algorithms

MDPI

Article

Mapping the Frontier: A Bibliometric Analysis of Artificial Intelligence Applications in Local and Regional Studies

Camelia Delcea *, Ionuț Nica, Ștefan Ionescu, Bianca Cibu and Horațiu Țibrea

Department of Economic Informatics and Cybernetics, Bucharest University of Economic Studies, 0105552 Bucharest, Romania; ionut.nica@csie.ase.ro (I.N.); stefion09@gmail.com (Ș.I.); bianca.cibu@csie.ase.ro (B.C.); horatiu.tibrea@net.ase.ro (H.Ț.)

* Correspondence: camelia.delcea@csie.ase.ro

Abstract: This study aims to provide a comprehensive bibliometric analysis covering the common areas between artificial intelligence (AI) applications and research focused on local or regional contexts. The analysis covers the period between the year 2002 and the year 2023, utilizing data sourced from the Web of Science database. Employing the Bibliometrix package within RStudio and VOSviewer software, the study identifies a significant increase in AI-related publications, with an annual growth rate of 22.67%. Notably, key journals such as Remote Sensing, PLOS ONE, and Sustainability rank among the top contributing sources. From the perspective of prominent contributing affiliations, institutions like Duy Tan University, Ton Duc Thang University, and the Chinese Academy of Sciences emerge as leading contributors, with Vietnam, Portugal, and China being the countries with the highest citation counts. Furthermore, a word cloud analysis is able to highlight the recurring keywords, including "model", "classification", "prediction", "logistic regression", "innovation", "performance", "random forest", "impact", "machine learning", "artificial intelligence", and "deep learning". The co-occurrence network analysis reveals five clusters, amongst them being "artificial neural network", "regional development", "climate change", "regional economy", "management", "technology", "risk", and "fuzzy inference system". Our findings support the fact that AI is increasingly employed to address complex regional challenges, such as resource management and urban planning. AI applications, including machine learning algorithms and neural networks, have become essential for optimizing processes and decision-making at the local level. The study concludes with the fact that while AI holds vast potential for transforming local and regional research, ongoing international collaboration and the development of adaptable AI models are essential for maximizing the benefits of these technologies. Such efforts will ensure the effective implementation of AI in diverse contexts, thereby supporting sustainable regional development.

Keywords: local development; local economy; local resilience; regional development; regional economy; regional resilience; artificial intelligence; bibliometric analysis

Citation: Delcea, C.; Nica, I.; Ionescu, Ș.; Cibu, B.; Țibrea, H. Mapping the Frontier: A Bibliometric Analysis of Artificial Intelligence Applications in Local and Regional Studies. *Algorithms* **2024**, *17*, 418. https://doi.org/10.3390/a17090418

Academic Editor: Nuno David

Received: 12 August 2024
Revised: 15 September 2024
Accepted: 18 September 2024
Published: 20 September 2024

1. Introduction

Nowadays, both regional and local studies have become of paramount importance, playing a central role in understanding as many details and nuances as possible. The specter of local and regional studies may be described by analysis in areas such as economic [1], social [2], cultural [3], political [4], urban or rural planning [5], and environmental [6], with this diversity being able to characterize different parts of a country or region. One advantage of these studies is their focus on the characteristics that are present within a given area, allowing the identification of unique features such as available natural resources, demographic structure, cultural traditions, level of economic development, and local challenges. This level of detail is essential for the development of policies and strategies that respond effectively to local needs.

Local studies have proven to play an important role in addressing regional discrepancies, being capable of identifying disadvantaged areas and proposing measures in order to reduce economic and social disparities [7,8]. They also support the communities' capacity development, thus making them able to manage their own resources [9] and respond to challenges, like climate change [10], migration, or economic crises [11], therefore promoting equitable and sustainable development. Thus, regional or local studies are an essential tool for implementing effective public policies and preserving cultural heritage while promoting sustainable and harmonious development at the community level.

Artificial intelligence (AI) is a set of technologies that replicates human cognitive processes, such as learning, thinking, and self-recognition. Over the past few years, there has been a growing interest in the potential uses of AI in both private and public sectors [12]. The main argument for the application of AI technologies in these kinds of organizations is the fact that AI can enhance or even replace human actions and decisions [13]. This can be considered a benefit, providing the possibility for human resources to be engaged in more important and less repetitive tasks, thus contributing to improved efficiency, reducing errors, and lowering costs [14]. Although the potential of AI has brought a strong wave of excitement, understanding the stage of AI adoption, the challenges faced in implementation, and the expectations of organizations remains limited [15]. This problem is more common in the public sector, where the lack of competitive pressures that characterize private companies usually slows down the implementations [16].

AI has the capacity to transform industries and markets by managing unexpected changes [17]. Over the years, AI has been applied across various sectors, significantly influencing their development. Notable domains include transportation [18], healthcare [19], energy [20], agriculture [21], and even media [22].

AI has become an essential technique because it fundamentally transforms the way we live, work, and interact with technology. AI is based on computation, reasoning, action, and perception, using artificial neurons and scientific theorems [23]. According to Barr and Feigenbaum [24], AI is a part of computer science that focuses on systems, being characterized by the association of intelligence with human behavior (language, understanding, solving certain problems, etc.) [25,26]. By automating repetitive tasks and analyzing vast volumes of data, AI increases efficiency in a variety of industries, facilitates innovation by improving the process of scientific discovery and technological development, and personalizes user experiences by providing solutions tailored to individual needs and preferences, thus contributing to a significant increase in the quality of life. To help the user and to be present in different analytics, AI is composed of several branches: genetic algorithms, artificial neural networks, expert systems, problem-solving and planning, logic programming, robotics, planned learning, natural language processing, and even various hybrid systems, which are formed by combinations of the previously mentioned branches [26,27].

Given its use in many fields, AI has also been proven to be invaluable for local or regional studies, helping researchers to carry out various meaningful analyses. Xing L. [28] analyzed the influence that the population's mobility has over the differences in the regional economy in China, by generating an economic measurement algorithm with the help of AI and the Internet of Things (IoT), the purpose of which was to reduce the processing delay time and the error rate in processing economic information. Moreover, AI has been used in various studies at both regional and local levels to forecast the human capital stock in different regions of China using neural networks [29], predict the risk of cardiovascular disease patients in China by improving the sparrow search algorithm (SSA) [30], analyzing how the Chinese economy is influenced by the transportation infrastructure by combining AI with econometric techniques [31], and investigate the influence of climate change on cooling energy consumption in buildings, with a prediction of this consumption [32].

The rapid advancement of AI technologies has opened new avenues for research and application, transforming the way data are collected, analyzed, and used to understand spatial dynamics and regional development. Consequently, we can see that AI has brought

powerful tools for analyzing complex and diverse data from these domains. By using AI, researchers and local authorities can quickly and efficiently analyze different information to better understand the dynamics of a region. Moreover, it aids decision-making by providing predictive analytics and simulations, allowing the local authorities to plan their resource management more effectively and to implement policies tailored to their community's specific needs. Not only does it improve the accuracy and efficiency of these studies, but it also contributes to the development of better-informed and better-prepared communities for the future.

This study aims to map the frontier of AI applications in local and regional studies through a comprehensive bibliometric analysis. By examining the literature, we aim to identify key themes, influential authors, and important journals that shape the discourse in this interdisciplinary field. Understanding these trends not only highlights the current state of AI integration, but also provides insights into future directions and possible research gaps. This review will provide a detailed overview of the landscape, underscoring the evolving role of AI in improving the understanding and management of local and regional phenomena.

As it facilitates knowledge development and the identification of existing connections [33], bibliometric analysis was considered the best option for this paper in order to investigate both the impact and the benefits that the use of AI has brought, once it has been implemented in both local and regional studies [34–36]. In this context, for the first stage of the research, taking into account the recommendations of Zupic and Cater [37], a set of questions was established, the answers to which were followed throughout the research:

- How has the scientific output of local or regional studies applying AI evolved over time?
- Which are the countries with the most articles published?
- Which authors have conducted the most significant local or regional studies using AI?
- Which were the most impactful journals in the field of local or regional studies that applied AI?
- Which are the most significant universities for the field of local or regional studies that have used AI?

This study consists of the extraction of a database, on the basis of which a bibliometric analysis was performed, using VOSviewer and the Bibliometrix library in RStudio, according to specific methodologies and tools, and is divided into several distinct and essential sections.

In this section, we have discussed the chosen research area, and in Section 2, the objectives and methodology are established, and the criteria for inclusion and exclusion of papers are defined. Section 3 presents the actual data analysis, in which various bibliometric techniques are used to calculate performance indicators and apply network methods to understand the structure and dynamics of the research domain. Section 4 covers discussions and limitations, and the final stage formulates some conclusions on all the research conducted.

2. Materials and Methods

Bibliometric analysis employs statistical methodologies and specialized software tools to extract, process, and interpret data related to scientific output. The primary objective of this approach is to provide an unbiased overview of the progress within a research field, identify contributions from authors or institutions, and highlight potential future research directions. In our bibliometric analysis, we utilized RStudio software (version 2024.04.2), leveraging the Bibliometrix package along with the "biblioshiny()" function and VOSviewer software (version 1.6.20), for enhanced data visualization, mixture analysis, and interpretation [38,39]. The "biblioshiny()" function is called in this format to launch the graphical interface of the Bibliometrix platform in RStudio. The empty parentheses are part of the syntax specific to the use of this function in the R environment, allowing access to an interactive bibliometric analysis environment. Bibliometric analysis, according to Donthu et al. [40], has increased in popularity due to its widespread availability and

the portability of software tools, as well as the existence of databases that collect quality scientific publications, such as the Web of Science (WoS).

Over the years, through literature research, it has been observed that bibliometric analysis has been used in the research of a quite high number of fields of activity. These include business [41], education [42], policymaking [43], medicine [44], management and organization [37], marketing [45], engineering [46], and cybernetics [47].

The workflow recommended by Aria and Cuccurullo [38] and described by Börner et al. [48], Zupic and Cater [37], and Cobo et al. [49] will be followed in this study (Figure 1). It consists of five stages [37]: research design, data collection, data analysis, data visualization, and interpretation. Moreover, as described in the study conducted by Öztürk et al. [50], the research design stage defines the research's purpose, questions, and focus. Regarding the data collection stage, a specific database, in our case the WoS, is selected, and the inclusion and exclusion criteria for the queries are determined. In the analysis and visualization stage, specific techniques for bibliometric analysis such as citation analysis, a co-occurrence network, and co-word analysis are identified. Finally, the results are interpreted by validating/verifying the established research questions, illustrating the newly identified insights, and providing recommendations for future research directions.

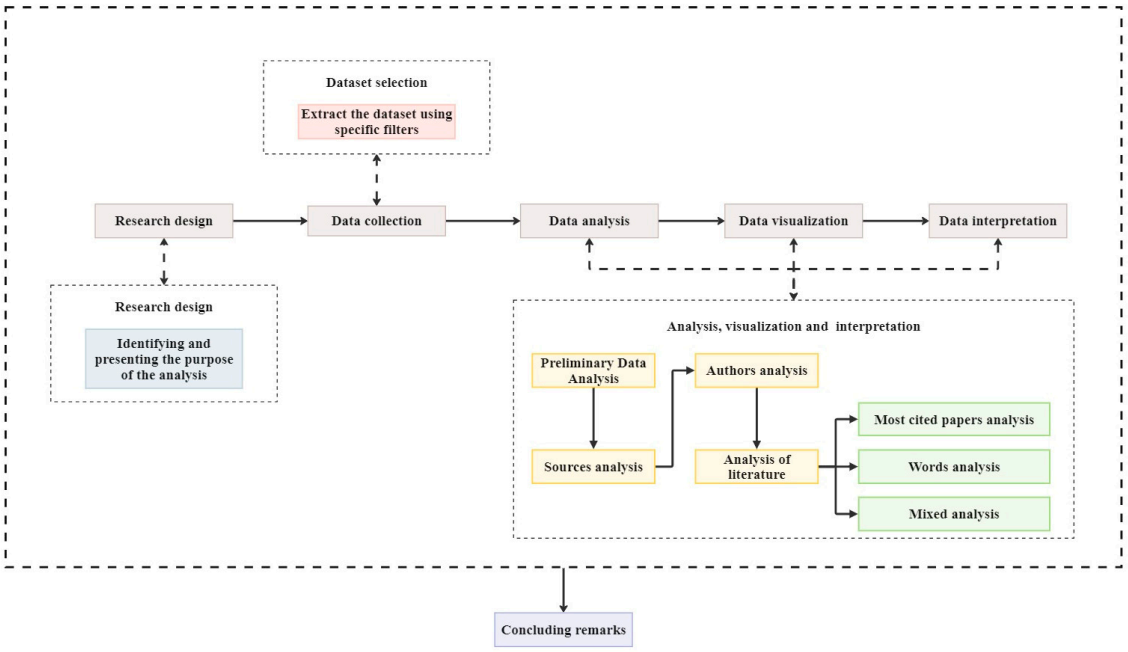


Figure 1. Methodological flow.

With regard to the first stage, this analysis to aimed bring a benefit to the reader by identifying the most relevant insights related to local or regional studies, emphasizing the analysis performed and the techniques used by applying artificial intelligence and how it stands out in studies through the significant results obtained.

For data collection (the second stage), we used the Web of Science (WoS) database to gather the scientific publications for analysis through the Bibliometrix platform using the biblioshiny() library in RStudio and the software VOSviewer. While there are various sources such as Scopus, Crossref, and Dimensions for collecting scientific research data, we selected the WoS because of its extensive database of over 18 million documents, as noted by Visser et al. [51].

The WoS Core Collection database was added commercially by International Scientific Indexing in 1964, and is considered the first citation index assigned to the sciences. It was initially used as a retrieval tool and was called the Science Citation Index (SCI) [52]. Due to its longevity, it has earned the title of the most influential data source and is often used by researchers for research evaluation, journal selection, or bibliometric analysis [53].

In our work, we chose to extract the most significant articles from the WoS database, considering the complex indexing system on which it is formed, as it contains the necessary information for the study. Our insight was based on the fact that over the years, ISI has added a number of products and innovations, which were founded by Garfield as early as 1960 [54–56]. Among other indices used, we can mention the Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), and Conference Proceedings Citation Index. In addition to these, a citation index for books was launched. These were introduced with the purpose of covering the widest possible overview of the literature, regardless of format [57]. With technological advances, the distribution and analysis of SCI data have evolved profoundly, changing access to information and accelerating bibliometric research based on publication and citation data [58].

A very important aspect to mention is that the WoS platform offers access to users on a subscription basis, with the analysis being influenced by the number of indices used [59,60]. In our case, we had total access through a subscription that included all the indices available on the WoS platform:

- Science Citation Index Expanded (SCIE)—1900–the present;
- Social Sciences Citation Index (SSCI) 1975–the present;
- Emerging Sources Citation Index (ESCI) 2005–the present;
- Arts & Humanities Citation Index (A&HCI)—1975–the present;
- Conference Proceedings Citation Index—Social Sciences and Humanities (CPCI-SSH)—1990–the present;
- Conference Proceedings Citation Index—Science (CPCI-S)—1990–the present;
- Book Citation Index—Science (BKCI-S)—2010–the present;
- Book Citation Index—Social Sciences and Humanities (BKCI-SSH)—2010–the present;
- Current Chemical Reactions (CCR-Expanded)—2010–the present;
- Index Chemicus (IC)—2010–the present.

According to a study conducted by Li et al. [53], whose objective was to investigate the ways in which the WoS was mentioned and utilized in a total of 19,478 research papers for the period 1997–2017, a significant increase in research using the WoS was observed. The number of these papers was, in 2016, more than 120 times the number of papers that were published in 1997 and about 0.21% of all papers published that year. This increase indicates, once again, the special role that the WoS plays in the academic community.

Even though the WoS database was not originally designed for scientometric analysis, the information that researchers have had access to in order to understand the global scientific system has favored both the development of this analysis and the evolution of science [58]. Cole [61] even asserted the fact that the formation of the SCI is an excellent example of techniques in which technological innovations often build the conditions necessary to achieve significant progress in scientific fields.

Through regional economics, we can understand economic analysis at the level of larger administrative or geographical units, such as the regions or counties of a country, while local economics refers to smaller communities, towns, or villages, where local factors such as infrastructure, demographics, and cultural specificity play a major role in local economic development [62]. For instance, Salder [63] conventionally defines local economics as being represented by administrative units, which are restructured around cities. On the other hand, considering the understanding of the concept of regional economics, Naftaly [64] analyzes in his study the determining factors that contribute to the growth of the regional economy in Kenya, having conducted an analysis of 47 counties.

Table 1 provides a detailed overview of the methodology used to gather relevant data, focusing on both local and regional economies and artificial intelligence. Initially, Query #1 involved a search for keywords in titles related to the regional or local economy, such as local development, local resilience, local economy, local authorities, regional development, regional resilience, regional economy, and regional authorities, resulting in 14,834 scientific documents. Query #2 focused on keywords related to artificial intelligence (e.g., artificial intelligence, machine learning, deep learning), resulting in 249,873 scientific articles. The combination of

these searches, Query #3, identified 20 scientific documents containing both local or regional elements and artificial intelligence. It shall be noted that in the queries provided in Table 1, we have added "*" to the end of the search keywords in order to allow to the results to contain various forms of the keyword – e.g. "regional_authorit*" stands for both the singular ("regional authority") and the plural form ("regional authorities") of the keyword.

Table 1. Data selection steps.

Exploration Steps	Questions on Web of Science	Description	Query	Query Number	Count
1	Title	Contains one of the local or regional specific keywords	((((((TI = (local_development)) OR TI = (local_resilience)) OR TI = (local_econom*)) OR TI = (local_authorit*) OR TI = (regional_development)) OR TI = (regional_resilience)) OR TI = (regional_econom*)) OR TI = (regional_authorit*)	#1	14,834
		Contains one of the artificial intelligence specific keywords	((TI = (artificial_intelligence)) OR TI = (machine_learning)) OR TI = (deep_learning)	#2	249,873
		Contains the agent-based modeling and artificial intelligence specific keywords	#1 AND #2	#3	20
2	Abstract	Contains one of the local or regional specific keywords	((((((AB = (local_development)) OR AB = (local_resilience)) OR AB = (local_econom*)) OR AB = (local_authorit*) OR AB = (regional_development)) OR AB = (regional_resilience)) OR AB = (regional_econom*)) OR AB = (regional_authorit*)	#4	58,188
		Contains one of the artificial intelligence specific keywords	((AB = (artificial_intelligence)) OR AB = (machine_learning)) OR AB = (deep_learning)	#5	553,359
		Contains the agent-based modeling and artificial intelligence specific keywords	#4 AND #5	#6	355
3	Keywords	Contains one of the local or regional specific keywords	((((((AK = (local_development)) OR AK = (local_resilience)) OR AK = (local_econom*)) OR AK = (local_authorit*) OR AK = (regional_development)) OR AK = (regional_resilience)) OR AK = (regional_econom*)) OR AK = (regional_authorit*)	#7	12,312
		Contains one of the artificial intelligence specific keywords	((AK = (artificial_intelligence)) OR AK = (machine_learning)) OR AK = (deep_learning)	#8	359,634
		Contains the agent-based modeling and artificial intelligence specific keywords	#7 AND #8	#9	22

Table 1. *Cont.*

Exploration Steps	Questions on Web of Science	Description	Query	Query Number	Count
4	Title/abstract/keywords	Contains one of the artificial intelligence specific keywords and one of the local or regional specific keywords	#3 OR #6 OR #9	#10	371
5	Language	Limit to English	(#10) AND LA = (English)	#11	363
6	Document Type	Limit to article	(#11) AND DT = (Article)	#12	287
7	Year published	Exclude 2024	(#12) NOT PY = (2024)	#13	237

In abstracts, searching for the same local or regional keywords resulted in 58,188 documents, while the artificial intelligence-related keywords yielded 553,359 documents. By combining these results, 355 scientific articles were identified that include both local or regional and artificial intelligence elements.

Keywords were similarly examined, with local or regional keywords resulting in 12,312 documents and artificial intelligence keywords in 359,634 documents. Combining these two identified 22 articles of interest.

A comprehensive query combined the title, abstract, and keyword searches, ensuring the capture of all relevant articles, and resulted in 371 documents.

To ensure logical consistency and to facilitate global dissemination, documents were filtered to include only those written in English, narrowing the selection to 363 results. English-language papers are preferred due to their greater visibility and impact in the academic community, which increases the likelihood of being cited. Furthermore, many major databases and indices predominantly feature English-language papers, with top journals often enforcing strict peer-review processes to ensure scientific quality and rigor. Bibliometric research often includes only English-language papers, as noted in various studies [65–67].

The documents were further filtered to retain only those classified as articles, which are reports of original research that can include meta-analysis and vary in length, resulting in 287 documents. In scientometrics, differentiating document types is important because of their specific content and purposes, which can influence citation distributions [68].

To ensure relevance and accuracy, documents published in 2024 were excluded, leaving a final count of 237 articles.

These steps were used to narrow down the search and identify the most relevant articles for the bibliometric analysis of artificial intelligence applications in local and regional studies. The process ensures a rigorous and precise selection of relevant literature, providing a solid foundation for the analysis and interpretation of the collected data.

Coming back to the five stages of our analysis (Figure 1), the last three stages utilized an integrated development environment for R, specifically RStudio and VOSviewer. R is a programming language specifically for graphics and various statistical computations. RStudio Bibliometrix, developed in the R language, is an open-source environment that provides rich functionalities for the visualization of scientific literature and quantitative analysis. An important feature of Bibliometrix is cluster analysis, which helps researchers to identify and group key topics, journals, or authors in the literature, thus revealing the structure and patterns of the research domain [69,70]. VOSviewer is a specialized software tool designed for the analysis and visualization of networks within bibliometric data [71]. As demonstrated in the study by Ionescu et al. [39], VOSviewer is used for analyzing and visualizing complex networks in bibliometric data. In the section related to mixed analysis, we discuss the interconnections between various analyzed elements, such as keywords from our bibliometric dataset. VOSviewer is extensively utilized by the academic

community [72] to analyze and visually depict networks of scientific information, aiding in the identification of trends, relationships, and patterns within the literature.

For data analysis, visualization, and interpretation, the focus was on understanding the dataset, starting with the Preliminary Data Analysis, where the number of sources, the annual growth rate, the average number of citations per document, the number of references, the annual evolution of the scientific output, how many Keywords Plus or authors' keywords were identified, the total number of authors, and how many of them preferred to work individually or to collaborate.

In Sources Analysis, the most relevant journals were identified by searching the number of papers, which included the application of AI to regional or local studies published in the dataset.

In the Authors Analysis, we followed the scientific evolution of each author over the analyzed period of time, observing the volume of published works, the countries with a higher output, as well as their collaboration mode.

The literature review includes extensive information about the works cited worldwide, including the number of citations, authors, regions, journals of publication, datasets used, and abstracts of the works. This analysis helps us to understand the purposes and techniques used by each author.

Furthermore, the most frequently used keywords were identified, as well as the bigrams or trigrams at the title or abstract level to be able to observe the similarity between papers.

The mixed analysis is composed of two three-field diagrams between countries–authors–journals and affiliations–authors–keywords to illustrate the links between these elements, a map in which the relevant keywords are divided into clusters at the title and abstract levels, a keyword co-occurrence map, and two thematic maps at the Keywords Plus and authors' keyword levels to observe the interconnection between the use of artificial intelligence and local or regional studies.

3. Dataset Analysis

3.1. Preliminary Data Analysis

This section is designed to provide a preliminary analysis of the most important data that have been collected from our bibliometric research on the AI applications used in local and regional studies. This analysis is able to provide a better understanding of the research landscape, emphasizing how proactive and comprehensive the community of researchers in the proposed field is. Not only the dynamics but also the impact and potential impact of the research have been explored, emphasizing the existing trend that exists between internationalization and collaboration. Beyond the above, this section will contain important visualizations to gain a broader understanding of the research landscape in terms of AI applications used in local and regional studies. Notably, concepts such as the annual scientific production or the average citations per year will be examined. Therefore, with the help of this section, we will be able to provide a holistic perspective on the current state and future directions of exploration in AI applications used for local and regional studies, underscoring how important global cooperation is to gain more knowledge and practice in this field of study.

Table 2 represents the overview of the analyzed data in the context of our bibliometric study. Therefore, the timespan that was considered for our study ranges between 2002 and 2023, considering more than two decades of research. From the perspective of the total number of sources used, of which books, journals, and even other documents were included, 158 are present. Additionally, with regard to the number of documents analyzed, there are 237 documents. Furthermore, it is visible the fact that the annual growth rate of the total number of documents stands at 22.67% per year, with the average years since the documents were published being 2.81. Moreover, the total number of references that are present in our analysis is 11,903, and the average number of citations each document registers is 17.31. Therefore, Table 2 indicates a surge of interest in the analyzed field, demonstrated not only by the significant annual growth rate, but also by the notable

number of citations. This underscores the significance of research on AI applications in local and regional studies.

Table 2. Main data overview.

Indicator	Value
Timespan	2002:2023
Sources (books, journals, etc.)	158
Documents	237
Average years from publication	2.81
Annual growth rate (%)	22.67
Average citations per document	17.31
References	11.903

Figure 2 describes the scientific output that exists for the used timeframe, 2002–2023. Considering the number of articles published annually, an almost flat linear trend can be seen between the year 2002 and the year 2017, ranging from 0 to 2 articles, with the latter being registered only once, in 2011. Yet, starting with 2018, a significant interest in AI applications within local and regional studies was registered, with the number of published articles exponentially rising from 2018 to 2023, ranging from 9 papers at its lowest to 73 at its highest. The recent major growth in the number of published articles suggests that researchers are more and more interested in the area of AI applications, as the available technology is also exponentially improving year by year.

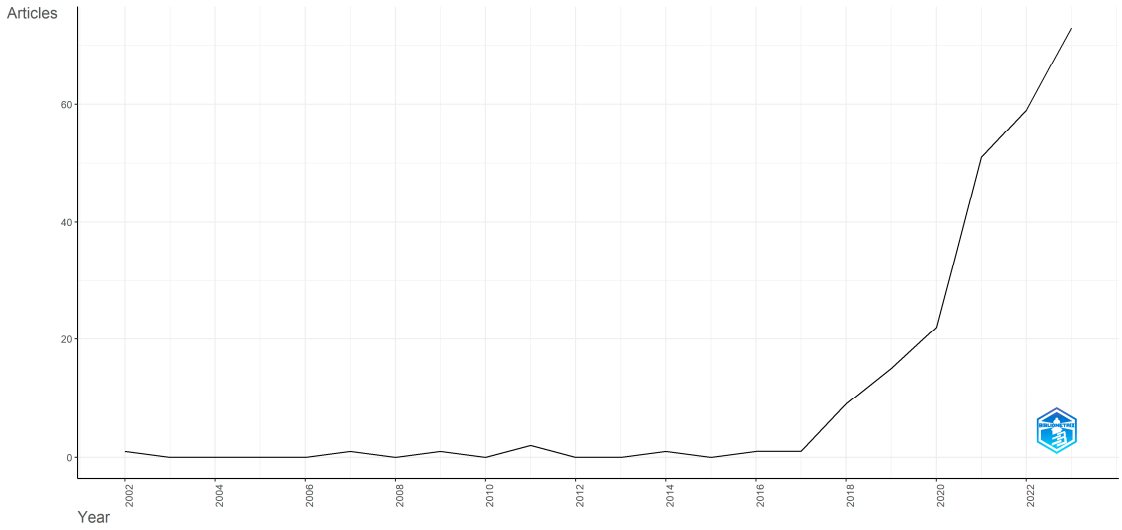


Figure 2. Annual scientific production evolution.

Figure 3 illustrates the fact that the trend of yearly citations was highly volatile across the analyzed timeframe, with average citations ranging from 0.1, in 2007, to a peak of 32.4, in 2009. Between 2002 and 2007, there was a steady decline in citations, decreasing consistently from an average of 4 to 0.1. However, in 2009, there was a significant surge, reaching the highest peak of the period at 32.4 average citations. This increase is attributed to major players in the industry, such as Microsoft and Google, implementing technologies that were using aspects of artificial intelligence, according to Reynosso [73]. Continuously, for the next period, other fluctuations can be seen, with less intensity than the first one. Yet, another particular moment is the year 2017, with a value of 20.9 citations, considering that Google launched its "Google Home" technology, consisting of a smart speaker that uses AI [73]. Therefore, it is observable that the increase in authors' interest is highly linked to major AI breakthrough events, which impacts knowledge of AI applications within local and regional studies.

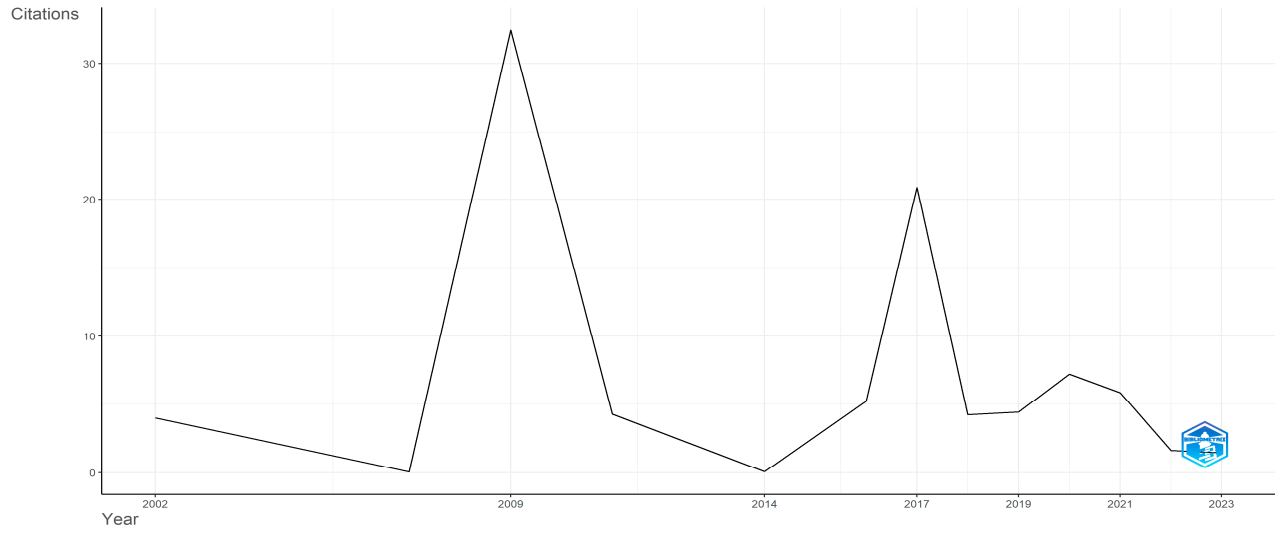


Figure 3. Annual evolution of average article citations per year.

Table 3 provides essential details about the content of the documents analyzed in the bibliometric study. It can be observed that the total number of Keywords Plus used is 668, words that are being generated by the selected databases in order to provide an enhanced search, leading to a better reflection of the content present in the article. Furthermore, the authors' keywords score is 817 occurrences, highlighting the main topics that have been tackled in the articles, and offering valuable insights into the attraction points of AI applications within local and regional studies research. Moreover, the increased volume of authors' keywords and Keywords Plus shows the presence of topic diversity within the studied literature, thus suggesting a holistic approach to matters that are related to AI applications, emphasizing how complex the research in this area is.

Table 3. Document contents.

Main Information about Documents	Results
Keywords Plus	668
Authors' Keywords	817

Relevant data about the authors of the articles used in our bibliometric analysis can be seen in Table 4. Out of a total of 1066 authors who contributed to the advancements of AI applications research in local and regional studies, only 22 of them stated that they were single authors of the articles. This implies that even though there are many collaborations in the field of study, there is also an interest in individual study. Therefore, because there are efforts that come from both individual and collaborative perspectives, a complex and diverse portfolio of techniques used in the study of AI applications in local and regional studies can be described.

Table 4. Authors.

Main Information about Authors	Results
Authors	1066
Authors of single-authored docs	22

Table 5 shows the importance of collaboration between authors, especially international collaboration. From the total number of documents used in this bibliometric analysis, 23 of them are single-authored, emphasizing the fact that even if the collaboration between the authors is essential for progress in the field of study, individual research is also of

very high importance. More than this, the documents have, on average, 4.41 co-authors, underscoring how essential collaboration between authors is. On top of that, 30.8% of the documents registered international authors' collaboration, suggesting that this kind of collaboration is a pillar as strong as individual research or national collaboration research regarding knowledge advancements that can be achieved in the field of study.

Table 5. Collaboration of the authors.

Main Information about Authors	Results
Single-authored docs	23
Co-authors per doc	4.41
International co-authorships (%)	30.8

3.2. Sources Analysis

The analysis of this study in relation to the top 20 most representative sources for the topic under discussion highlights the diversification that exists among the research considered, as it has been published in various journals, as shown in Figure 4. In Figure 4, the number inside the dots represent the number of papers published in each source, while the color and the size of the dots provide a visually representation of this contribution (e.g. larger and darker dots represent a higher contribution of the journals to the field).

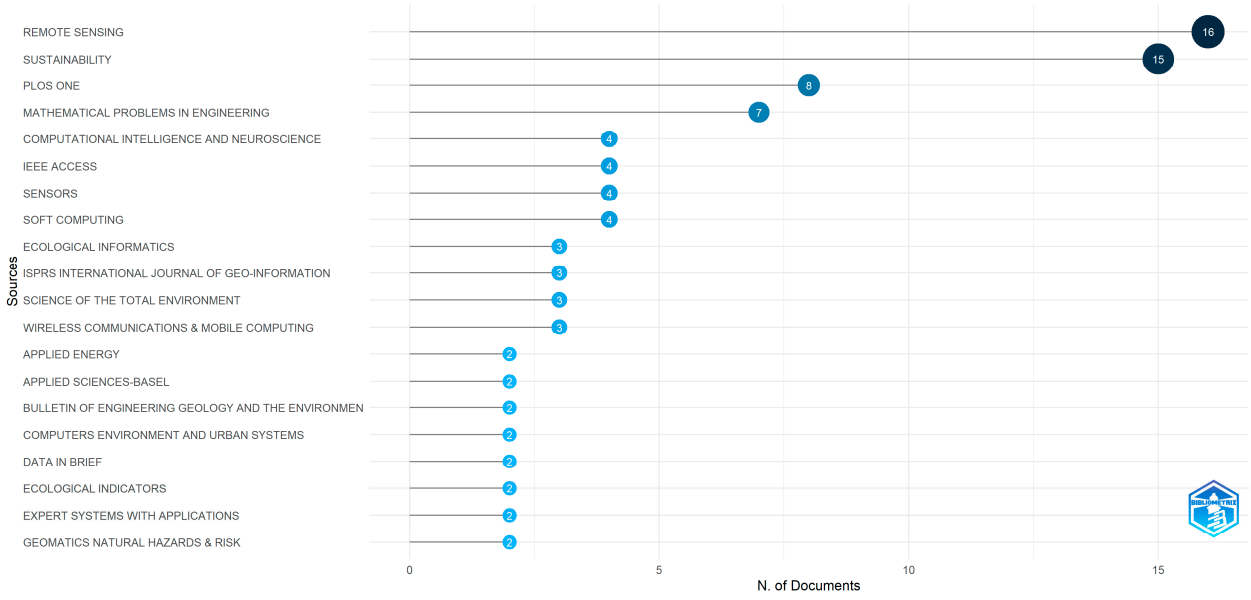


Figure 4. Top 20 most relevant journals.

The most significant source is represented by *Remote Sensing*, with 16 articles, emphasizing the importance of the usage of AI applications within local and regional studies, especially their usage in facilitating our day-to-day lives. The second-ranked source is *Sustainability*, with 15 articles, highlighting the positive impact that studies related to the subject matter have, covering topics such as applied sciences, economics, or engineering. Amongst other notable sources, there are *PLOS ONE*, with eight articles, *Mathematical Problems in Engineering*, with seven articles, followed by *Computational Intelligence and Neuroscience*, *IEEE Access*, *Sensors*, and *Soft Computing*, each of them being described by four articles. Consequently, given the existing journal variation that exists within the analyzed topic, it is evident that the discussed topic is a complex one, covering the impact that AI applications have over the global context, whether it is an economic, engineering, or theoretical one, so there is a need for research that addresses the use of AI applications in local and regional studies.

Using Figure 5, the grouping of sources based on Bradford's law can be seen, as they have been categorized into separate areas, given the distribution of articles. Bradford's law is a theory in bibliometrics that classifies scientific journals into three zones based on the relevance and frequency of article appearances. Zone 1, known as the core of highly productive journals, includes those most frequently cited in specialized literature. Zone 2 represents journals with a moderate number of citations, while Zone 3 consists of journals that are less frequently cited [74,75]. Figure 5 shows all journals that have a high number of citations; thus, they are placed into Zone 1 according to Bradford's law.

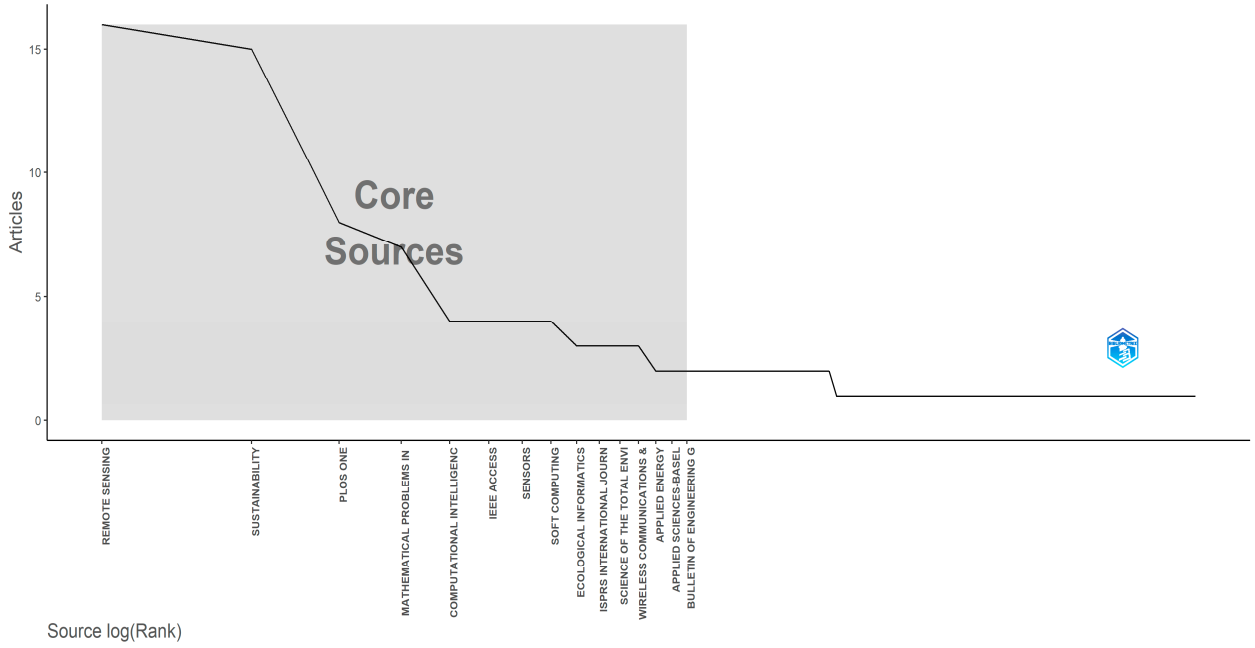


Figure 5. Bradford's law on source clustering.

The first zone described by Bradford's law consists of sources that have the highest productivity, contributing the most to the research field. In our scenario, the first zone is characterized by journals such as *Remote Sensing*, *Sustainability*, *PLOS ONE*, *Mathematical Problems in Engineering*, *Computational Intelligence and Neuroscience*, *Ecological Informatics*, and *Applied Energy*. The aforementioned journals are only a few examples of highly important journals in the context of our study, proving that the usage of AI applications in local and regional studies can be covered from very wide ranges, although most of them are mainly focused on technological computation.

Journals' local impact, underscored by the H-index, emphasizes how impactful various journals are. The H-index is described by the number of articles from a specific source, each of them having more than H citations. The H-index (Hirsch index) is a measure used to assess the productivity and citation impact of a researcher, journal, or institution. It reflects both the number of publications (productivity) and the number of citations each publication receives (impact) [76]. Figure 6 puts this into perspective, with the journal *Remote Sensing* having an H-index of 6, implying the fact that this journal contains six articles that have at least six citations each. *IEEE Access*, *Mathematical Problems in Engineering*, and *Sustainability* are all described by an H-index of 4, meaning that, within each journal, there are four articles with more than four citations each. In Figure 6, the size and color of the dots are adjusted to match the impact of the journal's based on H-index–with darker and larger dots representing higher contribution. This kind of analysis can provide an immediate overview of the relative impact each source has, taking into account not only the number of articles but also the number of citations. Generally, an increased H-index indicates a more significant influence within the scientific community.

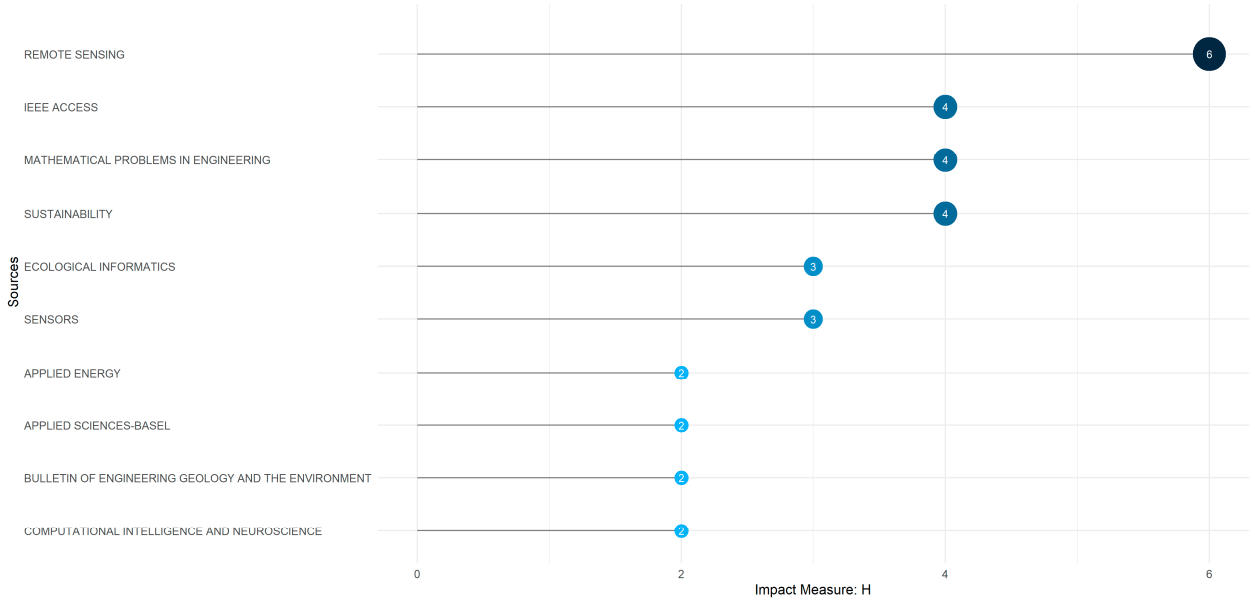


Figure 6. Journals' impact based on H-index.

The journals' growth over time represents how the numbers of articles have evolved yearly in the context of each source, as can be seen in Figure 7, where the focus can turn towards specific observations:

- *Remote Sensing* and *Sustainability* have surged in recent years, starting with the year 2019;
- The journal *PLOS ONE* has also registered a surge over the more recent years, but it is slightly lower than the one for the aforementioned two journals;
- Even if they initially registered a high growth rate, the journals *Mathematical Problems in Engineering* and *Sensors* are now registering a constant growth rate.

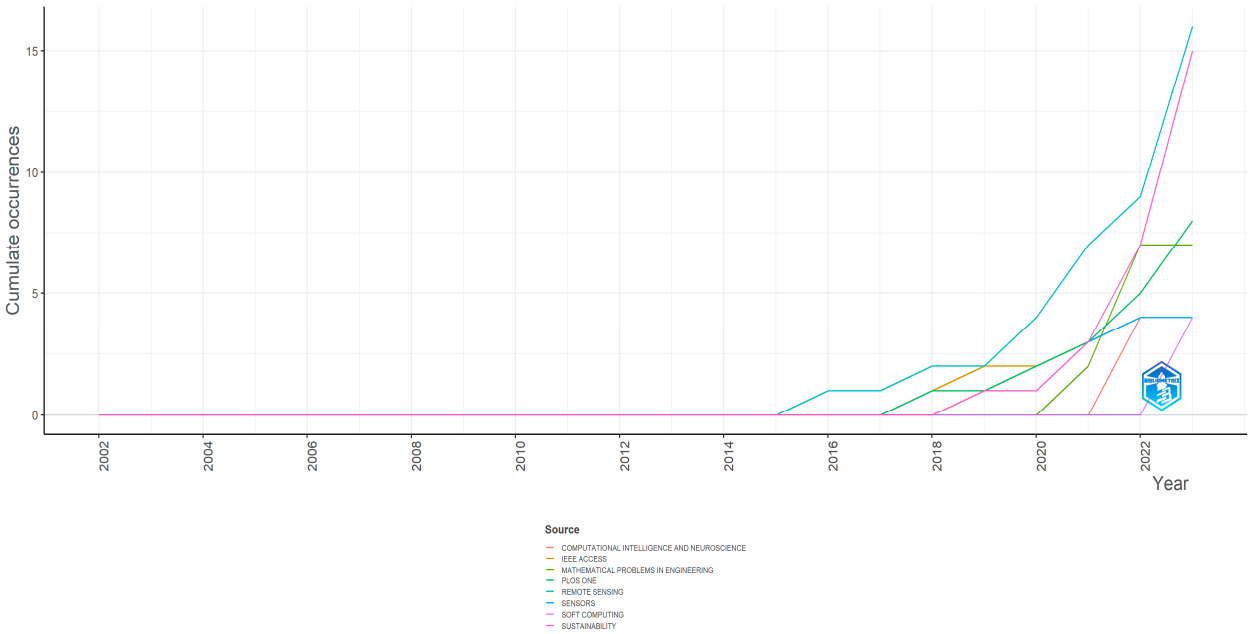


Figure 7. Journals' growth (cumulative) based on the number of papers.

3.3. Authors

In the context of the Authors Analysis, the authors with the most relevance will be examined, along with the top 20 most relevant affiliations, the top 20 authors' production over time, and the top 20 most relevant corresponding authors' countries.

With regard to the first 20 most relevant authors, as can be seen in Figure 8, Bui D.T. and Hoang N.D. stand out, with six articles each, followed by Chen W., Lee S., Li Y., Nguyen H.D., and Pham Q.B. with three articles each.

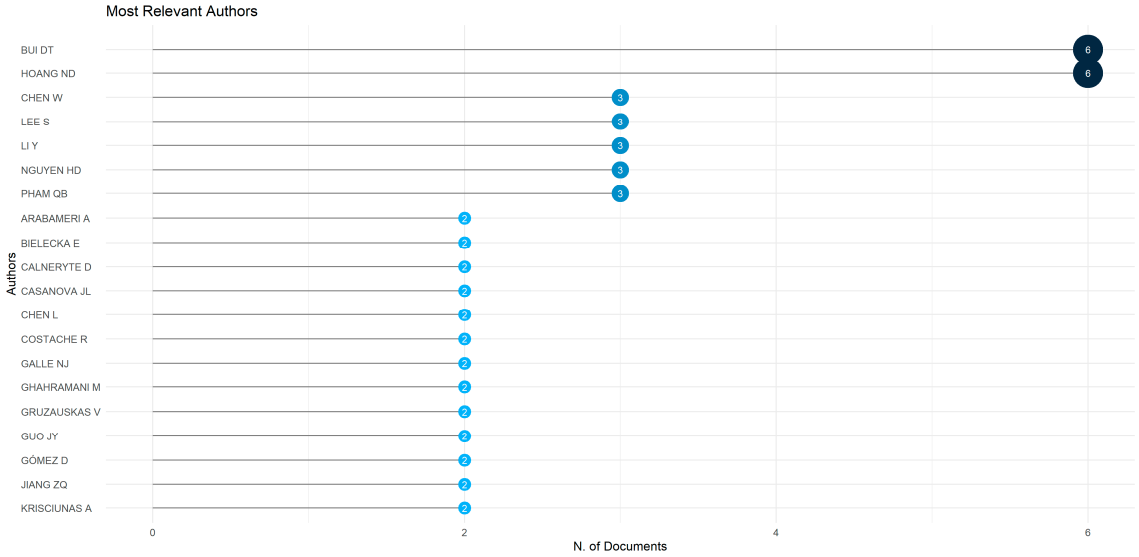


Figure 8. Top 20 authors based on number of documents.

From the perspective of the publication date of the scientific papers, in our analysis, only the first 20 authors with the most publications have been considered. Based on Figure 9, it is visible that the topic of AI applications within local and regional studies registers a significant emerging trend, with the majority of articles being published from the year 2018 onwards, mainly due to the fact that there is an exponential advancement of technologies that can be used in the context of AI applications. For instance, Bui D.T. has published six articles across the 2018–2023 period, receiving a total number of 45 citations over the same period of time. Additionally, Hoang N.D. has managed to publish the same amount of articles, six, averaging 13 citations yearly.

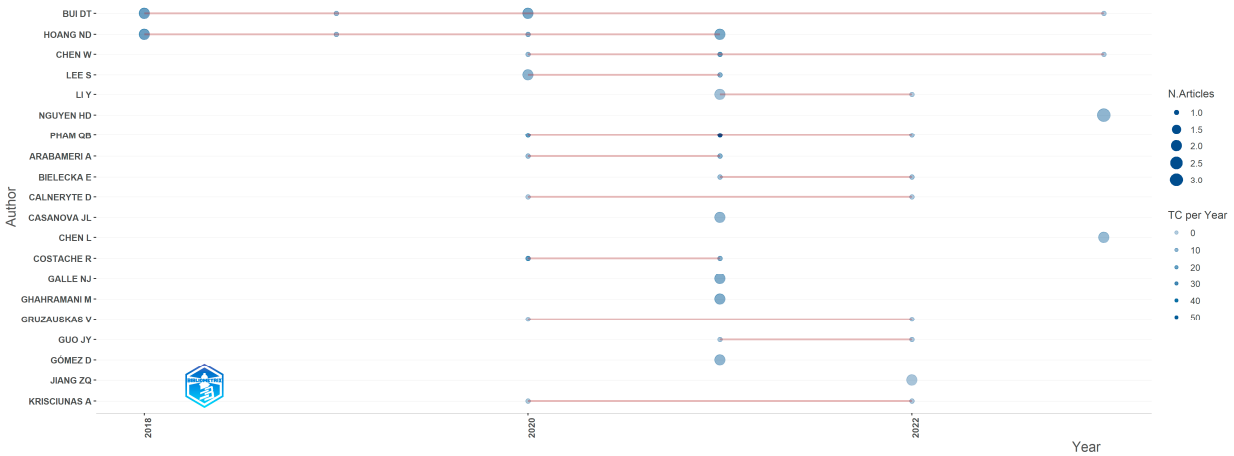


Figure 9. Top 20 authors' production over time.

With regard to the most relevant affiliations based on the number of articles, Figure 10 depicts the first 20 universities that are the most relevant to our study. These affiliations

presented not only a high throughput of articles over the analyzed period, but also displayed significant productivity in the area of AI applications within local and regional studies, contributing to the comprehensiveness of our research. Explicitly, universities such as "Duy Tan University", the "Chinese Academy of Science", and "Ton Duc Thang University" proved to be the universities that have been the most productive.

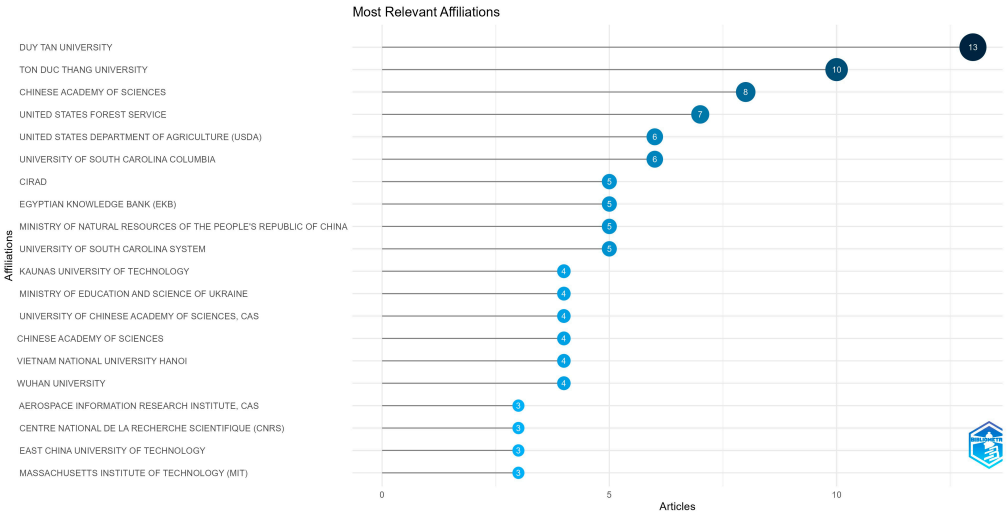


Figure 10. Top 20 most relevant affiliations.

In Figure 11, countries that have the most relevant corresponding authors in the context of our research are presented. These corresponding authors have mainly focused on the usage of AI applications within local and regional studies. Additionally, in order to determine the countries with the most relevant corresponding authors, two metrics have been considered: SCP (single-country publication) and MCP (multiple-country publication). Both of these metrics proved to be highly valuable in our analysis, as the SCP metric provides essential information regarding the collaborative nature that exists amongst the articles and its frequency, whereas the MCP metric shares key information about the existing distribution and collaboration patterns.

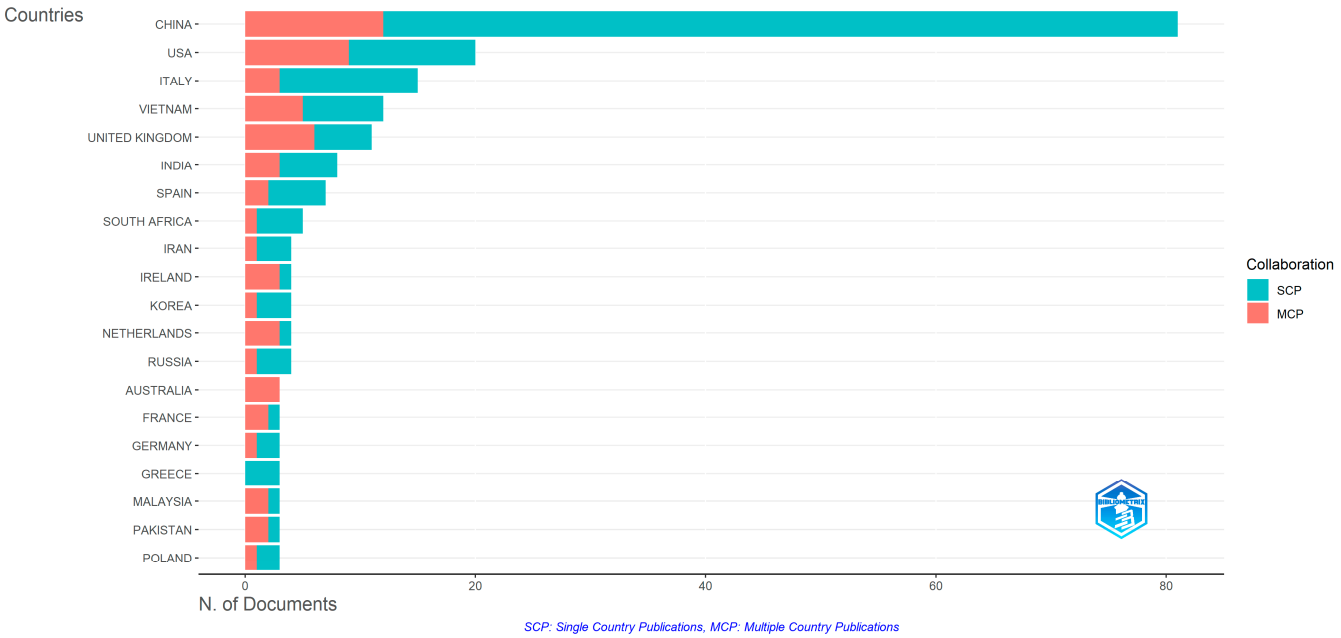


Figure 11. Top 20 most relevant corresponding authors' countries.

For our analysis, the information illustrated in Figure 11 can be analyzed from three dimensions:

- Total number of articles—China is by far the country with the greatest amount of research, with a total of 81 articles, followed by the United States of America, with 20 studies, and Italy, with 15 scientific studies;
- SCP articles—similarly to the previous point, China is the country with the most single-country publications, with an impressive number of 69 articles, followed by Italy, with 12 studies, and the United States of America, with 11 scientific studies;
- MCP articles—the country with the most published articles that are authored by corresponding authors who are from different countries is China, with 12 studies, closely followed by the United States of America, with 9 articles, and the United Kingdom, with 6 scientific studies.

Considering the complexity of Figure 11, it is visible that national collaboration in research in the area of AI applications within local and regional studies is a critical point for further expanding the knowledge in the field of study. Yet, international collaboration is also an important step in broadening the knowledge of the subject matter. Amongst the countries that prefer to have national collaborations rather than international ones, countries such as China, Italy, India, Spain, and South Africa stand out, whereas countries that tend to have more international collaborations than national ones are the United Kingdom, Ireland, the Netherlands, Australia, France, Malaysia, and Pakistan.

The map that can be seen in Figure 12 represents the scientific output based on the country of origin. Gray and various nuances of blue are visible in the map below, where a gray color represents a country that had no scientific publications, whereas the intensity of the blue color corresponds to the number of scientific outputs of that specific country. With regard to the intensity of the blue color, a darker shade of blue for a specific country corresponds to a high volume of publications, and a lighter shade of blue describes it as having a low number of scientific studies. Based on the illustration below, it is certain that some specific countries are dominating the research landscape, whereas other countries are contributing in a lower manner to the total number of publications. Notably, China is the country that dominates scientific production, with 215 articles, followed by the United States of America, with 64 articles, indicating the importance that these countries have in the context of global research.

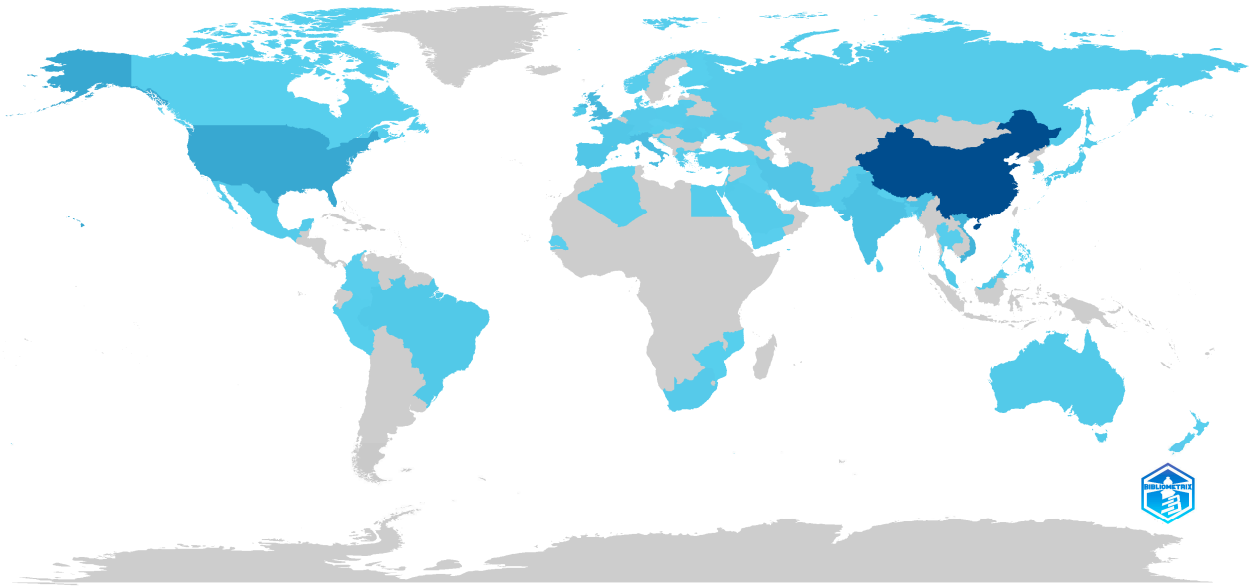


Figure 12. Scientific production based on country.

In the context of the countries that had the most citations, Figure 13 showcases the first 20 of them. It can be easily observed that the most cited country is Vietnam, with 614, closely followed by China, with 595 citations, and Portugal, with 532 citations, suggesting that these are the countries that are the most impactful with regard to the scientific landscape of the subject matter, AI applications in local and regional studies. Among other notable countries that greatly contribute to the area of study, there are Italy, with 299 citations, Iran, with 289 citations, and the United States of America, with 255 citations.

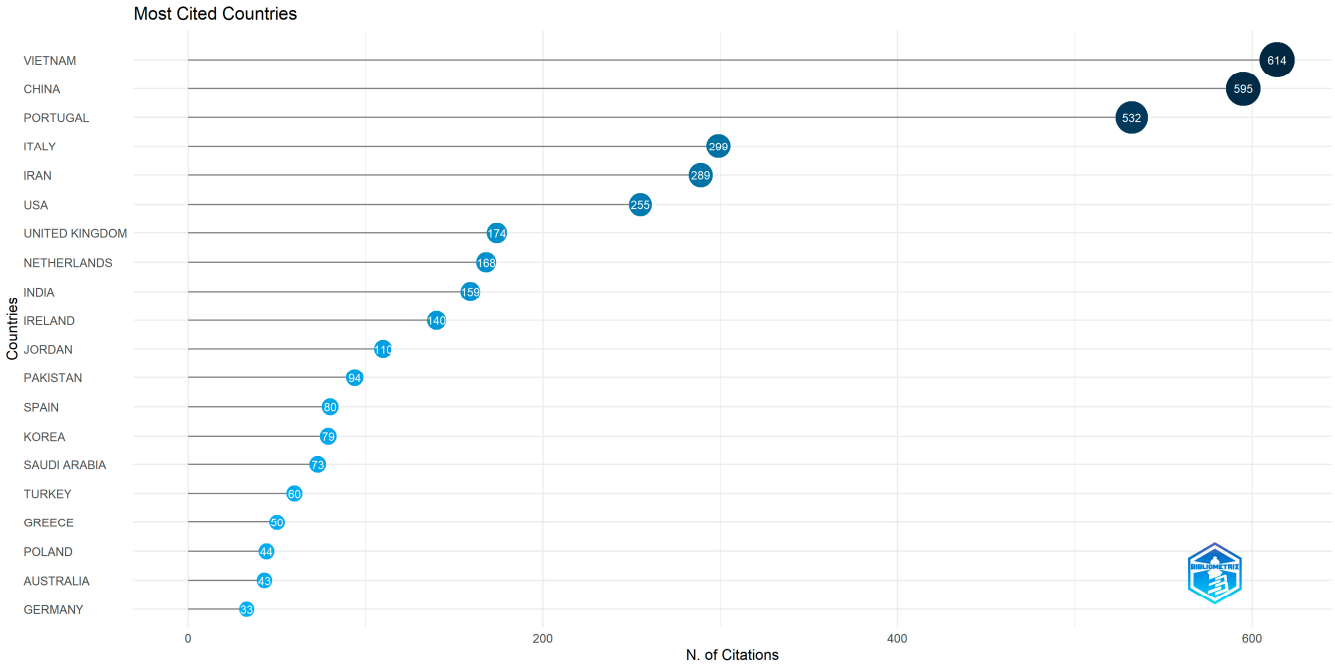


Figure 13. Top 20 countries with the most citations.

The country collaboration map can be conceptualized as the frequency of collaboration that exists between different pairs of countries. Specifically, a key point in this regard is to examine the countries that are collaborating most frequently and the context in which these countries collaborate. According to Figure 14, the following observations can be made:

- Amongst European countries, only Germany, Italy, Spain, and the United Kingdom tend to collaborate with each other;
- Asian countries, such as China or Vietnam, frequently collaborated with European countries, like Italy, Romania, or the United Kingdom;
- The most notable countries that are situated in the same region and collaborate with each other are Germany and Italy, China and India, and Vietnam and Iran;
- With regard to collaborations between countries that have different cultural perspectives, being located in different regions, the most significant links are between China and the United States of America, and China and Australia;
- The most intense collaborations that can be seen in our analysis are represented by the links between the United States of America and China or the United Kingdom, and Vietnam and Iran.

Therefore, the collaboration map that can be seen below may suggest common interests or areas of research between the involved countries, emphasizing the existing network of researchers. If the color of a country is darker, we can conclude that it has a higher number of collaborations compared to those whose color is light. As we could expect from the rest of the elements studied up to this point, the highest number of collaborations in the analyzed field comes from China, with a total number of 40 collaborations, of which 5 were with the United Kingdom, 3 were with India, and 2 each were with Australia, Egypt, Iran, Pakistan, Netherlands, the United States of America, and Yemen. The United States

of America had a total of 32 collaborations, the United Kingdom had 17, and India and Vietnam had 21 each.

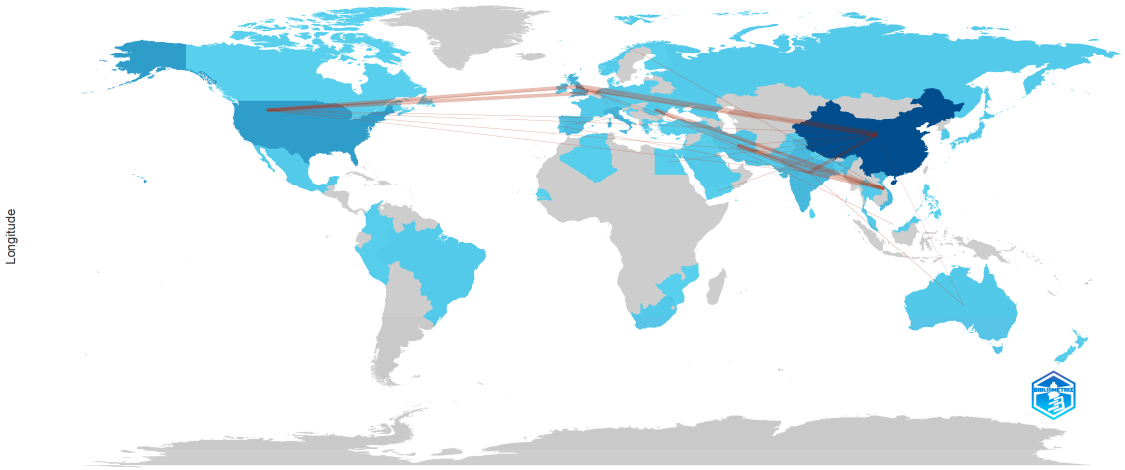


Figure 14. Country collaboration map.

From the perspective of the author collaboration network, Figure 15 describes the network that exists between the top 50 authors who have managed to collaborate with each other. These collaborations are illustrated by the links that can be seen in the figure below, where more collaborations between specific authors are indicated by more links. Additionally, the nodes vary in size, with larger ones representing authors that had a more notable contribution. In our analysis, the author collaboration network was divided into 10 clusters (noted from Cluster #1 to Cluster #10), with each of these clusters having a different color, which indicates a highly intensive collaboration amongst these groups.

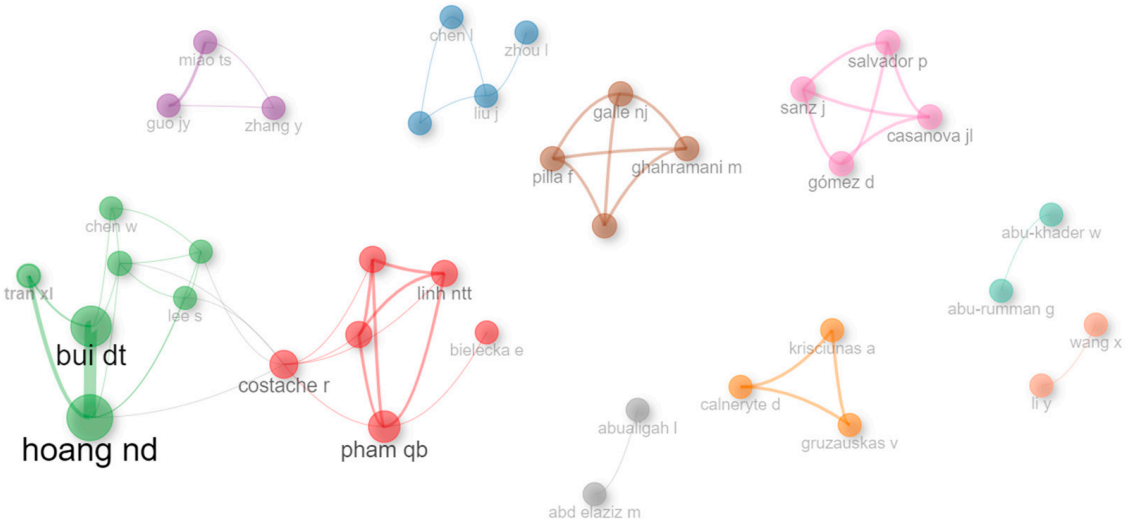


Figure 15. Top author collaboration networks.

Cluster #1, in red, consists of the following six members: Pham QB, Bielecka E, Costache R, Linh NTT, Mahato S, and Talukdar S. These authors have dedicated their analyses to finding techniques to identify and predict prone places or even where floods will occur with the help of machine learning algorithms [77], creating a map that includes the totality of flood vulnerabilities [78], and researching the discovery of a hybrid education technique [79].

Cluster #2, in blue, is represented by Chen L, Liu J, Zhou L, and Abbas H. They researched the technique to improve an existing algorithm to assess and control the risks of

cardiovascular disease [30], the identification of the limits of land extraction to generate efficient agricultural management [80], and a system capable of real-time warning of various natural phenomena [81].

Cluster #3, in green, constitutes the largest number of authors and consists of Bui DT, Hoang ND, Chen W, Lee S, Arabameri A, Pal SC, and Tran XL. During their research, they have developed techniques to avoid certain catastrophes. Among these we can mention models for generating predictions of fires, soil erosion, or landslides using different models such as the Random Forest Machine [82–84].

Cluster #4, in purple, consists of Guo JY, Miao TS, and Zhang Y,. Starting from climate change, the authors have investigated the impacts brought by a constant rise in sea level, using techniques such as deep learning or Monte Carlo [85,86].

Cluster #5, in yellow, is composed of Calneryte D, Gruzauskas V, and Krisciunas A, who proposed a framework for a system to monitor market trends, using a methodology comprising literature review, machine learning, and various statistical techniques, as well as a strategy to identify indicators from orthoimages [87,88].

Cluster #6, in brown, consists of Galle NJ, Ghahramani M, Pilla F, and Ratti C. They showed how the particularities of different green spaces can be analyzed, using both a sentiment analysis model and artificial intelligence to investigate what citizens' opinions were [89,90].

Cluster #7, in pink, is composed of Casanova JL, Gomez D, Salvador P, and Sanz J, who tried to monitor the deterioration of water quality by analyzing specific indicators through different techniques such as the deep neural network, support vector machine, or artificial neural network [91]. Moreover, they investigated with time series data the dynamics of senescence [92].

The last three clusters (#8 in gray, #9 in turquoise, and #10 in orange) consist of two authors each and are grouped as follows: Abd Elaziz M and Abualigah L, Abu-Khader W and Abu-Rumman G, as well as Li Y and Wang X. Among the areas of work they have tackled are pollution forecasting in three cities in China with PM2.5 using a deep learning technique [93], urban non-compliance due to lack of coordination [94], economic growth forecasting [95], and mountain road mining [96].

3.4. Analysis of Literature

In this part of the review, the focus is on analyzing those papers that have been considered the most appreciated, represented by a high number of global citations. The most relevant information for these is presented, including a summary of each study, in order to emphasize the way different problems are approached in local or regional studies and especially the solution techniques discovered for certain problems.

Moreover, various analyses and graphical representations are made to observe the existing links between affiliations–authors–keywords, countries–authors–journals, and the most representative groups of words identified at the levels of title, abstract, or Keywords Plus.

3.4.1. Top 10 Most Cited Papers—Overview

Table 6 highlights the top 10 papers with the most global citations in the field of artificial intelligence applications in local and regional studies. Each paper is evaluated based on several criteria: number of authors, region of origin, total number of citations (TC), total citations per year (TCY), and normalized citations (NTC). The NTC indicator is used in order to be able to create a picture of how a paper scores in terms of the citations it has recorded compared to other papers that have a similar research topic and that were published in a given reference year. As a calculation formula, it is determined by the ratio between the number of citations recorded by a paper and the average number of citations in the same year that the rest of the papers we have in the dataset have, in similar fields of activity [97].

Table 6. Top 10 most globally cited documents.

No.	Paper (First Author, Year, Journal, Reference)	Number of Authors	Region	Total Citations (TC)	Total Citations per Year (TCY)	Normalized TC (NTC)
1	Paulo Leitão, 2009, *Engineering Applications of Artificial Intelligence*, [98].	1	Bragança, Portugal	519	32.44	1.00
2	Towfiqul Islam, 2021, *Geoscience Frontiers*, [99].	8	Rangapur, Bangladesh	226	56.50	9.65
3	Xiaojun Xiang, 2021, *Environmental Impact Assessment Review*, [100].	4	Hubei, China	191	47.75	8.15
4	Aiding Kornejady, 2017, *Catena*, [101]	3	Gorgan, Iran	167	20.88	1.00
5	Anne Gharaibeh, 2020, *Heliyon*, [102]	4	Irbid, Jordan	110	22.00	3.06
6	Swapan Talukdar, 2020, *Stochastic Environmental Research and Risk Assessment*, [77]	9	West Bengal, India	108	21.60	3.00
7	Federico Brunetti, 2020, *The TQM Journal*, [103]	6	Verona, Italy	105	21.00	2.92
8	Peter Nijkamp, 2002, *Sage Journals*, [104]	3	Amsterdam, the Netherlands	92	4.00	1.00
9	Saba Ameer, 2019, *IEEE Access*, [105]	7	Islamabad, Pakistan	89	14.83	3.34
10	Mohammad Hossein Sowlat, 2011, *Atmospheric Environment*, [106]	5	Tehran, Iran	87	6.21	1.45

With 519 total citations, Leitão's study from Portugal has the most citations and an NTC score of 1.00 (obtained as the ratio between 519, representing the total citations, and the average number of citations recorded per document for 2009, which was also 519), indicating its significant influence in the field. With an average of 32.44 citations per year, this scientific paper is a benchmark in AI applications in engineering. The study by Islam et al. from Bangladesh, published in *Geoscience Frontiers*, reached an impressive 226 citations in just one year, with a TCY of 56.50 and a very high NTC of 9.65 (226 citations divided by 23.43 citations), reflecting its contemporary relevance. Published in the *Environmental Impact Assessment Review*, Xiang's research from China received 191 citations and a TCY of 47.75, with an NTC of 8.15, highlighting its significant contribution to environmental impact assessment. The study by the authors from Iran, with 167 citations and a TCY of 20.88, maintains an NTC of 1.00, indicating a consistent influence in the field. Published in *Heliyon*, the research by Gharaibeh et al. from Jordan has 110 citations and a TCY of 22.00, with an NTC of 3.06, reflecting an important contribution to interdisciplinary studies. With 108 citations and a TCY of 21.60, the study by Talukdar et al. from India published in *Stochastic Environmental Research and Risk Assessment* has an NTC of 3.00, indicating its relevance in risk assessments. This analysis provides an overview of the most influential papers in the field of artificial intelligence applications in local and regional studies. By analyzing the citations and normalized scores, we can observe research trends and priorities in this field. Also, the geographical distribution of authors suggests a global collaboration and diversity of methodological approaches.

3.4.2. Top 10 Most Cited Papers—Review

Table 7 presents a summary of the 10 most cited scientific papers, outlining their main objectives, the input data used, and indicating whether the authors employed a hybrid approach that integrates quantitative and qualitative methods, or if they utilized only theoretical, qualitative methods.

Table 7. Brief summary of the contents of top 10 most globally cited documents.

No.	Paper (First Author, Year, Journal, Reference)	Title	Context and Problem Statement	Data	Purpose	Hybrid Approach/ Theories Considered
1	Paulo Leitão, 2009, *Engineering Applications of Artificial Intelligence*, [98]	Agent-based distributed manufacturing control: A state-of-the-art survey	Manufacturing has transitioned from a local to a global, competitive economy; enterprises must enhance flexibility and agility while maintaining productivity and quality.	Literature review of manufacturing control systems using distributed artificial intelligence techniques (multi-agent systems (MASs) and Holonic Manufacturing Systems (HMSs)).	Survey the current state of manufacturing control systems that use MAS and HMS; identify and discuss the challenges and research opportunities in the field.	Hybrid approach
2	Towfiqul Islam, 2021, *Geoscience Frontiers*, [99]	Flood susceptibility modeling using advanced ensemble machine learning models	Floods are highly destructive natural disasters causing significant damage to land, buildings, and human lives; the dynamic and complex nature of flash floods makes it challenging to forecast vulnerable areas. There is difficulty in early identification of flash flood-prone sites due to their unpredictable nature.	Twelve flood-influencing factors. Data from 413 current and former flooding points. GIS environment for data transfer and analysis. Statistical appraisal measures (Freidman, Wilcoxon signed-rank, t-paired tests) and ROC for model validation and comparison.	Apply and assess the performance of hybrid ensemble models for flood susceptibility mapping. Assist authorities and policymakers in reducing flood-related threats and implementing effective mitigation strategies.	Hybrid approach
3	Xiaojun Xiang, 2021, *Environmental Impact Assessment Review*, [100]	Urban water resource management for sustainable environment planning using artificial intelligence techniques	Water is an essential resource for socio-economic growth and environmental protection. Proper management of water resources is essential for development, poverty reduction, and equity. Climate change intensifies challenges in water resource management, contributing to uncertainty.	Annual water use and release data with locational constraints. Numerical simulations of water resource management policies.	Propose and validate the Adaptive Intelligent Dynamic Water Resource Planning (AIDWRP) approach. Enhance decision-making in water resource management through AI and improve local economic efficiency.	Hybrid approach
4	Aiding Kornejady, 2017, *Catena*, [101]	Landslide susceptibility assessment using maximum entropy model with two different data sampling methods	The study aims to map landslide susceptibility over the Ziarat watershed in Golestan Province, Iran.	92 landslides recorded using GPS, field surveys, and local data. 12 landslide-controlling factors selected through principal component analysis.	Combination of maximum entropy (ME) model with two sampling strategies: Mahalanobis distance (MEMD) and random sampling (MERS).	Hybrid approach

Table 7. *Cont.*

No.	Paper (First Author, Year, Journal, Reference)	Title	Context and Problem Statement	Data	Purpose	Hybrid Approach/ Theories Considered
5	Anne Gharaibeh, 2020, *Heliyon*, [102]	Improving land-use change modeling by integrating ANN with Cellular Automata-Markov Chain model	The main objective in this study is to enhance the simulation capability of the Cellular Automata Markov Chain (CA-MC) model in predicting land-use changes by integrating artificial neural networks (ANNs).	Socio-economic, spatial, and environmental variables for Irbid City, Jordan. Actual and simulated land-use maps for the year 2015.	Predict changes in land use using an enhanced simulation model combining ANNs and CA-MC. Guide local authorities in urban expansion management and agricultural region protection.	Hybrid approach.
6	Swapan Talukdar, 2020, *Stochastic Environmental Research and Risk Assessment*, [77]	Flood susceptibility modeling in Teesta River basin, Bangladesh using novel ensembles of bagging algorithms	The principal purpose of this study is to predict and identify flood-prone zones in the Teesta River basin, Bangladesh, using advanced ensemble machine learning algorithms.	Twelve conditioning factors influencing floods. 413 current and former flooding points in the Teesta River basin.	Develop reliable and accurate models for predicting flood-prone areas. Assist regional and local authorities in mitigating flood risks and developing preventive measures.	Hybrid approach.
7	Federico Brunetti, 2020, *The TQM Journal*, [103]	Digital transformation challenges: strategies emerging from a multi-stakeholder approach	The main objective of this research is to propose strategies for companies, public administrators, and organizations in the education industry to successfully navigate the digital transformation within the Tyrol–Veneto macroregion.	Interviews with 60 stakeholders in the Tyrol–Veneto macroregion.	Explore and propose strategies for digital transformation in a regional innovation system.	Hybrid approach.
8	Peter Nijkamp, 2002, *Sage Journals*, [104]	A Comparative Institutional Evaluation of Public-Private Partnerships in Dutch Urban Land-use and Revitalisation Projects	The main element of this study is to explore the shift towards decentralized decision-making in urban land-use policy, emphasizing the collaborative role of local/regional authorities and the private sector in urban development projects.	Systematic database of nine urban development projects in the Netherlands.	Understand the factors that drive the decision-making process in decentralized urban land-use policies. Evaluate the effectiveness of public–private partnerships in achieving revitalization objectives.	Hybrid approach.

Table 7. *Cont.*

No.	Paper (First Author, Year, Journal, Reference)	Title	Context and Problem Statement	Data	Purpose	Hybrid Approach/ Theories Considered
9	Saba Ameer, 2019, *IEEE Access*, [105]	Comparative Analysis of Machine Learning Techniques for Predicting Air Quality in Smart Cities	The main objective is to address air pollution challenges in smart cities by comparing different machine learning regression techniques for real-time pollution prediction.	Multiple datasets for pollution estimation using Apache Spark.	Provide local authorities with a better understanding of machine learning techniques for real-time air quality prediction. Determine the most efficient and accurate model for predicting air quality in smart cities.	Hybrid approach.
10	Mohammad Hossein Sowlat, 2011, *Atmospheric Environment*, [106]	A novel, fuzzy-based air quality index (FAQI) for air quality assessment	The main purpose of this study is to develop a novel fuzzy-based air quality index (FAQI1) to address the limitations of existing air quality indices, such as high levels of subjectivity.	Air quality data from five sampling stations in Tehran, Iran (January 2008 to December 2009).	Create a more accurate and comprehensive air quality index using fuzzy logic to overcome the subjectivity of traditional indices.	Hybrid approach.

Leitão [98] proposes in his study to survey the current state of manufacturing control systems that use multi-agent systems (MASs) and Holonic Manufacturing Systems (HMSs), to identify and discuss the challenges and research opportunities in the field and to understand why these advanced approaches have not been widely adopted in the industry. His approach is a hybrid study in that it integrates the principles of MASs and HMSs, and their combination capitalizes on the strengths of both paradigms to create manufacturing systems that are more adaptable and efficient. It utilizes distributed artificial intelligence techniques and principles of MASs and HMSs in the context of manufacturing.

The study by Islam et al. [99] highlights the application of advanced machine learning models to predict flood-prone areas in the Teesta River basin, in northern Bangladesh. The research employs two hybrid ensemble models, Dagging and Random Subspace, combined with an artificial neural network (ANN), random forest (RF), and support vector machine (SVM). These models are validated using multiple statistical measures, showing high accuracy, with ROC AUC values above 0.80. The Dagging model outperformed others, indicating its potential for superior flood susceptibility modeling. The findings aim to support state and local authorities in mitigating flood risks and developing effective strategies for future flood management.

Xiang et al. [100], in their study, present Adaptive Intelligent Dynamic Water Resource Planning (AIDWRP) as a solution to the challenges of sustainable water management in urban areas. The approach leverages AI, specifically the Markov Decision Process (MDP), to manage dynamic water resources efficiently. By combining AI tools and human expertise, AIDWRP aims to optimize environmental planning policies, improving water use efficiency and local economic performance. Numerical simulations demonstrate substantial improvements in balancing water supply and demand, indicating the potential of AIDWRP to address water management issues exacerbated by climate change.

Kornejady et al. [101], in their study, aim to map landslide susceptibility in the Ziarat watershed, in Golestan Province, Iran, using the maximum entropy (ME) machine learning model with two sampling strategies: Mahalanobis distance (MEMD) and random sampling

(MERS). A total of 92 landslides were recorded using GPS, and 12 controlling factors were selected through principal component analysis. The results showed that both MEMD and MERS performed well, with AUSRC values of 0.884 and 0.878, respectively. MEMD was found to have superior predictive power, with an AUPRC of 0.906. Lithological formations, proximity to roads, and precipitation were identified as the most significant factors. The study highlights that about 13.8% of the area is highly susceptible to landslides, providing critical information for land-use planning and risk management.

In the study by Gharaibeh et al. [102], the purpose is to improve the simulation capability of the Cellular Automata Markov Chain (CA-MC) model by integrating it with an ANN to better predict land-use changes. The model uses socio-economic, spatial, and environmental variables to generate potential transition maps, which are then fed into the CA-MC model. The study validated the enhanced model using Kappa indices by comparing simulated maps with actual maps of Irbid City, Jordan, from 2015. The results showed that the integrated ANN and CA-MC model significantly outperformed the original CA-MC model in accuracy. The predicted maps for 2021 and 2027 are expected to help local authorities in managing urban expansion and protecting agricultural regions, thereby supporting Jordan's food security.

The study by Talukdar et al. [77] focuses on predicting flood-prone zones in the Teesta River basin, Bangladesh, using state-of-the-art ensemble machine learning algorithms. By integrating bagging with REPtree, RF, M5P, and Random Tree (RT), the study aims to provide reliable and accurate flood susceptibility models. Twelve conditioning factors and 413 current and former flooding points were used to develop the models. The models were validated using the ROC curve, and several statistical tests were applied to compare their performance. The findings revealed that more than 800 km^2 of the area was predicted as having high flood susceptibility by all models, with the bagging with the M5P algorithm performing the best. The results offer valuable insights for regional and local authorities to mitigate flood risks and implement effective measures to prevent potential damage.

The study by Brunetti et al. [103] explores strategies for companies, public administrators, and educational organizations to address digital transformation within the Tyrol–Veneto macroregion. The research employs qualitative methods, including interviews with 60 stakeholders and analyses using IRaMuTeQ and NVivo software. The findings reveal three strategic pillars: culture and skills, infrastructures and technologies, and ecosystems. These pillars encompass various fields of action, emphasizing the importance of a systemic perspective and collaboration among stakeholders. The study's insights are adaptable to other regional innovation systems, providing valuable references for enhancing business, market, and local development.

The next study, by Nijkamp et al. [104], investigates the shift towards decentralized decision-making in urban land-use policies, focusing on the collaborative roles of local authorities and the private sector in urban development. Through a comparative study of nine public–private partnerships in the Netherlands and the application of rough set analysis, the research identifies key factors such as institutional structure, financial viability, and spatial externalities that influence the success of urban revitalization projects. The study provides insights into the critical policy variables that can guide future urban development strategies.

In the research by Ameer et al. [105], the authors address the major environmental challenge of air pollution in smart city environments through real-time data monitoring and advanced machine learning techniques. By deploying IoT-based sensors, the study compares four regression models for pollution prediction using multiple datasets processed using Apache Spark. The evaluation criteria include Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) for accuracy, alongside processing time. The comparative analysis aims to identify the best model for accurate and timely air quality prediction, assisting local authorities in making informed decisions to manage traffic and reduce pollution levels.

In the last study analyzed, Sowlat et al. [106] address the limitations of existing air quality indices by developing a novel fuzzy-based air quality index (FAQI1). Utilizing fuzzy logic, which is a key computational method in artificial intelligence, the index incorporates two criteria, air pollutants and volatile organic compounds, due to their health impacts. Different weighting factors are assigned to each pollutant, and trapezoidal membership functions are employed for classifications. The final index is based on 72 inference rules. A case study using air quality data from Tehran was conducted, comparing FAQI1 with the USEPA AQI, showing that FAQI1 is a comprehensive and accurate tool for air quality classification. This new index is proposed as a reliable method for local authorities to use in air quality management.

These studies demonstrate how AI is being applied in diverse regional and local contexts, providing concrete solutions to real problems. Leitão [98] contributes to the development of adaptive manufacturing systems using advanced distributed AI principles. Islam et al. [99] support authorities in flood prevention using hybrid machine learning models. Xiang et al. [100] optimize the use of water resources and improve local economic performance through AI simulations. Kornejady et al. [101] provide solutions for landslide risk management, informing land-use planning. Gharaibeh et al. [102] help to manage urban sprawl by improving predictive models of land-use change. Talukdar et al. [77] provide accurate models to support local authorities in flood risk mitigation. Brunetti et al. [103] guide the digital transformation of companies and public administrations, contributing to regional innovation ecosystems. Nijkamp et al. [104] identify key success factors for public–private partnerships in urban development. Ameer et al. [105] provide local authorities with tools for real-time air quality management, and Sowlat et al. [106] develop a more accurate index for air pollution management, useful in strategic planning at the local level. Thus, the AI applications presented in these studies highlight the significant impact they can have in improving local and regional performance by providing authorities with data-driven solutions for better resource and risk management.

3.4.3. Words Analysis

In order to provide a method that is efficient when investigating the language or the existing content within scientific documents, an analysis of the keywords was conducted. This analysis not only provides valuable insights into the research area, but also offers valuable information regarding the trends or characteristics that are present within specific domains. Studying the keywords is an essential step in order to better understand the key concepts and terminologies that are used in the research field, proving to be really helpful when it comes to being able to comprehend the definition of some specific terms, or in scenarios when some clarification is needed. Additionally, by inspecting the group of words that often appear together in documents, groups of words or clusters where each word is associated with the others can be easily identified. Furthermore, topics that possess a high relevance within the research area can also be determined with the help of the number of citations that their specific keywords have. Therefore, with the help of this kind of analysis, not only is a rundown of the main themes or subdomains provided, but subjects that are impactful on the field of study can also be discovered.

With the help of Table 8, the top 10 most frequent words that have occurred under Keywords Plus are presented. It can be observed that the word with the most occurrences is “model”, implying the fact that, in order to make use of the AI applications within local and regional studies correctly, researchers should first develop an AI model that is suitable to their own needs, to correctly analyze its output. More than this, “classification” also registers a high number of occurrences, with 19, emphasizing the fact that the data used in the research need to be first locally or regionally classified. Another frequently used term is “prediction”, indicating that the articles often rely on prediction models, as they prove to give robustness to the quantitative models used in various regional contexts. Thus, the words with the most occurrences for the Keywords Plus section suggest that there is a strong focus on using an AI model, such as random forest or Linear Regression, based on

the locally or regionally classified data in order to correctly predict the output in various economic contexts. Furthermore, the appearances of other words, such as "impact", "gis", "index", "performance", and "support vector machine" also indicate some specific areas which the researchers are paying attention to in the area of AI applications within local and regional studies.

Table 8. Top 10 most frequent words in Keywords Plus.

Words	Occurrences
model	24
classification	19
prediction	18
logistic-regression	17
impact	15
random forest	15
gis	11
index	10
performance	10
support vector machine	10

With regard to the top 10 most frequent words in authors' keywords, these are described with the help of Table 9. The recurring terms serve to illustrate the dominant themes, as these are the focus within the research. Amongst the most frequent words that have been used in authors' keywords, terms such as "machine learning", "deep learning", "artificial intelligence", and "random forest" are present, underscoring the fact that these concepts represent focal points in the context of scientific research. Collectively, these groups of words indicate a major interest in the usage of AI applications, especially in local and regional studies, as suggested by the appearance of other terms that can be seen in the table below, like "air pollution" or "regional economy". Thus, the focus of our research can be determined by the word frequency analysis, as this analysis is able to provide a very solid perspective on the key themes and areas present in our article, offering details about the predominant methodologies and topics in the area of study.

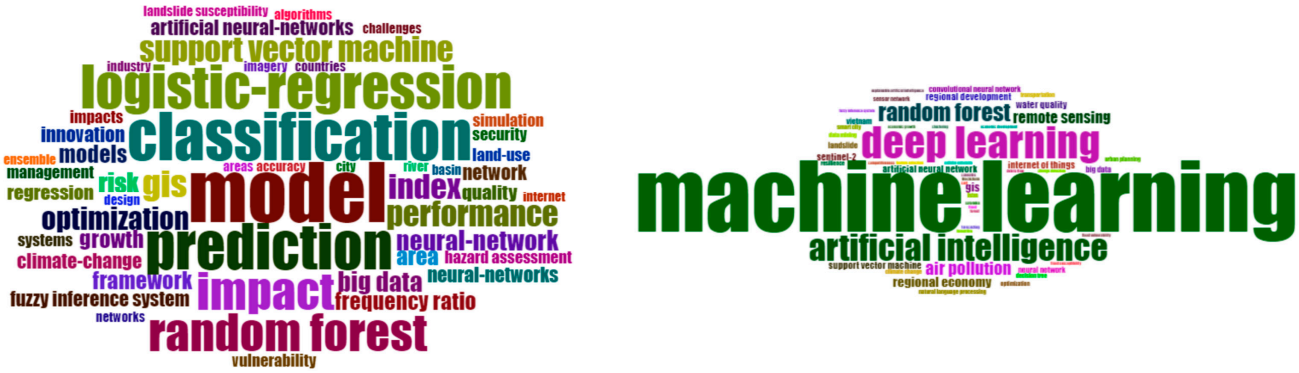
The high frequency of the keyword "machine learning" indicates that this technology is central to current research on the applications of artificial intelligence at the local and regional levels. This suggests that many studies focus on the use of machine learning algorithms to solve problems specific to the analyzed areas. This can also be observed in the word cloud in Figure 16B. Likewise, the emergence of "deep learning", "artificial intelligence", and "random forest" indicates that many studies focus on advanced methods to improve the accuracy and efficiency of artificial intelligence models in a regional context.

Table 9. Top 10 most frequent words in authors' keywords.

Words	Occurrences
machine learning	48
deep learning	22
artificial intelligence	18
random forest	12
air pollution	9
remote sensing	8
regional economy	7
gis	6
artificial neural network	5
internet of things	5

Figure 16A shows the word cloud based on the keywords used in the analyzed research. We observe a high frequency of occurrence of the following words: model,

classification, prediction, optimization, index, quality, performance, and climate change. The high frequency of the word "model" indicates that a large part of the researched research focuses on the development and application of artificial intelligence models. These models are used to simulate and analyze various phenomena and processes at the local and regional levels. "Classification" suggests the use of classification algorithms in AI to sort and organize data into distinct categories. This is essential in many applications, such as risk analysis, pattern identification, and geographic data segmentation. The word "prediction" reflects the importance of predictions in regional and local studies. AI models are often used to predict future trends, such as climate change, regional economic developments, or environmental risks. "Optimization" highlights the use of optimization techniques to improve the efficiency and performance of the systems under analysis. This term is relevant in the context of resource management, urban planning, and optimization of transport networks. "Index" indicates the development and use of indices to measure and compare different aspects of performance and quality of life in the regions under study. Indices may include measures of air quality, economic development, or environmental sustainability. "Quality" suggests that research focuses on assessing and improving quality in a variety of areas, from air and water quality to the quality of public services and infrastructure. The word "performance" emphasizes the interest in measuring and evaluating performance in various contexts. This term can be associated with economic performance, infrastructure performance, or the performance of resource management systems. "Climate change" emphasizes concern about the impact of climate change on the regions under study. The research focuses on how AI can be used to monitor, predict, and manage the effects of climate change.



(**A**) Top 50 words based on Keywords Plus (**B**) Top 50 words based on authors' keywords

Figure 16. Top 50 words based on Keywords Plus (**A**) and authors' keywords (**B**).

Tables 10 and 11 give an overview of the most frequent bigrams and trigrams in the titles and abstracts of the analyzed articles. These tables highlight the main themes and concepts that are frequently discussed in the literature, emphasizing the predominant research directions. Regarding Table 10, the most frequent bigrams in the abstracts are "machine learning", with 173 occurrences, and "artificial intelligence", with 96 occurrences, emphasizing the importance of these technologies in local and regional research. Also, the high frequency of the key concepts "regional economic" and "local authorities" indicates an emphasis on the economic impact and the role of local authorities in the deployment and use of these technologies. In terms of the frequency of occurrence of bigrams in titles, "machine learning" and "artificial intelligence" continue to be the dominant keywords, which confirms their relevance in the titles of scientific articles.

Table 11 shows the most frequent trigrams in abstracts and titles. In terms of trigrams in abstracts, the occurrence of "regional economic development" and "machine learning algorithms" emphasizes the focus on regional economic development and machine learning algorithms. Also, the keywords "support vector machine", with 19 occurrences, and

"random forest RF", with 18 occurrences, reflect the use of machine learning techniques to address various local and regional problems. From the perspective of the trigrams in the titles, "machine learning algorithms" and "machine learning approach" emphasize the relevance of these algorithms and approaches in the titles of the scientific articles.

Table 10. Top 10 most frequent bigrams in abstracts and titles.

Bigrams in Abstracts	Occurrences	Bigrams in Titles	Occurrences
Machine learning	173	Machine learning	58
Artificial intelligence	96	Artificial intelligence	24
Regional economic	86	Regional economic	16
Local authorities	81	Deep learning	15
Neural network	74	Learning approach	12
Economic development	65	Neural network	9
Deep learning	52	Landslide susceptibility	8
Regional economy	50	Learning algorithms	8
Random forest	41	Remote sensing	8
Regional development	38	Economic development	7

Table 11. Top 10 most frequent trigrams in abstracts and titles.

Trigrams in Abstracts	Occurrences	Trigrams in Titles	Occurrences
Regional economic development	26	Machine learning algorithms	7
Machine learning algorithms	22	Machine learning approach	7
Support vector machine	19	Machine learning methods	5
Random forest RF	18	Machine learning models	4
Artificial intelligence AI	17	Artificial intelligence technology	3
Artificial neural network	16	Convolutional neural networks	3
Machine learning model	14	Deep learning approach	3
Vector machine SVM	13	Ensemble machine learning	3
Convolutional neural network	12	Erosion susceptibility mapping	3
Machine learning models	12	Forest fire danger	3

3.4.4. Mixed Analysis

In Figure 17, a three-field plot has been realized, connecting countries with authors and sources. This type of visualization provides insight into international research relationships and collaborations, as well as the publication sources preferred by researchers from different countries. Spain, the United States of America, Ireland, and Brazil are linked to journals such as *Remote Sensing*, *Ecological Informatics*, *Geomatics*, *Natural Hazards and Risk*, and *Mathematical Problems in Engineering*. This indicates that researchers from these countries publish frequently in these journals, highlighting a common orientation towards certain research areas such as ecological monitoring, natural hazards, and applied mathematical problems in engineering. The authors mentioned in the center of the plot are nodal points linking different countries to their publication sources. For example, Hoang is linked to Vietnam as well as Romania, India, and Korea, indicating the international

collaborations or academic mobility of the author. Countries such as Vietnam, Portugal, China, and Romania are also represented in the plot, suggesting that researchers from these countries contribute to articles published in relevant international journals. This emphasizes the importance of their contributions to the global research landscape and may reflect international collaborations or academic influences in these regions.

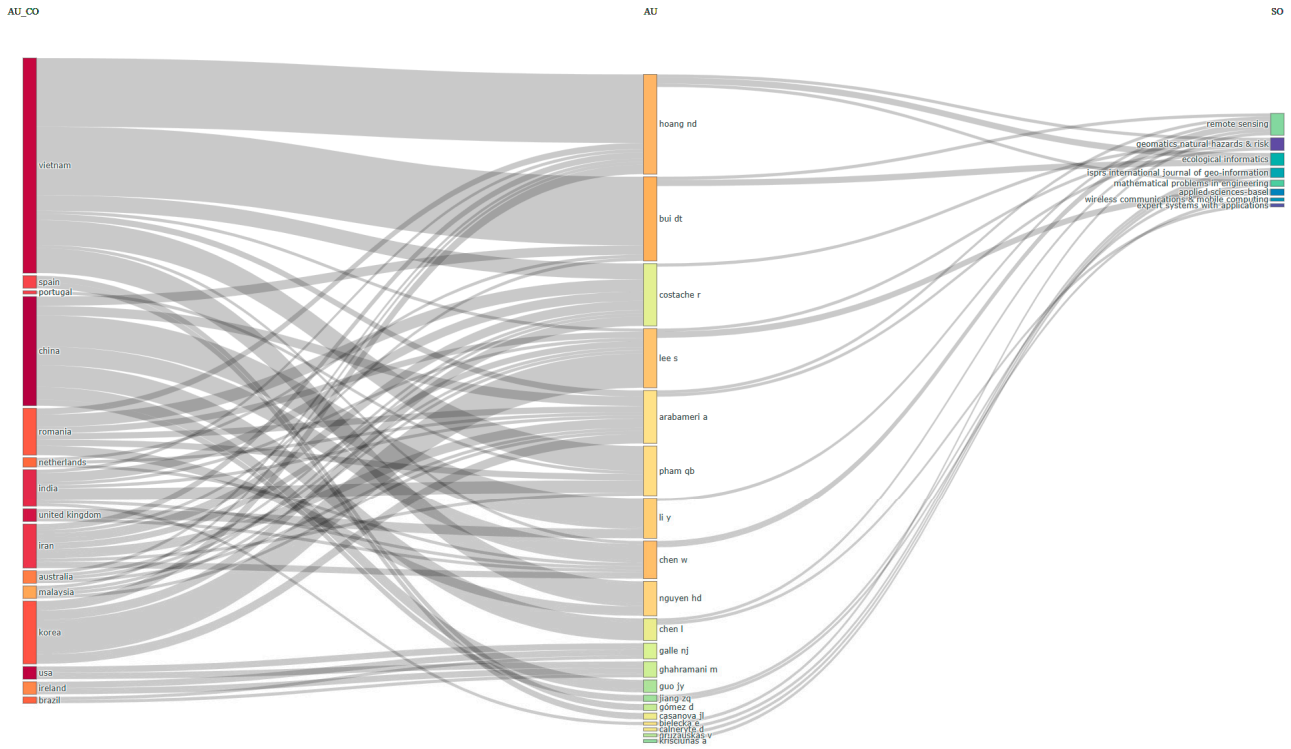


Figure 17. Three-field plot: countries (**left**), authors (**middle**), journals (**right**).

This three-field plot clearly shows the global interconnectivity in research, highlighting how different nations contribute to and rely on scientific journals. Additionally, visualization of this diagram can highlight influential authors who play important roles in facilitating these international collaborations.

In Figure 18, we realized a three-field plot connecting affiliations, authors, and keywords. This type of visualization is useful to understand the links between research institutions, individual researchers, and the research topics addressed in the studies. We observe that Duy Tan University has connections with several important authors, such as Hoang, Pham, Costache, and Lee. This may suggest that Duy Tan University is an active research hub in relevant fields and that authors associated with this university contribute significantly to the literature. Duy Tan University is associated with keywords such as machine learning, Geographic Information Systems (GIS), and artificial neural network. This indicates that research at this university focuses on the use of advanced technologies and artificial intelligence in geographical analysis and neural modeling. Other notable institutions are Ton Duc Thang University and the Ministry of Natural Resources of the People's Republic of China. These institutions are associated with keywords such as landslides, regional economy, and big data, suggesting a focus on environmental studies, regional economics, and the use of big data in research. The authors mentioned, such as Hoang, Pham, Costache, and Lee, relate to key research themes in their fields, indicating their expertise and valuable contributions to the development of these areas of study. For example, connections with machine learning and artificial neural networks suggest their involvement in advanced applied artificial intelligence research.

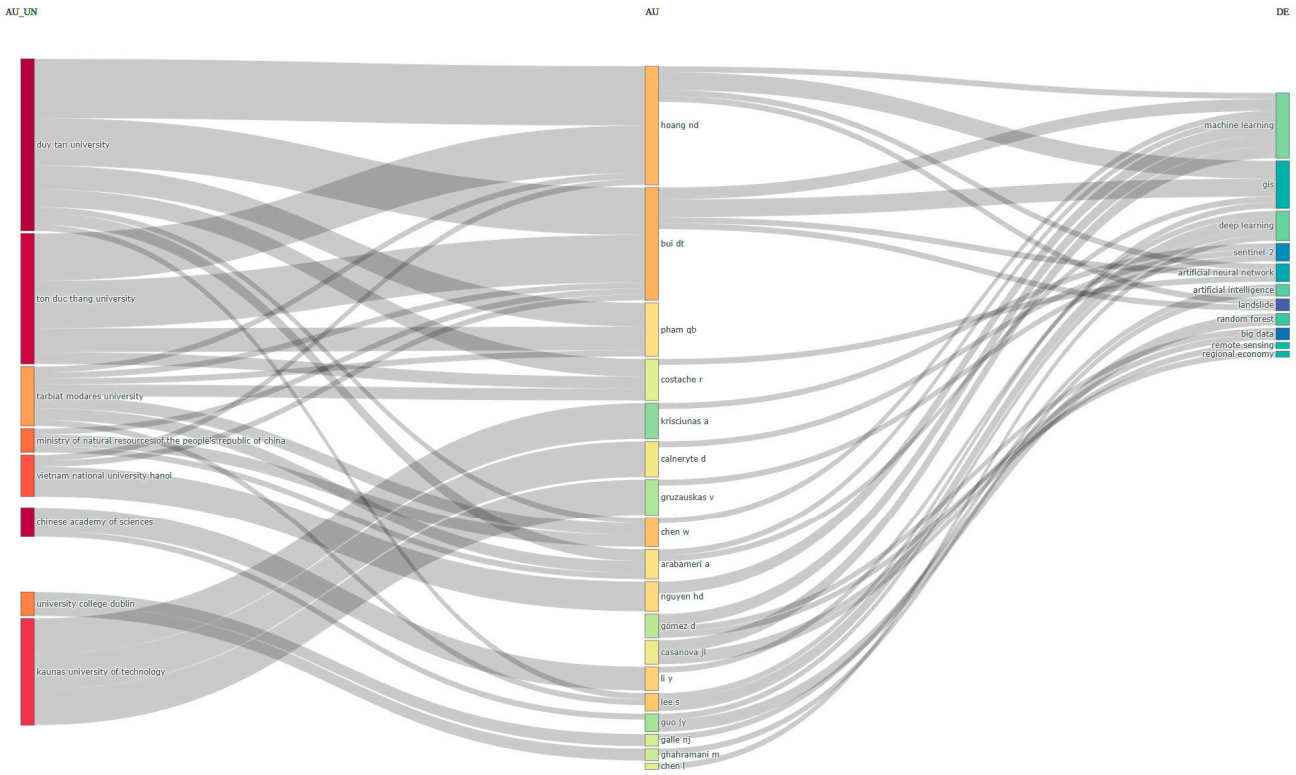


Figure 18. Three-field plot: affiliations (**left**), authors (**middle**), keywords (**right**).

In Figure 19, the map groups key terms into two clusters, one composed of keywords from titles and the second from abstracts. These clusters provide important insights into the themes and relationships among the concepts analyzed in our study. To create this map in VOSviewer, we used a binary approach that accounts for whether a term is present or absent, rather than how many times it appears. This helps by simplifying the analysis, as the focus is on the presence of keywords rather than their direct frequency. We set a minimum occurrence threshold of 10 to ensure that only terms with a significant presence in the dataset are considered, reducing noise caused by rarely mentioned terms. Applying these filters resulted in 120 terms meeting the aforementioned criteria. A relevance score was calculated for these, and we selected the top 60% most relevant terms from the 120. As observed in Figure 19, Cluster 1 (on the left side of the diagram) contains terms frequently associated with titles. These are keywords related to general themes, specifically the development of the regional and local economy, technology, and their impact on industry. The second cluster, consisting of 32 keywords, is extracted from the most frequently encountered terms in abstracts. These keywords, as seen on the right side of the diagram, are more technical concepts, such as methods used and practical applications in studies related to the regional and local economy. We can also observe that there are connecting terms in both clusters, such as "Artificial Intelligence" from titles and "Machine Learning Algorithm" from abstracts. This suggests that these keywords are central topics addressed in the analysis of the regional and local economy.

Table 12 presents 10 relevant key concepts identified in the map from Figure 19. In Cluster 1, we observe the following keywords:

- ➢ Development: This may indicate a strong emphasis on growth and advancement in various fields, such as technology or the correlation between regional and local economic well-being and the national economy.
- ➢ Economy, Regional Development, Sustainable Development, Economic Development: These keywords indicate a focus on economic growth and sustainability at regional and broader levels.

➢ Technology, Artificial Intelligence, Industry, Efficiency, Stakeholder: These reflect an interest in research on technological advancements and their impact on industries and stakeholders.

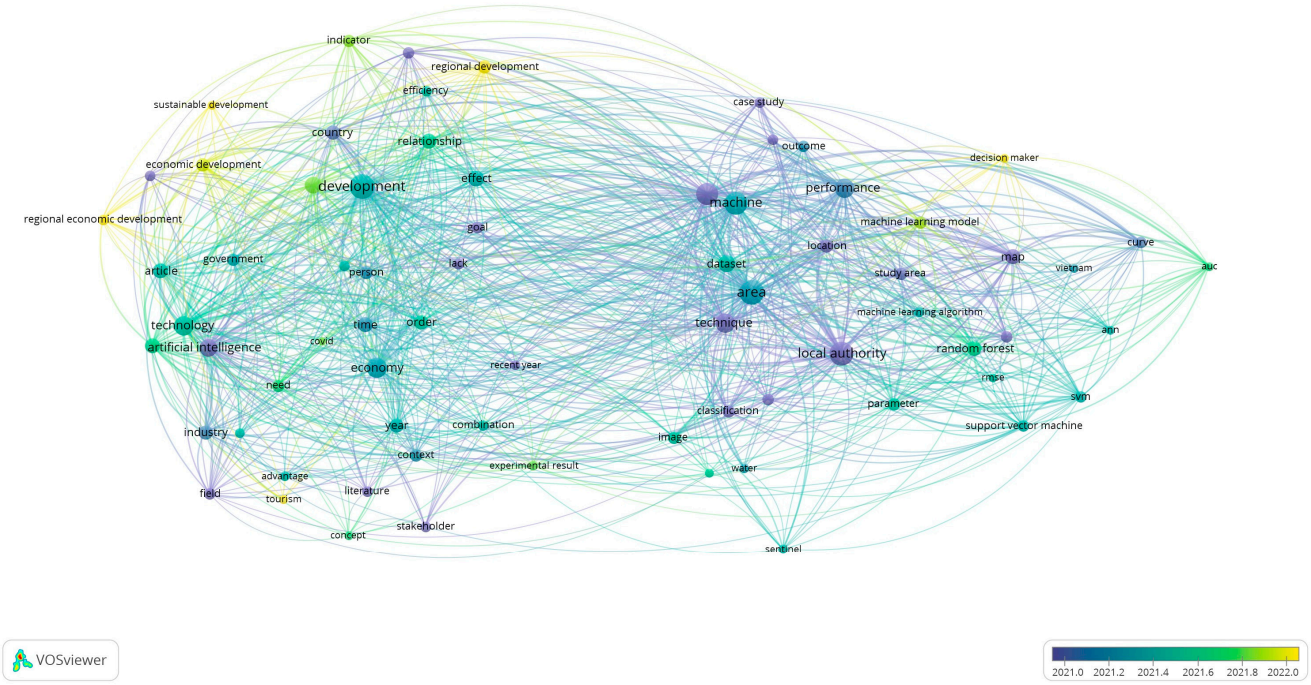


Figure 19. Map of keywords in two clusters—titles and abstracts.

Table 12. Map of keywords in two clusters—titles and abstracts.

Cluster 1—Titles	Cluster 2—Abstracts
Development	Machine
Economy	Technique
Regional Development	Area
Sustainable Development	Classification
Economic Development	Local Authority
Technology	Performance
Artificial Intelligence	Machine Learning Algorithm
Industry	Decision Maker
Efficiency	Outcome
Stakeholder	Location

The second cluster presents the keywords with the highest occurrence rate from abstracts:

➢ Machine, Technique, Area, Classification: These suggest an emphasis on technical methods applied to geographical or specialized areas.
➢ Local Authority, Performance, Machine Learning Algorithm, Decision Maker: These highlight the role of machine learning and decision-making processes in specific local contexts or performance evaluations.
➢ Outcome, Location: These indicate a focus on results and geographical aspects in the context we analyzed.

In Figure 20, the map of keyword co-occurrence provides a visual representation of how terms are interconnected in the context of artificial intelligence applications in local and regional studies. The map was created in VOSviewer using all the keywords from our dataset, totaling 1485 keywords. We used the co-occurrence analysis method to identify relationships between the keywords. We applied the full counting method,

meaning that each co-occurrence of keywords was considered to evaluate the strength of the links between terms. We set a minimum occurrence threshold of 5 for the keywords. Of the 1485 keywords, 52 met this threshold, ensuring that only those with a significant presence in the literature are included. For each of the 52 keywords, the total strength of co-occurrence links with other keywords was calculated. This allowed us to select the keywords with the greatest total link strength for inclusion in the analysis. The resulting map was divided into five distinct clusters, each representing areas of interest and the application of AI technologies in regional and local studies. As shown in Figure 20, Cluster 1 focuses on the use of neural networks and machine learning techniques for risk assessment and land use. Cluster 2 reflects concerns related to regional development and the impact of climate change. Regarding Cluster 3, it suggests the integration of artificial intelligence and big data into regional economic development. Cluster 4 is centered on the prediction and optimization of phenomena such as air pollution, while Cluster 5 focuses on evaluating water quality using fuzzy inference systems.

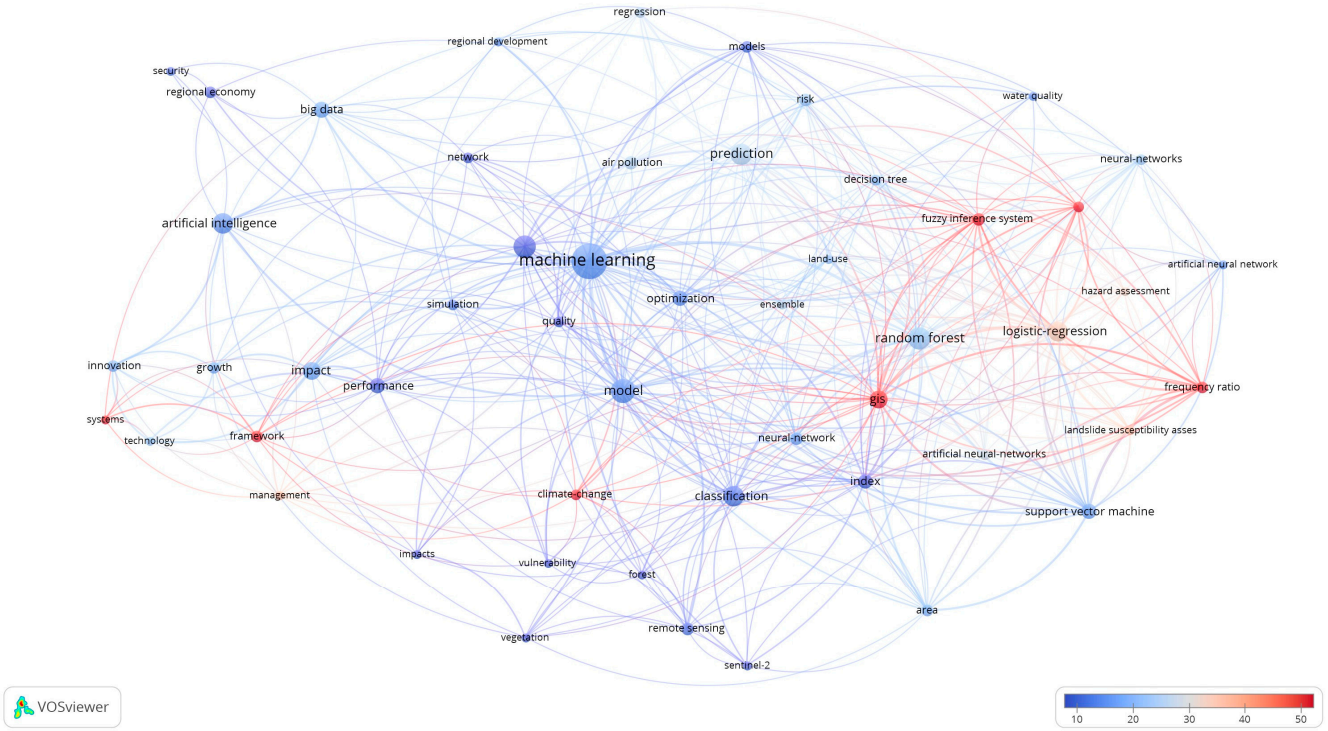


Figure 20. Co-occurrence map of keywords.

Figure 21 illustrates a thematic map of the Keywords Plus in four quadrants, grouped according to density and centrality. The thematic map was generated with the help of previously defined parameters: 100 words entered in the analysis, three labels, and a minimum cluster frequency of 15.

In the upper right quadrant, we observe two clusters in green and brown colors that are quite similar in size, containing words such as “model”, “classification”, “performance”, “prediction”, “logistic-regression”, and “random forest”. Next to these, we can also observe a red cluster containing the words “security”, “countries”, and “system”. Their positioning indicates that within the literature selected for the analysis, they represent constantly debated topics in the research field. During the analysis, while observing the most cited articles at the global level, when a brief description of the topic of these articles or of the authors’ network of collaboration was made, we noticed that these terms represent, on the one hand, techniques with which the analysis is carried out, but are also the desired objectives to be achieved with the results obtained.

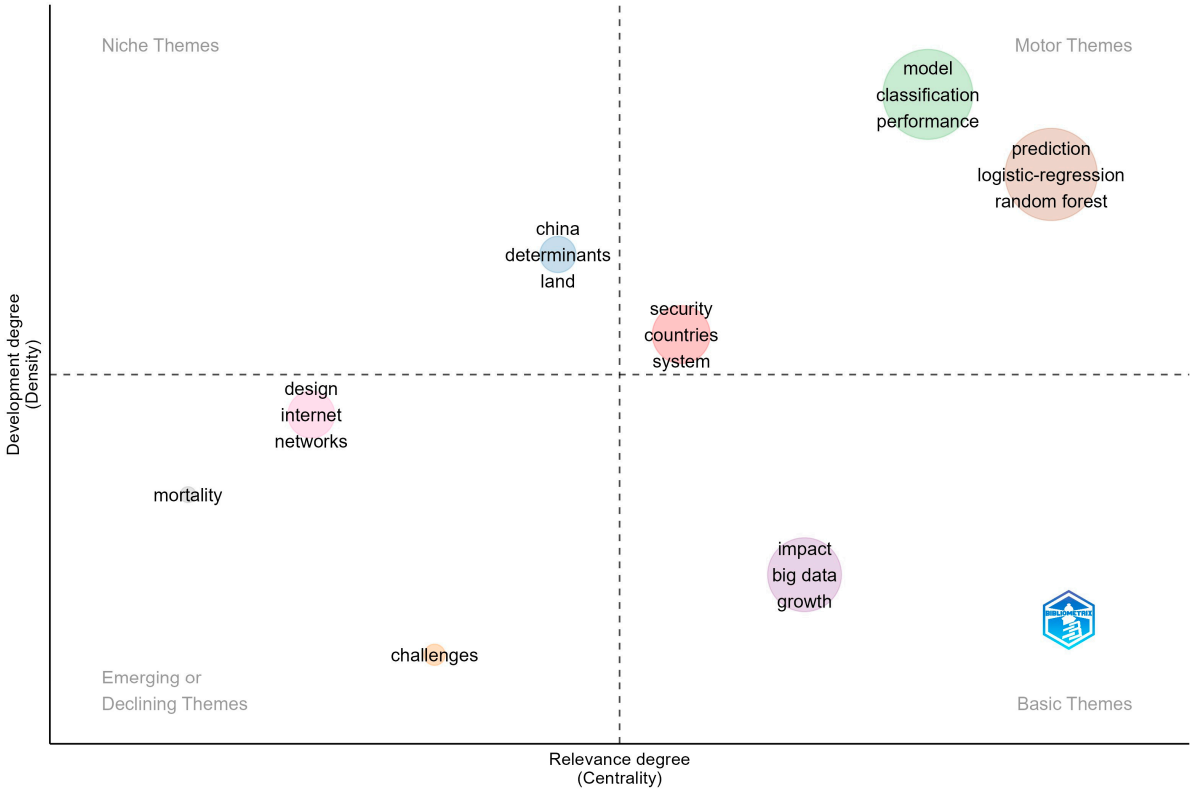


Figure 21. Thematic map: Keywords Plus.

In the lower right quadrant, the elements related to the impact of the identified works are inferred, including terms such as "impact", "big data", or "growth". Moreover, due to their positioning, they can lead to different research streams. In the top right quadrant, we have a blue cluster with the words "China", "determinants", or "land", representing research themes that we have previously observed in the analysis. Often, China was identified as the reference country or the field of agriculture. In addition to these, in the bottom left, we have words like "design", "internet", "networks", "mortality", or "challenges".

At the level of the authors' keywords (Figure 22), we identify a total of seven clusters in the four quadrants. We can observe at the border between "Motor Themes" and "Basic Themes" the largest cluster, including research algorithms from local or regional studies (bigrams: "machine learning", "random forest", or "remote sensing"). This time, in the "Basic Themes" quadrant, we have a cluster with "deep learning", "air pollution", and "convolutional neural network" and one with "regional economy" and "internet of things", a quadrant that has an important role in the continuous development of the field. The regional economy is essential for the overall development of a country, having a significant influence on social stability, job creation, and living standards.

In the "Emerging or Declining Themes" quadrant, we have data understanding and manipulation techniques often encountered in selected papers, and the trigrams often appearing are "artificial neural network" and "support vector machine". In the "Niche Themes" quadrant, two clusters of different sizes are represented, symbolizing constantly used developmental themes. Within these, terms are specified: "sensor network", "transportation", "artificial intelligence", "big data" and "data mining".

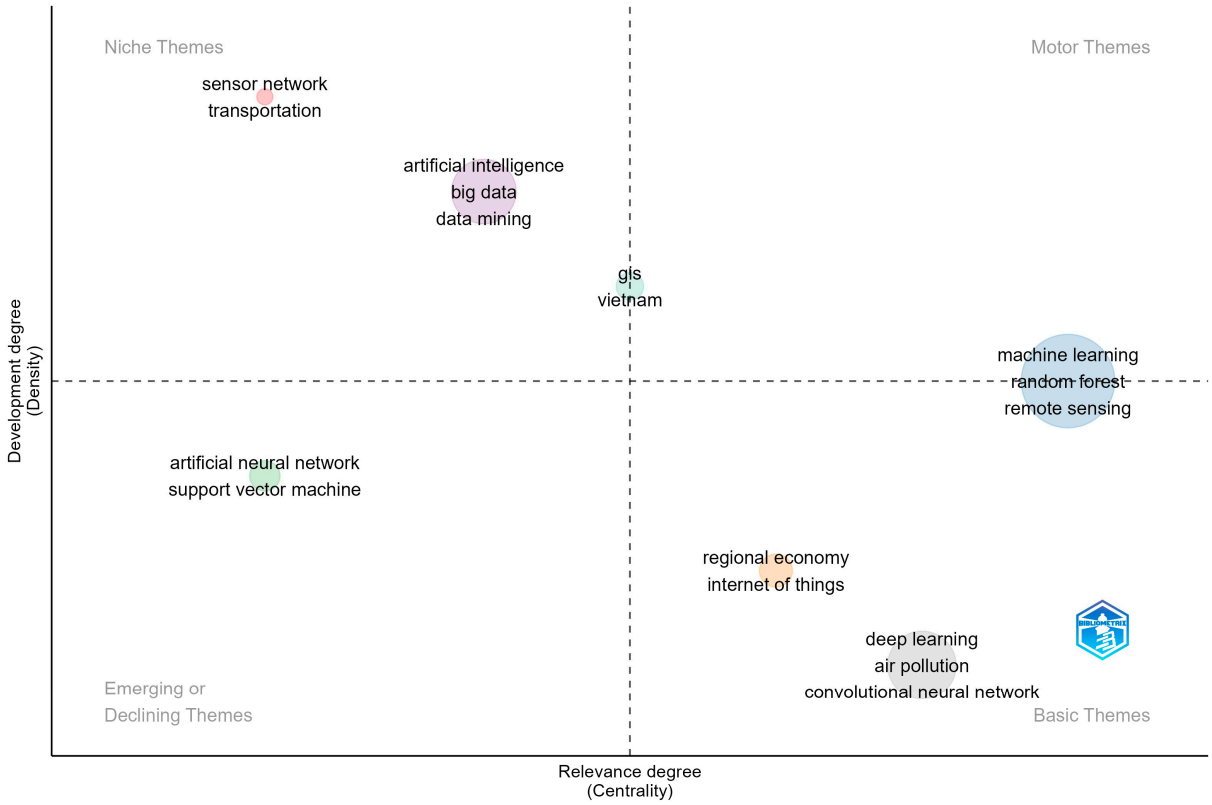


Figure 22. Thematic map: authors' keywords.

4. Discussions and Limitations

During the analysis performed, using the graphs generated and the information extracted over the period 2002–2023, an increased interest in the applicability of artificial intelligence to local or regional studies was observed, registering a high annual growth rate of 22.67%. Starting with a single article published in the field in 2002, the number of publications increased considerably, reaching a high number of 73 articles in 2023.

In terms of the most relevant journals, four of them stood out, with a higher number of published articles, totaling 46 articles out of a total of 237 (*Remote Sensing*, *Sustainability*, *PLOS ONE* and *Mathematical Problems in Engineering*). These publications are among the best known, with the main aim of promoting science at a global level through research on various topics of interest.

In our analysis, China was observed as the country with the highest number of published articles, registering 215 publications in the field of using AI in local or regional studies, which represents 30.32% of the total scientific output by country, followed by the United States of America with 64, i.e., 9.03%. According to a bibliometric analysis carried out by Zhang et al. [107] over the period 2009–2018, whose objective was to realize a bibliometric profile of the journal *Remote Sensing*, which we also observed in our analysis as the most favorite journal for authors to publish their creations, the two countries (China and the United States of America) represent the countries that contributed most frequently with publications, but also where a constant cooperation could be observed.

Even though the highest number of articles came from China, in terms of the number of citations, this was observed in Vietnam, registering 614 citations, which represents 15.02% of the total number of citations by country. China is right behind with 595 citations, which is 14.55% of the total number of citations by country. As expected, according to the number of citations, but also to the ranking of the most productive countries, the top three universities from which significant articles originated were in Vietnam or China: "Duy Tan University", "Chinese Academy of Science", and "Ton Duc Thang University".

Even if our work has provided valuable insights in terms of the applicability of AI to regional or local studies, we have to admit that during its realization, it has encountered some limitations.

It is worth mentioning that the selection of articles for the formation of the database was limited to only those papers that were available in the WoS database. Thus, papers published in unindexed journals or in other document formats may have been excluded, which can be perceived as a limitation. The involvement of several databases (Scopus, Dimensions, or SpringerLink), could help to generate more comprehensive results of the field under study. Although the WoS does not include every publication, it remains one of the most respected and rigorous academic databases [108,109]. Indexing in the WoS is an indicator of quality and relevance [110,111], which means that the available articles have gone through a strict selection and evaluation process. In addition, the WoS offers advanced citation and analysis tools that allow researchers to identify trends and impacts in various academic fields [112]. Thus, although there are publications that may have been missed out on, the quality and integrity of the indexed articles compensates for this limitation, providing a solid basis for high-quality research.

Another aspect to consider is the linguistic bias and the strict selection of document type. Even if English is one of the most widely known and widespread languages, restricting the analysis to papers only in this language could have an impact on the analysis. Moreover, including more types of papers could have helped by broadening the dataset.

The restriction imposed by the choice of keywords is another limitation. In this case, the addition of other research keywords could have been performed on an extended dataset. The limitation related to paper type should also be mentioned, as extending the types of papers considered would have led to an extended dataset.

5. Conclusions and Policy Recommendations

Our study focused on the analysis of AI applications in local and regional studies. The results provide a comprehensive understanding of the dynamics and impact of existing research, highlighting international trends and scientific collaborations.

The analysis revealed a significant increase in interest in AI applications in local and regional studies since 2018, as demonstrated by the growing number of papers published annually. Similar observation have been made in other studies [113–115], where AI has been shown to contribute to solving urbanization challenges and to the development of sustainable local policies. This growth aligns with rapid technological advancements and the widespread implementation of AI-based solutions across various industries. Annual citation rates have also shown notable fluctuations, with significant spikes over the years where major technological launches occurred.

The most cited studies cover a wide range of AI applications, from water resource planning to flood-prone area prediction, demonstrating the versatility and potential of these technologies in addressing complex local and regional problems.

The use of AI applications has a significant impact on optimizing processes and improving decisions at local and regional levels. For example, AI can positively influence public transportation and Industry 4.0, improving resource management efficiency and risk anticipation. ML algorithms and artificial neural networks are essential for modeling, classification, and prediction. Studies on multi-agent systems have demonstrated that AI can optimize industrial processes and support land-use planning and urban sprawl.

The main objective of the study was to provide the reader with a comprehensive bibliometric analysis of the applicability of AI in local or regional studies, based on a total of 237 papers extracted from the WoS database, over a period from 2002 to 2023. From the very beginning of the analysis, some key scientific questions were set, the answers to which were followed throughout the research in order to observe the evolution of the field.

For the analyzed period, 2002–2023, until 2017 the number of published articles ranged from 0 to 2 (in 2011). The number of published articles was not very high until 2017; the period of ascension started in 2018. Between the years 2018 and 2023, there were between 9 and 73 published papers, which indicates a growing interest in the application of AI in local or regional studies.

In terms of the number of publications in the field by country, China recorded the highest number of publications, with 215 articles, followed by the United States of America with 64 articles, Vietnam with 44, the United Kingdom with 35, Italy with 30, and India with 23. The remaining countries recorded numbers of publications during the period under analysis of less than 20 articles. Throughout the analysis, China constantly stood out at the top of the results obtained, which indicates a particular interest in local or regional studies.

Another important factor in our analysis was the authors. There was a total of 992 authors, who, according to their preferences, chose to work individually or in collaboration with other researchers. Among those whose contribution was the most significant, we have Bui DT and Hoang ND, with six published papers each, Chen W, Lee S, Li Y, Nguyen HD, and Pham QB, with three papers each, and the rest of the authors participated with the publication of two papers each at most.

Among the authors' favorite journals to publish their work, the most used journal was *Remote Sensing*, where a total of 16 articles were published. In addition, we can also mention *Sustainability* (15 articles), *PLOS ONE* (8 articles), *Mathematical Problems in Engineering* (7 articles), *Computational Intelligence and Neuroscience* (4 articles), *IEEE Access* (4 articles), *Sensors* (4 articles), and *Soft Computing* (4 articles).

The most relevant affiliations in terms of published papers, as one would expect, come from China: "Duy Tan University" (13 papers), "Ton Duc Thang University" (10 papers), and "Chinese Academy of Science" (8 papers). Along with these, we also have "United States Forest Service", "United States Department of Agriculture (USDA)", "University of South Carolina Columbia", "CIRAD", "Egyptian Knowledge Bank (EKB)", "Ministry of Natural Resources of the People's Republic of China", and "University of South Carolina System", which have each registered between seven and five published articles.

In terms of future research, researchers could expand the present work by including more databases to enlarge the portfolio of selected papers, keeping in the analysis papers written in languages other than English and including more keywords specific to the application of AI in local or regional studies.

In conclusion, our research underscores the importance of AI applications in local and regional studies, highlighting both the challenges and opportunities of this emerging field. The results provide a solid foundation for further research development and the practical implementation of AI technologies for the benefit of local and regional communities.

Author Contributions: Conceptualization, C.D., I.N., Ș.I. and B.C.; Data curation, C.D., I.N., Ș.I., B.C. and H.Ț.; Formal analysis, C.D., I.N., Ș.I. and B.C.; Investigation, C.D., Ș.I. and B.C.; Methodology, C.D., I.N., Ș.I. and B.C.; Project administration, C.D.; Resources, C.D. and B.C.; Software, C.D., I.N., Ș.I., B.C. and H.Ț.; Supervision, C.D.; Validation, C.D., I.N., Ș.I., B.C. and H.Ț.; Visualization, I.N., Ș.I., B.C. and H.Ț.; Writing—original draft, Ș.I. and B.C.; Writing—review and editing, C.D., I.N. and H.Ț. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by the EU's NextGenerationEU instrument through the National Recovery and Resilience Plan of Romania—Pillar III-C9-I8, managed by the Ministry of Research, Innovation and Digitization, within the project entitled "Place-based Economic Policy in EU's Periphery—fundamental research in collaborative development and local resilience. Projections for Romania and Moldova (PEPER)", contract No. 760045/23.05.2023, code CF 275/30.11.2022. This paper was co-financed by the Bucharest University of Economic Studies during the PhD program.

Data Availability Statement: Data are contained within paper.

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

References

1. Ascani, A.; Crescenzi, R.; Iammarino, S. Regional Economic Development: A Review; Regional Economic Development: 2012. Available online: http://projects.mcrit.com/foresightlibrary/index.php/key-concepts/cooperation/local-and-regional/1236-regional-economic-development-a-review (accessed on 12 June 2024).
2. Carr, D. Population and Deforestation: Why Rural Migration Matters. *Prog. Hum. Geogr.* **2009**, *33*, 355–378. [CrossRef] [PubMed]
3. Corballis, M.C. Language Evolution: A Changing Perspective. *Trends Cogn. Sci.* **2017**, *21*, 229–236. [CrossRef] [PubMed]
4. Skiadas, D.V.; Ftaklaki, P. Regional Self-Government and Regional Governance in Greece and the EU: Developments, Concerns and Recommendations. *Int. J. Latest Res. Humanit. Soc. Sci. (IJLRHSS)* **2020**, *03*, 55–66.
5. Liu, H.; Zhou, G.; Wennersten, R.; Frostell, B. Analysis of Sustainable Urban Development Approaches in China. *Habitat Int.* **2014**, *41*, 24–32. [CrossRef]
6. Kampa, M.; Castanas, E. Human Health Effects of Air Pollution. *Environ. Pollut.* **2008**, *151*, 362–367. [CrossRef]
7. Iammarino, S.; Rodriguez-Pose, A.; Storper, M. Regional Inequality in Europe: Evidence, Theory and Policy Implications. *J. Econ. Geogr.* **2019**, *19*, 273–298. [CrossRef]
8. Panzera, D.; Postiglione, P. Measuring the Spatial Dimension of Regional Inequality: An Approach Based on the Gini Correlation Measure. *Soc. Indic. Res.* **2020**, *148*, 379–394. [CrossRef]
9. Fowler, D.D. 1—Cultural Resources Management. In *Advances in Archaeological Method and Theory*; Schiffer, M.B., Ed.; Academic Press: San Diego, CA, USA, 1982; pp. 1–50. ISBN 978-0-12-003105-4.
10. Misra, A.K. Climate Change and Challenges of Water and Food Security. *Int. J. Sustain. Built Environ.* **2014**, *3*, 153–165. [CrossRef]
11. Roos, C.; Zaun, N. The Global Economic Crisis as a Critical Juncture? The Crisis's Impact on Migration Movements and Policies in Europe and the U.S. *J. Ethn. Migr. Stud.* **2016**, *42*, 1579–1589. [CrossRef]
12. Ransbotham, S.; Gerbert, P.; Reeves, M.; Kiron, D.; Spira, M. Artificial Intelligence in Business Gets Real. *MIT Sloan Management Review*, 17 September 2018.
13. Davenport, T.H.; Ronanki, R. Artificial Intelligence for the Real World | Harvard Business Publishing Education. Available online: https://www.hbsp.harvard.edu/product/R1801H-PDF-ENG (accessed on 3 August 2024).
14. Li, B.; Hou, B.; Yu, W.; Lu, X.; Yang, C. Applications of Artificial Intelligence in Intelligent Manufacturing: A Review. *Front. Inf. Technol. Electron. Eng.* **2017**, *18*, 86–96. [CrossRef]
15. Mikalef, P.; Boura, M.; Lekakos, G.; Krogstie, J. Big Data Analytics and Firm Performance: Findings from a Mixed-Method Approach. *J. Bus. Res.* **2019**, *98*, 261–276. [CrossRef]
16. Sun, T.Q.; Medaglia, R. Mapping the Challenges of Artificial Intelligence in the Public Sector: Evidence from Public Healthcare. *Gov. Inf. Q.* **2019**, *36*, 368–383. [CrossRef]
17. Enholm, I.M.; Papagiannidis, E.; Mikalef, P.; Krogstie, J. Artificial Intelligence and Business Value: A Literature Review. *Inf. Syst. Front.* **2022**, *24*, 1709–1734. [CrossRef]
18. Abduljabbar, R.; Dia, H.; Liyanage, S.; Bagloee, S.A. Applications of Artificial Intelligence in Transport: An Overview. *Sustainability* **2019**, *11*, 189. [CrossRef]
19. Lee, D.; Yoon, S.N. Application of Artificial Intelligence-Based Technologies in the Healthcare Industry: Opportunities and Challenges. *Int. J. Environ. Res. Public Health* **2021**, *18*, 271. [CrossRef]
20. Ahmad, T.; Zhang, D.; Huang, C.; Zhang, H.; Dai, N.; Song, Y.; Chen, H. Artificial Intelligence in Sustainable Energy Industry: Status Quo, Challenges and Opportunities. *J. Clean. Prod.* **2021**, *289*, 125834. [CrossRef]
21. Jha, K.; Doshi, A.; Patel, P.; Shah, M. A Comprehensive Review on Automation in Agriculture Using Artificial Intelligence. *Artif. Intell. Agric.* **2019**, *2*, 1–12. [CrossRef]
22. Chan-Olmsted, S.M. A Review of Artificial Intelligence Adoptions in the Media Industry. *Int. J. Media Manag.* **2019**, *21*, 193–215. [CrossRef]
23. Nalbant, K. The Importance of Artificial Intelligence in Education: A Short Review. *J. Rev. Sci. Eng.* **2021**, 2106302112361.
24. The Handbook of Artificial Intelligence, Volume 1: Barr, Avron, 1949-: Free Download, Borrow, and Streaming: Internet Archive. Available online: https://archive.org/details/handbookofartific01barr/page/n5/mode/2up (accessed on 11 August 2024).
25. Kalogirou, S.; Kalogirou, S.A. Artificial Intelligence for the Modeling and Control of Combustion Processes: A Review. *Prog. Energy Combust. Sci.* **2003**, *29*, 515–566. [CrossRef]
26. Kalogirou, S. *Artificial Intelligence in Energy and Renewable Energy Systems*; Nova Publishers: Hauppauge, NY, USA, 2006.
27. Krishnamoorthy, C.S.; Rajeev, S. *Artificial Intelligence and Expert Systems for Engineers*; CRC Press: Boca Raton, FL, USA, 2018; ISBN 978-1-315-13777-3.
28. Xing, L. Evaluation of the Impact of Artificial Intelligence and Intelligent Internet of Things on Population Mobility on Regional Economic Differences. *Soft Comput.* **2023**. [CrossRef]
29. He, M.; Huang, J.; Sun, R. Forecast of Advanced Human Capital Gap Based on PSO-BP Neural Network and Coordination Pathway: Example of Beijing–Tianjin–Hebei Region. *Sustainability* **2023**, *15*, 4671. [CrossRef]
30. Wei, X.; Rao, C.; Xiao, X.; Chen, L.; Goh, M. Risk Assessment of Cardiovascular Disease Based on SOLSSA-CatBoost Model. *Expert Syst. Appl.* **2023**, *219*, 119648. [CrossRef]
31. Magazzino, C.; Mele, M. On the Relationship between Transportation Infrastructure and Economic Development in China. *Res. Transp. Econ.* **2021**, *88*, 100947. [CrossRef]

32. Chakraborty, D.; Alam, A.; Chaudhuri, S.; Başağaoğlu, H.; Sulbaran, T.; Langar, S. Scenario-Based Prediction of Climate Change Impacts on Building Cooling Energy Consumption with Explainable Artificial Intelligence. *Appl. Energy* **2021**, *291*, 116807. [CrossRef]
33. Gumpenberger, C.; Wieland, M.; Gorraiz, J. Bibliometric Practices and Activities at the University of Vienna. *Libr. Manag.* **2012**, *33*, 174–183. [CrossRef]
34. Sandu, A.; Ioanăș, I.; Delcea, C.; Florescu, M.-S.; Cotfas, L.-A. Numbers Do Not Lie: A Bibliometric Examination of Machine Learning Techniques in Fake News Research. *Algorithms* **2024**, *17*, 70. [CrossRef]
35. Sandu, A.; Ioanăș, I.; Delcea, C.; Geantă, L.-M.; Cotfas, L.-A. Mapping the Landscape of Misinformation Detection: A Bibliometric Approach. *Information* **2024**, *15*, 60. [CrossRef]
36. Sandu, A.; Cotfas, L.-A.; Delcea, C.; Crăciun, L.; Molănescu, A.G. Sentiment Analysis in the Age of COVID-19: A Bibliometric Perspective. *Information* **2023**, *14*, 659. [CrossRef]
37. Zupic, I.; Čater, T. Bibliometric Methods in Management and Organization. *Organ. Res. Methods* **2015**, *18*, 429–472. [CrossRef]
38. Aria, M.; Cuccurullo, C. Bibliometrix: An R-Tool for Comprehensive Science Mapping Analysis. *J. Informetr.* **2017**, *11*, 959–975. [CrossRef]
39. Ionescu, Ș.; Delcea, C.; Chiriță, N.; Nica, I. Exploring the Use of Artificial Intelligence in Agent-Based Modeling Applications: A Bibliometric Study. *Algorithms* **2024**, *17*, 21. [CrossRef]
40. Donthu, N.; Kumar, S.; Mukherjee, D.; Pandey, N.; Lim, W.M. How to Conduct a Bibliometric Analysis: An Overview and Guidelines. *J. Bus. Res.* **2021**, *133*, 285–296. [CrossRef]
41. Khan, M.A.; Pattnaik, D.; Ashraf, R.; Ali, I.; Kumar, S.; Donthu, N. Value of Special Issues in the Journal of Business Research: A Bibliometric Analysis. *J. Bus. Res.* **2021**, *125*, 295–313. [CrossRef]
42. Marius Profiroiu, C.; Cibu, B.; Delcea, C.; Cotfas, L.-A. Charting the Course of School Dropout Research: A Bibliometric Exploration. *IEEE Access* **2024**, *12*, 71453–71478. [CrossRef]
43. Smith, K.; Marinova, D. Use of Bibliometric Modelling for Policy Making. *Math. Comput. Simul.* **2005**, *69*, 177–187. [CrossRef]
44. Kokol, P.; Blažun Vošner, H.; Završnik, J. Application of Bibliometrics in Medicine: A Historical Bibliometrics Analysis. *Health Inf. Libr. J.* **2021**, *38*, 125–138. [CrossRef]
45. Martínez-López, F.; Merigo, J.M.; Valenzuela, L.; Nicolas, C. Fifty Years of the European Journal of Marketing: A Bibliometric Analysis. *Eur. J. Mark.* **2018**, *52*, 439–468. [CrossRef]
46. Shukla, A.K.; Janmaijaya, M.; Abraham, A.; Muhuri, P.K. Engineering Applications of Artificial Intelligence: A Bibliometric Analysis of 30 Years (1988–2018). *Eng. Appl. Artif. Intell.* **2019**, *85*, 517–532. [CrossRef]
47. Cibu, B.; Delcea, C.; Domenteanu, A.; Dumitrescu, G. Mapping the Evolution of Cybernetics: A Bibliometric Perspective. *Computers* **2023**, *12*, 237. [CrossRef]
48. Börner, K.; Chen, C.; Boyack, K. Visualizing Knowledge Domains. In *Annual Review of Information Science & Technology*; Cronin, B., Ed.; Information Today, Inc./American Society for Information Science and Technology: Medford, NJ, USA, 2003; Volume 37.
49. Cobo, M.J.; López-Herrera, A.G.; Herrera-Viedma, E.; Herrera, F. Science Mapping Software Tools: Review, Analysis, and Cooperative Study among Tools. *J. Am. Soc. Inf. Sci.* **2011**, *62*, 1382–1402. [CrossRef]
50. Öztürk, O.; Kocaman, R.; Kanbach, D.K. How to Design Bibliometric Research: An Overview and a Framework Proposal. *Rev. Manag. Sci.* **2024**. [CrossRef]
51. Visser, M.; Van Eck, N.J.; Waltman, L. Large-Scale Comparison of Bibliographic Data Sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. *Quant. Sci. Stud.* **2021**, *2*, 20–41. [CrossRef]
52. Garfield, E. "Science Citation Index"—A New Dimension in Indexing. *Science* **1964**, *144*, 649–654. [CrossRef]
53. Li, K.; Rollins, J.; Yan, E. Web of Science Use in Published Research and Review Papers 1997–2017: A Selective, Dynamic, Cross-Domain, Content-Based Analysis. *Scientometrics* **2018**, *115*, 1–20. [CrossRef]
54. Lazerow, S. Institute for Scientific Information. *Encycl. Libr. Inf. Sci.* **1974**, *12*, 89–97.
55. Lawlor, B. The Institute for Scientific Information: A Brief History. In *The Future of the History of Chemical Information*; ACS Symposium Series; American Chemical Society: Washington, DC, USA, 2014; Volume 1164, pp. 109–126, ISBN 978-0-8412-2945-7.
56. Cawkell, T.; Garfield, E. Institute for Scientific Information. In *International Encyclopedia of Information and Library Science*; Routledge: London, UK, 2001; pp. 149–160.
57. Adams, J.; Testa, J. Thomson Reuters Book Citation Index. In *The 13th Conference of the International Society for Scientometrics and Informetrics*; International Society for Scientometrics and Informetrics, Leiden University, and University of Zululand: Durban, South Africa, 2012.
58. Birkle, C.; Pendlebury, D.A.; Schnell, J.; Adams, J. Web of Science as a Data Source for Research on Scientific and Scholarly Activity. *Quant. Sci. Stud.* **2020**, *1*, 363–376. [CrossRef]
59. Liu, W. The Data Source of This Study Is Web of Science Core Collection? Not Enough. *Scientometrics* **2019**, *121*, 1815–1824. [CrossRef]
60. Liu, F. Retrieval Strategy and Possible Explanations for the Abnormal Growth of Research Publications: Re-Evaluating a Bibliometric Analysis of Climate Change. *Scientometrics* **2023**, *128*, 853–859. [CrossRef]
61. Cole, J.R. A Short History of the Use of Citations as a Measure of the Impact of Scientific and Scholarly Work. In *The Web of Knowledge a Festschrift in Honor of Eugene Garfield*; Information Today, Inc.: Medford, NJ, USA, 2000; pp. 281–300.

62. Pike, A.; Rodríguez-Pose, A.; Tomaney, J. What Kind of Local and Regional Development and for Whom? *Reg. Stud.* **2007**, *41*, 1253–1269. [CrossRef]
63. Salder, J. Defining Local Economies beyond Their Boundaries. *Local Gov. Stud.* **2022**, *48*, 579–603. [CrossRef]
64. Naftaly, G.M. Determinants of Regional Economic Growth in Kenya. *Afr. J. Bus. Manag.* **2021**, *15*, 1–12. [CrossRef]
65. Şahin, E.; Yiğitoğlu, V.; Gök Demir, Z.; Karakaya, Ç.; Erendağ Sümer, F.; Güneri, B. Circular Economy for Sustainability: A Bibliometric Analysis for the Tourism/Hospitality Field. *Sustainability* **2024**, *16*, 6290. [CrossRef]
66. Sun, Y.; Ma, Z.; Chi, X.; Duan, J.; Li, M.; Khan, A.U. Decoding the Developmental Trajectory of Energy Trading in Power Markets through Bibliometric and Visual Analytics. *Energies* **2024**, *17*, 3605. [CrossRef]
67. Vrdoljak, L.; Racetin, I.; Zrinjski, M. Bibliometric Analysis of Remote Sensing over Marine Areas for Sustainable Development: Global Trends and Worldwide Collaboration. *Sustainability* **2024**, *16*, 6211. [CrossRef]
68. Donner, P. Document Type Assignment Accuracy in the Journal Citation Index Data of Web of Science. *Scientometrics* **2017**, *113*, 219–236. [CrossRef]
69. Bhat, W.; Manzoor, A.; Ahmad, Z.; Qureshi, D. How to Conduct Bibliometric Analysis Using R-Studio: A Practical Guide. *Eur. Econ. Lett.* **2023**, *13*, 681–700. [CrossRef]
70. Guleria, D.; Kaur, G. Bibliometric Analysis of Ecopreneurship Using VOSviewer and RStudio Bibliometrix, 1989–2019. *Libr. Hi Tech* **2021**, *39*, 1001–1024. [CrossRef]
71. Meng, L.; Wen, K.-H.; Brewin, R.; Wu, Q. Knowledge Atlas on the Relationship between Urban Street Space and Residents' Health—A Bibliometric Analysis Based on VOSviewer and CiteSpace. *Sustainability* **2020**, *12*, 2384. [CrossRef]
72. Martins, J.; Gonçalves, R.; Branco, F. A Bibliometric Analysis and Visualization of E-Learning Adoption Using VOSviewer. *Univ. Access Inf. Soc.* **2022**, *23*, 1177–1191. [CrossRef]
73. Reynoso, R. Brief History of Artificial Intelligence—From 1900 till Now. Available online: https://learn.g2.com/history-of-artificial-intelligence (accessed on 24 July 2024).
74. Nash-Stewart, C.E.; Kruesi, L.M.; Del Mar, C.B. Does Bradford's Law of Scattering Predict the Size of the Literature in Cochrane Reviews? *J. Med. Libr. Assoc.* **2012**, *100*, 135–138. [CrossRef] [PubMed]
75. Yang, J.-M.; Tseng, S.-F.; Won, Y.-L. A Bibliometric Analysis on Data Mining Using Bradford's Law. In *Proceedings of the 3rd International Conference on Intelligent Technologies and Engineering Systems (ICITES2014)*; Juang, J., Ed.; Lecture Notes in Electrical Engineering; Springer International Publishing: Cham, Switzerland, 2016; Volume 345, pp. 613–620, ISBN 978-3-319-17313-9.
76. Shah, F.A.; Jawaid, S.A. The H-Index: An Indicator of Research and Publication Output. *Pak. J. Med. Sci.* **2023**, *39*, 315–316. [CrossRef] [PubMed]
77. Talukdar, S.; Ghose, B.; Shahfahad; Salam, R.; Mahato, S.; Pham, Q.B.; Linh, N.T.T.; Costache, R.; Avand, M. Flood Susceptibility Modeling in Teesta River Basin, Bangladesh Using Novel Ensembles of Bagging Algorithms. *Stoch. Environ. Res. Risk Assess.* **2020**, *34*, 2277–2300. [CrossRef]
78. Pham, Q.B.; Ali, S.A.; Bielecka, E.; Calka, B.; Orych, A.; Parvin, F.; Łupikasza, E. Flood Vulnerability and Buildings' Flood Exposure Assessment in a Densely Urbanised City: Comparative Analysis of Three Scenarios Using a Neural Network Approach. *Nat. Hazards* **2022**, *113*, 1043–1081. [CrossRef]
79. Arabameri, A.; Chandra Pal, S.; Costache, R.; Saha, A.; Rezaie, F.; Seyed Danesh, A.; Pradhan, B.; Lee, S.; Hoang, N.-D. Prediction of Gully Erosion Susceptibility Mapping Using Novel Ensemble Machine Learning Algorithms. *Geomat. Nat. Hazards Risk* **2021**, *12*, 469–498. [CrossRef]
80. Long, C.; Wenlong, S.; Tao, S.; Yizhu, L.; Wei, J.; Jun, L.; Hongjie, L.; Tianshi, F.; Rongjie, G.; Abbas, H.; et al. Field Patch Extraction Based on High-Resolution Imaging and U2-Net++ Convolutional Neural Networks. *Remote Sens.* **2023**, *15*, 4900. [CrossRef]
81. Fan, X.; Xu, Q.; Liu, J.; Subramanian, S.S.; He, C.; Zhu, X.; Zhou, L. Successful Early Warning and Emergency Response of a Disastrous Rockslide in Guizhou Province, China. *Landslides* **2019**, *16*, 2445–2457. [CrossRef]
82. Arabameri, A.; Chen, W.; Lombardo, L.; Blaschke, T.; Tien Bui, D. Hybrid Computational Intelligence Models for Improvement Gully Erosion Assessment. *Remote Sens.* **2020**, *12*, 140. [CrossRef]
83. Dang, V.-H.; Hoang, N.-D.; Nguyen, L.-M.-D.; Bui, D.T.; Samui, P. A Novel GIS-Based Random Forest Machine Algorithm for the Spatial Prediction of Shallow Landslide Susceptibility. *Forests* **2020**, *11*, 118. [CrossRef]
84. Xuan, T.T.; Nam, P.D.T.; Thanh, N.L.; Viet-Ha, N.; Bui, D.T. A Novel HHO-RSCDT Ensemble Learning Approach for Forest Fire Danger Mapping Using GIS. *Viet. J. Earth Sci.* **2023**, *45*, 338–356. [CrossRef]
85. Miao, T.; Huang, H.; Guo, J.; Li, G.; Zhang, Y.; Chen, N. Uncertainty Analysis of Numerical Simulation of Seawater Intrusion Using Deep Learning-Based Surrogate Model. *Water* **2022**, *14*, 2933. [CrossRef]
86. Miao, T.; Guo, J. Application of Artificial Intelligence Deep Learning in Numerical Simulation of Seawater Intrusion. *Environ. Sci. Pollut. Res.* **2021**, *28*, 54096–54104. [CrossRef]
87. Gruzauskas, V.; Krisciunas, A.; Calneryte, D.; Navickas, V.; Koisova, E. Development of a Market Trend Evaluation System for Policy Making. *J. Compet.* **2020**, *12*, 22–37. [CrossRef]
88. Fyleris, T.; Kriščiūnas, A.; Gružauskas, V.; Čalnerytė, D.; Barauskas, R. Urban Change Detection from Aerial Images Using Convolutional Neural Networks and Transfer Learning. *ISPRS Int. J. Geo-Inf.* **2022**, *11*, 246. [CrossRef]
89. Ghahramani, M.; Galle, N.J.; Ratti, C.; Pilla, F. Tales of a City: Sentiment Analysis of Urban Green Space in Dublin. *Cities* **2021**, *119*, 103395. [CrossRef]

90. Ghahramani, M.; Galle, N.J.; Duarte, F.; Ratti, C.; Pilla, F. Leveraging Artificial Intelligence to Analyze Citizens' Opinions on Urban Green Space. *City Environ. Interact.* **2021**, *10*, 100058. [CrossRef]
91. Gómez, D.; Salvador, P.; Sanz, J.; Casanova, J.L. A New Approach to Monitor Water Quality in the Menor Sea (Spain) Using Satellite Data and Machine Learning Methods. *Environ. Pollut.* **2021**, *286*, 117489. [CrossRef] [PubMed]
92. Gómez, D.; Salvador, P.; Sanz, J.; Gil, J.; Rodrigo, J.F.; Casanova, J.L. Machine Learning Approach to Predict Leaf Colour Change in *Fagus Sylvatica L.* (Spain). *Agric. For. Meteorol.* **2021**, *310*, 108661. [CrossRef]
93. Al-qaness, M.A.A.; Dahou, A.; Ewees, A.A.; Abualigah, L.; Huai, J.; Abd Elaziz, M.; Helmi, A.M. ResInformer: Residual Transformer-Based Artificial Time-Series Forecasting Model for PM2.5 Concentration in Three Major Chinese Cities. *Mathematics* **2023**, *11*, 476. [CrossRef]
94. Al-Hadidi, S.; Sweis, G.; Abu-Khader, W.; Abu-Rumman, G.; Sweis, R. Managing Future Urbanization Growth Patterns Using Genetic Algorithm Modeling. *Eng. Constr. Archit. Manag.* **2023**, *31*, 2648–2668. [CrossRef]
95. Zhang, Q.; Yan, L.; Hu, R.; Li, Y.; Hou, L. Regional Economic Prediction Model Using Backpropagation Integrated with Bayesian Vector Neural Network in Big Data Analytics. *Comput. Intell. Neurosci.* **2022**, *2022*, 1438648. [CrossRef] [PubMed]
96. Xu, Z.; Shen, Z.; Li, Y.; Xia, L.; Wang, H.; Li, S.; Jiao, S.; Lei, Y. Road Extraction in Mountainous Regions from High-Resolution Images Based on DSDNet and Terrain Optimization. *Remote Sens.* **2021**, *13*, 90. [CrossRef]
97. Carhuallanqui-Ciocca, E.I.; Echevarría-Quispe, J.Y.; Hernández-Vásquez, A.; Díaz-Ruiz, R.; Azañedo, D. Bibliometric Analysis of the Scientific Production on Inguinal Hernia Surgery in the Web of Science. *Front. Surg.* **2023**, *10*, 1138805. [CrossRef] [PubMed]
98. Leitão, P. Agent-Based Distributed Manufacturing Control: A State-of-the-Art Survey. *Eng. Appl. Artif. Intell.* **2009**, *22*, 979–991. [CrossRef]
99. Towfiqul Islam, A.R.M.; Talukdar, S.; Mahato, S.; Kundu, S.; Eibek, K.U.; Pham, Q.B.; Kuriqi, A.; Linh, N.T.T. Flood Susceptibility Modelling Using Advanced Ensemble Machine Learning Models. *Geosci. Front.* **2021**, *12*, 101075. [CrossRef]
100. Xiang, X.; Li, Q.; Khan, S.; Khalaf, O.I. Urban Water Resource Management for Sustainable Environment Planning Using Artificial Intelligence Techniques. *Environ. Impact Assess. Rev.* **2021**, *86*, 106515. [CrossRef]
101. Kornejady, A.; Ownegh, M.; Bahremand, A. Landslide Susceptibility Assessment Using Maximum Entropy Model with Two Different Data Sampling Methods. *Catena* **2017**, *152*, 144–162. [CrossRef]
102. Gharaibeh, A.; Shaamala, A.; Obeidat, R.; Al-Kofahi, S. Improving Land-Use Change Modeling by Integrating ANN with Cellular Automata-Markov Chain Model. *Heliyon* **2020**, *6*, e05092. [CrossRef]
103. Brunetti, F.; Matt, D.T.; Bonfanti, A.; De Longhi, A.; Pedrini, G.; Orzes, G. Digital Transformation Challenges: Strategies Emerging from a Multi-Stakeholder Approach. *TQM J.* **2020**, *32*, 697–724. [CrossRef]
104. Nijkamp, P.; Van Der Burch, M.; Vindigni, G. A Comparative Institutional Evaluation of Public-Private Partnerships in Dutch Urban Land-Use and Revitalisation Projects. *Urban Stud.* **2002**, *39*, 1865–1880. [CrossRef]
105. Ameer, S.; Shah, M.A.; Khan, A.; Song, H.; Maple, C.; Islam, S.U.; Asghar, M.N. Comparative Analysis of Machine Learning Techniques for Predicting Air Quality in Smart Cities. *IEEE Access* **2019**, *7*, 128325–128338. [CrossRef]
106. Sowlat, M.H.; Gharibi, H.; Yunesian, M.; Tayefeh Mahmoudi, M.; Lotfi, S. A Novel, Fuzzy-Based Air Quality Index (FAQI) for Air Quality Assessment. *Atmos. Environ.* **2011**, *45*, 2050–2059. [CrossRef]
107. Zhang, Y.; Thenkabail, P.S.; Wang, P. A Bibliometric Profile of the Remote Sensing Open Access Journal Published by MDPI between 2009 and 2018. *Remote Sens.* **2019**, *11*, 91. [CrossRef]
108. Mongeon, P.; Paul-Hus, A. The Journal Coverage of Web of Science and Scopus: A Comparative Analysis. *Scientometrics* **2016**, *106*, 213–228. [CrossRef]
109. Pranckutė, R. Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's Academic World. *Publications* **2021**, *9*, 12. [CrossRef]
110. Merigó, J.M.; Gil-Lafuente, A.M.; Yager, R.R. An Overview of Fuzzy Research with Bibliometric Indicators. *Appl. Soft Comput.* **2015**, *27*, 420–433. [CrossRef]
111. Gaviria-Marin, M.; Merigó, J.M.; Baier-Fuentes, H. Knowledge Management: A Global Examination Based on Bibliometric Analysis. *Technol. Forecast. Soc. Chang.* **2019**, *140*, 194–220. [CrossRef]
112. Yan, L.; Zhiping, W. Mapping the Literature on Academic Publishing: A Bibliometric Analysis on WOS. *SAGE Open* **2023**, *13*, 215824402311585. [CrossRef]
113. Cicerone, G.; Faggian, A.; Montresor, S.; Rentocchini, F. Regional Artificial Intelligence and the Geography of Environmental Technologies: Does Local AI Knowledge Help Regional Green-Tech Specialization? *Reg. Stud.* **2023**, *57*, 330–343. [CrossRef]
114. Mrówczyńska, M.; Sztubecka, M.; Skiba, M.; Bazan-Krzywoszańska, A.; Bejga, P. The Use of Artificial Intelligence as a Tool Supporting Sustainable Development Local Policy. *Sustainability* **2019**, *11*, 4199. [CrossRef]
115. Yigitcanlar, T.; Corchado, J.M.; Mehmood, R.; Li, R.Y.M.; Mossberger, K.; Desouza, K. Responsible Urban Innovation with Local Government Artificial Intelligence (AI): A Conceptual Framework and Research Agenda. *J. Open Innov. Technol. Mark. Complex.* **2021**, *7*, 71. [CrossRef]