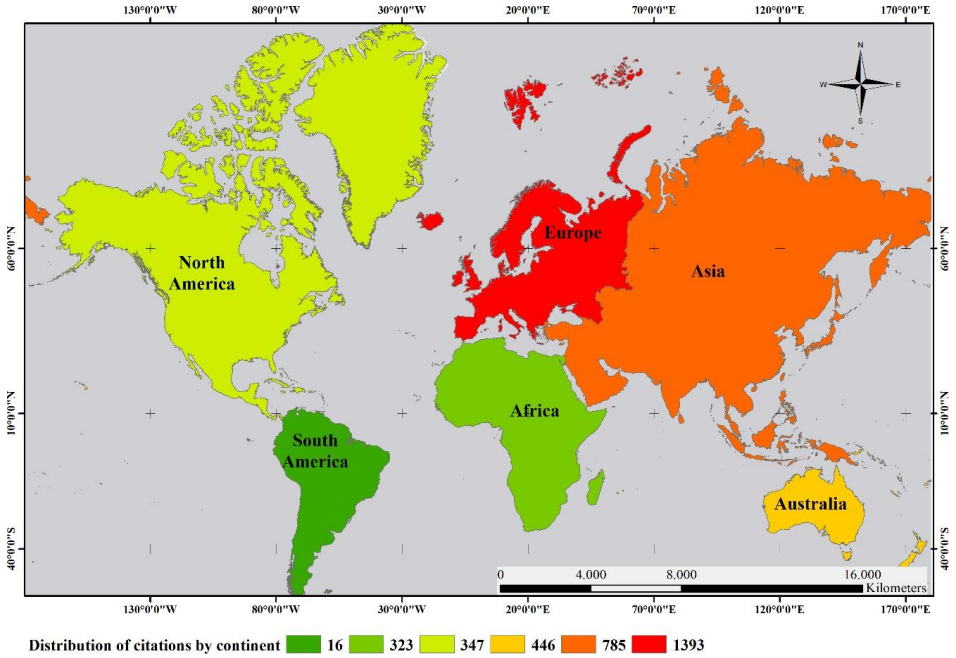

Figure 11. Continental distribution of publications according to the number of citations (Source: Authors)

RESULTS

This study conducted a comprehensive review of the scientific literature on the use of GIS in tourism planning using VOSviewer software. Bibliometric analysis systematically revealed the relationships between publications, authors' collaborations, number of citations, and keyword matches. The analysis reveals that GIS plays a crucial role in tourism planning, encompassing both spatial analysis and decision support systems. The main areas of research are sustainable tourism, recreation planning, infrastructure management, and environmental impact assessments. In

particular, it is seen that sustainable tourism is predominantly examined in studies on how GIS technologies are used in environmental management and resource planning. However, areas such as smart cities, big data analytics, and spatial analysis of tourist behavior that have not yet been addressed in sufficient depth leave the door open for future studies in this field.

In the thematic cluster analysis conducted with VOSviewer software, three main themes emerged in the studies on the use of GIS in tourism planning. The first theme is sustainable tourism and environmental management. This thematic cluster includes studies on the sustainable management of natural resources, ecotourism projects, and monitoring the environmental impact of tourist destinations. The emphasis on sustainability focuses on research into the long-term preservation of tourism destinations and their impact on local communities. The second theme is recreation and infrastructure planning. This theme encompasses the planning and management of the physical infrastructure in tourist areas, utilizing GIS. The use of GIS in infrastructure projects primarily focuses on optimizing transportation networks and determining the layout of tourist facilities. The third theme is spatial analysis of tourism data and decision support systems. This cluster encompasses studies on the development of decision support systems in the tourism sector, utilizing GIS-based analysis and the application of spatial data. Data-driven management of tourism destinations enables more efficient use of resources. These themes illustrate the multidimensional and multifaceted applications of GIS in the tourism sector, revealing research trends in the field. In particular, how GIS supports sustainability and infrastructure planning highlights the wide range of uses for this technology.

The analysis revealed that international academic collaborations are concentrated among countries such as the United States, China, the United Kingdom, Turkey, and Germany. These countries are pioneers in the use of GIS technologies in tourism planning and actively participate in joint projects and research. The United States and China, in particular, stand out as the countries with the highest number of publications and citations in the academic literature. Turkey, on the other hand, is one of the countries producing an increasing amount of work in this field and is involved in collaborative projects, especially in infrastructure planning and the spatial analysis of tourism data. The international cooperation network accelerates knowledge transfer between countries and contributes to the development of innovative solutions in the tourism sector.

Citation analysis helps to identify the most influential studies and authors in this field. Tim Bahaire, Martin Elliott-White, Mehmet Çetin, and Clare Gunn are among the most cited authors on the use of GIS in tourism planning. In particular, studies on sustainable tourism and environmental impact assessments have been frequently cited by other researchers and have become key reference points in this field. The most cited publications are typically studies that demonstrate the application of GIS in tourism destination management and spatial analysis. This reinforces the importance of GIS in tourism planning and shows how this technology plays a critical role in strategic decision-making processes.

This study also identified existing research gaps in the use of GIS in tourism planning. According to the analysis results, topics such as big data analytics, spatial analysis of tourist behavior, the impacts of climate change on tourism destinations, smart city planning, and innovative GIS solutions in tourism have not been adequately addressed. Further studies in these areas will further advance the use of GIS in tourism planning.

In particular, topics such as modeling the impacts of climate change on tourism using GIS and forecasting tourism demand with big data offer important opportunities for future research. These areas will contribute to the development of sustainable tourism solutions by addressing new challenges facing the tourism sector. Additionally, striking results were obtained from the study's findings, which were analyzed using spatial analysis. The findings reveal that the use of GIS in tourism planning is unevenly distributed on a global scale. The results of the study show that China is the country with the highest number of studies on GIS and tourism planning. Turkey, Iran, Malaysia, and India were among the other countries that made significant contributions to this field. The developed countries of the United Kingdom and the United States are noteworthy, with few studies. Likewise, the limited number of GIS-based studies in some countries rich in historical and touristic aspects stands out as a striking finding.

When analyzed on a continent basis, Asia ranked first in terms of both the number of publications and author contributions. Europe and North America were the other continents following Asia. However, in terms of the number of citations, Europe was identified as the continent with the highest impact. This suggests that studies conducted in Europe hold a strong position in terms of scientific impact, with a higher number of references. Another noteworthy finding is that the studies were generally conducted with few international collaborations, and mostly authors from the same country worked together. These findings provide a basis for future studies to expand the integration of tourism planning and GIS to wider geographical areas.

In summary, the theoretical contributions of this study extend the existing body of knowledge in the literature on the use of GIS in tourism planning, systematically identifying the main themes and trends in the field. The bibliometric analysis provides a deeper understanding of the impact of GIS on the tourism sector. From a theoretical perspective, this study, through thematic cluster analysis, examines the relationship between GIS in tourism planning and various issues, including sustainability, infrastructure management, and environmental impact assessments. Furthermore, the identification of issues that have not yet been adequately addressed in the literature, such as big data analytics and the impacts of climate change on tourism, provides an important direction for future theoretical work. This study offers new theoretical perspectives on the current and potential roles of GIS in tourism planning.

In terms of practical contributions, this study provides a guide for the more effective use of GIS in the tourism sector. The analysis demonstrates how GIS is applied in practical settings, such as decision support systems and spatial analysis, and identifies areas where it has the most potential. In particular, the contributions of GIS in applications such as sustainable tourism planning, infrastructure development, and spatial analysis of tourist behavior are detailed. In this context, the advantages of GIS for tourism managers, urban planners, and policymakers are presented, along with practical suggestions on how to use this technology more effectively in the future. The study also provides strategic insights for further development of international cooperation by showing the countries in which international cooperation is concentrated.

DISCUSSIONS

This study provides a comprehensive bibliometric analysis of the scientific literature on the use of Geographic Information Systems (GIS) in tourism planning and management. The findings underscore the crucial role of GIS in collecting, analyzing, and informing decision-making processes within the tourism sector. While the study confirms the widespread use of GIS in areas such as sustainable tourism, infrastructure planning, and environmental impact assessments, it also identifies significant research gaps. It provides a comparative perspective in relation to existing literature.

The findings of this study align with and extend previous research on the use of GIS in tourism planning. For instance, similar to the work of Bahaire and Elliott-White (1999), who emphasized the role of GIS in sustainable tourism development, this study also identifies sustainable tourism as a dominant theme in the literature. However, unlike previous studies that often focus on specific applications of GIS (e.g., environmental monitoring or site suitability analysis), this study provides a holistic overview of the field, revealing the interconnectedness of themes such as sustainability, infrastructure planning, and spatial analysis.

In contrast to Chen's (2007) study, which highlighted the underutilization of GIS in tourism planning, this research demonstrates that the adoption of GIS has increased significantly over the past decade, particularly in countries such as China, Turkey, and the United States. This shift suggests a growing recognition of the value of GIS in addressing complex challenges in tourism planning. However, the uneven geographical distribution of GIS-based studies, as revealed in this analysis, indicates that developing countries and regions with rich tourism potential (e.g., Africa and South America) are still lagging in the adoption of this technology.

Another key distinction of this study is its focus on international collaborations and citation networks. While previous bibliometric analyses in tourism (e.g., Koseoglu et al., 2016; Leong et al., 2020a) have examined research trends and thematic developments, they often lack a

detailed exploration of collaborative networks. This study reveals that collaborations are predominantly concentrated among developed countries (e.g., the United States, the United Kingdom, and Germany), with limited involvement from developing nations. This finding underscores the need for more inclusive international partnerships to bridge the knowledge gap and promote the global adoption of GIS in tourism planning.

One of the most significant contributions of this study is the identification of underexplored areas in the literature. While previous studies have extensively covered traditional applications of GIS, such as environmental impact assessments and recreation planning, this analysis highlights emerging topics that warrant further investigation. For example, the integration of GIS with big data analytics and artificial intelligence (AI) remains largely unexplored, despite its potential to revolutionize tourism planning through real-time data analysis and predictive modeling. This gap is particularly evident when compared to studies in other fields, such as urban planning and transportation, where the integration of GIS with advanced technologies has already yielded significant advancements.

Similarly, the impacts of climate change on tourism destinations, though recognized as a critical issue, have not been adequately addressed in GIS-based tourism research. While studies like Raymond and Brown (2006) have explored the use of GIS in environmental management, there is a lack of focused research on how GIS can be leveraged to model and mitigate the effects of climate change on tourism. This study calls for more interdisciplinary research that combines GIS with climate science to develop sustainable tourism strategies.

Practical Implications and Future Directions

The findings of this study have important practical implications for tourism planners, policymakers, and researchers. First, the integration of GIS with big data and AI technologies offers a promising avenue for enhancing decision-making processes in tourism planning. For instance, predictive models based on real-time data can help optimize resource allocation, improve visitor experiences, and mitigate overcrowding in popular destinations. Future studies should explore the technical and operational challenges of implementing such integrated systems, particularly in resource-constrained settings.

Second, the uneven adoption of GIS across different regions highlights the need for capacity-building initiatives, especially in developing countries. Training programs and knowledge-sharing platforms can help bridge the gap between developed and developing nations, fostering a more inclusive global research community. International organizations and academic institutions should play a proactive role in facilitating these efforts.

Ultimately, the study highlights the significance of interdisciplinary research in addressing complex tourism challenges. By combining GIS with fields such as climate science, cultural heritage management, and biodiversity conservation, researchers can develop innovative solutions that balance tourism development with environmental and social sustainability. For example, GIS can be used to map and monitor cultural heritage sites, ensuring their preservation while promoting sustainable tourism practices.This study conducted a comprehensive bibliometric analysis of the scientific literature on the use of GIS in tourism planning and management. The findings reveal that GIS is an important tool for collecting, processing, and analyzing spatial data in the tourism sector. The study shows that the use of GIS is widespread, especially in areas such as sustainable tourism, infrastructure planning, and environmental impact assessments. However, some research gaps remain unaddressed. For example, although big data analytics and smart tourism applications are other increasingly important uses of GIS technology, they have not been thoroughly examined in the literature.

In light of these findings, important questions arise about the impact of GIS on tourism planning. On the one hand, the spatial analysis and decision support tools offered by GIS enable tourism destinations to be managed more effectively. On the other hand, how this technology can further contribute to sustainability goals is an area that still needs to be explored. Additionally, issues related to technological access and training must be addressed to enable GIS technology to be effectively utilized by a broader audience. At this point, the use of GIS, particularly in developing countries, and its role in tourism planning should be further explored.

This study highlights the significance of GIS in tourism planning and provides recommendations for future research and applications. First, the integration of big data and artificial intelligence technologies with GIS has the potential to provide more advanced decision support systems and forecasting models for the tourism sector. Therefore, it is suggested that future studies should focus on how this integration can be achieved. The combination of big data analytics and GIS can provide significant benefits in areas such as predicting tourist behavior and forecasting tourist demand. Secondly, the impacts of climate change on tourism destinations should be further investigated. In this context, GIS can be used to conduct detailed spatial analyses on how tourism activities can be managed in regions sensitive to climate change. This is especially critical for sustainable tourism planning. Finally, international cooperation needs to be strengthened. There should be greater cooperation between different countries further to expand the use of GIS in tourism planning and generate innovative solutions. These collaborations have great potential for both academic research and tourism policy development. Therefore, international academic projects and collaborations should be encouraged, and necessary steps should be taken to expand the use of GIS on a global level. The findings of this study offer important insights into how GIS technology can be utilized more effectively in tourism planning, paving the way for new horizons in future research.

By providing a comprehensive bibliometric analysis of the use of GIS in tourism planning, this study deepens the existing knowledge in the field. It provides an essential foundation for future research. The findings not only reveal the multifaceted use of GIS in tourism planning and the research trends in this field but also reveal topics that have not yet been sufficiently explored. In this context, the study serves as a strategic guide for future research on the interactions between GIS and tourism.

One of the most important contributions of this study is to systematically analyze the main trends and research gaps in the literature and identify topics that future studies can focus on. In particular, the existing studies, centered around themes such as sustainable tourism, recreation planning, and environmental impact assessments, emphasize the importance of GIS in these fields and provide a solid foundation for further investigation in the future. In addition, the data on international collaborations shows which countries' academic collaborations are concentrated with and how these collaborations can be developed in the future. In this context, researchers can contribute to a broader understanding of this technology by conducting comparative studies on how GIS is utilized in tourism planning across different geographical regions.

Future studies should be conducted to complement the findings of this study. Firstly, studies examining the integration of advanced technologies, such as big data analytics and artificial intelligence, with GIS are needed. The combination of these technologies can produce more innovative and data-driven solutions in tourism planning. For example, issues such as real-time monitoring and forecasting of tourist movements can be addressed more effectively with the integrated use of big data and GIS. Additionally, studies on the impacts of climate change on tourism destinations are crucial for sustainable tourism planning. Detailed analysis of climate change-sensitive regions using GIS can provide strategic solutions to minimize the environmental impacts of tourist activities. This study reveals the need for further research in climate change-sensitive regions.

Finally, interdisciplinary studies on the tourism sector and the use of GIS should be encouraged. It should explore how GIS technology can be applied not only in tourism planning but also in other areas, such as smart cities, cultural heritage management, and biodiversity conservation. Such interdisciplinary approaches will contribute to the development of more comprehensive and innovative solutions in the tourism sector. In conclusion, this study presents a comprehensive literature review on the application of GIS in tourism planning, offering valuable insights for future research. Further exploration of these findings, combined with various technologies, will enable the expansion and development of GIS use in the tourism sector.

CONCLUSION

In conclusion, this study presents a comprehensive and systematic analysis of the application of GIS in tourism planning, providing valuable insights into current trends, research gaps, and future directions. By comparing its findings with existing literature, the study highlights its unique contributions, including the identification of emerging themes, the exploration of international collaborations, and the emphasis on underexplored areas such as big data integration and the impacts of climate change. These findings not only deepen our understanding of the role of GIS in tourism planning but also provide a roadmap for future research and practical applications. As the tourism sector continues to evolve, the integration of GIS with advanced technologies and interdisciplinary approaches will be crucial for achieving sustainable and inclusive tourism development.

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