



## The Use of Virtual Technologies in Ecotourism: A Bibliometric Analysis Using Web of Science and Scopus Databases

(Ekoturizmde Sanal Teknolojilerin Kullanımı: Web of Science ve Scopus Veri Tabanları Üzerinden Bibliyometrik Bir Analiz)

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### ABSTRACT

This study aims to present the research developed to date in the literature on ecotourism and virtual technologies in general using a bibliometric analysis method. Data extracted from Web of Science and Scopus databases were analyzed through graphs showing the evolution of publications, geographical origin, and document types, as well as trends, and bibliometric analysis was performed on journals, authors, citations, and influential keywords. In light of the findings, it has been revealed that the first study on ecotourism and virtual technologies was conducted in 2011, the number of studies has increased over the years, the countries contributing most to the subject area are China, Australia, Indonesia, and Spain, Xueqin Wang ranks first as a researcher with 3 studies and 48 citations, the most common publication type is articles, and the subject area focuses heavily on Sustainable Development Goal 11: Sustainable Cities and Communities. In conclusion, although the number of studies integrating virtual technologies into ecotourism is relatively small in the literature, it has increased over the years, and studies focusing on virtual technology and ecotourism provide a framework for sustainable tourism and sustainable travel. The reason for focusing on sustainable cities and communities may be the prediction that making cities and human settlements inclusive, safe, resilient, and sustainable will be a significant challenge for humanity in the future. Databases examined on this subject, Scopus is considered to cover the field of virtual technologies and ecotourism better due to its larger number of publications. This study is limited to WOS and Scopus databases indexed in the field of ecotourism and virtual technologies between 2011 and 2025.

### MAKALE BİLGİSİ

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### ÖZ

Çalışmada ekoturizm ve genel olarak sanal teknolojiler hakkında bugüne kadar alanyazında geliştirilen çalışmaların bibliyometrik analiz yöntemiyle ortaya konması amaçlanmıştır. Veri tabanı olarak Web of Science ve Scopus üzerinden çekilen veriler; yayınların evrimi, coğrafi köken ve belge türlerinin analizleri ve grafikleri eğilimler ile dergi, yazar, atf ve etkili anahtar kelimelerin bibliyometrik analizi yapılmıştır. Elde edilen bulgular ışığında; ekoturizm ve sanal teknolojiler üzerine ilk çalışmanın 2011 yılında yapıldığı, yıllara göre çalışma sayılarının yükseldiği, konu alanına ilişkin en fazla katkı sağlayan ülkelerin Çin, Avustralya, Endonezya, İspanya olduğu, araştırmacı olarak 3 çalışma 48 atfıla Xueqin Wang'ın ilk sırada yer aldığı, en fazla yayın türünün makale olduğu, konu alanının sürdürülebilir kalkınma hedeflerinden Hedef 11 Sürdürülebilir Şehirler ve Topluluklar üzerinde yoğunluk kazandığı ortaya çıkmıştır. Sonuç olarak sanal teknolojileri ekoturizme entegre eden çalışmaların alanyazında miktar olarak az bulunmasına rağmen yıllara göre artış gösterdiği, sanal teknoloji ve ekoturizm odaklı çalışmaların sürdürülebilir turizm ve sürdürülebilir seyahate yönelik çerçeve çizdiği ortaya çıkmıştır. Sürdürülebilir şehirler ve topluluklar üzerine odaklanılmasının sebebi ise gelecekte insanlığın önemli bir sorunu olarak şehirleri ve insan yerleşimlerini kapsayıcı, güvenli, dayanıklı ve sürdürülebilir kılma olacağı öngörüsü olabilir. Konuyla ilgili incelenen veri tabanlarından Scopus'un daha fazla sayıda yayın içermesiyle sanal teknolojiler ve ekoturizm alanını daha iyi kapsadığı düşünülmektedir. Bu çalışma, 2011-2025 yılları arasında ekoturizm ve sanal teknolojiler konu alanında indekslenen WOS ve Scopus veri tabanlarıyla sınırlıdır.

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The author(s) has no conflict of interest to declare.

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This study does not require ethics committee approval as it uses secondary data.

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## Introduction

In the context of tourism, virtual technologies have influenced the innovation of products, services, processes, and management (Hjalager, 2010). Virtual technologies have changed the way tourism providers create and deliver tourism experiences, and the way tourists perceive and experience destinations. In particular, the introduction of cutting-edge wearable devices and Virtual Reality (VR) systems offers significant opportunities to enhance the potential for creating awareness, interest, and appeal to a destination. Today, VR and its reflections have begun to take place in many areas such as entertainment services, design, simulation training within the tourism industry and will continue to have an impact in the future (Guttentag, 2010; Timur & Kız, 2022). The reason for these, according to Ioannides and Gyimothy (2020), are that virtual technology applications are held as a tool for the revitalization of tourism, which has been particularly affected by the global pandemic. In this regard, the tourism sector has embraced the digital environment and has begun to integrate technology operations such as personalized experiences, omnichannel customer communication, VR, real-time marketing, messaging platforms and chatbot applications, mobile integration, Internet of Things (IoT) and augmented reality (AR) (Çiğerci, 2025; Pajo, 2025)

Technological developments have direct and permanent effects on the tourism industry. In recent years, the latest technology in information and communication tools has shaped the tourism sector in many areas, from tourist demand to business management (Buhalis & Law, 2008; Koçkaya, 2025). Today, people prefer social platforms more when making holiday decisions (Ghandour & Bakalova, 2014). Businesses that are aware of this demand of people are rapidly learning and using technologies that will enable them to continue their activities in virtual environments. In this context, information and communication technologies have paved the way for tourism research. On the one hand, these studies provide full-time information on how information and communication technologies are changing the tourism industry and how the tourism industry can adapt to new technologies. On the other hand, the continuity of technological developments and changes has made it necessary for the actors in the tourism industry to constantly update and renew themselves in terms of marketing and management processes (Egger & Buhalis, 2008; Grønflaten, 2009).

Virtual technologies have the potential to increase operational efficiency while mitigating environmental concerns. Ecotourism prioritizes conservation efforts aimed at preserving natural ecosystems in good condition for the benefit of future generations. It aims to find a middle ground between protecting the ecological integrity of destinations and offering meaningful experiences to visitors (Zhang & Deng, 2024). Ecotourism is a specific type of tourism associated with activities carried out in harmony with the richness of plant and animal life, without harming nature. If successfully implemented, ecotourism will be key to capacity building. The reasons for focusing on virtual technology and ecotourism in this study can be summarized as follows: Through sensors supported by the IoT, tourist activities, environmental conditions, and resource consumption patterns can be monitored in real time, enabling informed decisions and timely interventions; by examining how ecotourists use virtual technologies to enhance the development of ecotourism destinations, the role of virtual technologies in providing sustainable and improved tourism experiences, and the coordination and cooperation between various stakeholders in the tourism industry and government actors can be investigated. Following this investigation, management approaches and strategies for the implementation of ecotourism can be determined.

The methodological framework of this study is generally composed of virtual technologies and ecotourism. Virtual technologies form a broad set of literature. The reason for not focusing on a specific technology and ecotourism is the limited number of studies on the subject. The cluster was determined to be generally virtual technologies for its suitability for analysis. This study aims to present the accumulated knowledge in the literature in the fields of ecotourism and virtual technology. Data from Web of Science and Scopus covering the years 2011-2025 were used as the database, and VOSviewer software was utilized for analyses of publication evolution, origins of sections, and document types, as well as analyses related to yearbooks, journals, authors, and citations. The study also highlights the potential of using smart technologies such as AR/VR, AI-powered chatbots, and personalized recommendation systems to create eco-friendly, immersive vacations.

## 1. Study Background

### 1.1. The Concept of Ecotourism

When we look at the literature, it is seen that the concept of ecotourism emerged from ecology (environmental science), which is based on the Greek words *oikos* (house) and *logos* (word), and which examines the relationships of living things with each other and their environment. There is no consensus in the literature on the etymology of the term ecotourism. Some researchers have argued that Hetzel was the first person to use the concept of ecotourism (Demir & Çevirgen, 2006: 50-51). According to Hetzel, environmentally sensitive tourism should create minimum impact on local culture and the natural environment, while providing maximum benefit to local people economically and visitors at a satisfaction level (Fennell, 2003: 18).

According to Ceballos-Lascurain, ecotourism is enjoying nature and appreciating and understanding nature (Erdoğan, 2003:109). However, ecotourism is defined in different ways by many researchers in the literature. The reason for this is that ecotourism has different meanings for people with different desires. Therefore, there is no internationally accepted definition of ecotourism (Demir & Çevirgen; 2006: 52). In the modern age, it is possible to define ecotourism as "a form of tourism that encourages learning". The first definition of ecotourism was made by Hector Ceballos-Leascurain, a Mexican environmentalist architect, in 1987. In 1983, while working for the PRONATURA company in Mexico City, his efforts to protect a wetland area were seen as a sustainable tourism activity and were an important tool in determining the place of ecotourism in the literature (Jamal et al., 2006). Based on the definitions obtained, ecotourism in its broadest sense is a nature-based tourism form that acts with a sustainable perspective, is sensitive to the environment and nature, and at the same time increases the social, cultural and economic well-being of the local people.

### 1.2. The Concept of Virtual Technologies

The tourism market, made more competitive by globalization, has forced tourism destinations to implement innovative ways to attract visitors to their unique locations and attractions (González-Rodríguez et al., 2016). In this context, the use of modern technologies is crucial for destinations. Developments in information and communication technologies over the last two decades have significantly impacted the marketing efforts of destination marketing organizations, providing them with unprecedented opportunities and tools to attract and retain visitors (Buhalis & Law, 2008). In particular, the introduction of cutting-edge wearable devices and VR systems offers significant opportunities to enhance the potential for creating awareness, interest, and appeal to a destination.

Metaverse: The Metaverse is a platform containing 3D virtual universes. It achieves this through AR, VR, 3D modeling, the

IoT, holographic avatars, video, and other forms of digital communication. Unlike other social media platforms, it allows users to interact with each other using their virtual characters, or avatars (Hommes Studio, 2022). The Metaverse enables users to engage in activities such as communicating with virtual friends, conducting commerce, visiting virtual museums, and attending virtual concerts (Al-Ghaili et al., 2022). This internet-based universe is virtualized and synchronized.

**AR (AR) Technology:** AR technology is created by adding digital elements to a real universe. These digital elements can be 2D additional information, graphics, and sounds. AR, which enriches the image of the space we are in by adding digital elements synchronously, can be experienced with smartphones, tablets, computers, and AR glasses (Çuhadar, 2024).

**VR:** The concept of VR (VR) is defined as computer-aided three-dimensional environments where one or more users' senses are stimulated, directed and interacted with in real time (Guttentag, 2010). The three most distinctive features of VR applications are; visualization that allows users to look around with a device they can wear on their heads, diving into VR, which is the feeling of being away from the physical environment, and interaction, where the experience can be controlled and directed with tools such as glasses, gloves, clothing and platforms. VR is a technology that creates the feeling of experiencing experiences that are not actually happening in real life, thanks to special cameras, sensors and other equipment in three-dimensional environments created using computer graphics, photos and videos. Mandal (2013) defined VR as a technology in which users can interact in real time and move and control various objects in a computer-generated environment. According to Brooks (1999), VR refers to any experience in which the user is effectively surrounded in a sensitive virtual world. When the definitions of VR are examined, it is seen that VR technology differs from traditional media tools with the depth perception, immersion and interaction features provided by the 3-dimensional environment. VR technologies have gained different features over the years and have been adapted to various areas of use.

The term VR was first used by Jaron Lanier in the late 1980s (Reznek et al., 2002). On the other hand, pioneering studies on VR that provided multi-sensory stimulation were carried out in the 1950s. The device called Sensorama, developed by Morton Heilig in 1957, is considered one of the first VR technologies (Serrano et al., 2016). With this technology, in addition to 3-dimensional stereoscopic images, multiple stimuli such as stereo sounds, wind, smell and seat vibration were provided. Although Sensorama was one of the first technologies developed to create a virtual environment, its design is very different from the head-mounted VR headsets commonly used today. The first example of head-mounted displays widely used today was invented by Sutherland in the 1960s. Ivan Sutherland proposed the "Ultimate Display" system, a display model that resembles the physical world and allows users to interact directly with the computer (Reznek et al., 2002). In 1968, Sutherland developed the first head-mounted VR prototype, the "Sword of Damocles" (Liu et al., 2018).

### 1.3. Virtual Technologies Applications in Tourism

The use of virtual technologies in tourism and recreation is becoming increasingly widespread. While the number of studies on virtual technologies is increasing day by day, businesses have started to use this technology in new business models and operational processes. Developments in the field of mixed reality technology, which offers AR and VR together, provide clues about the role that reality technologies will take in business and social life. When VR applications and past studies are examined, the applications of this technology in tourism and recreation areas are diverse. Carvalho and Ivanov

(2024) stated that ChatGPT and other similar models have a profound impact on many tourism processes and revealed that they will be beneficial in facilitating customer service in front office operations and increasing productivity and efficiency in back office operations.

In sustainable tourism, while ensuring economic sustainability, the protection of cultural, biological, ecological, environmental and aesthetic resources is a mandatory requirement (Sonuç, 2014). Overtourism negatively affects the quality of life of local people and tourists in a destination (Öztürk, 2020). Various studies have been conducted on the use of virtual technologies in the protection of cultural heritage. The jumps made from the Monstar Bridge to the Neretva River in Bosnia and Herzegovina reflect a tradition of approximately 460 years. Selmanovic et al. (2018) investigated the contribution of 360-degree VR videos to the protection of intangible cultural heritage. For this purpose, they designed a VR video containing 360-degree video stories about the history and bridge diving tradition and a VR application that allows the user to virtually jump off the bridge. VR is a low-cost technology that requires less technical expertise to realize different virtual environment designs (Browning et al., 2020). For this reason, it can contribute to the creation of fast and low-cost content in various operations and planning of destination managers and marketers. Content created with VR technology can provide realistic and interactive environments and enable tourism planners to evaluate possible developments (Guttentag, 2010). The use of VR in the development of marketing strategies can affect the information search and decision-making processes of potential tourists (Rainoldi et al., 2018).

Museum visitors find it difficult to develop a coherent understanding of the relevant society based solely on the artifacts and descriptions displayed in museums (Puig et al., 2020). Virtual technologies can be used as an educational tool in museums, etc., with the interactive experiences it provides. In past studies, different applications for the use of virtual technologies in museums have been developed. These applications include virtual tours and VR games. Although VR games are designed for entertainment and leisure activities, their great potential for use in education cannot be ignored. Liu et al. (2021) designed a virtual technologies archaeology education game, Relic VR, to enrich museum visits and learning experiences. In the game, users separate the soil surrounding the ruins with the tools in their hands like an archaeologist. VR can positively affect the participation of people who do not have the opportunity to participate in ecotourism activities or who lack motivation in sports or artistic activities. On the other hand, in addition to the physiological and psychological effects of VR, determining people's attitudes towards VR is an important area of research. Nature hosts many recreational activities. It is known that spending time in nature and being exposed to nature has a positive effect on psychological indicators such as stress, mood, and concentration (Kaplan & Kaplan, 1989; Ulrich, 1984). VR offers important alternatives for people who cannot reach nature due to various obstacles or the intensity of daily life. Some studies have stated that although VR has positive effects on mood, the effects of real nature are greater (Browning et al., 2020). On the other hand, Fan and Baharum (2024) stated that digital and real nature reduce stress to the same level. While passive 360-degree videos (Browning et al., 2020) were generally used in past studies, interactive contents such as nature hiking (Calogiuri et al., 2018) and fishing (Inan, 2023) have also been used.

### 1.4. Bibliometric Analysis Studies on Ecotourism

Çinbilgel and Ergün (2022) conducted a bibliometric analysis of ecotourism on the Scopus database, and the most common keywords were biodiversity, sustainable development, environmental protection, and tourism. Khanra et al. (2022), a

product of ecotourism and bibliometric analysis, identified four main thematic areas: ecological protection, interests of residents, carbon footprints and the form of prohibition. However, such attempts to review the literature on ecotourism are narrowly focused and fragmented, presenting a lack of comprehensive understanding of this topic, which is particularly important in the present context because concepts such as ecotourism are endogenously multidisciplinary (Boley et al., 2015).

In this study, bibliometric analysis was used to quantitatively and qualitatively investigate the global research trend of virtual technologies and ecotourism during the period from 2011 to 2025. Specifically, this article aims at identifying (a) the general patterns for document type, publication output, journals and contribution of territories/countries and institutions in virtual technologies and ecotourism research; (b) the overall development of the research topics, the geographic areas of case study, and the research methods in ecotourism; (c) the characteristics of dynamic changes of virtual technologies and ecotourism research at developing stages. The problems of this research are as follows;

- How have virtual technologies been applied in ecotourism, and what are the main research trends emerging from this field?
- What is the distribution of studies on ecotourism and virtual technology by year?
- Which countries, institutions, and researchers have contributed to ecotourism and virtual technology?
- Which of the sustainable development goals has the focus of studies on ecotourism and virtual technology been?

## 2. Research Method

The primary research question guiding this study is: How have virtual technologies been applied in ecotourism, and what are the main research trends emerging from this field? To answer this question, the study uses VOSviewer 1.6.20 to conduct a scientometric review of publications indexed in the Scopus and Web of Science. The methodology chosen for this study is appropriate for the purpose. The methodology incorporates robust and high-quality analysis methods to address comprehensive research questions from diverse disciplines. The methods used to evaluate and modify scientific anomalies can be modified (Özyurt Kaptanoğlu, 2025). The research methodology was planned to include the following stages, as suggested by Börner (2010). These stages are; data collection and analysis; selection of mapping tools; visualization; presentation, interpretation and discussion of findings.

### 2.1. Data Collection

To examine studies on virtual technology and ecotourism focusing on the research topic, a search was conducted in WOS and Scopus using the combination of the keywords TITLE-ABS-KEY "Virtual technology" and "Ecotourism" OR "Eco tourism", "Virtual technology" AND ("Ecotourism" OR "Eco tourism"). Generally, considering the topic area's relevance, the first study was published in 2011, and all years (2011-2025) were covered in the databases without any year criteria. Since the beginning of 2011, a total of 89 studies have been included, 59 in the Scopus database and 30 in the Web of Science. Research data were withdrawn from the databases on April 15, 2025. Why were Scopus and Web of Science databases chosen? There are some criteria that can be used in selecting any database in bibliometric research (Öztürk et al., 2024):

- Number of journals covered for the research field,
- Accessibility to the database (e.g., free access, institutional memberships, etc.),
- Journal impact factors and their field-leading potential,
- The ability to download data in a format compatible with bibliometric analysis software,

- The ability to filter data in compliance with the software that enables to address research questions,
- Number of records that can be exported from the database.

**Table 1** Search Strategy Adopted By the Researcher for Bibliometric Analysis

Stages	Inclusion criteria	Exclusion criteria	Obtained results
Stg 1	Databases: Web of Science and Scopus	Google Scholar	Web of Science: 30 studies
Stg 2	Search terms: Virtual technology and ecotourism	EXCLUDE Tourist Destination EXCLUDE Sustainability	Scopus: 59 studies
Stg 3	2011-2025 April 15th	No exclusions were made at this stage.	Total number of documents: 89 studies
Stg 4	Source Type: All documents	No exclusions were made at this stage.	
Stg 5	Language: English	Chinese, Russian	

The search strategy adopted by the researcher for the bibliometric analysis consisted of five stages (Table 1).

- Stage 1 involved databases: The exclusion of other databases, such as Google Scholar, was due to inconsistent accuracy and lack of comprehensive citation data.
- Stage 2 involved search terms: Virtual technology and ecotourism.
- Stage 3 involved year range.
- Stage 4 involved source type: No exclusions were made at this stage.
- Stage 5 involved language preference: English.

In the general criteria listed in Table 1, expressions related to tourist destinations and sustainability have been excluded. The reason for this is to prevent issues arising from ecotourism subsidies from being exploited. Since the datasets extracted from the Web of Science and Scopus databases were small, the extraction process was performed manually. Similarly, the analyses were also carried out separately. To prevent duplicate publications, articles were removed if a journal was indexed in both SCOPUS and WOS. To identify this, articles were reviewed sequentially. Articles that were duplicated twice were removed. Due to the small number of studies, this method was performed manually.

### 2.2. Analysis of Data

This study used the VOSviewer scientific mapping system to perform quantitative bibliometric analysis of the literature collected from the WOS and Scopus database (Van Eck & Waltman, 2010). In previous studies, bibliometric analysis was used to map the prevalence of related topics in databases and areas of little academic interest (Klarin, 2019). VOSviewer tools (Van Eck & Waltman, 2013) were used for bibliometric analysis of selected related articles. VOSviewer has become popular in the scientometric community and other fields where scientific maps are used due to its ease of use and numerous features (including specialized clustering and natural language processing algorithms) (Orduña-Malea & Costas, 2021). Van Eck and Waltman (2010) stated that, unlike other computer tools used for bibliometric mapping, VOSviewer is expressed as a graphical representation. The analyses were performed separately for each of the two databases. The information for the documents that meet the requirements contained year of publication, language, journal, title, author, affiliation, keywords, document type, abstract and counts of citation

which were exported into CSV format. The date of the retrieval was 15th April 2025. VOSviewer (version 1.6.10) was used to analyze the Co-authorship, Co-occurrence, Citation, and themes. VOSviewer is a software tool that creates maps using network data to build networks of scientific articles, scientific journals, scientists, research organizations, countries, and keywords. VOSviewer creates network-based maps, visualizes and explores maps (Oyewola & Dada, 2022).

The network analyses performed are as follows:

- Co-authorship of authors
- Citation Analysis of Organizations
- Keyword analysis
- Citation Analysis According to Sources

In author data based on the co-authorship network, the threshold value was set at two to easily identify prominent authors. The minimum number of citations of an organization is set as 2. Keywords provided by authors of the paper and occurred for more than 5 times in the WOS and Scopus database were enrolled in the final analysis. According to the citation analysis of the documents, a network map was created by determining at least 1 publication and at least 1 citation criteria to determine the most linked documents.

3. Findings

The Web of Science and Scopus database examined within the scope of the study was searched as 'Virtual Technologies and Ecotourism' and the distribution of the studies by year is presented in Table 2.

Table II Distribution of Studies on Ecotourism and Virtual Technology by Year (WOS & Scopus)

Publication Years	Record Count (Web of Science)	Record Count (Scopus)
2025	1	7
2024	4	12
2023	4	9
2022	6	8
2021	2	6
2020	1	2
2019	2	4
2018	-	-
2017	-	-
2016	1	1
2015	2	1
2014	4	4
2013	2	4
2012	-	-
2011	1	1
<b>Total</b>	<b>30</b>	<b>59</b>

It was revealed that the first study on ecotourism and virtual technology was conducted in 2011. It is thought that the number of studies is low due to the newness of the field and that the number of studies will increase over time. It was revealed that the first similar study in the Scopus database was conducted in 2011. Studies on virtual technology and ecotourism were found to be the most numerous in the Scopus database, with 59 studies. No studies have been conducted for the years 2018, 2017 and 2012. Databases examined on this subject, Scopus is considered to cover the field of virtual technologies and ecotourism better due to its larger number of publications.

The analysis of research country will give us the information that which country stand on the frontier of this research (Figure 1).

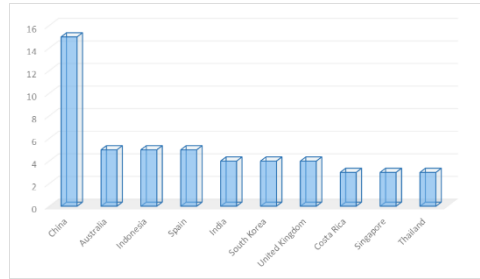


Figure 1 Most Productive Countries

According to the Web of Science database, the countries contributing the most to the field are China (15), Australia (5), Indonesia (5), Spain (5), India (4), South Korea (4), United Kingdom (4), Costa Rica (3), Greece (3), Singapore (3), Thailand (3), Brazil (2), Italy (2), Malaysia (2), Portugal (2), Taiwan (2), Turkey (2), respectively.

Table III Ecotourism and Virtual Technology Studies According to Sustainable Development Goals (WOS)

Sustainable Development Goals	Record Count	% of 30
04. Quality Education	4	13,33
09. Industry Innovation And Infrastructure	2	6,66
11. Sustainable Cities And Communities	15	50
12. Responsible Consumption And Production	1	3,33
13. Climate Action	4	13,33
14. Life Below Water	1	3,33
15. Life On Land	3	10

The distribution of Sustainable Development Goals (SDGs) in Table 3 was automatically obtained from the Web of Science SDG classification. Studies on ecotourism and virtual technology are mostly concentrated on the 11 Sustainable Cities and Communities headings (15 studies) among SDGs. This is followed by 04 Quality Education (4 studies) and 13 Climate Action (4 studies).

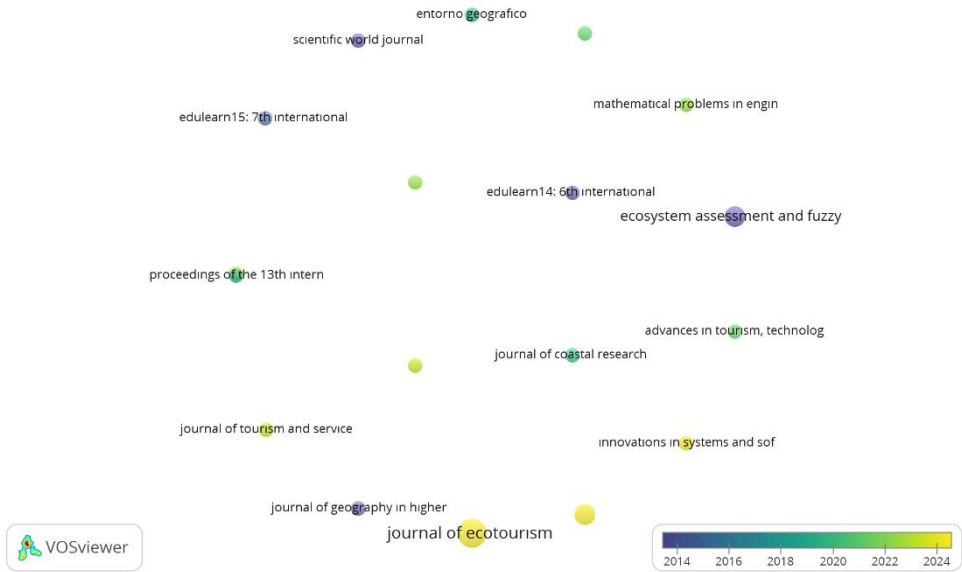
Table IV Researchers Who Contribute to the Field

Researchers by Research	Num. of stu.	Researchers by Citations	Num. of cit.
Xueqin Wang	3	Xueqin Wang	48
Kum Fai Yuen	3	Kum Fai Yuen	48
F. Ioras	3	Huang-Ming Chuang	48
You-Shang Chen	2	Chien-Ku Lin	48
Huang-Ming Chuang	2	Da-Ren Chen	48

The researchers who have made the most contribution to the field of ecotourism and virtual technology are presented in Table 4. In the light of all these findings, the fact that the country with the highest concentration in the field of ecotourism and virtual technologies is China, the university that provides the most contributions located in China, the fact that the researchers who receive the most studies/citations on the subject are Chinese has revealed the dominance in this field.

The network of the co-author analysis is presented in Figure 2. The co-author network is formed as 2 clusters in Figure 2. The authors in the first cluster are; Abrudan, Calderon-Guerrero, Garcia Robledo, Garcia Rodriguez, Gimenez Suarez, Lopez Alvarez, Martin Fernandez and Santamarta. The authors in the second cluster are; Arraiza, Calderon, Cordon, Garcia, Gimenez, Ioras and Lopez.





**Figure V** Citation Analysis According to Sources

Cluster 1 contains the keywords 3D digital outcrop models, geoheritage, geoparks, geotourism, web-gis; Cluster 2 contains anchoring effect, museum learning outcome, museum tourism, technological optimism; Cluster 3 contains cue consistency, place attachment, sensory information, VR. The ones with the strongest ties in the Scopus database are; VR (12), sustainable tourism (10), sustainable travel (8), while those with the strongest ties in the WOS database are; it is in the form of VR (55), ecotourism (19), Covid-19 (17).

According to the citation analysis of the documents, a network map was created by determining at least 1 publication and at least 1 citation criteria to determine the most linked documents.

The network of the document citation analysis is presented in Figure 5. According to the sources, it has been revealed that the studies on ecotourism and virtual technology are mostly published in the Journal of Ecotourism and in recent years, the Journal of Ecotourism has gained importance in this subject area.

**4. Conclusion**

In the study, it was revealed that the first study on ecotourism and virtual technology was conducted in 2011, the university and the country that provided the most contributions and funding for the subject area were based in China, Xueqin Wang ranked first with 3 studies and 48 citations as a researcher, the most types of publications were articles, the subject area focused on 11 Sustainable Cities and Communities from the SDGs. In the light of all this information, the fact that the country with the highest concentration in the field of ecotourism and virtual technologies is China, the university that provides the most contributions and funding is located in China, the fact that the researchers who receive the most studies/citations on the subject are Chinese has revealed the dominance in this field. The Chinese Academy of Sciences was the most prolific contributor (Liu & Li, 2020). The top three countries contributing most to ecotourism and virtual technology are China, Australia, and Indonesia. Dinç et al. (2023) conducted a bibliometric study on ecotourism, and the

countries with the most published research are Australia, the United States, and China. China is the country that has emerged as a step ahead in integrating virtual technology into ecotourism. From a national perspective, the Chinese government promotes the view that “lucid waters and lush mountains are invaluable assets,” advocating that eco-environmental protection and enhancement lead to greater productivity. This perspective mandates sustainable development as a guiding principle, prioritizing ecological protection to develop tourism activities centered on ecological experience, cognition, and ecology (Yang et al., 2025).

Research trends show increasing depth and breadth, evolving hotspots, and a growing emphasis on ecotourism management (Hasana et al., 2022; Sing et al; 2022; Yang et al., 2025). Yet the research on ecotourism is fragmented, presenting gaps in the current understanding of this topic (Khanra et al., 2022). In this research, bibliometric analysis was conducted on academic studies that combine ecotourism and virtual technologies.

Bibliometric analysis confirms that virtual technologies play a very important role in shaping ecotourism. Bibliometric analysis confirms that virtual technologies play a very important role in shaping ecotourism. The increase in publications focusing on ecotourism and virtual technologies reflects the growing interest in the use of immersive tools to bibliometric analysis confirms that virtual technologies play a very important role in shaping ecotourism. The increase in publications focusing on ecotourism and virtual technologies reflects the growing interest in the use of immersive tools to enhance visitor experiences, promote sustainability, and reduce overtourism in ecologically sensitive areas. These technologies are used not only for marketing purposes in ecotourism, but also for environmental education and virtual access to restricted or endangered areas. In ecotourism studies on virtual technology, research topics appear to be focused on virtual and AR. It has been observed that there is a gap in the field of ecotourism regarding big data and artificial intelligence studies on virtual technology, research topics appear to be focused on virtual and AR. It has been observed.

The bibliometric analysis conducted on ecotourism and virtual technology is an original study. Virtual technologies within ecotourism, a form of responsible travel, will help guide tourists toward responsible behavior (Fatma & Bhatt, 2024). Furthermore, virtual technologies will assist practitioners in marketing ecotourism (Huang & Wang, 2022). In this context, a segment called virtual ecotourism is anticipated to emerge. As a result of the bibliometric analysis focused on virtual technologies and ecotourism, it was observed that the terms "VR" and "AR" gained prominence in the keyword analysis, while artificial intelligence, big data and blockchain were underrepresented, indicating a gap in the literature in this area. This study provides a comprehensive overview of how virtual technologies affect ecotourism. It provides strategic information for researchers, practitioners and policy makers who want to promote more inclusive, sustainable and virtually adaptive tourism development. When comparing the databases, it was observed that studies on virtual technologies and ecotourism were included more frequently in the Scopus database. In this respect, it is thought that Scopus, with its larger number of publications, better covers the field of virtual technologies and ecotourism.

The study's originality stems from its scope as a bibliometric analysis that generally addresses virtual technologies and ecotourism. Ecotourism is becoming a strategic approach for destinations within the framework of sustainable tourism. This subfield in tourism literature has significant potential and is expected to continue growing. The results of this research also contain some implications for academics and practitioners. From an academic perspective, the bibliometric analysis contributes to answering some important questions that researchers should consider in their research on virtual technologies and ecotourism. This analysis can help researchers understand and identify new trends in this area, the terminology used, the journals that most frequently address this research, and reference studies in the field. From a practical perspective, the findings of this research show that practitioners in the field of ecotourism need to consider, understand, and integrate different dimensions of ecotourism development in their decision-making processes.

This study was limited to WOS and Scopus publications indexed on the subject area of ecotourism and virtual technologies during 2011-2025. Only studies conducted in English were considered for evaluation as the language of study writing. The date of the retrieval was 15th April 2025. VOSviewer (version 1.6.10) was used to analyze the Co-authorship, Co-occurrence, Citation, and themes. Ultimately, this study aims to provide a comprehensive understanding of how the convergence of sustainability and technology can redefine the future of tourism toward a more responsible and innovative paradigm.

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