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Bibliometric Analysis of Wos Indexed Forestry Articles from Türkiye

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Abstract

Aim of study: This research aims to conduct a bibliometric analysis of forestry-related publications from Türkiye that are indexed in the Web of Science (WoS) database. The study seeks to identify prominent topics, authors, institutions, and patterns of international collaboration within the field. The findings aim to guide future forestry researchers by identifying and addressing existing literature gaps.

Material and method: The dataset consists of 4098 forestry-related articles affiliated with Turkish institutions, which were published during the period from 1983 to 2023 and indexed in the SCI-E, SSCI or AHCI. Bibliometric analysis was performed using VOSviewer software, which facilitated the visualization of co-authorship networks, citation relationships, and keyword associations. A thorough data cleaning process was implemented to ensure the accuracy and consistency of author and institutional information.

Main results: Istanbul University-Cerrahpaşa ranks highest in terms of publication and citation counts. Keywords like 'mechanical properties' and 'surface roughness' were prevalent, indicating a strong focus on wood science. Türkiye has the strongest co-authorship links primarily with the USA and Czechia.

Research highlights: This study identifies significant research themes within the field of Turkish forestry, including wood properties and the application of Geographic Information Systems (GIS). Istanbul University-Cerrahpaşa and Karadeniz Technical University are at the forefront of scholarly contributions in this area.

Keywords: Bibliometric Analysis, Forestry, WoS, VOSviewer, Türkiye

Ormancılık Alanında Yayımlanmış Türkiye Adresli Makalelerin Bibliyometrik Analizi

Öz

Çalışmanın amacı: Bu araştırma, Türkiye'den Web of Science (WoS) veri tabanında indekslenen ormancılıkla ilgili yayınların bibliyometrik bir analizini yapmayı amaçlamaktadır. Çalışma, bu alanda öne çıkan konuları, yazarları, kurumları ve uluslararası iş birliği modellerini belirlemeyi amaçlamaktadır. Bulguların, literatürdeki mevcut boşlukları ele alarak ormancılık alanında gelecekteki araştırmacılara yardımcı olması amaçlanmaktadır.

Materyal ve yöntem: Veri seti, 1983-2023 yılları arasında yayınlanmış ve SCI-E, SSCI veya AHCI'de indekslenmiş, Türkiye'deki kurumlar adresli ormancılıkla ilgili 4098 makaleden oluşmaktadır. Bibliyometrik analiz, ortak yazarlık ağlarının, atıf ilişkilerinin ve anahtar kelime ilişkilerinin görselleştirilmesini kolaylaştıran VOSviewer yazılımı kullanılarak gerçekleştirilmiştir. Yazar ve kurum bilgilerinin doğruluğunu ve tutarlılığını sağlamak için kapsamlı bir veri temizleme süreci uygulanmıştır.

Temel sonuçlar: İstanbul Üniversitesi-Cerrahpaşa yayın ve atıf sayıları açısından en üst sırada yer almaktadır. Yayınlarda baskın olan 'mekanik özellikler' ve 'yüzey pürüzlülüğü' gibi anahtar kelimeler, orman endüstri alanına odaklanıldığını göstermektedir. Türkiye'nin en güçlü ortak yazarlık bağlantıları olan ülkeler ABD ve Çekya'dır.

Araştırma vurguları: Bu çalışma, odun özellikleri ve Coğrafi Bilgi Sistemleri (CBS) uygulamaları başta olmak üzere Türk ormancılığı alanındaki önemli araştırma temalarını tanımlamaktadır. İstanbul Üniversitesi-Cerrahpaşa ve Karadeniz Teknik Üniversitesi bu alandaki bilimsel katkılarda ön sıralarda yer almaktadır.

Anahtar Kelimeler: Bibliyometrik Analiz, Ormancılık, WoS, VOSviewer, Türkiye

Introduction

Advancements in technology and increased resources have led to the creation of more databases, significantly boosting the volume of scientific publications. While this may initially appear to be a positive development, it poses a challenge for researchers to conduct literature reviews in specific fields, as they are confronted with an overwhelming volume of data. Consequently, bibliometric analysis serves as a valuable method for researchers to gain a comprehensive insight into their field of study, identify other scholars and their contributions, and pinpoint prominent research topics.

Bibliometric analysis allows for the examination of data such as co-authorship relationships, citation networks, frequently used keywords in research, and common terms in abstracts. This analysis can be conducted based on various factors, including authors, organizations, and countries, for research published in international journals. A review of international articles in this field reveals several key areas of focus: innovations in forest bioeconomy (Jankovský et al., 2021), studies on forest fires and remote sensing (Santos et al., 2021), articles within the forestry category (Polinko and Coupland, 2020; Yuan and Sun, 2021), the application of remote sensing in forest management and ecosystem services (Abad-Sgura et al., 2020), research on forest carbon sequestration (Huang et al., 2020), articles published in Forests Journal (Uribe-Toril et al., 2019), studies on forest ecosystem services (Aznar-Sanchez et al., 2018), co-benefits of greenhouse gas emission reduction (Deng et al., 2018), and articles concerning the carbon market (Du et al., 2015). However, there has yet to be a bibliometric analysis specifically related to forestry in Türkiye. This study aims to identify the key research topics of international research published in the field of forestry in Türkiye, as well as to highlight the most active and productive authors and organizations in this domain. Additionally, it seeks to elucidate Türkiye's research networks with other countries and to address the existing gap in the literature, thereby guiding future researchers in the field of forestry. To achieve this objective, it is essential to understand the organizations conducting scientific studies in forestry in Türkiye. It is evident that nearly all forests in Türkiye are state-owned and consequently, managed by the government. In this context, research in forestry is primarily conducted by scientists in the forestry faculties of 12 state universities and researchers in 12 research institutes located throughout the country.

In this context, the study aims to address the following questions: Who are the most prolific authors in the field of forestry in Türkiye? Who are the most cited authors in this field? Which organizations publish the most research in forestry in Türkiye? Which organizations receive the highest citation rates in this discipline? What are the most widely published journals in the field of forestry in Türkiye? What are the most cited journals in this area? Which countries have the most collaborative relationships in forestry research with Türkiye?

Material and Methods

Materials

The scope of this study encompasses research articles with addresses in Türkiye that have been published in international journals, as accessed through the Web of Science (WoS) database. The data collection occurred between November and December 2023. By searching for address terms "fac forestry" AND "Türkiye" in the database, publications indexed in SCI-E, SSCI, AHCI were identified, focusing on article types classified as research and review. The earliest publication identified through this search was dated 1983. All publications up to 2024 were included as material for the study. To conduct the bibliometric analysis, the files were downloaded in .txt format by selecting the tab-delimited file option, which allows access to a maximum of 500 articles at a time, followed by the options for tab-delimited files, full records, and cited references. The dataset was verified to ensure it included all articles authored by the researchers by re-searching the database using the authors' information. Missing articles were subsequently added to the data set, resulting in a total of 4,098 articles. The dataset was initially converted into .xls format. Subsequently, various issues were identified, including the use of

abbreviations, misspellings and inconsistencies in the names of authors and their affiliated organizations. Each of these discrepancies was standardized according to a specified format, preparing the dataset for analysis. For instance, authors might present their name as both surname and first name in one publication, while in another, they might use only the initial of their first name. Similarly, one author may have used an abbreviated or the English version of their organization's name, while another may have used a different version or a misspelled version. Similarly, some universities have undergone name changes, leading to their representation as two distinct entities; these were corrected to reflect the most recent name. All these procedures were implemented to enhance the validity and reliability of the study. The final dataset was then converted back to .txt format, and the analysis commenced using the designated software.

Methods

The purpose of bibliometrics is to evaluate scientific literature within a specific field, making it applicable across various disciplines (Andrés, 2009). Bibliometric analysis is a widely utilized method for researching and analyzing extensive volumes of scientific data. This analysis employs statistical and numerical techniques to describe scientific publications, effectively summarizing and synthesizing literature. It condenses large amounts of bibliometric data to present the intellectual structure of a research topic or field, as well as emerging trends (Donthu et al., 2021). The VOSviewer software was employed for the bibliometric analysis of the studies (Van Eck & Waltman, 2010a). VOSviewer is an open-source bibliometric analysis tool that facilitates the creation and visualization of maps based on various data from literature on a subject, providing general insights into the studies (Van Eck & Waltman, 2010b). Data from 4098 articles collected in .txt format from the WoS database uploaded to the program. Subsequently, threshold values were established to conduct the analyses. The analysis commenced based on these values, encompassing various evaluations such as co-authorship relationships, citation analysis, and keyword analysis. The analyses were conducted using the network visualization capabilities of VOSviewer program. In this visualization, each item is represented by a label and a corresponding circle. The size of an item's label and circle is determined by its weight; the greater the weight, the larger the label and circle. In some cases, labels may not be displayed to prevent overlapping. The color of each element indicates the set to which it belongs, while the lines connecting elements represent their relationships. The closer the elements are to one another, the stronger their relational ties. There are two standard weight specifications: the Links specification and the Total Link Strength specification. The number of Links an element has with other elements is denoted as "Link", while the total strength of its Links is referred to as "Total Link Strength" (Van Eck & Waltman, 2010b).

Results and Discussion

Co-authorship of Authors

Figure 1 illustrates the network visualization of the publications in the WoS database, highlighting the co-authorship relationships among authors. A minimum threshold of 10 articles and 10 citations was established, resulting in the selection of 237 authors. The analysis revealed relationships among 234 authors, which we proceeded to examine. The findings identified 17 clusters, 811 links and a total link strength of 2973. The size of clusters varies significantly based on co-authorship status. The colors in the visualization represent the relationships among co-authors working within the same field. It is noteworthy that the co-author with the highest total link strength is Nadir Ayrılmış. He is a professor at Istanbul University-Cerrahpaşa Forest Industry Engineering Department. Halil Barış Özel, a professor in the Department of Forest Engineering at Bartın University, also has a significant number of co-authors. Hakan Şevik, a professor in the Department of Environmental Engineering at Kastamonu University, also has a substantial number of co-authors. Şevik has a background in Forest Engineering, with a focus on silviculture and has previously worked in Landscape Architecture. Both Halil Barış Özel and

Hakan Şevik are closely connected and represented by the same colors on the map, indicating a strong collaborative relationship and shared research interests.

According to the number of documents, Nadir Ayrılmış ranks first with 188 documents, followed by Mehmet Hakkı Alma in second place with 119 documents, and Halil Barış Özel in third place with 95 documents. When analyzing citations, it was found that Nadir Ayrılmış leads with 3877 citations, followed by Mehmet Hakkı Alma with 2961 citations in second place, and Hakan Şevik in third place with 1745 citations.

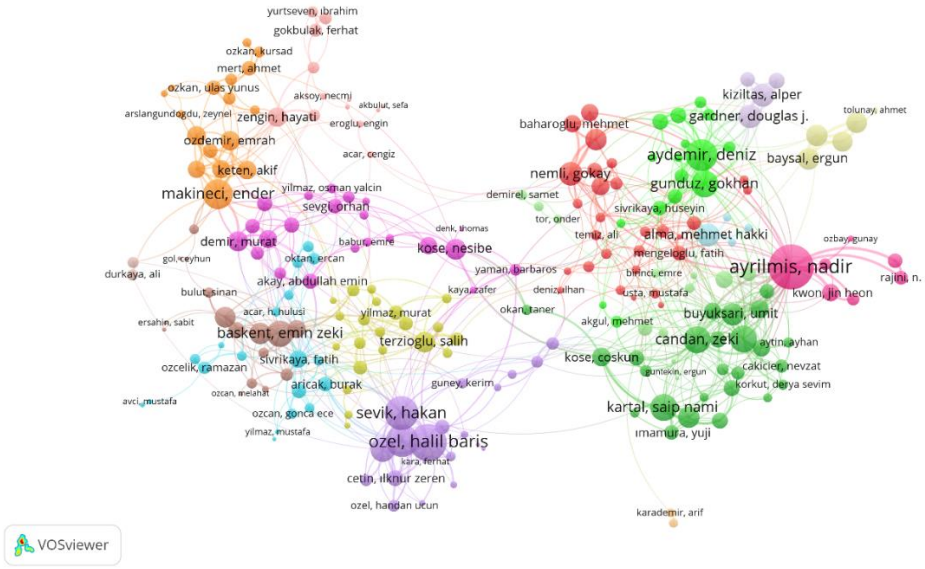

Figure 1. Network visualization shows the co-authorship relationships of publications in the WoS database by authors

Co-authorship of Organizations

Figure 2 illustrates the network visualization of the co-authorship relationships among the organizations associated with the publications in the WoS database. A threshold of a minimum of 20 articles and 100 citations from an organization was established. Out of 1259 organizations, 38 met these criteria, and the analysis revealed significant relationships among these 38 institutions. The analysis identified a total of 7 clusters, 283 links, and a total link strength of 1936. According to the total link strength, Istanbul University-Cerrahpaşa has the highest number of total links, followed by Karadeniz Technical University and Düzce University. In terms of the number of documents published, Istanbul University-Cerrahpaşa and Karadeniz Technical University also rank in the top three, with Bartın University holding the third highest number of documents. Given that Istanbul University-Cerrahpaşa and Karadeniz Technical University are the two oldest institutions in the field of forestry, it is expected that they would rank at top (URL-1, 2023; URL-2, 2023).

When analyzing institutions based on citation relationships, Istanbul University-Cerrahpaşa emerges as the leader with 13756 citations, followed closely by Karadeniz Technical University with 12775 citations, and Kahramanmaraş Sütçü İmam University with 7074 citations. These results align with expectations, as the first two universities are among the oldest and possess the highest number of published documents. However, it is noteworthy that Kahramanmaraş Sütçü İmam University ranks as the third most cited institution despite having only 395 published documents. This suggests that the documents produced by this university have reached a broader audience and have generated publications with significant impact value.

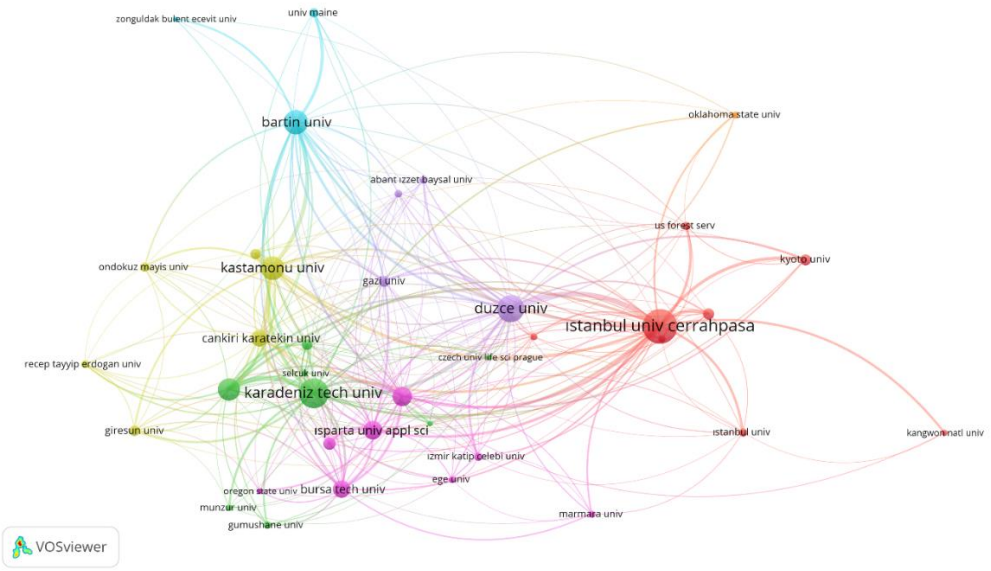

Figure 2. Network visualization shows the co-authorship relationships of publications in the WoS database according to organizations

Co-authorship of Countries

Figure 3 illustrates the network visualization of the co-authorship relationships among the countries represented in the WoS database. A threshold of a minimum of 10 articles and 200 citations was established for selection. Following these criteria, 34 countries out of 93 countries qualified for analysis. Results revealed a total of 7 clusters, 311 links, and a total link strength of 2060. Based on total link strength, Türkiye emerged as the country with the highest number of co-authorships, which is expected given that the data originate from Türkiye. The United States of America (USA) ranked as the second most co-author country, while the Czechia ranked third.

It is noteworthy that Czechia ranks as the third country in terms of connectivity strength, based on total connectivity power. An examination of the overlay map (Figure 4) reveals that relationships with the United States, Japan, and Germany have historical roots, while connections with Czechia have been established more recently. Despite this relatively recent foundation, a new cooperation network is emerging with Czechia, characterized by a high level of connectivity strength.

When analyzing the number of documents published by various countries, Türkiye emerges as the leader with 3992 documents, as anticipated. The United States ranks second with 314 documents, followed by Japan with 78 documents and Germany with 69 documents. In terms of citations, Türkiye again holds the highest position with 53082 citations, while the United States has 6517 citations, Japan has 1998 citations, and Germany has 1371 citations.

When examining the relationships between Türkiye and other countries, it is evident that many scientists from 12 forestry faculties were sent abroad, particularly to the USA, as part of the graduate scholarship program offered by the Ministry of National Education. This program requires recipients to fulfill a compulsory service obligation to address the needs of higher education institutions for academic staff and to provide trained human resources for public institutions and organizations. Consequently, it was anticipated that Türkiye would forge the strongest ties with the USA.

According to the number of documents and citations, Japan ranks second in terms of collaborative ties. An examination of various publications by scientists in forestry faculties revealed that researchers specializing in forest entomology and wood conservation traveled to Japan to establish numerous collaborations. Additionally, it was found that Germany accounted for one of the highest numbers of collaborations. A historical review of forestry

in Türkiye indicates that when the foundations of the field were established, expert foresters from Germany significantly contributed to its development. During this period, German scientists visited Türkiye to offer their expertise, while Turkish foresters and scientists were also sent to Germany by the state, allowing them to observe and implement practices from there.

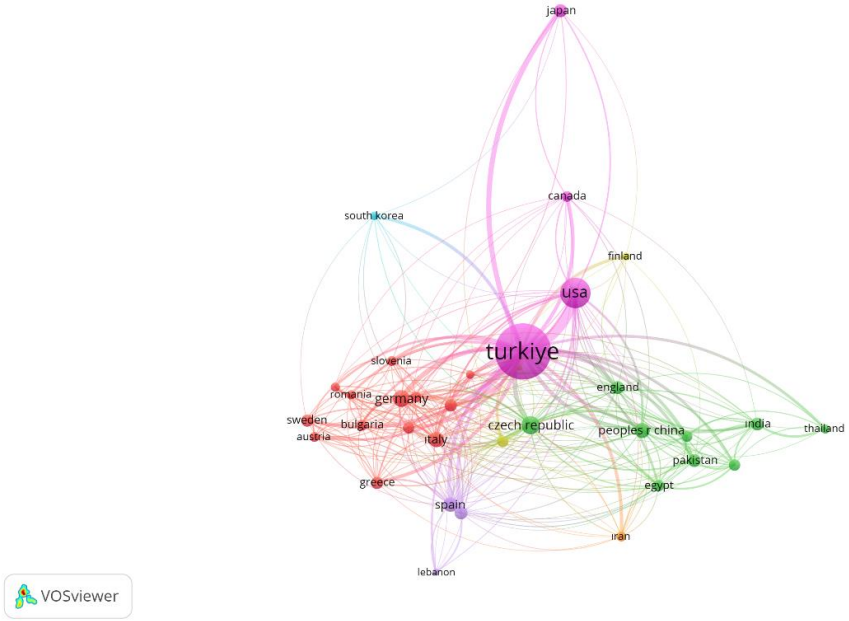

Figure 3. Network visualization shows the co-authorship relationships of publications in the WoS database by country.

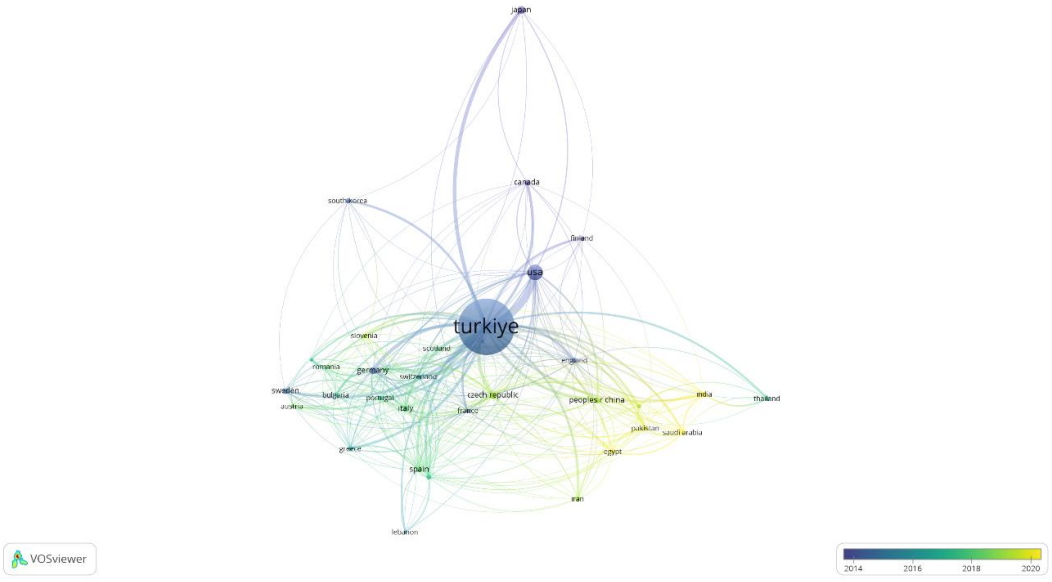

Figure 4. Overlay visualization shows the co-authorship relationships of publications in the WoS database by country

Co-occurrence of Author Keywords

Figure 5 presents the network visualization of the co-occurrence relationships among author keywords from publications in the WoS database. A threshold was established, requiring that a keyword be used at least 10 times for inclusion in the analysis. The keyword Türkiye, which is one of the frequently used keywords, was excluded, resulting in an analysis based on 212

remaining keywords. The analysis identified a total of 8 clusters, 1499 links, and a total link strength of 2742. Based on the total link strength, the top three keywords were mechanical properties, surface roughness and heat treatment. The prominence of the keyword in the field of wood science and technology suggests that a significant number of the studies may have been conducted within the Forest Industrial Engineering departments.

When analyzing the frequency of author keywords, the most frequently used term is Türkiye, used primarily for local reference. Other frequent keywords are mechanical properties (166 occurrences), (106 occurrences), and Geographical Information System (GIS) (93 occurrences). Notably, the most used keyword is frequently employed by researchers publishing in the Department of Forest Industrial Engineering. Upon examining the structures of forestry faculties in Türkiye, it is evident that they are primarily composed of the oldest department, Forest Engineering, followed by Forest Industrial Engineering, and finally, Landscape Architecture. In this context, it is expected that keywords and terms are closely related. Figure 5 illustrates various fields of study, represented by different colors. For instance, keywords highlighted in green correspond to Forest Industrial Engineering, while those in red and pink represent mainly Forest Engineering.

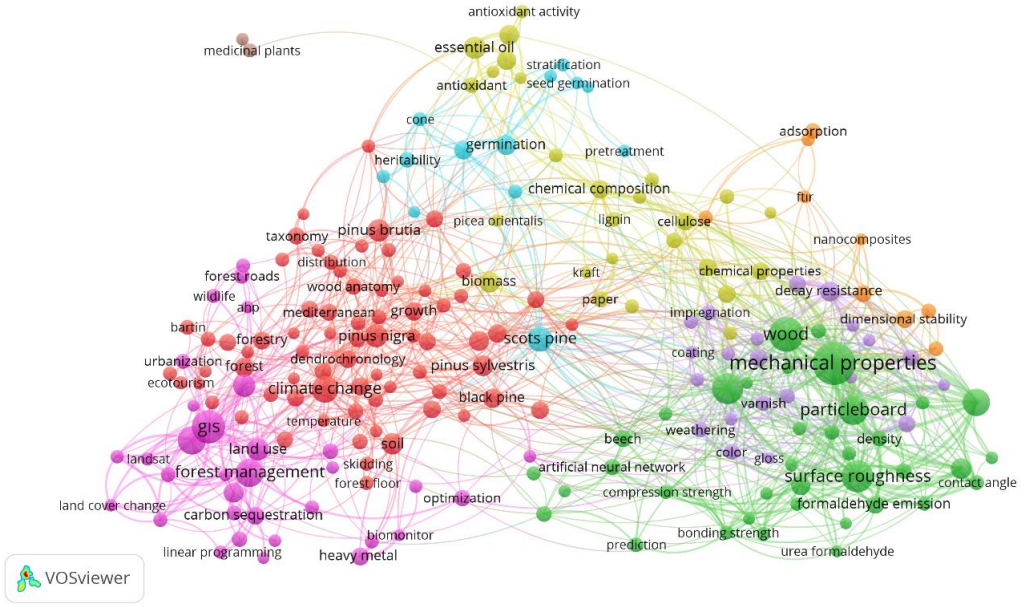

Figure 5. Network visualization shows the co-occurrence relationships of keywords of publications in the WoS database

Figure 6 presents a network visualization depicting the overlay analysis of keywords by year. Notably, while the terms mechanical properties and wood were used more frequently after 2013, keywords such as climate change, artificial neural network and medicinal plants were used more frequently after 2018. It has been observed that keywords such as climate change, sustainability, biodiversity and ecosystem services were used more frequently after 2018. It is anticipated that these keywords will continue to gain prominence in the forthcoming years, attributable to the shifting focus of research in response to the increasingly evident impacts of climate change on the global environment in recent years.

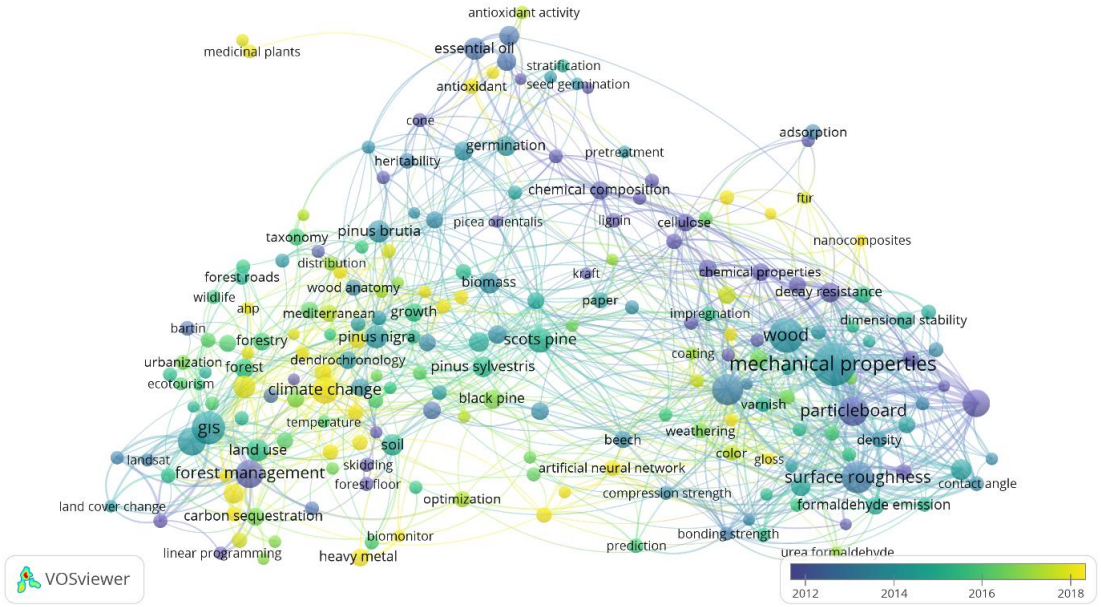

Figure 6. Overlay visualization shows the co-occurrence relationships of keywords of publications in the WoS database.

Citation Analysis of Sources

Figure 7 illustrates the network visualization of the citation and source relationships of publications in the WoS database. A threshold of a minimum of 10 articles and 100 citations was established for selection. Following this criterion, 52 journals out of 768 journals were analyzed. The analysis identified three clusters, 548 links, and a total link strength of 2369. Based on citation metrics, the most cited journal, "Bioresources" is represented as a large green circle; the second most cited journal, "Building and Environment", is also depicted as a large green circle, while the third most cited journal "Environmental Monitoring and Assessment", is represented as a large red circle.

Bioresources is a journal indexed within the Materials Science, Paper & Wood category of the Web of Science Core Collection. According to the 2023 data from Journal Citation Reports (JCR), this journal is classified in the Q2 category based on its impact factor (Journal Impact Factor).

Building and Environment is a journal that is indexed within the Environmental Engineering category of the WoS Core Collection. It is classified in the Q1 category according to JCR 2023. Environmental Monitoring and Assessment is under the Environmental Sciences category in the WoS Core Collection, and it is categorized as Q3 according to the JCR 2023.

Upon analyzing the sources based on the quantity of documents, it was found that the source with the highest document count was the Fresenius Environmental Bulletin, which contained 231 documents. This was followed by Bioresources with 203 documents and Environmental Monitoring and Assessment with 126 documents. In terms of total link strength, Bioresources exhibited the highest link strength, followed by Fresenius Environmental Bulletin in second place and Environmental Monitoring and Assessment in third place.

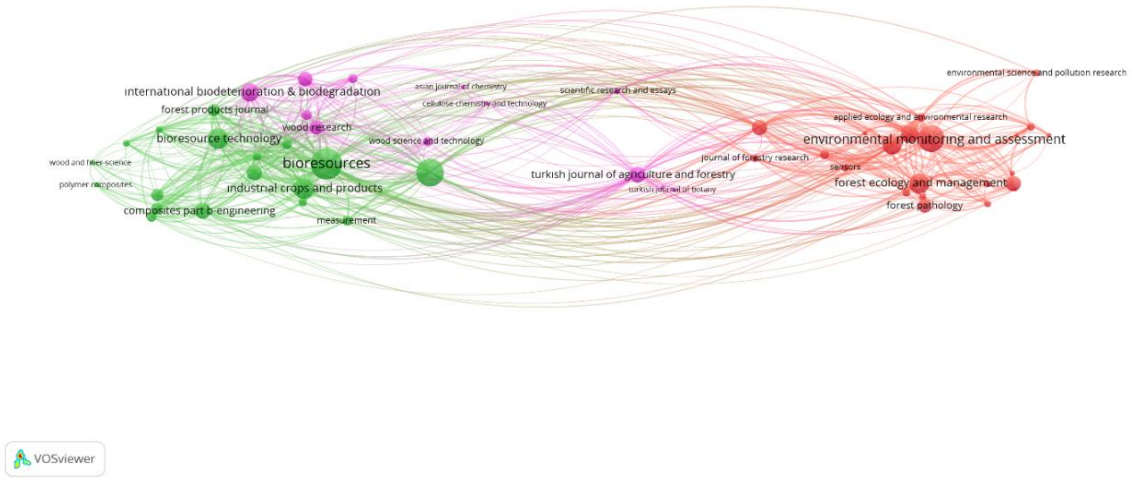

Figure 7. Network visualization shows the citation and source relationships of publications in the WoS database

Citation Analysis of Organizations

Figure 8 shows a network visualization of the citation and organizations relationships of publications sourced from the WoS database. A threshold of at least 20 articles and 100 citations was established for selection. Following the elections, 38 organizations remained from an initial pool of 1259 organizations. The analysis revealed a total of 9 clusters, 387 links and a cumulative strength of 10079. Notably, the organization with the highest number of citations in this database is Istanbul University Cerrahpaşa, represented by a large circle in lilac circle. Karadeniz Technical University also ranks among the organizations with the highest citation counts, indicated by a large red circle. The third most cited organization is Kahramanmaraş Sütçü İmam University, which is represented by a pink circle. Based on the number of documents and total connection strength, Istanbul University-Cerrahpaşa and Karadeniz Technical University occupy the top two position, while Bartın University ranks third.

Among the twelve forestry faculties in Türkiye, Istanbul University-Cerrahpaşa and Karadeniz Technical University possess the most extensive histories. Consequently, a significant number of scholars affiliated with other faculties have obtained their undergraduate and graduate degrees from these institutions. As a result, many of their scientific publications, including those related to their educational endeavors, list these universities as their affiliations. This phenomenon accounts for the prominent citation rates of these two universities. In terms of total link strength, Istanbul University-Cerrahpaşa and Karadeniz Technical University occupy the first and second positions, respectively, while Bartın University ranks third.

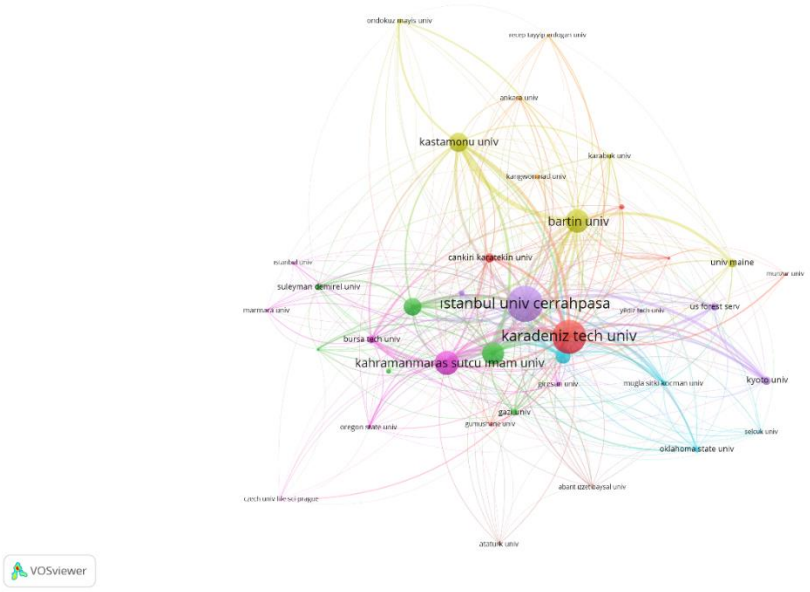

Figure 8. Network visualization shows the citation and organizational relationships of publications in the WoS database

Citation of Countries

Figure 9 illustrates the network visualization of publications in the WoS database, highlighting the citation and country relationships. A threshold of at least 10 articles and 200 citations was established for selection. A total of 34 countries meeting these criteria were identified. The analysis revealed 9 clusters, 249 links and a total link strength of 4671. Notably, Türkiye emerged as the country with the highest number of citations within this dataset, indicated by a large red circle. Following Türkiye, USA ranked as the second cited country. The strongest citation network relationship for Türkiye is with the United States of America, depicted by a thick light red line. Japan and Germany ranked as the third and fourth most cited countries, respectively. When examining the number of documents and total connection strengths, Türkiye, the United States, Japan and Germany consistently occupy the top four positions.

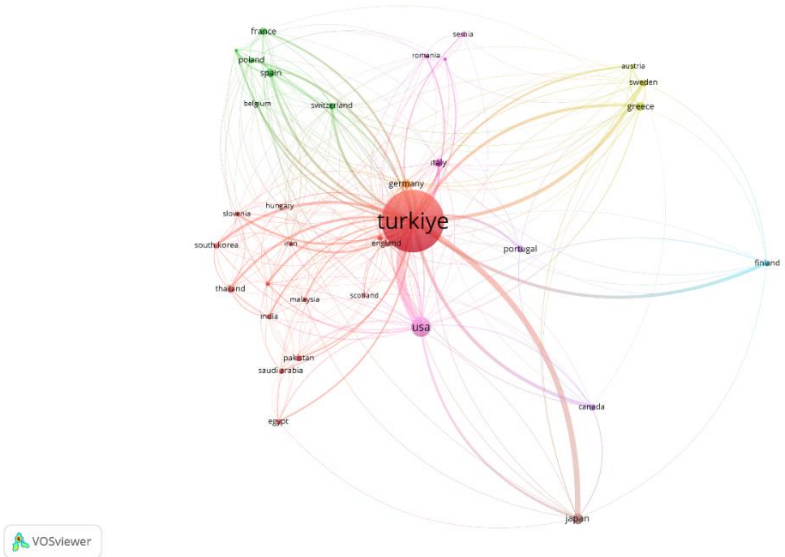

Figure 9. Network visualization shows the citation and country relationships of publications in the WoS database.

Most Related Terms Used in Abstracts

Figure 10 shows a network visualization of co-occurrence maps for terms found in publication abstracts in the WoS database. Using the criterion of at least 50 occurrences, a total of 455 words and phrases were identified. The program selected the most relevant terms from the 60% level, which resulted in 273. To eliminate generic terms, VOSwiever calculates a relevance score for each term (Van Eck and Waltman, 2011). When creating a map based on text data, it is often undesirable to include generic terms such as "result", "new method" and "interesting result". These terms provide minimal information, and the overall utility of a map tends to increase when these terms are excluded. Among these, the terms with the highest relevance scores in the summaries in this database were mcc (microcrystalline cellulose), flower and polypropylene. An analysis of the terms with the highest relevance levels revealed that two of the top three terms were associated with the Forest Industry Department.

An analysis of the frequency of the terms revealed that the most repeated term is "area" with 2137 occurrences, followed by "wood" with 1605 occurrences and "model" with 1433 instances.

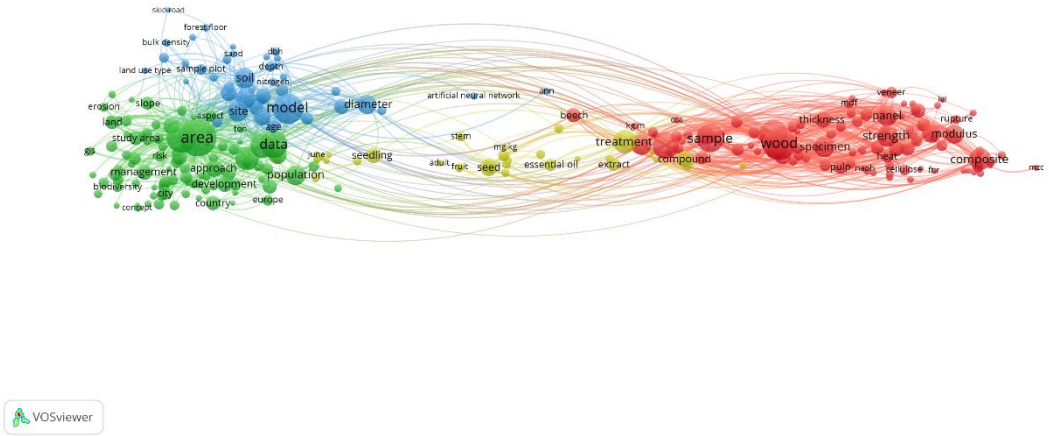

Figure 10. Network visualization shows the co-occurrence maps of terms in publication abstracts in the WoS database.

Conclusions

Although forestry is a branch of science where biological sciences and social sciences intersect, it is seen that forestry today prioritizes biophysical sciences more than social sciences (Durusoy and Bahçeci Öztürk, 2022). One primary reason for this emphasis on biophysical sciences is the persistence of the wood-based forestry approach. This study aims to focus on the social aspects of forestry in Türkiye, to determine which topics international studies published in the field of forestry focus on and who the most active and productive authors and institutions are in this field, to reveal Türkiye's research networks with other countries, and to fill the gap in the literature by guiding scientists who will work in the field of forestry in this sense. When the scientific publications were analyzed in general, it was revealed that international publications, citations and linkage strengths made based on the Department of Forestry Industrial Engineering demonstrated superior performance across nearly all analyses conducted. It is noteworthy that researchers in this discipline tend to produce publications with a greater impact and experience a marginally shorter publication timeline compared to their counterparts in other departments. This expedited publication process can be attributed to the nature of laboratory studies, which yield results more rapidly than field-based research.

It is noteworthy that the brevity of publication processes can be attributed to the fact that studies yielding rapid results are typically conducted in laboratory settings rather than in field and forest environments. Given that the Department of Forest

Engineering is comparatively older than other departments, one would anticipate that factors such as the volume of publications and citations from this department would be more pronounced. However, this expectation is not met. This discrepancy may be explained by the department's continued emphasis on research that necessitates greater labor and time investment, such as fieldwork, as well as its adherence to traditional subject areas.

Among the twelve forestry faculties evaluated, Istanbul University-Cerrahpaşa and Karadeniz Technical University exhibited the highest performance ratios, as anticipated. These institutions are recognized as the oldest in terms of establishment. However, the analysis revealed that several other universities, despite not being the oldest, managed to secure positions within the top three by fulfilling criteria such as the highest number of citations, document count, and total link strength. This indicates that relatively new faculties have achieved a level of research excellence that allows them to compete with the oldest faculties in terms of bibliometric indicators. While the historical establishment of an institution may confer certain advantages, the findings suggest that there is no singular factor that accounts to produce high-impact and high-quality publications that resonate with a broader audience.

The journals with the highest number of publications were the Fresenius Environmental Bulletin, Bioresources, and Environmental Monitoring and Assessment, respectively. The requirement to publish in SCIE journals for academic promotion in Türkiye leads researchers to favor journals that they believe will expedite the publication process. In recent years, the Inter-Universities Council Presidency (ÜAK), the national authority responsible for the associate professorship title processes, has begun to consider the quartiles of SCIE journals. Additionally, TUBITAK evaluates the impact factor and quartiles of journals when providing publication incentive support. Consequently, researchers must consider these factors alongside the scope of the journals.

The data collection phase of this study was a laborious and time-consuming process. After the international data was collected, it took time to prepare the data for analysis. Many reasons such as the lack of a standard for author names, organizations changing names, authors changing organizations, authors moving abroad only specifying the name of their new organizations caused the data collection process to be prolonged. All changes were made manually in a careful and labor-intensive manner. In this sense, it is extremely important that all databases, especially the WoS database, and the journals in this database establish a common standardized imprint language. Likewise, researchers should comply with this standard as much as possible.

Recent trends highlight the importance of ecosystem services, biodiversity, and sustainability in forestry research. Turkish forestry research should further explore these areas, particularly considering the growing challenge of climate change. Turkish forestry research often emphasizes biophysical sciences, especially wood-based forestry, neglecting socio-economic impacts. More studies are needed to explore community involvement, policy analysis, and forest-dependent livelihoods.

Established collaborations with the USA, Japan, and Germany could be expanded to include other nations, diversifying perspectives and fostering innovative approaches in forestry research.

Acknowledgement

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Ethics Committee Approval

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Author Contributions

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Conflict of Interest

The authors declare that they have no conflict of interest.

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