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Trends and Future Directions in Analysing Attractiveness of Geoparks Using an Automated Merging Method of Multiple Databases—R-Based Bibliometric Analysis

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Abstract: Since their creation, geoparks have been among the fastest growing natural environments. Their attractiveness is one of the most important factors for the success of this natural destination. Despite their importance, a bibliometric analysis on geopark attractiveness is missing from the studied databases. The aim of this paper is to synthesise a heterogeneous body of knowledge of geoparks in terms of attractiveness, highlighting the evolution and breadth of the research field. To achieve this, the following objectives were set: (a) to adopt a method based on functions provided by the bibliometrix package to automatically combine databases, namely WoS, Scopus, PubMed and Dimensions, detailing the method used and (b) to analyse the bibliometric indicators in order to identify the trends in the literature and the possible directions for future research. The applied methodology was based on bibliometric analysis using R for non-coders. From the 707 documents retrieved, the validation process resulted in 349 eligible documents published between 2002 and 2024, on which the analysis was carried out. The current study elaborated a method and examined the key information on the topic trends, which were given by production performance, productivity trends, spatial analysis and abstract approach analysis. Additionally, strategic mapping of the conceptual context was performed. Thus, the result provides a description of the automatic method with practical applications. As discerned from the three-dimensional analysis (spatial, temporal and size), the emerging research directions within scientific creativity encompassed (1) forms of tourism practiced in geoparks, especially focused on ecotourism and volcanic tourism; (2) geomorphological features, mineral springs and mud volcanoes; (3) aesthetic aspects, scenic sites and mining heritage; and (4) methodology, data analysis and modelling methods across different regions and countries.

Keywords: bibliometric analysis; geopark; attractiveness; R; bibliometrix; Biblioshiny; WoS; Scopus; PubMed; dimensions; automatically merged database; merge method; state of the art

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Citation: Nyulas, J.; Dezsi, Ș.; Niță, A.; Toma, R.-A.; Lazăr, A.-M. Trends and Future Directions in Analysing Attractiveness of Geoparks Using an Automated Merging Method of Multiple Databases—R-Based Bibliometric Analysis. *Land* **2024**, *13*, 1627. https://doi.org/10.3390/land13101627

Academic Editors: Rafael Becerra-Ramírez and Javier Dóniz-Páez

Received: 25 July 2024
Revised: 23 September 2024
Accepted: 30 September 2024
Published: 7 October 2024

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1. Introduction

Geoparks are unified areas that promote the sustainable development of the destination. They protect and use the geological heritage in a sustainable way while promoting the economic well-being of the people who live there. These parks are internationally recognised primarily for their geological importance, which is managed with a holistic concept of protection, education and sustainable development [1]. Moreover, one of the most important tasks of UNESCO's global geoparks consists of the holistic interpretation of the Earth's heritage. The ABC (abiotic–biotic–cultural interconnections) concept is a potential

interpretive approach used in Earth heritage popularisation through geotourism [2–4]. The enrichment of the geoparks concept by the ABC interpretive concept was an important milestone [2]. Thus, the potential tourism of geoparks can be assessed by using the ABC concepts [5].

The human population is growing rapidly around the world. As tourism continues to accelerate and expand around the world, its impact on natural ecosystems has become increasingly evident. This has led to major environment problems, such as pollution, climate change, environmental degradation and resource depletion [6]. For this reason, the necessity to protect the environment is becoming, day by day, a more important worldwide issue, especially at conferences, such as the first world conference in Stockholm in June 1972, the global environmental governance regime envisioned at the 1992 Rio Earth Summit in Rio, the Paris Agreement of 12 December 2015 and Stockholm+50 in June 2022 [7–9]. Geoparks are one outcome of global conservation efforts to protect the environment for future generations.

Many geoparks have aimed to become UNESCO geoparks. Therefore, the development of the network of the UNESCO geoparks has intensified over the last decade. At present, there are 213 UNESCO Global Geoparks in 48 countries (according to the latest update on 27 March 2024) [10], and this number is still growing. Concerns about their rapid growth overshadow the issues of attractiveness and scientific value. The truth is that the scientific value is largely represented by research materialised in scientific papers [11–16]. The scientific value of a geopark falls within UNESCO criteria; geoparks seeking UNESCO recognition must meet and maintain the strict criteria to be included in the Global Network of Geoparks. Without scientific studies and recognition, it can be a challenge to demonstrate this. Also, geoparks, like other natural areas, are vulnerable to the effects of change due to climate change, increased tourism or urban expansion. While continuing to protect the geological heritage, adapting to these changes requires innovative approaches and additional scientific research.

Given the growth of the interest in designating areas as UNESCO Global Geoparks, there has also been an increasing in the scientific research papers on geoparks, especially in the last decade [17].

The research started in 1999 when UNESCO presented the initiative on the creation of geoparks [17] to protect the environment and promote sustainable economic development [18,19]. Early studies concentrated on the implementation of geoparks, their role in sustainable development and the development of local communities [1,20–23]. For this purpose, inventory and quantitative assessment was essential [24–29]. Then, the research papers moved onto the capitalisation and sustainable development of geoparks. Tourism, through geotourism, was often targeted as the main activity that has the potential to bring social and economic growth [30–40].

Once the concept of geoparks was implemented, there were also papers emphasising the geodiversity resources for geoparks. In terms of geodiversity, meteor craters as well as paleontological [41–43] and volcanic areas with the potential for educational activities, tourism capitalisation [44–46] and geomorphological tourism [47–49] were proposed. In terms of the studies' emphasis on the touristic features of geoparks, their importance for geoconservation was yet another recommended approach, especially after 2010 [50,51]. Moreover, the scientific and educational value of geoparks has also been addressed since these early papers [52–57].

Finally, the rapid growth of the areas designated as geoparks, and their complexity as natural and cultural heritage sites has brought the need for modern management approaches in scientific papers [58,59].

With this increased number of published papers came reviews, especially of quantitative assessments of geosites [24,60,61]. In terms of reviews of geoparks, the interest started in 2018 [62], but they did not appear until 2020. These reviews were generally published once per year with an increase to two in 2023. The papers provided a general analysis of the academic research on geoparks [17,62,63], pointed out the relationship between the local

community and geoparks for sustainable development [62,64] and even approached in detail the sources of environmental pollution in geoparks. These studies allowed researchers to check their state critically and systematically, to detect biases and offer a preliminary research direction and to provide a conceptual framework [65]. As methodology, the information used was taken mostly from the Scopus database [40,62,64,65], and it was completed with the Web of Science database [17]. The software used for data analysis was Microsoft Excel Office365 ProPlus [17,62–64], and further analysis as well as its representation was made with VOSviewer [17,63,64]. The studies approached the descriptive statistics of paper classification, using a predefined coding scheme, on three themes [62], or the analytical literature review [65]. Then, bibliometric analysis was based on different procedures: (1) performance analysis (evaluating the scientific impact of the field and its scientific actors) and science mapping to provide an analysis of the academic research on geoparks [63]; (2) analysing the bibliographic portfolio by applying the PRISMA process (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) to provide an overview and analysis of scientific research on UNESCO Global Geoparks [17]; and (3) bibliometric analysis and content review to better understand the relationship and contributions of geoparks to sustainable development [64]. No multiple databases were used, and we considered that a deficiency.

The tourism engine of destinations is their attractiveness. "The attractiveness is a drawing force", Kaur thought, mentioned by Formica [66], and since the attractions are the foundation of the tourism industry, drawing tourists is a significant aspect of the success of any destination [67]. Moreover, attractiveness plays an important role in shaping the local economy, preserving the heritage and strengthening the identity of the community.

Therefore, the main aim of this paper is to synthesise a heterogeneous body of knowledge about geoparks in terms of attractiveness, highlighting the evolution and breadth of the research field. Thus, two important objectives were set. The first was to elaborate a method for automatically combining databases, namely WoS, Scopus, PubMed and Dimensions, detailing the new aspects of the used method. The second objective was to analyse the bibliometric indicators in order to identify the trends in the literature and the possible directions for future research. According to these objectives, the following research questions were formulated:

Q1: How do we automatically merge multiple databases? How do we remove duplicate papers from merged databases? Is it possible in one step?
Q2: What is the research trend in the field of geopark attractiveness in terms of academic production, performance and productivity?
Q3: What is the spatial gap in research literature?
Q4: What are the functional diversity factors of attractiveness?
Q5: What is the future three-dimensional research direction: spatial, temporal and dimensional (size) in the field of geopark attractiveness?

2. Materials and Methods

The applied methodology is based on bibliometric analysis using R for non-coders. Through the methodology, the most used software was R program, version 4.3.3, with its bibliometrix package for analysing and synthesising the result as well as for graphic representation. In addition, we used Microsoft Excel 365 for further analysis and ArcGIS Pro, version 3.3.1, for mapping and spatial analysis.

To answer the research questions, the data collection phase for conducting the metadata analysis was built on a seven-step workflow approach. The workflow provides a structured illustration of the research process, as well as the possibility of reapplication, as a benefit. This approach ensures that all relevant perspectives are considered, leading to a more comprehensive and interdisciplinary research result.

In Figure 1, the workflow is organised into 7 steps. The 1st step, Ask questions, is the starting point which gives the direction of the study by defining the research questions. The 2nd step, Data source, concentrates on selecting the literature resource platforms. The

3rd step, Data retrieve, includes the eligibility criteria and the search strategy to identify the relevant work: how, when and what. The 4th step, Interpret results, consists of checking the metadata for each database to see the level of compliance of each one. The 5th step, Analyse and model, is the process of combining multiple databases. The 6th step, Make decision, includes the process of title and abstract screening, deciding which document will go into the study and which will not. The 7th step, Results, presents the result of synthesising the findings to answer the research questions.

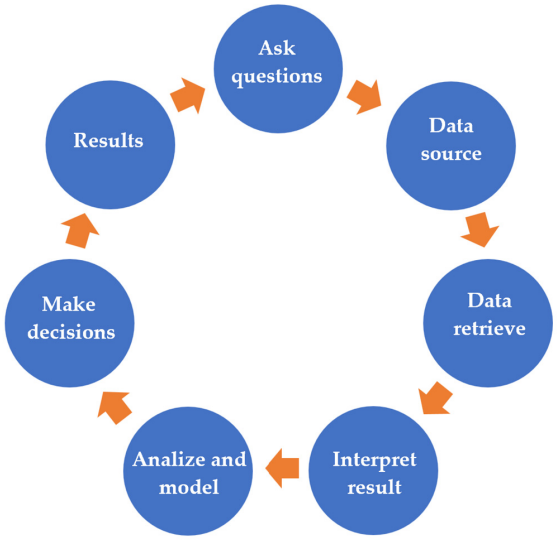


Figure 1. The 7-steps workflow approach in the process of obtaining the eligible data for meta-analysis.

2.1. Data Sources

To conduct a literature search, we used the main multidisciplinary bibliographic research databases: Clarivate Analytics' Web of Science (WoS), Scopus, Dimensions and the specialised database PubMed. Initially, we verified 6 databases supported by bibliometrix [68] (Web of Science, Scopus, Dimensions, Lens.org, PubMed and Cochrane Library), but after exploring them, only four were found to be of interest for the topic. The selected platforms provide a compressed know-how in the field and high reliability. WoS is known as one of the most trusted global independent publisher databases in the world and the most selective. Dimensions is the most exhaustive one. Scopus and WoS are offering multidisciplinary coverage, but Scopus has a wider coverage than WoS. PubMed focuses mainly on life sciences and biomedical disciplines [69]. However, the literature databases PubMed, Scopus and Web of Science differ in terms of their coverage, all of them providing well-ranked sources [69]. Instead, Dimensions is the newest database (2018), covering many smaller journals and containing a high number of documents, too [70,71]. This approach ensures an exhaustive result. Although each one covers literature that is not available in others, there is an overlap between these platforms [72]. The chosen platforms allow the user to obtain, analyse and disseminate information in a timely manner, which is useful for performing the data analysis: who, what and where or how many.

2.2. Eligibility Criteria

Defining the criteria is a very important phase, because it is a decisive factor for the result of the paper and presents a detailed investigation of previous research. Thus, seven elements were taken into account in establishing the criteria (C1–C7): choosing the platforms databases supported by R (C1); identifying the types of documents (C2); obtaining the metadata from the research documents (title, abstract and keywords were considered, C3); deciding to include all documents, whether they were open access or not to ensure a compressive coverage and to avoid missing crucial insights (C4); taking the whole time interval, because this topic has never had a review until now (C5); building

the right query, including the main keywords: geopark and attractiveness (C6); selecting all language, since, although English is considered the language of science, documents in other languages may be an important source of information too, especially if you search for a topic which has not yet been studied (C7) (Table 1).

Table 1. Eligibility criteria.

Criteria	Name	Feature
C_1	Platform	Web of Science, Scopus, PubMed and Dimensions
C_2	Documents type	All types
C_3	Search field	Title; abstract; keywords
C_4	Document accessibility	All (open access and non-open access)
C_5	Publisher data range	All years
C_6	Query expression main keywords	geopark; attractiveness
C_7	Language	Any

2.3. Search Strategy Data Retrieve

The search strategy was developed based on the criteria established above (Table 1), where the main role in order to discover data for the topic of interest in the study belongs to the key elements. The search terms were applied on two levels, leading to the main subject, increasingly narrowing the spectrum.

These queries were built with advanced search query builders. The search query was created based on a set of terms, known as key elements, linked by boolean operators. In this case, the key elements were the words used in search "geopark" and "attractiveness". The operators in the expression were represented by the basic Boolean operators OR, AND and NOT. Also, the Field Tags and the Quotation Marks were present as wildcards, such as asterisk (*), to include both the singular and the plural form, as well as the different attractiveness of nearby words. In addition, we checked whether attractiveness was the only potential word that relates to what we were looking for, but no proper synonyms were found.

Finally, with these search strings, we defined the inclusions and the exclusions. Using the query phrases, we found out how big our topic of interest is (level 2) and what the geopark report is (level 1). The search is highly specific to the topics, ensuring relevance and importance to the subject. By filtering the content and keeping only those that meet certain criteria, the final searching string expressions give a comprehensive systematic literature review image (Table 2).

Table 2. Platforms queries. Expression of searching stream built with Advanced Search Query Builder.

Database	Level	Query Expression	Records Retrieved
WoS	level 1	(TI = (geopark* OR "geo-park*")) OR (AB = (geopark* OR "geo-park*")) OR (AK = (geopark* OR "geo-park*"))	1336
	level 2	((TI = (("geopark*" OR "geo-park*") AND ("attract*"))) OR AB = (("geopark*" OR "geo-park*") AND ("attract*")) OR AK = (("geopark*" OR "geo-park*") AND ("attract*")))	183
Scopus	level 1	TITLE-ABS-KEY ("geopark*" OR "geo-park*")	1993
	level 2	TITLE-ABS-KEY (("geopark*" OR "geo-park*") AND ("attract*"))	280
PubMed	level 1	geopark*[Title/Abstract] OR "geo-park*"[Title/Abstract]	49
	level 2	("geopark*"[Title/Abstract] OR "geo-park*"[Title/Abstract]) AND ("attract*"[Title/Abstract])	1

Table 2. *Cont.*

Database	Level	Query Expression	Records Retrieved
Dimensions	level 1	(“geopark” OR “geoparks” OR “geo-park” OR “geo-parks”) NOT (“geo”) NOT(“park”)	5125
	level 2	((“geopark” OR “geoparks” OR “geo-park” OR “geo-parks”OR “geo parks”) NOT (“geo”) NOT(“park”)) AND (“attract” OR “attractive” OR “attractively” OR “attractiveness” OR “attractant” OR “attraction”)	243
Total level 1—geopark			8503
Total level 2—geopark attractiveness			707

After the final search query was run, the custom search gave us information and a report on geopark field (level 1) and on geopark attractiveness theme (level 2); where level 2 is searching, specific to the topic, for what is relevant from the perspective of the study. The findings present different ratios for the databases. The highest volume of research papers is in the WoS and Scopus databases, 14% each, and the lowest is in the PubMed platform, 2%. Overall, there were 8503 papers for geopark and 707 related to geopark attractiveness (Figure 2).

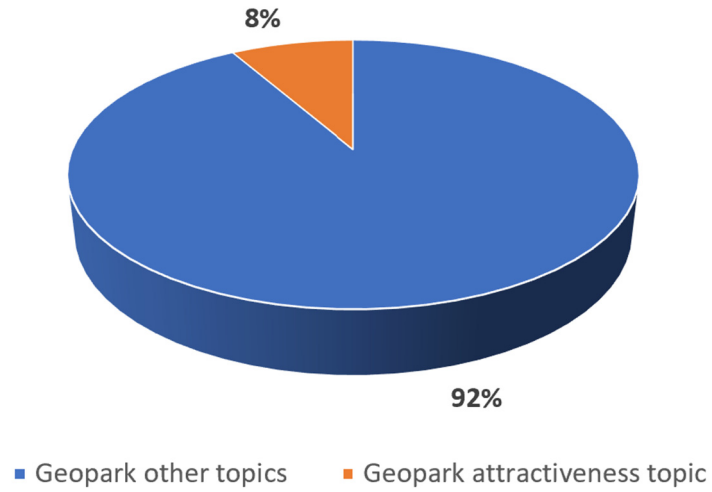


Figure 2. The scientific production on geoparks (8503 papers) and related to geopark attractiveness (707 papers, 8% of total) in WoS, Scopus, PubMed and Dimensions databases.

The graph shows that the attractiveness slide covers 8% as a preliminary raw data ratio. This means that the attractiveness-related research topic is still a relatively small part of the wider scientific output covered in the analysis. Nevertheless, this topic is of great interest for tourists, and it is one of the main reasons for visiting a place. Such research can be crucial for developing strategies and promoting areas as desirable destinations.

According to our research strategy, the data retrieval process described above was made on March 29, 2024 from four databases: Web of Science, Scopus, PubMed and Dimensions, although all databases compatible with the R program and its bibliometrix package were explored. The quantity of datasets (number of papers obtained) was as follows: WoS—183, Scopus—280, PubMed—1 and Dimensions—243. Overall, 707 documents were retrieved. These data include publication records and citation metrics, as well as metadata relevant to the timeframe of our study, from 2010 to March 2024. This period covers all existing documents related to our research subject up to the present day. Two authors carried out their validation, by checking the string, the possible synonyms available and by comparing the results.

The results, the bibliographic documents, were exported in the recommended format of each database, providing the best metadata [73]. Depending on the source, these included

the plain text file format for WoS (text document), csv file format for Scopus (Microsoft Excel comma-separated value file), PubMed txt file format for PubMed (text document), and xls file format for dimensions (Table 3).

Table 3. The volume of records, how and which format they were extracted from each database.

Database [1]	Validation	Export Method	File Format
Web of Science	☑	Export Plain text file, choosing "Full Record" and "Cited References" option [2]	Plaintext
Scopus	☑	Export documents, select all information	csv
PubMed	☑	Export save citation to file format PubMed	PubMed txt
Dimensions	☑	Export full record, Excel format version	Excel

[1] Databases which are compatible with R program and bibliometrix. [2] More exports above 500 are needed.

As there are overlaps at different levels between the platforms [70,74], there is always a need to eliminate the duplicate records [70,75], so the resulting files above must be combined.

2.4. Automated Method for Merging the Databases Results and Removing Duplicates

This main operation of the process can be accomplished in two ways: the first is combining the databases and then deduplicating, and the second is combining and deduplicating simultaneously. These operations can be performed by the latest R software with its extension tool package, bibliometrix [76], by using a software reference manager (e.g., EndNote, Zotero, Mendeley or Jabref [77]), as well as in Microsoft Excel. We have applied the process of combining and deduplicating simultaneously, using the automatic merging and deduplicating process in R.

Bibliometrix [78,79] is a R software package and a free R tool for comprehensive science mapping analysis. Biblioshiny is an application for non-coders and a package developed in the R program to use the bibliometrix R package in a web browser, performing science mapping analysis while making use of the main functions of the R bibliometrix package [80].

This process had three phases. The method was built on functions offered by the bibliometrix package in RStudio [78,79,81]. The first two are preparation phases for the metadata needed to carry out the main phase, simulating combination and elimination. The first phase consisted of downloading the tool and installing the packages. In the second one, we transformed the files achieved from WoS (plaintext), Scopus (csv), PubMed (Pubmed txt) and Dimensions (Excel) platforms (Table 3) into R data files to obtain the necessary format of the metadata in order to carry out the analysis in RStudio. These metadata include the bibliographic attributes of the academic papers, where the main fields are Author (AU), DOI (DI), Document Type (DT), Journal (SO), Publication Year (PY), Title (TI), Total Citation (TC), Abstract (AB), Affiliation (C1), Cited References (CR), Corresponding Author (RP), Keywords (DE), Keywords Plus (ID), Language (LA), and Science Categories (WC), according to the standard Clarivate Analytics WoS field tag codification [73]. A completeness verification of bibliographic metadata from the databases and from the analysis can also be performed; this is not mandatory to complete the method, but it is recommended (Supplementary Material S1, Tables S1-1 and S1-3) to ensure the accuracy of the result later in the meta-analysis stage. Finally, the third phase is the main one, merging automatic data and eliminating the duplicated references in R. We applied this process in the R program (R 4.3.3 program data), R Studio, which was specifically designed for the R programming language. The method phases are listed below (Table 4). In addition, the detailed method and description of the process are presented in the Supplementary Material (Table S2).

Table 4. Process phases of the automated method of merging data files and eliminating duplicates.

Phase	Where	Step 1	Step2	Step 3
Phase 1. Install bibliometrix package in RStudio	PC RStudio	Install RStudio	Install bibliometrix package in R install.packages ("bibliometrix")	Activate the Biblioshiny app bibliometrix::biblioshiny()
Phase 2. Data importing and conversion to Excel format	Biblioshiny app	Uploading data files retrieved from databases in bibliometrix	Checking the level of completeness of bibliographic metadata	Downloading from bibliometrix Excel data files for R
Phase 3. Combine databases and eliminate duplicated documents	RStudio	Uploading data in RStudio	Merge data from databases and eliminate duplicates in one step the documents, using the R command: M <- mergeDb-Sources(WoS,Scopus,Pubmed,Dimensions, remove.duplicated = T)	Download merged file from R

The result is a combined research papers database of 458 documents. The initial 707 documents were combined and reduced in this process to 458, removing 249 duplicated documents. Before the meta-analysis, this amount of 458 documents resulted from the automated method will be subjected to quality control.

The method was validated by three persons following the detailed steps in the supplementary added material with data retrieved from level 1 or from level 2, using the method for merging data files and eliminating duplicates (Supplementary Material S2). The time consumed to complete the operations (phases 1–3) for those who had never worked in R was, on average, 53:30 min, and for the experienced users (there was no need to install R), it was 8:30 min.

2.5. Quality Check—Validation of Documents

Bibliometrics is essentially a quantitative analysis that transforms this main tool of science into benefits. Still, in order to provide an accurate image, trends and direction for the scientific community, the quality of the used evidence is crucial. Ensuring evidence quality (on the topic of research) is the way to obtain an accurate result. Thus, to increase the confidence of the metadata, we established a selection (a screening) procedure. The aim of this procedure is to have the right data and a clear working method that can be easily followed by anyone involved in the screening. For this reason, we established the following. (1) Reading the title and the abstract for each report retrieved and the reading process must be conducted by two reviewers, working independently. (2) Selection-based inclusion and exclusion criteria must provide the answers to the research questions. (3) The result will be the amount of documents unanimously selected by both readers, thus avoiding the risk of bias.

The 458 titles and abstracts of documents from the automated merged process were read by two authors independently based on clusters of inclusion criteria: (a) geopark or potential geopark; (b) geodiversity, biodiversity and cultural diversity attractions; (c) attraction features of geopark; (d) attractive tourism types; (e) models, innovations, and tools contributing to the attractiveness of the geopark, attraction for tourists and researchers; and (f) recreational activities. The exclusion criteria were defined as negative topics like risks, hazards, gaps, problems, issues, and degradation.

During the checking process, 80 documents from 458 were eliminated, and an additional 29 duplicated documents were removed. These extra duplicated documents came from differences in the title due to apostrophes or non-English written documents, where one of the databases had only the English version (e.g., contribution to sustainable regional development of geoparks, coming from the WoS database) and other version consisting of English plus the title in the original language (contribution to sustainable regional development of geoparks, coming from the Scopus database) [82]. Due to these differences, the R function program treats them as different documents.

The result of this quality checking process provided 349 documents that were entered in the meta-analysis using R.

3. Results

The qualified documents with an appropriate metadata were subjected to a scientometric analysis (bibliometric analysis). In essence, bibliometrics is the application of quantitative analysis and statistics. The quantitative assessment of publication and citation data is currently used in almost all scientific fields to evaluate the performance in a certain subject. For quantitative analysis, meta-analysis uses the statistical method to analyse the included studies. Meta-analysis is a way to combine the results of the studies to provide an overall overview, which gives valuable information for scholars.

The meta-analysis of bibliometric data was performed in Biblioshiny. Biblioshiny is a web-based application [76] for bibliometric analysis, created as part of the bibliometrix package in R software (version 4.1). It provides an interactive, user-friendly interface to perform comprehensive bibliometric analyses without requiring in-depth knowledge of R programming.

The obtained eligible final dataset consists of 349 academic papers. They were retrieved on 29 March 2024 from the WoS, Scopus, PubMed and Dimensions databases, though data importing and processing. Before the analysis in Biblioshiny, we checked the completeness of bibliographic metadata from the merged database and the level of analysis that can be conducted. To assess the accuracy of the result, for the analysis, we took the highlighted green zone metadata (Supplementary Material S1, Tables S1-2 and S1-3).

This dataset was subjected to meta-analysis. Our synthesis of the results summarises the relevant characteristics of the included studies (Table 5).

Table 5. Main information retrieved from four merged databases.

	Description	Results
GENERAL	Timespan	2002–2024
	Sources	213
	Documents	349
	Annual growth rate %	11.03
	Document average age	5.35
	Average citations per doc	5917
	References	10,183
DOCUMENT CONTENTS	Keywords plus (ID)	743
	Author's keywords (DE)	997
AUTHORS	Authors	960
	Authors of single-authored docs	48
AUTHORS COLLABORATION	Single-authored docs	59
	Co-authors per doc	3.23
	International co-authorships %	8.88

Based on the study results presented in this paper, the first publishing year of studies on the attractiveness of geoparks was 2002, and by March 2024, there were 349 documents. A full list of the publications is provided in Supplementary Material S3. Since this study includes all types of papers, one can find a variety of documents: articles (245), article reviews (6), conference papers (64), books (3), book chapters (25), conference reviews (1), editorial materials (4) and preprints (1). Some of these academic papers do not have keywords or keywords plus, e.g., papers presented by scholars at the IOP Conference series: Earth and Environmental Science [83,84].

Biblioshiny analyses the dataset and generates interactive data and visualisations for networks, maps and trends [85]. The analysis carried out in this study shows the trends over time and the future research directions, including the production, performance, productivity, geospatial distribution, topic evolution, strategic mapping and factorial analysis, which all would be essentially helpful for scholars [86–89].

3.1. Academic Production, Performance, and Productivity

In terms of number of documents, we identified 349 eligible documents published between 2002 and 2024 with an average of 15.2 documents published per year and a trend of continuous growth. In the first part of the interval, between 2002 and 2012, one can find a slow growth from one document per year in 2002 to 10 documents in 2011 and an average of 3 documents published/year. Given the growing interest in evaluating new areas to implement geoparks after 2012 and especially after the establishment of The Global Geoparks Network (GGN), the number of documents increased intensively, reaching 53 in 2022, with an average, between 2013 and 2024, of 26.3 documents published/year. In the second half of the period, the annual scientific production shows an increase, to 316 publications, which materialised in a strong positive trend (Figure 3).

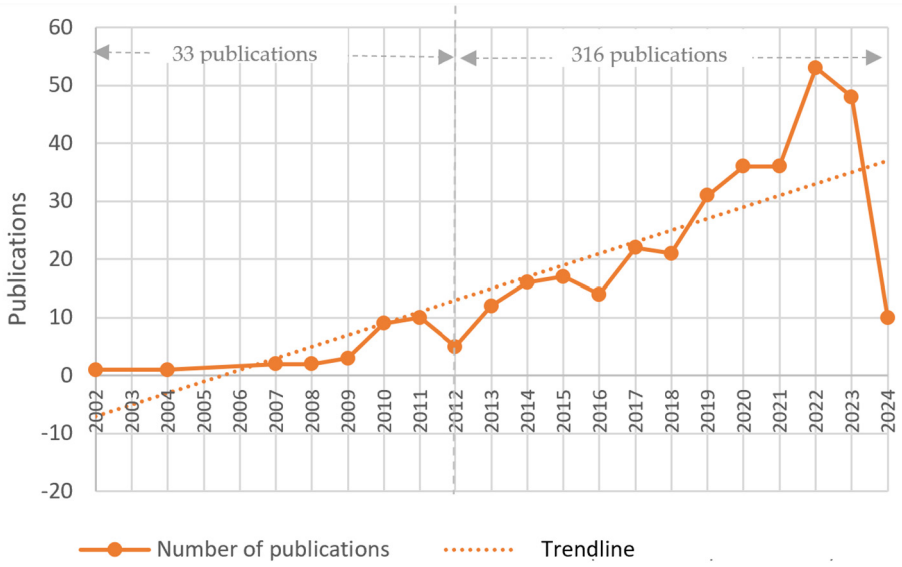


Figure 3. Annual scientific production. Production trend.

The impact of documents is measured as the citation level, since the number of citations factored by the years passed after publishing is an important indicator of the value of the document. Citation counts are a common metric for assessing the influence and relevance of academic publications, showing the performance of the academic work. Usually, the average citation number per year is higher for older documents, which is a trend that can be identified in this case, too. The average citations per year is higher for the documents published between 2011 and 2014 (1.4 in 2011, 1.9 in 2012, 1.2 in 2013 and 1.5 in 2014), when the geopark study methods have just been implemented, and between 2017 and 2019 (1 in 2017, 1.4 in 2018 and 1.2 in 2019) when numerous documents evaluating potential geoparks were published. The trend line is almost constant with a slight decrease (Figure 4).

Regarding the authors of the documents, Figure 5 shows the academic career of the first ten authors. They are ranked after the number of articles by analysing the number of authors per paper and their number of documents published. The impact of publications is evaluated by considering the total citations per year. First placed is Marzuki A.; with 8 documents, they are one of the most relevant authors, publishing on the studied subject almost every year since his first publication, in 2012, until 2020. He is followed by Rubin D. (7 documents) and Erfurt-Cooper P. (6 documents). The longest academic activity belongs

to Sinnyovsky D. For recently published documents, Dowling R. and Sinnyovsky D. had a higher number in 2023. Other recently active authors are Wulung S. and Yuliawati A. with one paper each. The result of the evaluation represents the number of papers per year using circle dimensions with a description of each author continuously publishing.

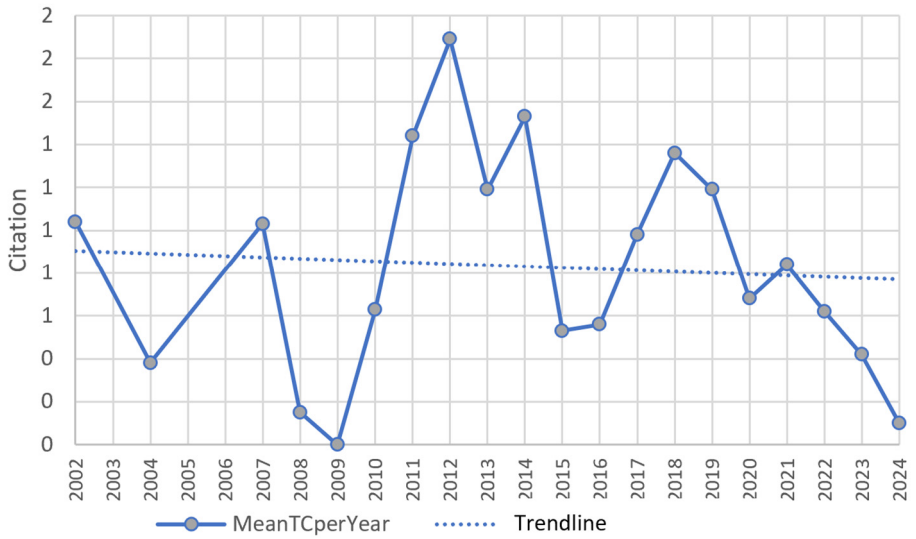


Figure 4. Performance of academic work. Average citations per year.

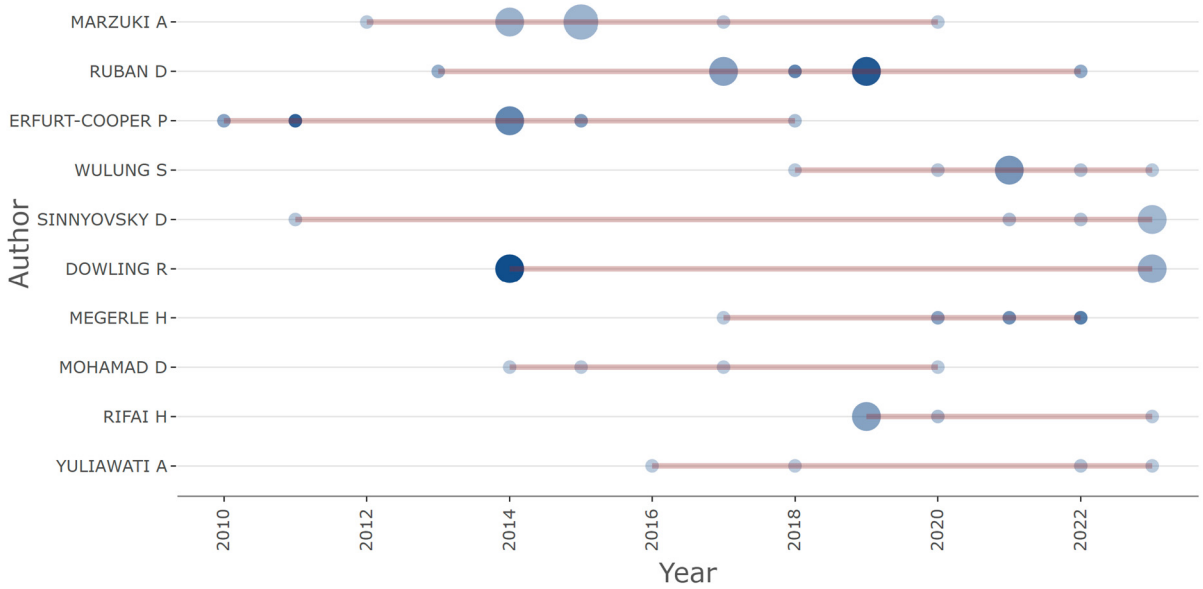


Figure 5. The production of the most relevant authors over time in the field. Note: The more articles the author has published in a given year, the larger the circle. The darker the circle, the more citations there are in a year. The line indicates the publishing period.

In addition, the number of citations of their publications shows how influential scientists were regarding each theme during this period. The most cited sources may be relevant for a descriptive evaluation of this bibliometric study. The most frequently cited authors per year (with one or two scientific papers), shown in darker blue circles, are Erfurt-Cooper P. in 2011 [90], Dowling R. in 2014 [4,91] and Rubin D. in 2019 [92,93].

Therefore, all researchers have articles with different levels of productivity. Their productivity can be expressed through the bibliometric Lotka's law [94,95]. As is known, one of the main areas in bibliometric research is represented by the applied bibliometric laws. "The three most commonly used laws in bibliometrics are Bradford's law of scattering,

Lotka's law of Scientific productivity, and Zipf's law of word occurrences" [96]. The Lotka function estimates the scientific productivity of the authors. It describes the frequency of publications on the topic of the attractiveness of geoparks. The number of authors (960) who have published a certain number of articles is a fixed ratio to the number of authors publishing a single article This assumption implies that the theoretical beta coefficient of Lotka's law is equal to 2. By using the Lotka function, it is possible to estimate the coefficient of bibliographic collection through a statistical test and through the similarity analysis of this empirical distribution with the theoretical one [97]. The analysis result, derived from Biblioshiny, is represented in Figure 6.

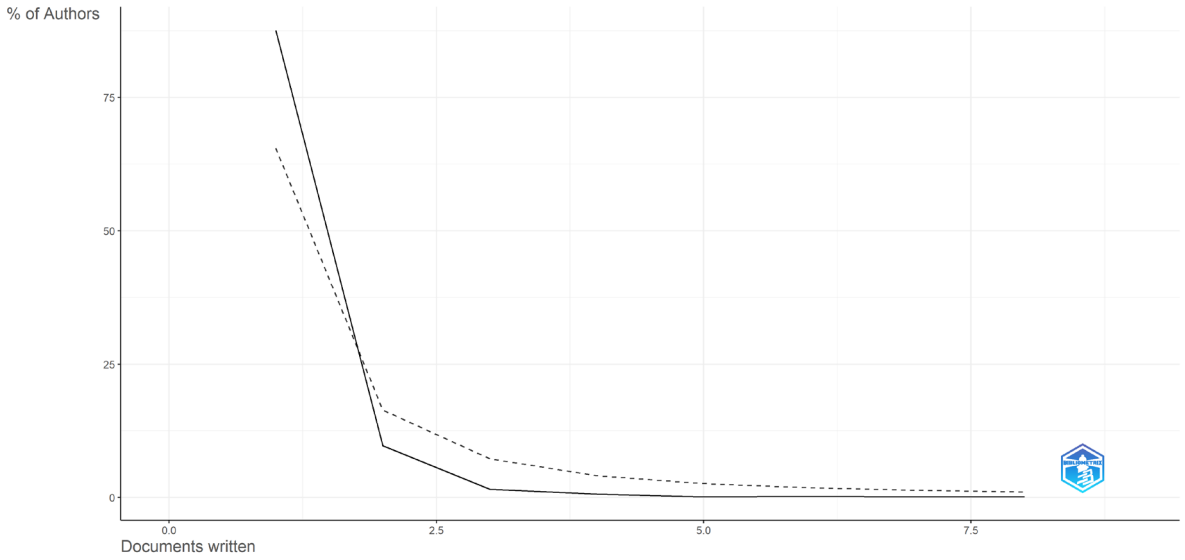


Figure 6. Author productivity through Lotka's Law.

Looking at the result, it can be stated that most documents are produced by a small minority of authors, and that as the number of authors per document increases, the number of documents decreases. In conclusion, a minority of authors contribute to a larger number of documents, while a majority of authors contribute to a smaller number of documents. Overall, 841 authors (87.6%) contributed a single document to scientific creativity.

The source of the documents may be analysed through the bibliometrics analysis law known as Bradford's Law. In 1934, Samuel C. Bradford described a distribution model which became known as Bradford's Law, which is used to measure the exponentially diminishing returns of reference searching in scientific journals and thus identify the core journals of the scientific field [98,99]. It states that if we sort the scientific journals in decreasing order of their articles' contribution on a given subject, we can identify a group of them as being more significant on a subject (the core zone); the other journals would be divided into a number of zones similar to the number of articles with the core zone, so the number of journals in each group will be proportional to 1:n:n2, where n is constant (the ratio of the preceding and of the succeeding groups is always constant). Bradford's Law shows how the papers are spread across the journals with the core collection in the first zone.

By applying Bradford's Law, there were three zones with Zone 1 as the core. These zones represent the level of significance of the sources in the studied domain. The sources are divided in Zone 1 (7%), Zone 2 (39%), and the remaining is the most extensive group, which is Zone 3 (54%). Based on the cumulative frequency of citations and the distribution of scientific papers according to zones, there were 118 publications in Zone 1, 116 publications in Zone 2 and 115 publications in Zone 3. (Table 6).

Table 6. Distribution of scientific papers according to the zones by Bradford's Law.

Zone	No. of Source	Percentage (S [1])	No. of Papers	Percentage (SP [1])
Zone 1	14	7%	118	34%
Zone 2	84	39%	116	33%
Zone 3	115	54%	115	33%
Total	213	100%	349	100%

[1] Note: S = source, SP = scientific paper.

Figure 7 is underlining the core sources, where the core sources are the top productive sources. On the studied topic, in the core zone (Zone 1), in the focus area, 14 journals were registered, covering a percentage of 7% of the total (213 journals). The most significant source is *Geoheritage* with 39 articles and 528 citations. Further on, at an appreciable distance, it is followed by 13 other journals: *IOP Conference Series: Earth and Environmental Science* (14), *Geoconservation Research* (9), *Geosciences* (8), *Przeglad Geologiczny*, *Geojournal of Tourism and Geosites* and *The International Journal of Geoheritage and Parks* (7 each), *Land* (6), *Geoheritage, Geoparks and Geotourism* (5), and the *Anuario Do Instituto De Geociencias*, *Arabian Journal of Geosciences*, *E3S Web OF Conferences* and *Geologos* (3 each).

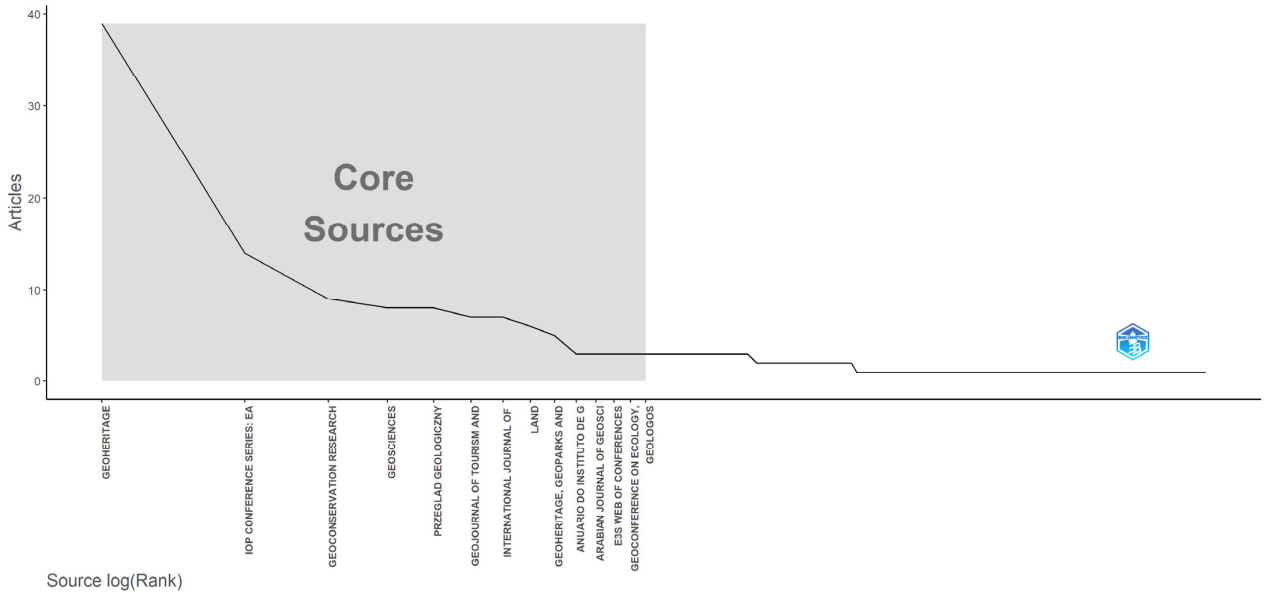


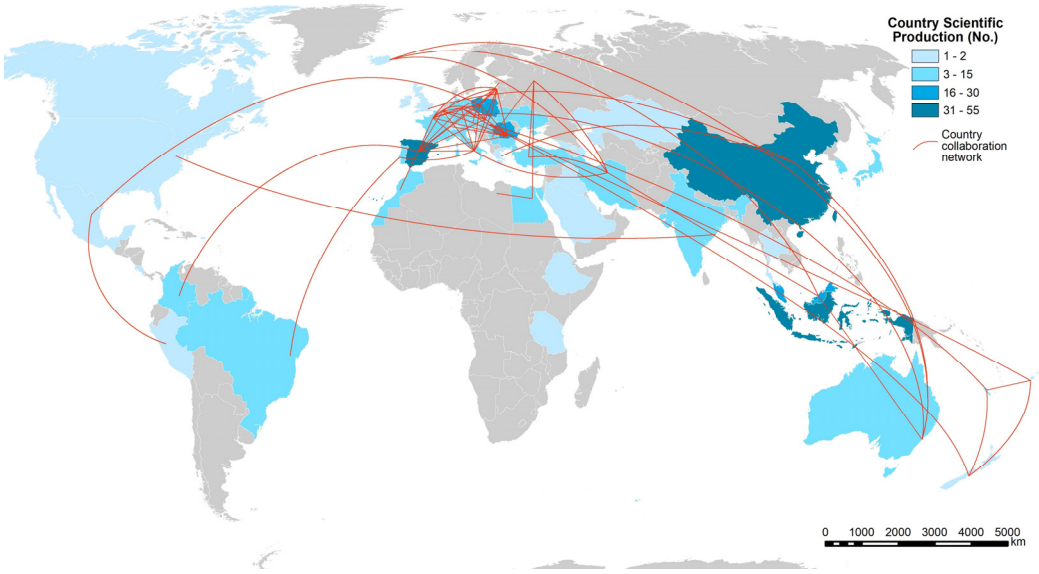
Figure 7. Core sources by Bradford's Law.

3.2. Spatial Distribution of Country's Scientific Production and Cooperation

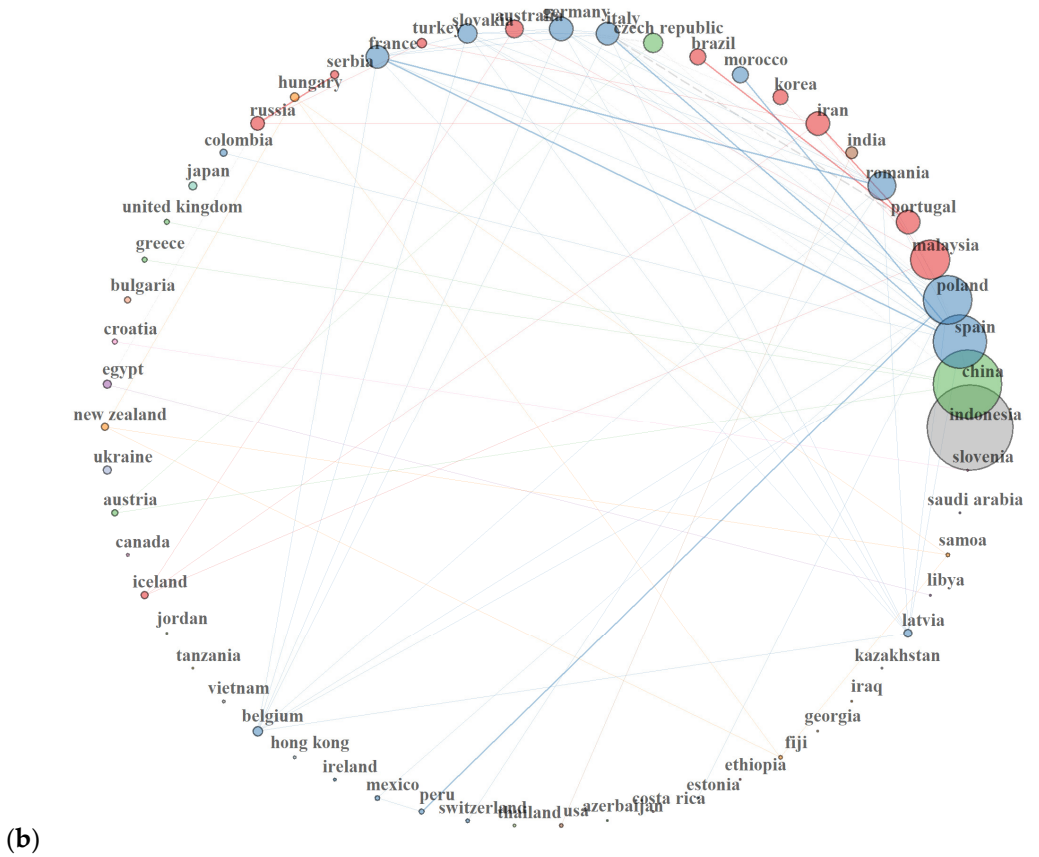
The country scientific production report is dominated by three countries that own 30.8% of the production (Figure 8a): Indonesia (60 documents, representing 12.9%), Spain (42 and 9.1%) and China (41 and 8.1%). Four other countries add up to 16.2% of the production: Poland (24 documents and 5.2% of the total number of documents), Portugal (18 and 3.9%), Malaysia (17 and 3.7%) and Iran (16 and 3.4%). Three countries are registered with 14 documents (Brazil, India and Romania), representing 3% of the total number of documents each, two (Morocco and South Korea) with 12 (2.6%) and three with 11 documents (2.4% each, Czech Republic, Germany and Turkey); in total, 21.3% of the documents.

Other countries represent between 1% and 2% of the documents each: Italy, Russia and Serbia (nine documents each), Australia, France and Hungary (eight documents each), Japan, Slovakia and United Kingdom (seven documents each), Bulgaria and Greece (six documents each) and Egypt and New Zealand (five documents each). In total, these countries account for 20.3% of the total number of documents. There are also 29 countries representing less than 1% of the registered documents each: Columbia, Croatia and Ukraine (four documents each), Canada, Iceland, Jordan and Tanzania (three each), Austria, Belgium,

Ireland, Mexico, Thailand, USA and Vietnam (two each) and Azerbaijan, Costa Rica, Estonia, Ethiopia, Fiji, Georgia, Iraq, Kazakhstan, Latvia, Libya, Peru, Samoa Saudi Arabia, Slovenia and Switzerland (one each), representing 11.4% of the total number of documents.



(**a**)



(**b**)

Figure 8. (**a**) Scientific production by country and countries' collaboration world map. (**b**) Authors' country scientific collaboration network. Author's own elaboration in ArcGIS Pro and RStudio [79,100].

In terms of collaborations among countries, one can find intense collaboration among the authors in European countries (Figure 8a,b) followed by collaborations between authors

in other countries in the world and the European ones and finally between authors in non-European countries.

In Europe, Spain has the highest collaboration frequency with 10 other countries and 12 papers (Belgium, Colombia, France—two papers, Germany, Italy, Latvia, Morocco, Poland—two papers, Romania and Slovakia). It is followed by Romania, collaborating with seven other countries and publishing eight papers (Belgium, France—two papers, Germany, Italy, Latvia, Slovakia and Switzerland) and Poland, collaborating with seven other countries (Belgium, Czech Republic, Estonia, France, Germany, Italy, Latvia, Mexico, Peru, Romania and Slovakia). The Czech Republic, France and Hungary have three collaborations each (the Czech Republic, with Australia, Austria and Germany; France, with Belgium, Latvia and Slovakia; Hungary, with non-European countries only, Fiji, New Zealand and Samoa) and Russia and Slovakia have two collaboration each (Russia, with Egypt and Serbia; Slovakia, with Belgium and Latvia). Belgium and Croatia have only one collaborating country, Latvia, respectively, Slovenia. Germany and Italy collaborated with four other countries each, publishing four articles each (Germany, with Belgium, France, Italy, Slovakia and Italy, with Belgium, France, Latvia, Slovakia) and Portugal collaborated with three other countries, but published five papers (Brazil—two papers, Iran—two papers, and Italy—one paper).

Countries outside Europe collaborating with the European countries are Iran (which collaborated with three European countries, Iceland, Italy and Russia), China (with two European countries, Greece and the United Kingdom) and a few others, collaborating with one country in Europe: Australia–Iceland, Malaysia–Iceland and Turkey and Russia.

The collaboration between non-European countries is represented by the articles published by New Zealand with Fiji and Samoa, Malaysia with Australia and Iran, China with Australia, Egypt with Libya, Fiji with Samoa, India with USA, Iran with Turkey, and Mexico with Peru (Figure 8b).

One can find that the spatial gaps of the documents are made of African countries (90.7% of them), North American countries (82.6% of them), South American countries (75% of them), and the countries from Australia and Oceania (71.4% of them), which are followed by the Asian countries (67.3% of them) and those from Europe (51% of them). Also, one can find the important gap between Europe and North America, which is caused by the differences in the number of geoparks (108 in Europe, 8 in North America) but also by the approaches in environmental protection, since North America is more focused on natural areas, such as the large national parks, and so are the researchers, while in Europe, there are large and dense populated areas with anthropic heritage included in the protected areas, too.

In fact, the spatial gaps in the research papers are close related, firstly, to the absence of geoparks and secondly, to the fact that the attractiveness of geoparks or the attractiveness elements in the existing geoparks have not yet been expressed. The cooperation network shows that further cooperation is much needed, and its expansion could lead to valuable multidisciplinary research.

3.3. Topic Trend

The graph is made by creating an ordered set of abstract words, where each key-frame contains the current view position of the year with the settled parameters (minimum frequency: five). Based on this analysis, the summary evolution trend of the words appearing in the abstract is synthetised in the results shown in Figure 9, where the important milestones are marked by the largest circles.

Geological survey stood at the beginning of the topics, since at that time it was the first step for creating geoparks, and the authors were concentrated on evaluating the existence of a geological and natural-based environment [101]. That was a subject of interest for a long period, and near the concept of geopark, the concept of geopark tourism emerged too as geotourism. Later, geological features were another important element of attraction for scientists. The “UNESCO global geopark” term was highly popular in 2018 with a presence

in 277 publications. In the graph, we can see its peak in 2020. It reflects the tendency of obtaining and achieving UNESCO Global Geopark status in some designated areas. In 2014, "geological heritage" peaked, since the exploration of geological heritage was vital to obtain the geopark status. Only later did the scholars focus on the cultural heritage, too. In 2024, the attention was oriented to mining fields as well as on the volcanic phenomenon of mud volcanoes [102]. Several exploration sites are architecturally scenic and landscape attractive, as they provide a combination of recreation, tourism and education. Closed mines are important attractions and should be further explored from a scientific point of view [103,104].

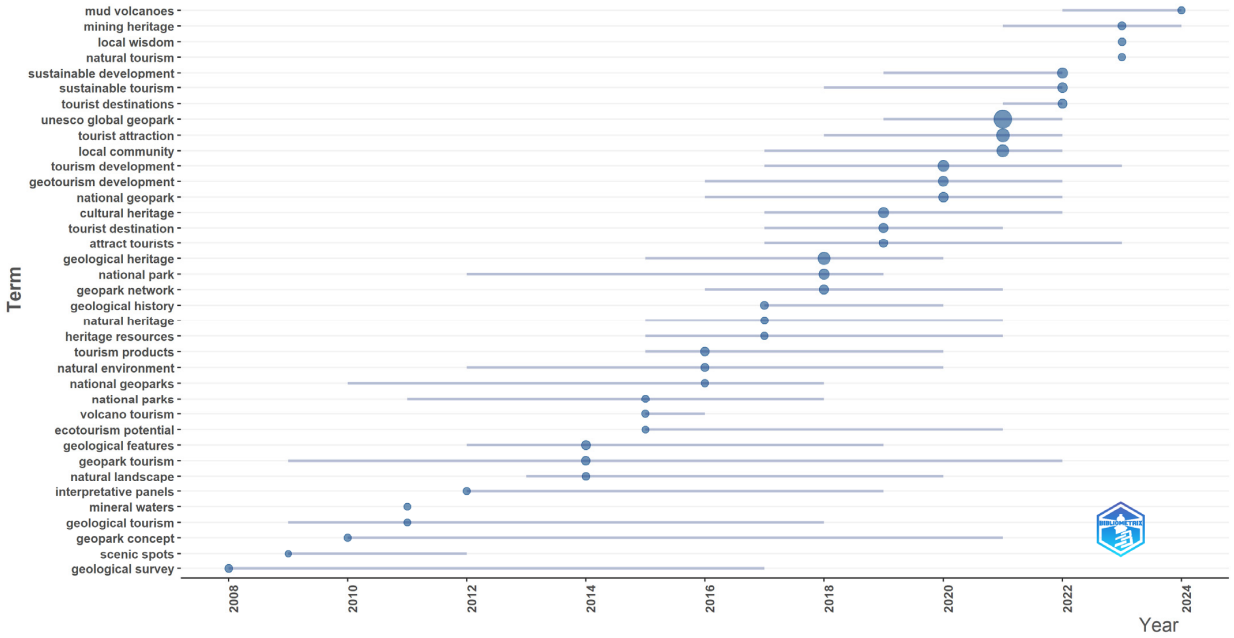


Figure 9. The topic trend of the geopark attractiveness. Analysing the abstract field by bigrams word.

In addition, there are low-frequency topics. Among these, there are "volcano tourism" and "mineral waters" [45,105–107]. Sometimes, one topic may be published over a longer period, but it still has low frequency: examples are "ecotourism potential "and "scenic spots", which may become future topics for researchers [108,109]. Any other topic that was not presented in the graph and thus has not been studied yet, in terms of geopark attractiveness, could be interesting as a future research direction. The education topic remains underserved, from the geoeducation pillar, knowing that geoparks are maintained through three pillars: geoconservation, geoeducation and sustainable development.

3.4. Abstract's Strategic Mapping

Thematic maps, also called strategic maps [110], represent the conceptual structure of the authors' written studies. The map contains four quadrants, and each one includes a theme and uses two axes. Development density, the X-axis, indicates the significance or the centrality of the topic of the study. Relevance degree, the Y-axis, represents the density, which measures the progression of the theme [111]. The analysis was made through the walktrap clustering algorithm, splitting the theme into four quadrants, which are named niche themes, motor themes, emerging or declining themes and basic themes (Figure 10).

The motor themes, as the driving force related to the attractiveness of the geopark, are expressed through the construction of the geopark and the main activity in the area, tourism, including the local community. On the one hand, there are "geopark development", "geotourism development" and "cultural diversity" and on the other, with a higher density value, are "tourist attraction", "tourism development" and "local community", which

are strongly supported, among others, by the following basic themes: "UNESCO global geopark", "geological heritage" and "sustainable development".

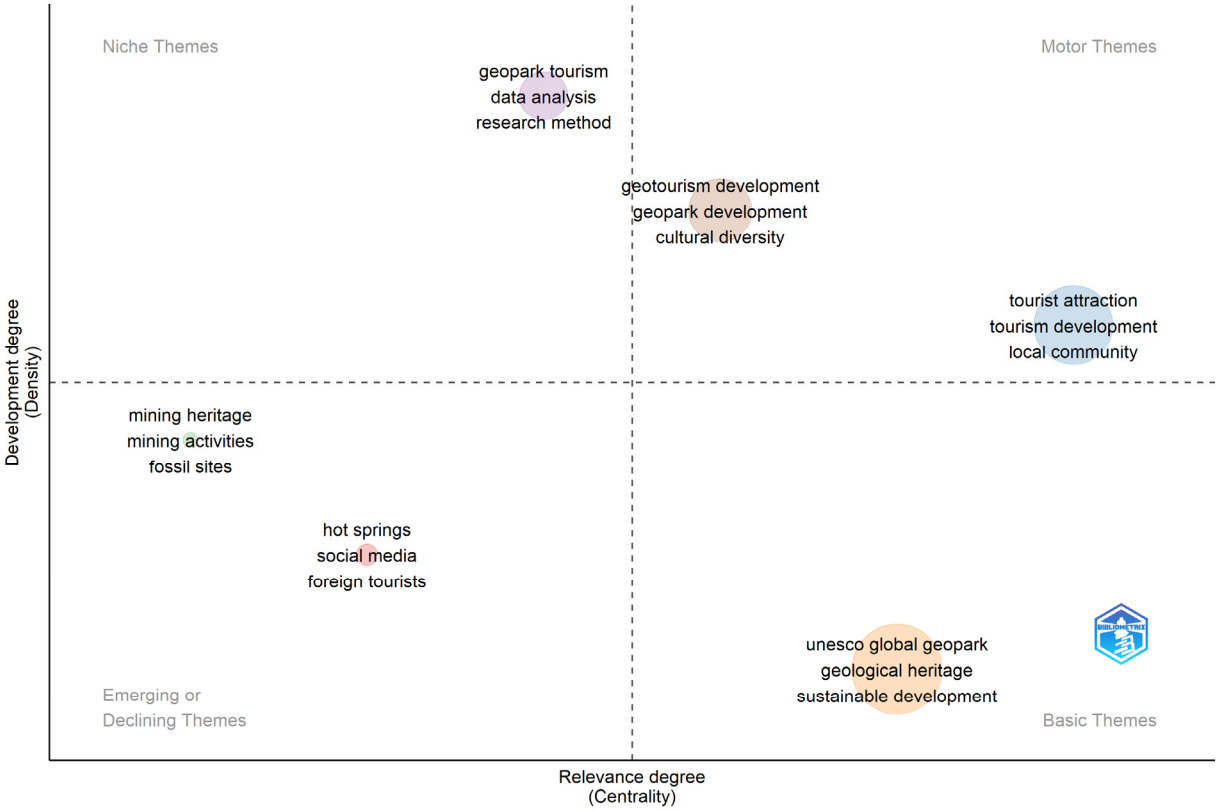


Figure 10. Thematic map or strategic map. Author's own elaboration on Biblioshiny app. Note: the size of each bubble is proportional to the number of documents containing each abstract word.

In the niche themes quadrant, the strategic map presents the possible future research subjects. They are focused especially on forms of tourism practiced in geoparks, "geopark tourism" and on data and methods in the geoparks field: "data analysis" and "research methods" [112–114]. Still, the sector of emerging or declining themes may be of interest to scholars, with the following subtopics having the lowest density: "mining heritage", "mining activities" and "fossil sites" and secondarily, "hot springs", "social media" and "foreign tourists".

3.5. Factorial Approach/Factorial Analysis of the Abstracts. Conceptual Map of the Relational Structure

A factorial approach was employed to establish the dimensions of the clusters and the hierarchical relations through the utilisation of Multiple Correspondence Analysis (MCA). The factor analysis was performed by using the Multiple Correspondence Analysis method for the eligible abstracts of the studies. Multiple Correspondence Analysis (MCA) is an extension of correspondence analysis and facilitates the exploration of the relational structure among numerous categorically dependent variables [115,116]. The result of the analysis is highlighted in two conceptual maps. They are shown in Figure 11a—The conceptual structure map and in Figure 11b—The topic tree dendrogram map. The conceptual structure map offers the dominating clusters, and the dendrogram offers an in-depth perspective of the cluster interrelationships among various components/research subthemes [117]. These maps categorise the attractiveness variables research into clusters, focusing on different topics or variables of the geopark attractiveness.

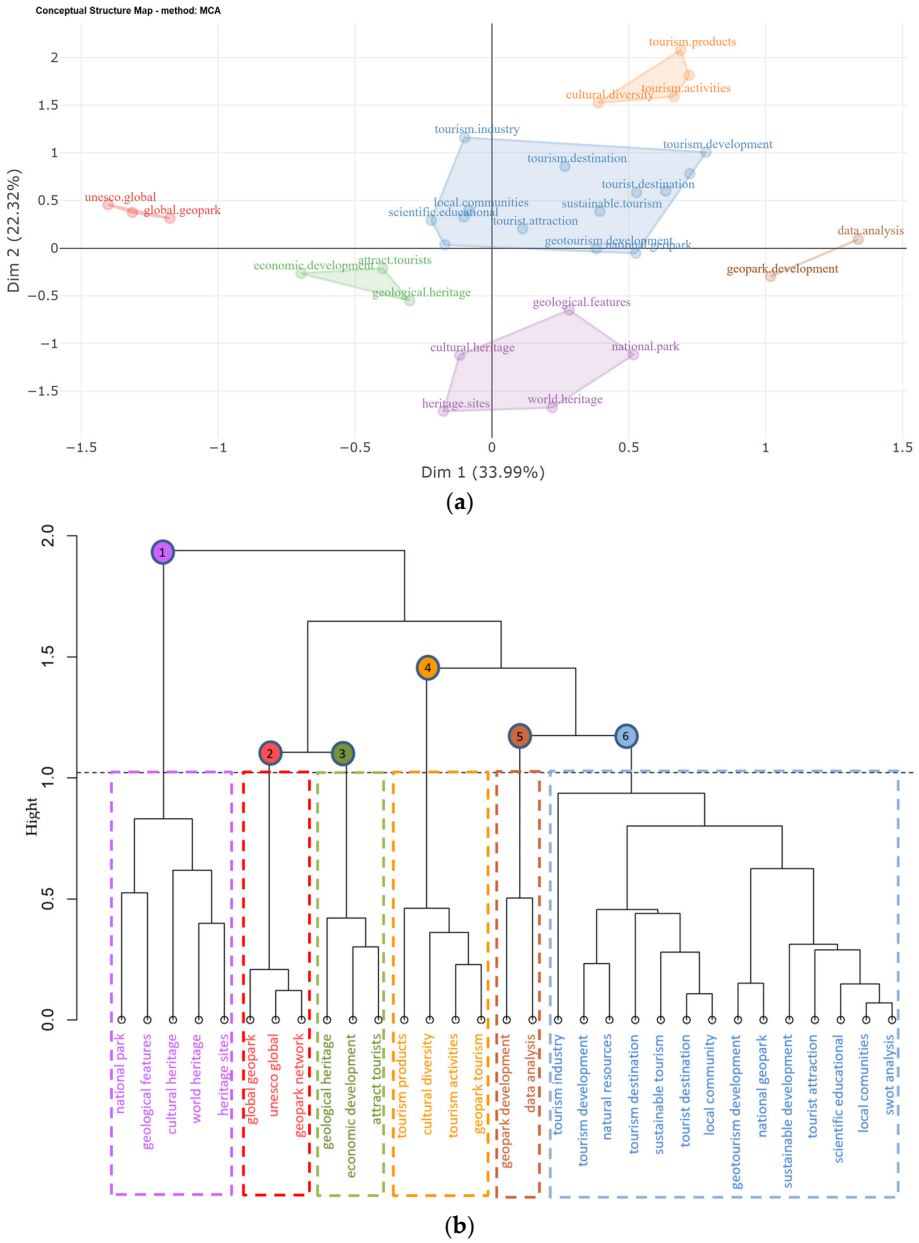


Figure 11. (**a**) Multiple correspondence analysis of high-frequency abstract words in the geopark attractiveness topic and (**b**) tree dendrogram of hierarchical cluster analysis. (1). Cluster 1 (purple)—national park; geological features; cultural heritage; world heritage; heritage sites. (2). Cluster 2 (green)—UNESCO global; global geopark; geopark network. (3). Cluster 3 (purple)—geological heritage; economic development; attract tourist. (4). Cluster 4 (orange)—tourism product; cultural diversity; cultural diversity; tourism activities; geopark tourism; geopark tourism. (5). Cluster 6 (brown)—geopark development; data analysis. (6). Cluster 6 (blue) —tourism industry; tourism development; natural resources; tourism destination; sustainable tourism; tourist destinations; local community; geotourism development; national geopark; sustainable development; tourist attraction; scientific educational; local communities; SWOT analysis.

The results of the MCA analysis illustrates, in Figure 11a, a group of six dominating clusters with their variables, in two dimensions, resulting from the investigation of an abstract diagram with settled words as parameters. The clusters contain the variables of the geopark attractiveness. According to Dim 1 (33.99%) and Dim 2 (22.32%), according to the content of the variables, there are six clusters:

1. The purple cluster—"national park", "geological features", "cultural heritage", "world heritage", and "heritage sites";
2. The red cluster—"global geopark", "UNESCO global" and "geopark network";
3. The green cluster—"geological heritage", "economic development" and "attract tourist";
4. The orange cluster—"tourism product", "cultural diversity", "tourism activities" and "geopark tourism";
5. The brown cluster—"geopark development" and "data analysis";
6. The blue cluster—"tourism industry", "tourism development", "natural resources", "tourism destination", "sustainable tourism", "tourist destinations", "local community", "geotourism development", "national geopark", "sustainable development", "tourist attraction", "scientific educational", "local communities" and "swot analysis".

The negative upper side predominantly consists of two clusters, where there appear fewer grouped elements: the green cluster and, in the middle, the purple cluster. They evidence the most important components of the geopark, such as "geological heritage", "geological features", "cultural heritage", and "world heritage". Instead, the positive upper part is more precisely characterised by three clusters, red, blue and orange, showing a wider number of attributes. These include"geopark network", "global geopark" and "UNESCO global", which reflect different types of geopark networks that are materialised in regional networks and UNESCO Global Geoparks. Moreover, there is a concentration on tourism—touristic, tourism, tourism destination and on the people living in the area of the geoparks, the local community. Clusters are grouped using plain distance and reflect the similarity between abstract words. A close proximity to the centre indicates that this type of topic received more attention, while a greater distance from the centre indicates less attention or a greater degree of deviation from the topic [118].

A tree-based thematic dendrogram, as shown in Figure 11b, effectively visualises the separation of the six clusters by aligning them hierarchically—determining the sizes and measuring the functionality and the diversity of the variables in a group [119]. The Y-axis shows the height of the branch, illustrating how close data points or clusters are from one another. As shown, the first level of the branch pertains to the core elements related to geopark attractiveness, which exhibit a specific height in their association [120–123]. Subsequently, subbranches 2 and 3 indicate a different higher level than group 4 and groups 5 and 6, which are similar. In the final subbranches, 5 and 6, although addressing different themes, a constant pitch is maintained, indicating a continued focus in the same domain. This distinction affirms the clear separation of the dimensions, where terms have notable differences. The taller the branch, the further and more different the clusters are. This tree-based thematic dendrogram visualisation serves to reinforce the dimensionality identified in the study.

The second cluster, 2, encompassing three terms hierarchically exposed, displays a lower distance between UNESCO global and geopark network terms, e.g., it expresses the geoparks from the list of UNESCO global geoparks as important tourist attractions [124]. Further examining the clusters, it reveals that the other most appropriate similarity terms (shortest branch) are in cluster 6. On one side, the local community is related to the tourist destination and to the forms of tourism (especially ecotourism); on the other, it is a factor of SWOT analysis leading to the need to develop a sustainable, comprehensive and holistic action plan for the development of geoheritage and geotourism sites with the involvement of the community [125–127].

These two graphs illustrate the clusters, the six research directions within geoparks attractiveness studies as well as the classified links between factors as its variables (/attributes). In conclusion, it showcases how the primary scientific creativity terms remain closely connected while further highlighting the unique variable of specific terms and concepts. Secondly, it contributes to a more powerful explanation of the geopark attractiveness by measuring the functional attribute diversity associated with the functional group diversity [128,129]. Thirdly, it gives a comprehensive understanding of the underlying structure of the studies.

4. Discussion

Geoparks are important natural-based environments that are maintained by three pillars: geoconservation, geoeducation and sustainable development. Understanding their attractiveness will certainly accelerate their development worldwide with the aim of protecting the environment. However, no analysis of this attractiveness theme has been carried out so far. Their scientific mapping niche opens a new window for exploration topics [130].

Science mapping can be carried out with many different software tools [131–135]. The newest tools, developed in the last decade, for scientometric and bibliometric analysis are the bibliometrix package with the Biblioshiny interface [76,78], in R programming language and BiblioMaps [136]. Both BiblioMaps and bibliometrix provide a clear and comprehensive overview of the scientific literature. In this study, the analysis was made with the R bibliometrix package. This package is accessible through the statistical program R [137], with its more user-friendly interface version, RStudio for desktop computers. Note that R is free open-source software, offering various advantages for data processing, thus making it a resourceful tool for scientometric analysis.

4.1. Automated Merging Method of Multiple Databases

All the main analyses in this paper were performed using R Statistical Software (v4.3.3; R Core Team 2021) [118,137]. Over time, other studies were carried out in R too, but not with geopark environment as the subject and often with data taken from a single database. The studies using R software frequently used data from Scopus [110,138–141] or WoS [142–146] databases, which was followed by PubMed [147–149] and barely from Dimensions [150,151]. The studies using more than one database are focused on the major scientific databases, Scopus and WoS [117,152–155]. Among these studies, the closest topics are forests or landscapes, which may be related in some way to the geopark.

On the side of the multi-data source retrieval and analysis made in R, there is even less in the literature [77,156]. Only one study has so far identified four databases as sources of information and conducted a bibliometric analysis of the digital images of ancient manuscripts as an attempt to conserve the cultural heritage [157]. The four databases selected, different than the ones we are using in this study, were Scopus, Dimensions, Science Direct and Google Scholar. There, a dataset of 15 articles was obtained, without describing exactly how the data sources were combined, knowing that if you are targeting more than one data source, the general issue is how to combine the data to perform a quantitative analysis, especially if large amount of data is available.

We built a method based on the functions offered by the bibliometrix package in RStudio. While testing the method, we noticed that the results were not satisfactory, so we remodelled it by trying different functions, several times, until we reached a final form and made sure the method worked by validating it. The process took into consideration the potential users, both beginners (non-users) and experienced users. It was carried out by two authors and an external scientist. The intention was to be efficient, simple and easy to replicate.

In this paper, we have adopted an automated combined method performed in R for four databases: WoS, Scopus, PubMed and Dimensions. This method leverages the functions provided by the bibliometrix package in R [76]. In the literature, one can find the steps toward merging databases, but for two databases only, each research taking in consideration the WoS and Scopus scientific databases: for sales force [158], an automatic merging of these databases [159] and an user-friendly method [160].

The methods presented in this paper contain the three phases of the merging process with some common steps as well as with some differences regarding how to upload the dataset retrieved in R [158–160]. One regards how to read the dataset retrieved from Biblioshiny, in R, by writing the path or by using the Import Dataset command, which is simpler for beginners. The main differences are that this study combined and eliminated duplicated records in one step and also regarding the number of databases combined. In

previous studies, this was completed in separate phases, using data from two databases. There, deduplication DOI (DI) vs. Title (TI) can be found [158–160]. However, eliminating duplicates based on DOI (DI) avoids the probability of finding other duplicated documents after the automated deduplication is completed (even if it is performed in separate steps or simultaneously with the merging phase), but if there are records without DOI (DI), performing the elimination in this way needs a further manual check. Another difference comes from merging or deduplicating in R or in Microsoft Excel, where Microsoft Excel was used to combine the two datasets manually in a file [160] and deduplication was made in Excel, with advice VBA code [158] or by using the remove duplications function [160].

The validated automatic method applied in our paper yields 458 registrations. After passing the documents through the quality verification process, through title and abstract screening, 349 academic documents were eligible for entry into the meta-analysis. To ensure the accuracy of the results of the study, the completeness of the bibliographic metadata used was rigorously checked. Finally, the metadata were considered as being in excellent condition, presenting 0% missing data, as highlighted in the Supplementary Material S1, Table S1-2. Thus, we can be confident in the results.

4.2. Trend

In the analysed interval, the documents production shows an increasing trend (Figure 3) as well as the number of geoparks (up to 213, according to the latest update on 27 March 2024) [10]. At first, the growth was a small one, while studying especially the concept of geopark, but later, after the establishment of The Global Geoparks Network (GGN), there was an increasing interest mainly in evaluating and implementing newer geopark areas. We compared the number of studies with the number of geoparks created in the given period to show the relationship between the two. To achieve this, we used the Spearman correlation in the R program. The Spearman correlation measures the strength and direction of the monotonic relationship between the two variables: in this case, the research papers and the geoparks. The result between the document production over the time and UNESCO geoparks created gave a value of 0.68. This value suggests a reasonably strong positive correlation, which was closest to the value 1 than to 0. The *p*-value indicates that this correlation is statistically significant, meaning that it is very unlikely to have occurred by chance. Thus, there is definitely a positive correlation between the two. The performance trend is decreasing, since the average citation number per year is higher for the older documents (Figure 4). Still, in terms of total number of citations, one can find a higher number for the papers published between 2011 and 2014, when the geoparks study methods were being implemented, and in 2018 and 2019, when numerous papers evaluating potential geoparks were published.

The productivity is characterised by a trend of concentration of the productions in the core zone (Figure 7), in 9 journals from a total of 50, among which *Geoheritage* is by far ahead of the others, concentrating 21% of the production. It is followed by *IOP Conference Series: Earth and Environmental Science* (7.5%), *Geoconservation Research* (4.8%), *Geosciences and Przeglad Geologiczny* (4.3% each), *Geojournal of Tourism* and *Geosites*, respectively, the *International Journal of Geoheritage and Parks* (3.8%, each), *Land* (3.2%), *Geoheritage*, *Geoparks and Geotourism* (2.7%), plus 41 others.

Collaborations among countries (Figure 8b) show a trend of concentration between the European ones; among them, those that most collaborate are Spain (whose authors collaborate with authors from 10 other countries) and Romania and Poland (with seven other countries). Less frequently, non-European countries collaborate with those in Europe (five countries initiated the collaboration: Iran, China, Australia, Malaysia and Turkey) and non-European countries collaborate (eight collaborations, initiated by New Zealand, Malaysia, China, Egypt, Fiji, India, Iran and Mexico).

In term of topics, one can find a trend of concentration on touristic capitalisation of geoparks: tourism resources, tourism destinations and tourism perspectives. According to the conceptual structure, the strategic map shows that the driver of attractions is tourism

(Figure 10), with an important development focus on geotourism development, in which the local community is also a key element. Moreover, as a form of tourism, geotourism is strongly present as an attraction of geoparks, which emerged from multiple analyses (Figures 9, 10 and 11a).

The factorial approach shows how the variables are connected dimensionally and hierarchically. The factorial analysis contributes to a more powerful explanation of the attractiveness of the geopark within the six research directions materialised by clusters. Measuring the functional attribute diversity, associated with the functional group diversity, gives a comprehensive understanding of the structure. The six clusters are representing the scientific creativity terms, which are closely connected (see Figure 11b).

4.3. Benefits of the Study

The study serves two purposes, pointing in two directions: at the data level and at the bibliometric analysis itself.

The methodology can be replicated for any other topic in the most important databases: WoS, Scopus, PubMed, Dimensions, Lens.org, Cochrane Library, with the purpose of scientific mapping. The described merging method in Supplementary Material S2 should be useful especially when obtaining a large amount of data as quick input for assessing the state of the art. In conclusion, this method offers two advantages for the scholars.

The searching query strings with an adaptation according to the search of interest may also be a benefit for future research. Regarding the used application, Biblioshiny, an additional advantage compared to other programs is that it gives exact feedback before starting the meta-analysis. It identifies whether there is an issue/there is no issue with the meta-data, and it informs the researcher regarding which analysis cannot be performed or on which data are missing and how much exactly.

In terms of bibliometric analysis, this study provides a condensed overview of the literature on the topic, helping researchers investigate a particular topic of geoparks, focusing in detail on one key factor of attractiveness. Using a multi-database approach, this bibliometric analysis systematically and exhaustively investigates what was written on the subject in the field. Contextualising, the research questions will allow researchers to better understand the attractiveness of geoparks in terms of space, time and scale. Moreover, the analysis allows a thorough investigation into key trends, which are the drivers behind the attractiveness of geoparks. Furthermore, it provides deeper insights into the current state of knowledge as well as the limits that lead to the suggestion for future research. Additionally, this approach allows for the recognition of strengths and shortcomings within the existing body of evidence, leading to a more informed strategy for advancing the field, supporting the decision-making process for researchers in developing new insights and providing directions for future research. For example, according to the strategic map (Figure 10), researchers can further explore the development of geotourism as a motor theme of geopark attractiveness or the development of geopark tourism, or other forms of tourism, as a niche theme. Another benefit is that it provides researchers with a consolidated list of all reviewed studies (Supplementary Material S3), enabling them to efficiently access and explore existing knowledge.

4.4. Limitations of the Study

The obtained data package is not identical for all databases and is as complete as the one from WoS and Scopus. Dimensions and PubMed are exporting only a limited set of metadata types, which implies some limitation in choosing the analysis type. This limitation can be solved with extra manual work, as the resulted merged method materialises in an Excel file. In this study, any extra manual work was not necessary. However, the quantity of the manual work depends on what kind of data is needed for the analysis to answer the research questions (Supplementary Material S1). At the same time, this form of Excel tab gives the opportunity to add additional important studies identified from previous experience. Another limitation is the duplicated documents occurrence, which

may appear after the automatic merge and deduplication. It occurs especially when in the study, documents written in "all languages" is selected as inclusion criteria. This issue can easily be solved by verifying the Excel file produced.

4.5. Suggestion for Future Research

We provide the following suggestions for future research from the meta-analysis.

According to the spatial distribution of the documents, there is a gap analysis present in a wide amount of countries, which is illustrated in Figure 8a as the grey zone. The main gap in terms of attractiveness is in Africa with 2 geoparks on the continent (90.7% of the countries), North America (including Central America), with 8 geoparks (82.6% of the countries), South America, with 10 geoparks (75%), Australia and Oceania, with 1 geopark each, (71.4% of the countries), Asia, with 84 geoparks (67.3) and Europe, with 108 geoparks (51%). One can see that there is a connection between the number of geoparks on the continents and the number of documents, but expanding the collaboration between countries (Figure 8b) can narrow the gap, leading authors to valuable multidisciplinary research too.

According to time (Figure 9), analysing the timespan (periods), we may identify the centre of interest of researchers, sequentially, on exploring the volcanic edifices, promoting the volcano tourism and mostly, the volcanic phenomenon, including mud volcanoes and the mineral waters (springs), illustrating the geological characteristics of the region. Few scholars' preoccupations are oriented toward mining fields and mining heritage, which were the smallest trend (unlike mud volcanoes). Several exploration sites are architecturally scenic and feature attractive landscapes, as they provide a combination of recreation, tourism and education. Closed mines are an important element of geoparks, and their attractiveness should be further explored. There are studies in these fields, but still, there remains a place for more study in term of attractiveness.

According to size, in term of frequency (Figure 9), a lower frequency presents the potential for a sustainable form of tourism, ecotourism and the scenic spots. Thus, that may represent a scientific highlight in the future, all the more as the core values of ecotourism are the conservation of nature and the value of local culture, as well as the involvement of the local community in the management of tourism sites and the consideration of their needs and interests. Moreover, promoting community involvement in protecting and managing the scenic sites is essential. According to the strategic map (Figure 10), the niche theme quadrant, the scholars can give, in the future, special attention to the forms of tourism practiced in geoparks.

In conclusion, the summary of the suggested subjects regarding geopark attractiveness indicates a focus on the tourism destination, on the tourist and tourism perspective, on the analysis of potential forms of tourism and on the scenic points of the landscape, including mining heritage. Further on, the data analysis and modelling the methods are crucial for information, organisation and reapplication of good practice. Expressing the attractiveness of geoparks is a real need in this moment when the development of geoparks is moving forwards very fast and, due the spatial gap, there still is a big opportunity over the world.

5. Conclusions

The present study offers a methodological contribution in the field of geopark natural environment, focusing on the topic of their attractiveness, providing scientific information for researchers. It presents a methodology based on bibliometric analysis using R software, which is designed for non-coders; the analysis can be conducted in R without having to write codes. Additionally, the methodology includes an adapted method to automatically combine the databases based on given functions [76]. At the same time, this paper contributes by using a described and validated automatic method (Supplementary Material S2). From the validation results, the proposed method consumed, on average, 53:30 min for those who had never worked in R and 8:30 min for the experienced users.

The current study examined the key information on trends regarding production, performance and productivity. Further, spatial analysis and an abstract approach analysis in the subtopic aspects and strategic mapping in the conceptual context provide insights for future research directions. The findings of this study, based on bibliometric quantitative analysis, suggest that in terms of the attractiveness of geoparks, future research can advance deeper into, but is not limited to, the following topics:

1. Tourism—potential forms of tourism practiced in geoparks, especially ecotourism and volcanic tourism;
2. Geomorphological features—mineral springs and mud volcanoes;
3. Aesthetic aspects—scenic sites and mining heritage;
4. Methodology—data analysis and modelling methods across different regions and countries.

We have not encountered any review in the studied topic, such as a bibliometric analysis of geopark attractiveness, or reviews that utilise R software for geoparks. We have also not yet encountered a bibliometric analysis of metadata from the four databases, WoS, Scopus, PubMed and Dimensions, or how to merge them in a single step, using combination and deduplication. These ensure the novelty of the study. Furthermore, this paper provides a compressive application in the horizontal direction of the methodology. In the long term, it can serve as a model for a new topic in the context of geopark environments interested in science mapping in R. The geopark attractiveness theme accounts for 8% of geopark academic studies, which leads to other opportunities (other topic or even a bibliometric analysis of geoparks across multiple databases). In the short term, the practical applicability of the merged method is demonstrated.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/land13101627/s1, Supplementary Material S1: Inventory of metadata, Table S1-1: Inventory of metadata, Table S1-2: Completeness of bibliographic metadata from merged database. Feedback from Biblioshiny app, Table S1-3: The level of analyses that can be performed in Biblioshiny. Feedback for WoS, Scopus, PubMed and Dimensions by advice button in Biblioshiny app. Checking the merged database by running all type of analysis. Supplementary Material S2: Method of merging data files and eliminate duplicates. Supplementary Material S3: List of publications, Table S3-1: List of documents analysed within the study.

Author Contributions: Conceptualisation, J.N. and Ș.D.; methodology, J.N.; R software, J.N.; GIS software, A.N.; validation, Ș.D.; method validation, A.N.; formal analysis, J.N.; investigation, J.N., Ș.D., R.-A.T. and A.-M.L.; resources, J.N. and Ș.D.; data curation, J.N.; writing—original draft preparation, J.N.; writing—review and editing, J.N.; A.N. and Ș.D.; visualisation, J.N., A.N., Ș.D., R.-A.T., and A.-M.L.; supervision, Ș.D.; project administration, Ș.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The original contributions presented in the study are included in the article/Supplementary Materials, further inquiries can be directed to the corresponding author/s.

Conflicts of Interest: The authors declare no conflicts of interest.

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