Bibliometric Evaluation of Academic Studies on Water Management in Xeriscape Landscape Applications: Analysis with R Studio-Biblioshiny Software

Kurakçıl Peyzaj Uygulamalarında Su Yönetimi Üzerine Akademik Çalışmaların Bibliyometrik Değerlendirmesi: R Studio-Biblioshiny Yazılımı ile Analizi

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Öz

Bu araştırma, kurakçıl peyzaj uygulamalarında su yönetimi ile ilgili akademik literatürü bibliyometrik analiz yöntemi ile inceleyerek, bu alandaki bilimsel üretkenlik ve akademik iş birliklerini değerlendirmektedir. Çalışma kapsamında, 1980-2025 yılları arasındaki akademik yayınlar Scopus veri tabanından elde edilerek R Studio-Biblioshiny yazılımı ile analiz edilmiştir.

Bulgular, su yönetimi, iklim değişikliği, sürdürülebilirlik ve doğaya dayalı çözümler gibi temaların literatürde öne çıktığını göstermektedir. Ayrıca, uluslararası iş birliklerinin ve disiplinler arası çalışmaların arttığı tespit edilmiştir. Çalışma, kurakçıl peyzajlarda su tasarrufu ve teknolojik yaklaşımların giderek daha fazla önem kazandığını ortaya koymaktadır.

Elde edilen veriler, gelecek araştırmalarda daha fazla veri kaynağı kullanılması, içerik analizlerinin derinleştirilmesi ve yenilikçi su yönetimi stratejilerine yönelik araştırmaların artırılması gerektiğini göstermektedir. Bu çalışma, peyzaj mimarlığı ve su yönetimi politikaları açısından akademik literatüre önemli katkı sunması beklenmektedir.

Anahtar Kelimeler: Biblioshiny, kurakçıl peyzaj, peyzaj mimarlığı, R-studio, su yönetimi.

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Abstract

This research evaluates scientific productivity and academic collaborations by examining the academic literature on water management in xeriscape landscape applications using bibliometric analysis. Within the scope of the study, academic publications between 1980 and 2025 were obtained from the Scopus database and analyzed with R Studio-Biblioshiny software.

Findings show that themes such as water management, climate change, sustainability, and nature-based solutions are prominent in the literature. Additionally, international collaborations and interdisciplinary studies have increased. The study reveals that water-saving and technological approaches are becoming increasingly important in xeriscape landscapes.

The data obtained show that future research should use more data sources, deepen content analyses, and increase research on innovative water management strategies. This study is expected to significantly contribute to the academic literature regarding landscape architecture and water management policies.

Keywords: Biblioshinny, xeriscape landscape, landscape architecture, R-studio, water management.

1. Introduction

Xeriscape landscaping practices are critically important for developing sustainable water management strategies in ecosystems where water resources are limited. Climate change and water scarcity intensely increase ecological and socio-economic risks (Sherwin et al., 2012). Limited water resources have made water management approaches in arid and semi-arid areas an important research area for landscape architects, environmental engineers, and urban planners (Chen et al., 2019). Designing and managing xeriscape landscaping based on sustainable water use contributes to both the protection of natural ecosystems and the long-term resilience of human settlements (Kazemi et al., 2023).

Landscaping practices to save water include collecting rainwater, selecting plant species that require less water, integrating effective and efficient irrigation systems, and sustainable land use planning. These factors are becoming increasingly important to improve the quality of life and ensure ecological continuity in urban and rural areas (Rebelo et al., 2010). While traditional landscape design is based on the intensive use of water resources, xeriscape landscape design and water management practices include innovative strategies that support the natural water cycle and increase ecological resilience (Sant et al., 2018).

Water management in xeriscape landscape design is becoming increasingly important in the landscape architecture discipline in line with sustainability principles (Li et al., 2020). Research reveals that strategies such as low-water consumption plant selection, rainwater harvesting, permeable surfaces, and smart irrigation systems play a critical role in landscape management in water-scarce regions (He et al., 2022). In this context, water-saving-oriented practices contribute to both the protection of ecosystems and the sustainability of human settlements (Li et al., 2022).

In recent years, the increase in academic studies on xeriscape landscape and water management reveals the rapid development of knowledge and academic interest in this field. In this context, research on xeriscape landscape management and design is of great importance for the effective use of water resources and the protection of ecosystems (Liu et al., 2022). Additionally, these studies provide an important basis for identifying future research trends and increasing the sustainability of xeriscape landscapes (Woinarski et al., 2000). Studies conducted in academic databases such as Web of Science and Scopus show that academic productivity in this field concentrates on certain key concepts (Velt et al., 2020). However, questions such as what trends the research on water management in xeriscape landscapes follows, what academic gaps it has, and which researchers have shaped it the most are still unanswered. Therefore, it is necessary to comprehensively examine the existing literature using the bibliometric analysis method (Dong et al., 2022). Bibliometric analyses are of great importance in evaluating research output and understanding the dynamics of scientific knowledge development (Aria & Cuccurullo, 2017). Bibliometric analysis is an important method for evaluating and mapping scientific literature. Tools like Bibliometrix play a key role in this process by enabling both quantitative and qualitative assessments of academic publications. This approach helps researchers identify trends, patterns, and emerging themes within a specific field of study, as highlighted by Kousis and Tjortjis (2021) and Ebrahim et al. (2019). Through these analytical frameworks, scholars can better understand research productivity, citation metrics, and the collaboration networks among different actors within a particular research area (Huang et al., 2023). Bibliometrics is also used to uncover and visualize complex relationships among authors, journals, and keywords, providing deeper insights into scientific networks and how knowledge is shared. Tools like VOSviewer and Biblioshiny help create visual maps that link various academic inputs, enabling researchers to better understand the shifting landscape of their fields (Ropret & Aristovnik, 2019; Burak & Küsbeci, 2023). These visualizations are particularly valuable for identifying key research areas and directing future studies toward less-explored topics, ultimately shaping the strategic direction of research agendas (Chen et al., 2023).

When previous bibliometric analysis studies are examined, it is seen that R studio- biblioshiny software is widely used in analyzing academic data sets (Bwambale et al., 2023). This software allows the visualization and interpretation of important metrics such as topic modeling, author collaborations, citation analysis, and keyword trends (Deng et al., 2020). Understanding the direction in which studies on water management in xeriscape landscapes have developed in prestigious databases such as Web of Science and Scopus is of great importance in terms of guiding future research (Jin et al., 2023). As a result, water management in xeriscape landscape design should be handled within the framework of sustainability principles, and academic studies in this field should be evaluated systematically. This will increase knowledge and determine future research directions (Khoiruddin et al., 2023).

This study analyzed academic publications on water management in xeriscape landscapes using R studio-biblioshiny, and answers to the following questions was sought.

 • What has the distribution of academic publications on water management in xeriscape landscapes been over the years?

• Which authors, universities, and countries have worked most in this field?

• When keyword analysis is done, which concepts stand out?

• What is the level of cooperation on xeriscape landscape and water management?

• What research gaps exist in the current literature, and in what directions are future studies needed?

In order to answer these questions, the bibliographic data between 1980 and 2025, obtained as a result of the literature review in the Scopus database, was analyzed in detail through the R studio-biblioshiny software, and scientific trends in the field were systematically revealed.

2. Research Methodology

In this research, bibliometric analysis, one of the academic literature review methods, was used. The data used for bibliometric analysis were obtained by applying specific keywords and institution name filters via the Scopus database. The Scopus database used the keywords xeriscape, xeriscape landscape, water management, r-studio, and biblioshiny to identify articles covering the specified research topics. Search query created based on keyword and institution name usage: (TITLE-ABS-KEY (("xeriscape" OR "xeriscape landscape" OR "water management" OR "r-studio" OR "biblioshiny")) AND AFFILORG ("landscape") OR AFFILORG ("landscape architecture") OR AFFILORG ("landscape studies") OR AFFILORG ("landscape design") OR AFFILORG ("landscape planning") OR AFFILORG ("landscape planning and design")) AND (LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "AGRI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "EART") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "ENER") OR LIMIT-TO (SUBJAREA , "ARTS") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "DECI") is defined as. This query is designed to include publications belonging to institutions operating in the landscape architecture discipline with the specified keywords. As a result of the scanning, 1123 academic documents, including 875 articles, 118 conference proceedings, 82 compilations, 33 book chapters, six editorial studies, five books, four notes, and one letter, published between 1980-2025, were identified and analyzed. The identified articles were downloaded to the computer using the export feature provided by the Scopus database. To perform bibliometric analysis, the relevant data from Scopus must first be downloaded in CSV format. To do this, after searching for the relevant topic in Scopus, the articles to be used in the analysis were selected and exported in CSV format using the "Export" option. After the data was prepared, it was downloaded and installed via the R program and RStudio from the official website. After the installation was completed, RStudio was opened, and the Bibliometrix package was loaded by typing the "install.packages("bibliometrix")" command into the console. After loading the package, it was activated with the "library(bibliometrix")" command. The "biblioshiny()" command was

used to start the web-based interface Biblioshiny. The "Data" tab was selected in the open interface, and the previously downloaded CSV file was loaded into the system with the "Load data" option. After the loading was completed, bibliometric analysis was performed using the analysis tools offered by Biblioshiny. Thanks to these analyses, relationships between researchers and publications were determined, citation analyses were conducted, and research trends were evaluated more comprehensively. During the analysis process, documents were evaluated based on the concepts used in the title, keywords, and summary sections. Social network analysis methods were used in the relational analysis of keywords, especially co-citation, collaboration network, and collocation analysis techniques.

3. Findings and Discussion

3.1. R Studio-Biblioshiny Software Analysis Findings

This research evaluated 1123 documents covering academic publications between 1980 and 2025 using the bibliometric analysis method. The annual increase rate of these publications obtained from 421 sources was 6.5%. This trend shows that academic studies are increasing, and the literature constantly expands (Figure 1).

The fact that 4548 different researchers contributed to the studies reveals a strong academic interaction in the field. The average number of authors per article is 5.39, which underlines the importance given to collaborative work. Additionally, the rate of international collaborations, which was determined as 38.65%, shows that this field is a subject that is collaborated on at a global level and supported by a wide academic network.

In the analysis, 3807 different keywords were used in the articles examined. This shows that the studies are highly terminologically diverse and that the subject is discussed in different contexts. On the other hand, the fact that the number of single-author publications is limited to 57 shows that individual studies are less preferred in the field and that research is largely based on teamwork.

The average age of the articles examined was 7.95. This data shows that studies in the field remain largely up-to-date. Additionally, a study received an average of 31.4 citations. This reveals that published research has a significant academic impact on the literature and is frequently referenced.

On the other hand, the lack of reference information in the analyzed data set indicates that the cited sources should be examined in detail. This deficiency emphasizes the importance of providing studies with a more systematic structure regarding resource use (Figure 1).

Figure 1. Main information of the academic publishing dynamics on xeriscape and water management

Table 1 shows an analysis of the main information of the data of Academic Publishing Dynamics on Xeriscape and Water Management.

Table 1. Biblioshiny-based analysis of the main ınformation of xeriscape and water management publications

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1980:2025
Sources (Journals, Books, etc)	421
Documents	1123
Annual Growth Rate %	6,5
Document Average Age	7,95
Average citations per doc	31,4
References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	8304
Author's Keywords (DE)	3807
AUTHORS	
Authors	4548
Authors of single-authored docs	57
AUTHORS COLLABORATION	
Single-authored docs	63
Co-Authors per Doc	5,39
International co-authorships %	38,65
DOCUMENT TYPES	
article	874
book	5
book chapter	33
conference paper	118
editorial	6
letter	1
note	4
review	82

Figure 2 shows the annual distribution of scientific production between 1980-2025. Data reveal that academic studies in this field have increased significantly, especially since the 2000s. A remarkable number of publications was observed in the post-2010 period, and this increase peaked in the 2020s. This shows that academic interest in topics such as xeriscape and water management is increasing, and researchers are increasingly turning to studies on sustainable water management strategies. A sharp decline towards 2025 may be due to the incompleteness of the dataset or publication processes that have not yet been completed.

This trend reveals that the subject has gained an important place in the scientific literature and has developed rapidly, especially in recent years. These results show that more research will be done in this field in the future and that academic studies will continue (Figure 2).
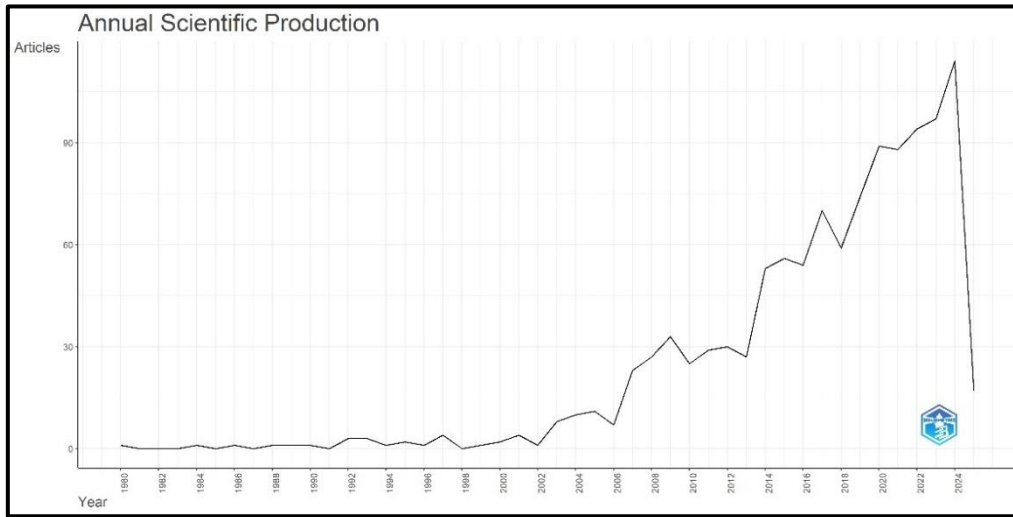
Figure 2. Annual Distribution of Academic Publications on Xeriscape and Water Management Between 1980-2025

Figure 3 reveals how authors, universities, and countries shape scientific collaborations. The authors are shown in the left column, the universities to which these authors are affiliated are in the middle column, and the countries where the relevant universities are located are shown in the right column. The data shows that academic studies are largely carried out through international collaborations. Universities in countries such as the USA, China, Germany, Portugal, and the United Kingdom significantly contribute to collaborative projects by establishing strong connections with different researchers. In particular, institutions such as the University of Arizona, Universidade de Lisboa, University of Florida, and Beijing Forestry University have wide academic networks and stand out in international collaborations.
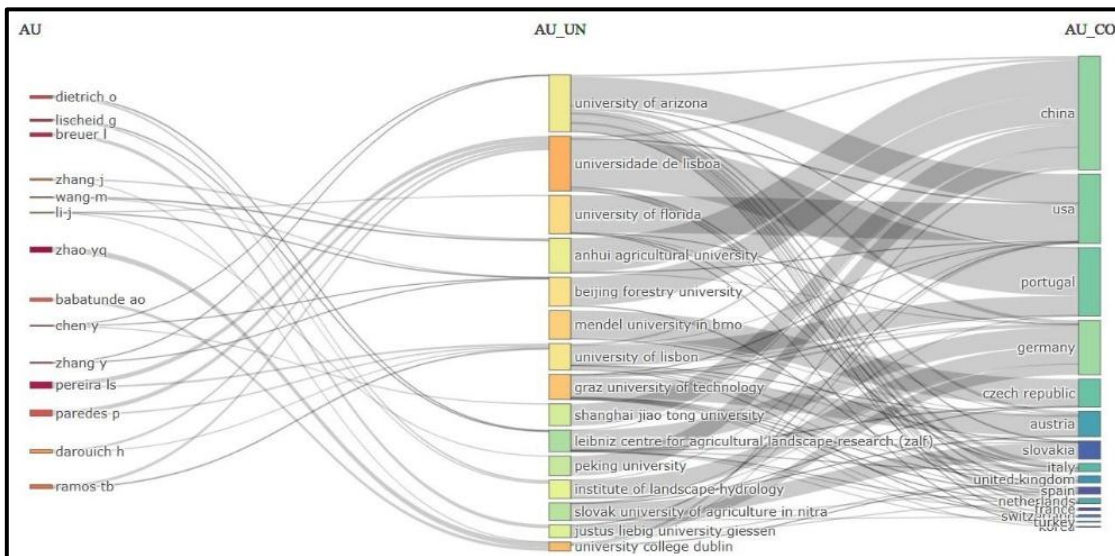

Figure 3. Bibliometric analysis at author, university and country level

Figure 4 shows the most frequently used keywords and how frequently they are repeated in academic studies on xeriscape and water management. One of the most prominent words in the figure is "water management," followed closely by "climate change". This shows that researchers attach great importance to the relationship between water management and climate change.

In addition, it has been determined that terms such as stormwater management, green infrastructure, and sustainability are frequently used. This reveals that in the literature, water management is discussed in terms of quantity and quality and within the framework of environmental sustainability. In addition, terms such as irrigation, water quality, and ecosystem services were also found to be prominent. This shows that water management is examined in many different aspects, such as agricultural irrigation, water quality, and ecosystem balance. In addition, it has been determined that technological concepts such as remote sensing, and GIS are common, technology is increasingly used in water management processes, and data-oriented approaches are gaining importance. Finally, the use of terms such as nature-based solutions, biodiversity, and constructed wetlands indicates that studies on water management also include nature-based sustainable solutions.

Overall, Figure 4 reveals that issues such as water management and climate change are increasingly prominent in academic literature and are also addressed alongside technology and nature-based solutions. More research will likely be conducted in these areas in the coming years.
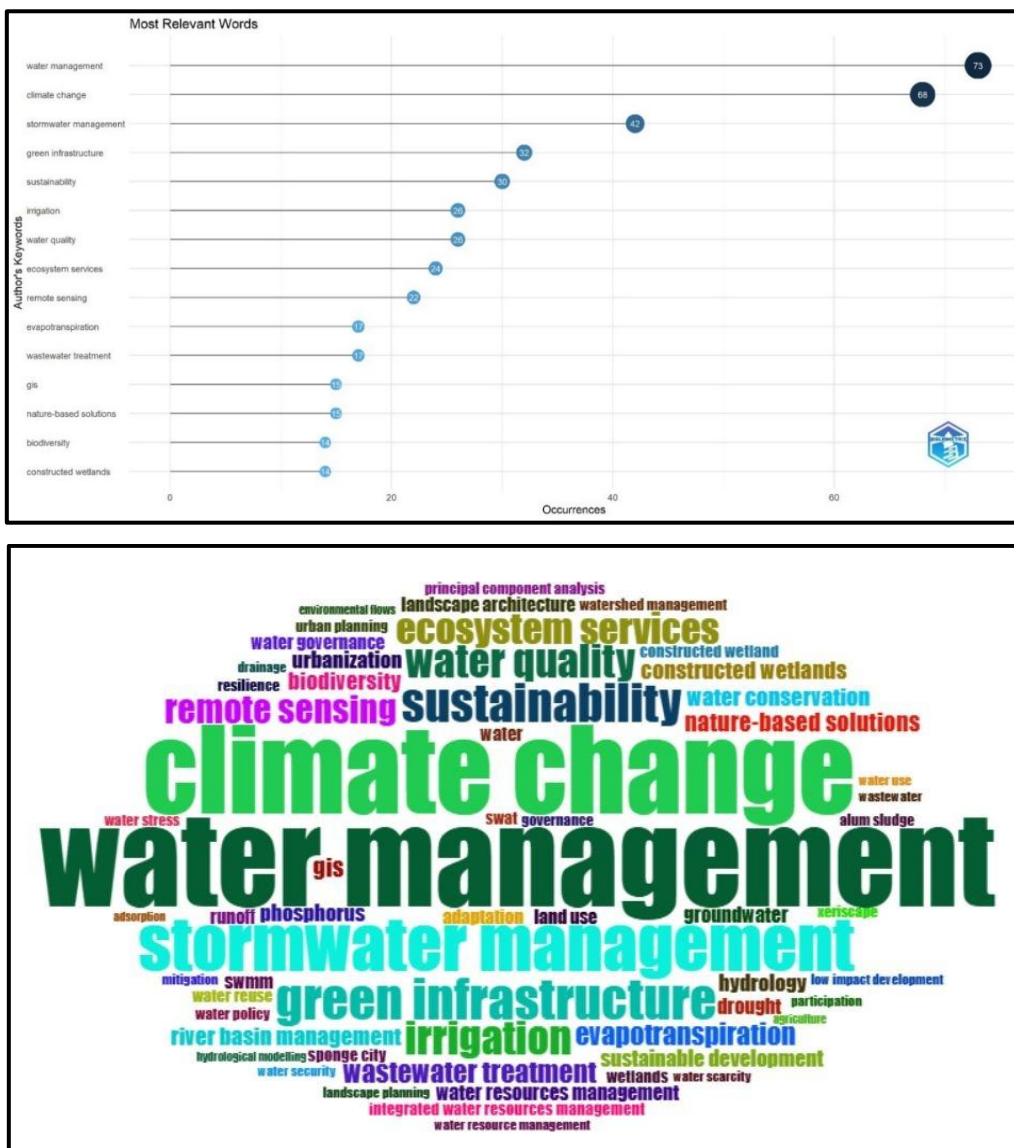

Figure 4. Most relevant keywords in xeriscape and water management research

The data in Figure 5 shows the development of issues such as water management, sustainability, and climate change in academic studies between 2005 and 2023. The years are on the horizontal axis, and the most frequently used terms are on the vertical axis. The popularity of the terms varies according to the size of the points.

Looking at the data, topics such as water stress, climate change mitigation, and nature-based solutions have received more attention in recent years. The fact that topics related to climate change have come to the agenda more frequently in the post-2015 period can be associated with the increasing awareness of managing water resources on a global scale. In addition, technological concepts such as machine learning, and GIS stand out. This is evidence of the increasing use of data-driven and innovative approaches in water management and landscape planning. On the other hand, the fact that terms such as green infrastructure, sustainable development, and ecosystem services are increasingly the subject of academic studies indicates that environmental sustainability and nature-based solutions are finding more space in scientific research.

Figure 5 shows which issues in areas such as water management, climate change, and sustainability have gained importance over time. This trend reveals that scientists and policymakers increasingly focus on water management and environmental sustainability.
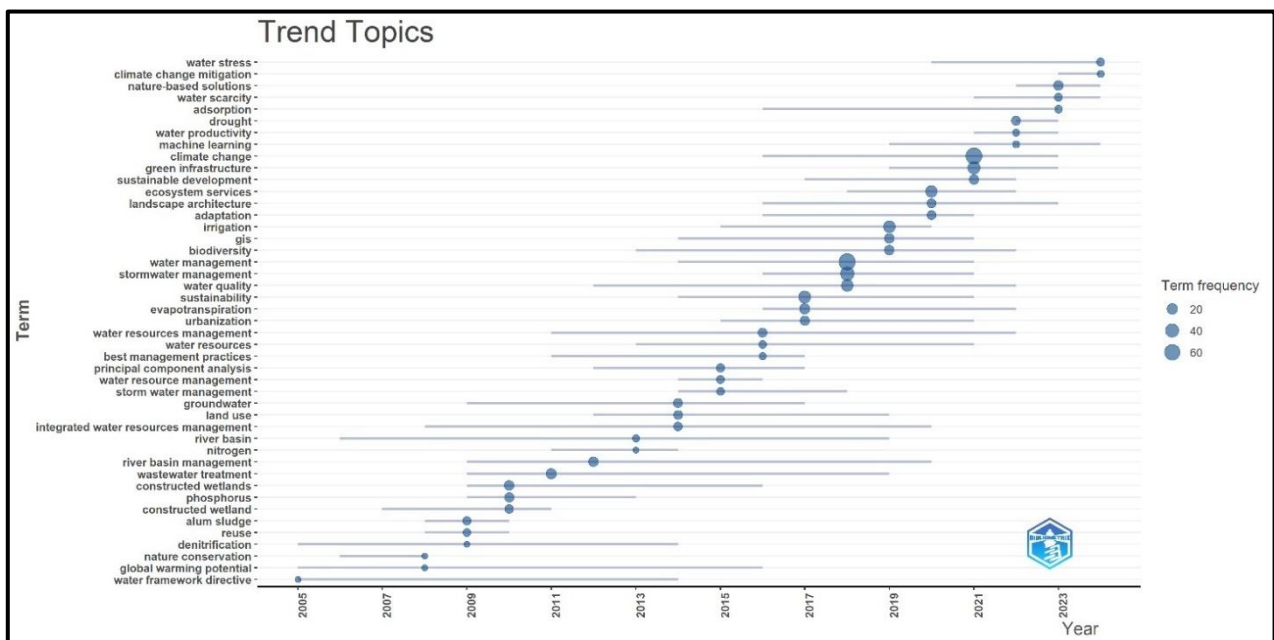

Figure 5. Evolution of trend topics in xeriscape and water management research (2005-2023)

The findings show that issues such as water management and climate change are increasingly being discussed in the academic world. The most frequently used keywords determined in the study include water management, climate change, sustainability, stormwater management, green infrastructure, and ecosystem services. This situation shows that academic studies on protecting and conserving water resources are becoming increasingly important.

The main reason for analyzing academic publications between 1980 and 2025 obtained from the Scopus database is that it provides access to a wider set of publications compared to the Web of Science database. In this way, it was possible to evaluate more academic publications on the subject, and the trends in the field were revealed more comprehensively.

In particular, Biblioshiny software is an effective tool that facilitates such bibliometric analyses and determines academic trends (Braga et al., 2020). In this context, studies emphasize that water management and arid landscape practices should be addressed on a global scale. A bibliometric analysis conducted by Liang et al. revealed the place of drought and climate change in water resource management in STEM (Science, Technology, Engineering, Mathematics) literature. Braga et al. (2020) evaluated water management practices

in coastal areas and examined the contribution of sustainable landscape management to the effective use of water resources.

The findings of the bibliometric analysis are mainly consistent with the previous literature. Li et al. (2020) revealed that climate change and water management strategies are at the center of environmental studies, while Sant et al. (2018) emphasized that nature-based solutions are increasingly included in academic publications on water management. Dong et al. (2022) showed that academic collaborations are increasing internationally and that these collaborations enable more interdisciplinary research on environmental sustainability issues.

Another important finding is that academic collaborations are increasing internationally. The study found that 4548 researchers contributed, and the international collaboration rate was 38.65%. This finding shows that environmental issues are addressed through interdisciplinary and global collaborations. A similar result was also revealed in the study conducted by Dong et al. (2022), who stated that global issues such as water management and climate change bring together academics from different countries.

Although the study's findings largely overlap with previous similar studies, some differences are also noticeable. For example, Rebelo et al. (2010) stated that water management strategies are generally addressed through large-scale basin management and hydrological modeling. However, this study shows that micro-level water management applications are more prominent in xeriscape landscape applications. It was also determined that technological approaches (e.g., machine learning and geographic information systems - GIS) are increasingly taking place in water management. Similarly, it has been determined by He et al. (2022) that data-driven approaches have gained importance for the protection and effective management of water resources.

However, while some studies in the existing literature focus on water management policies and legal regulations (Jin et al., 2023), this study focuses on scientific productivity, academic collaborations, and citation analyses. In the bibliometric analysis conducted by Xie et al. (2020), the relationship between water management and soil degradation was examined, and new research areas were opened in the context of sustainable ecosystem management. The results of the bibliometric analysis reveal that future research should focus more on topics such as water management policies, data-driven approaches, and the integration of sustainable landscape planning. While Multi-Criteria Decision Making (MCDM) techniques emphasize the importance of data-based decision-making processes in environmental management (Dwivedi et al., 2024), Machar (2020) addressed sustainable landscape management and evaluated the effects of habitat conversion on water resources.

Since this research was conducted using bibliometric analysis, it only focused on the number of publications, citation relationships, and keyword analyses. This situation has limitations as the study does not include qualitative content analysis. A more detailed examination of the identified key topics with content analysis will contribute to a more comprehensive and holistic literature evaluation in future studies. It should be noted that since the research covers a specific period (1980-2025), older studies on water management and xeric landscapes may not have been included in the analysis. In this context, conducting studies covering broader periods may provide a better understanding of long-term scientific trends in water management.

4. Conlusion

This study aims to examine academic publications on water management in arid landscape applications using the bibliometric analysis method and to reveal the current status of the field, academic trends, and research gaps. The study aims to contribute to the literature by analyzing academic publications between 1980-2025. The study results will provide significant academic contributions to landscape architecture, environmental engineering, and sustainable water management. The study systematically presents the development of academic literature on water management and provides a basis for future research. Prominent studies and academic collaborations were identified, creating a guiding framework for researchers in this field. The results

show that themes such as water management, climate change, sustainability, and nature-based solutions are increasingly prominent in the literature. Keyword and trend analyses revealed which topics are prominent and which areas need more research in the future. In addition, it was determined that international collaborations and interdisciplinary research have increased in recent years. The findings obtained in line with the questions determined at the beginning of the study are presented below:

• Academic production has steadily increased over the years and gained significant momentum, especially after the 2000s.

• Keyword analyses have shown that concepts such as climate change, sustainability, ecosystem services, and nature-based solutions related to water management are increasingly prominent in the literature.

• Academic collaborations reveal that international and interdisciplinary interaction is increasing.

• Gaps in the existing literature indicate that more focus should be placed on integrating technological approaches (e.g., remote sensing and machine learning) with water management strategies.

In this context, in the light of the data presented in the study, concrete suggestions for future research are expansion of data sources and analysis methods, development of technology-supported water management models, comparison of regional and global policies, dissemination of nature-based solutions and green infrastructure, increase of applied research and long-term monitoring systems, development of climate change adaptation strategies, encouragement of interdisciplinary research. Research that brings together different disciplines, such as landscape architecture, environmental engineering, urban planning, economics, and water policies, will allow water management strategies to be addressed in a more holistic framework. As a result, the existing knowledge of water management in arid landscapes has been systematically evaluated. The results guide developing water management policies, creating climate change resilient landscape strategies, and disseminating sustainable urban planning practices.

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