



Introduction

Urbanization has raised significant environmental concerns, including increased pollution, decreased water quality, and resource depletion. Urban sprawl has resulted in the loss of green spaces, exacerbating the urban heat island effect and contributing to temperature increases (Yenneti et al., 2017). Moreover, urbanization is a major contributor to greenhouse gas emissions, particularly through energy consumption and transportation, and is a significant factor in climate change (Caldarice et al., n.d.; Meng & Kenway, 2018; Patil & Anbalagan, 2023).

Accordingly , Sustainable urban planning is crucial for mitigating these effects by incorporating environmentally friendly solutions into urban design. This requires prioritizing sustainable urban expansion to limit cities' negative environmental footprint (Caldarice et al., 2020.; Meng & Kenway, 2018; Patil & Anbalagan, 2023). In addition, urban drainage systems face increasing strain due to urbanization and climate change, necessitating adaptation measures that consider the impacts of population growth, urbanization, and climate change (Kang et al., 2016).

In this regard, Sustainable urban drainage systems (SUDS) play a crucial role in climate change adaptation by mitigating the impacts of urbanization and extreme rainfall on drainage infrastructure (García-Terán et al., 2019; Zhou, 2014). These practices aim to restore natural water balance through enhanced infiltration, evapotranspiration, and rainwater harvesting, improving drainage efficiency and resilience (Ahammed, 2017; Kabisch et al., 2016; Patil & Anbalagan, 2023).

This research employs a bibliometric analysis to elucidate the multifaceted role of sustainable urban drainage in mitigating climate change and its associated greenhouse effects

Research Questions

- 1 What is the time distribution of publications on The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area over the last decade?
- 2 What are the most prevalent journals in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?
- 3 What are the most prevalent authors in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?
- 4 What are the most profic universities in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?
- 5 What are the most profic countries in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?
- 6 What are the most cited articles in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area ?
- 7 Which research keywords have been the most frequently used over the past ten years in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?

Methodology

A comprehensive review of the literature on Sustainable Urban Drainage Systems (SUDS) in adapting to climate change, spanning the past decade, has been conducted. Using the Scopus database, a keyword-title abstract search was conducted on May 1st, 2024, yielding 12 high-quality publications after a manual screening process (Figure 1).

The study employs bibliometric analysis to identify key characteristics, including keywords, prominent journals, most cited articles, authors, and countries conducting research on SUDS. Visualization of the bibliometric networks was achieved using VOSViewer software.

This review aims to contribute to our understanding of SUDS' capacity in adapting to climate change, an area of significant research importance given the lack of existing studies.

Identification of studies via databases and registers 01/05/2024

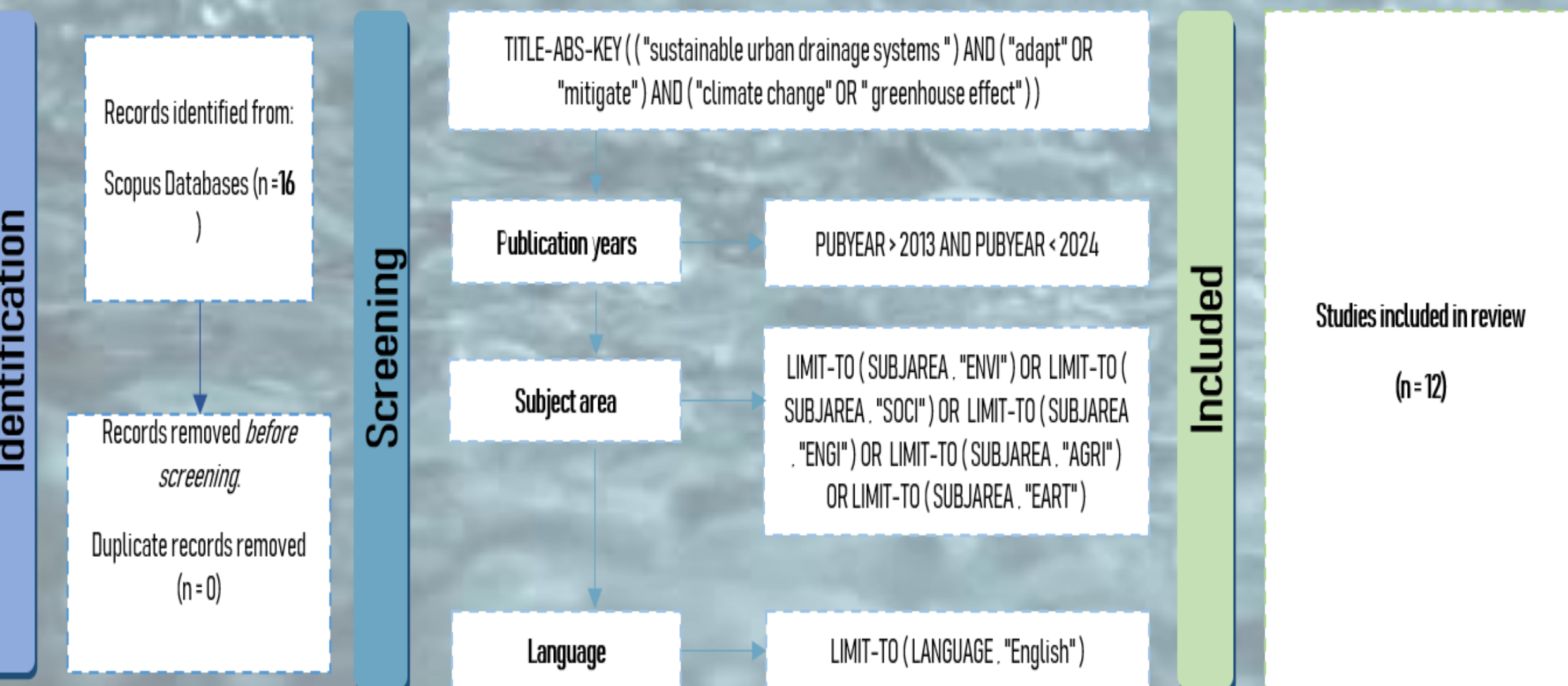
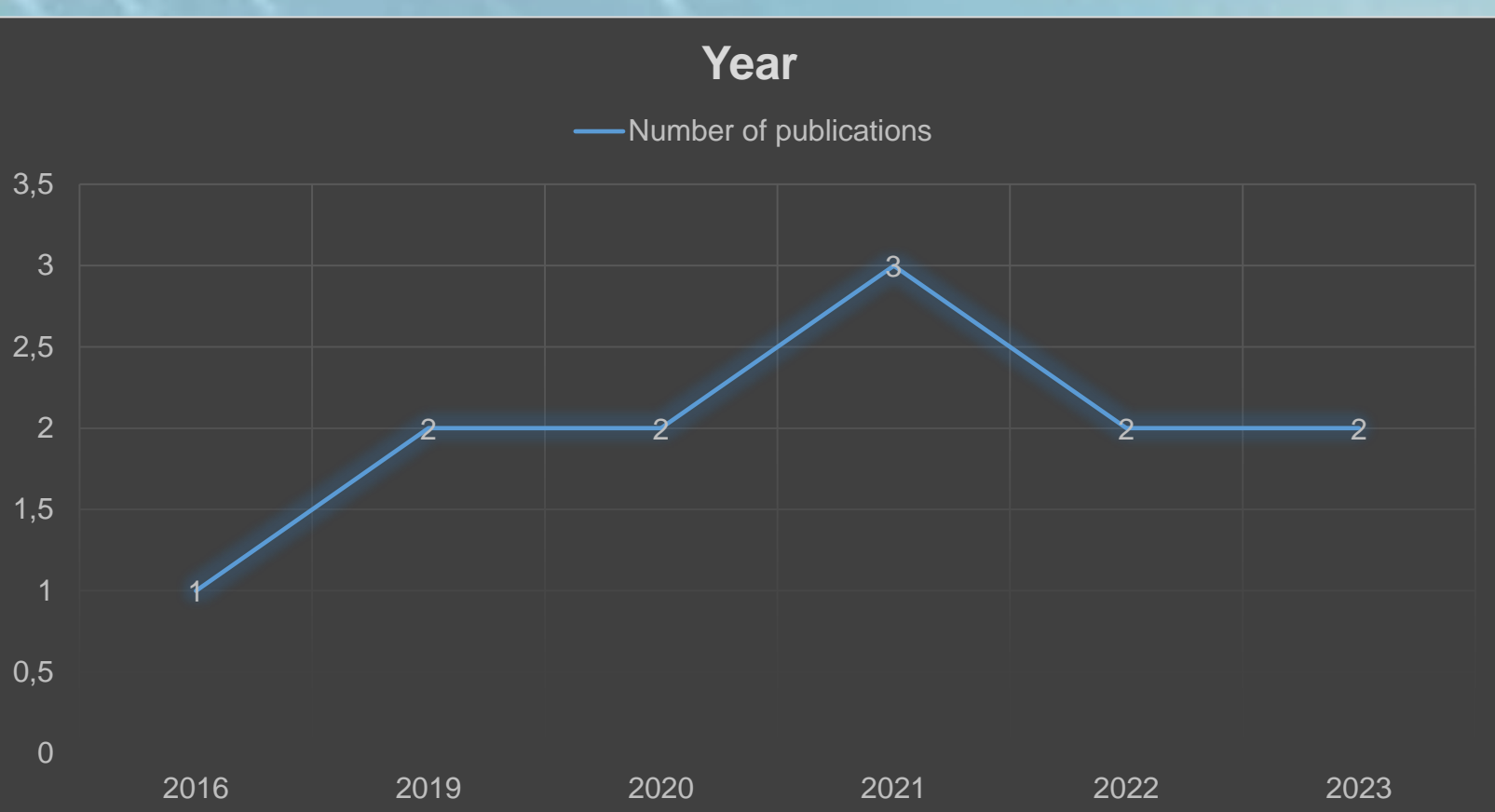
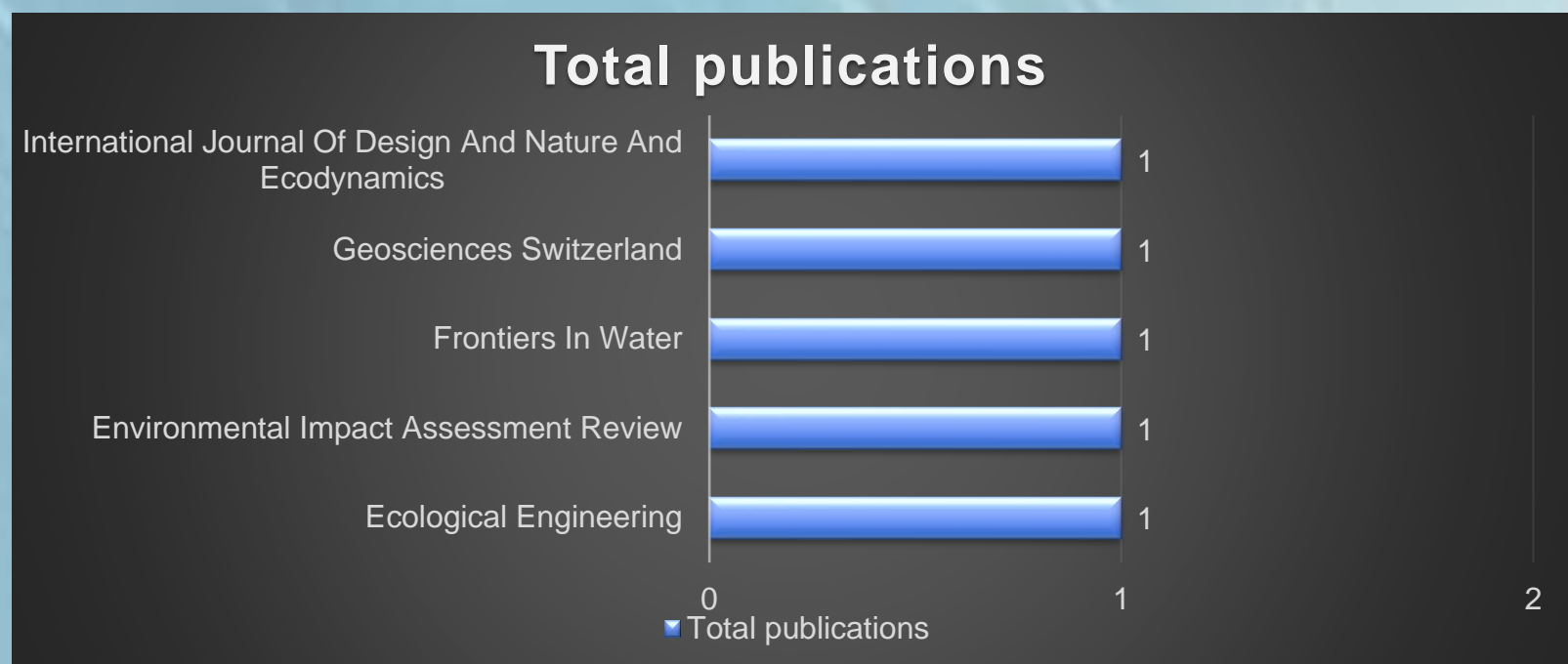


Figure 1: Analytic framework of the study



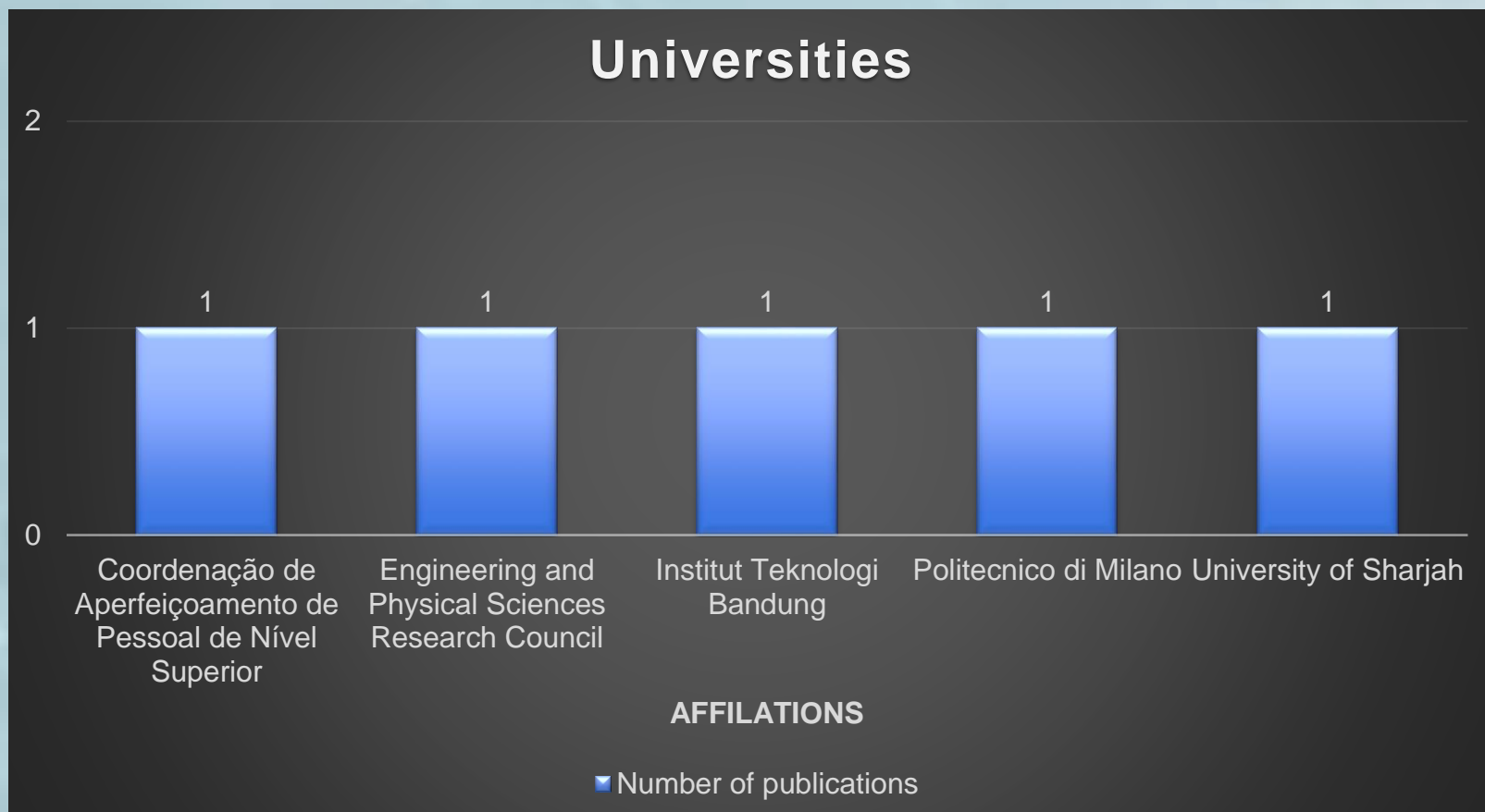
Graph 1 : Distribution of publications by years (2014–2023)



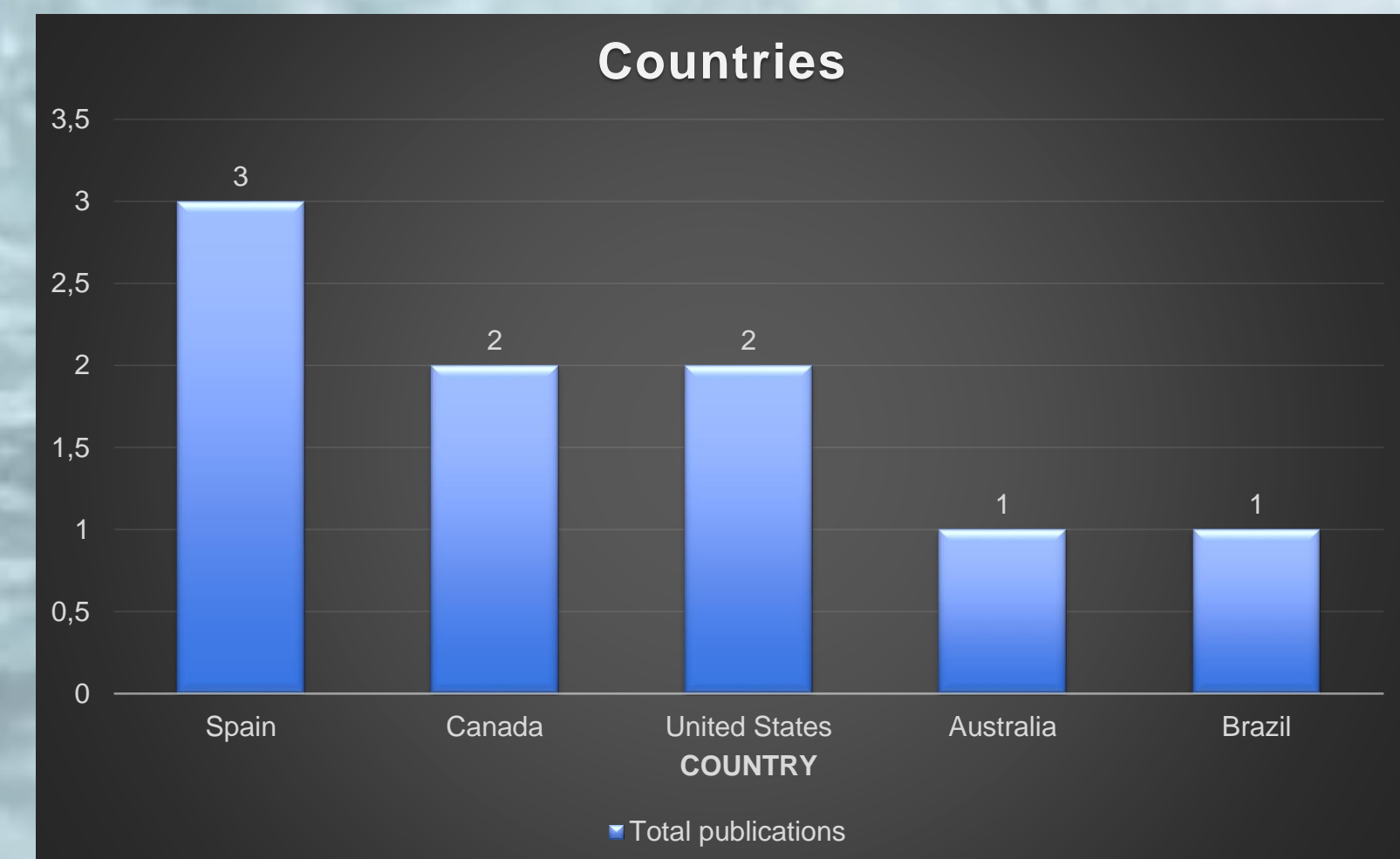
Graph 2 : The top 5 highly productive journals on the research topic (2014–2023)



Graph 3: The top 10 highly productive authors on the research topic (2014–2023)



Graph 4: The top 5 highly productive universities on the research topic (2014–2023)



Graph 5 : The top 5 highly productive countries on the research topic (2014–2023)

Research question 1 :

What is the time distribution of publications on The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area over the last decade?

To address the first research question, an analysis of publication year was conducted for articles published within the past decade. The findings revealed a skewed distribution, with a significant concentration of publications (3) in 2021. The years 2019, 2020, 2022, and 2023 each contributed two publications, while 2016 yielded only one which represents the beginning of publication in this field in the previous decade. The remaining years exhibited a more dispersed pattern of publication activity, as depicted in graph 1 .

Research question 2 :

What are the most prevalent journals and authors in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?

The second research finding was elucidated through an analysis of the source distribution of articles published within the past decade. Notably, all journals examined exhibited an equal number (1) of articles published on the topic under investigation. Consequently, none of the analyzed journals could be designated as a prominent source in this specific research domain.(graph 2)

Research question 3 :

What are the most prevalent authors in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?

Graph 3 displays the top ten highly productive authors in Sustainable Urban Drainage Systems in Adapting to Climate Change research, with 'Senosiain, J.L.' being the most prolific with 2 publications and an h-index of 2. 'Aljassem, F.' and 'Abdallah, M.'and 'Antunes, M.L.P.' have also made notable contributions, each with 1 publication and h-indices of 1 , 17 and 15 respectively. Emphasizing the significant contributions of the authors listed in the table.

Research question 4 :

what are the most profic universities in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?

The research finding emerged from an analysis of the institutional affiliation distribution of articles published within the past decade. An examination of the data revealed that all universities under consideration exhibited an equivalent number (n=1) of publications related to the topic of investigation. As a result, none of the analyzed universities could be identified as a predominant affiliation within this research domain. (graph 4)

Research question 5 :

What are the most profic countries in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?²

Graph 5 presents the distribution of research on the capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change among the top five contributing countries. Spain is the most prolific contributor, accounting for 3 publications (25% of the total publications), followed closely by Canada and the United States with 2 publications each (17% of the total publications).

Table 1 : The top 5 most cited articles on the research topic (2014–2023)

Article	Authors	Journal	Year of publication	Total citation
Urban regeneration: Green urban infrastructure as a response to climate change mitigation and adaptation	Senosiain, J.L.	International Journal of Design and Nature and Ecdynamics.	2020	20
The Impacts of Climate Change and Porous Pavements on Combined Sewer Overflows: A Case Study of the City of Buffalo, New York, USA	Roseboro, A., Torres, M.N., Zhu, Z., Rahideau, A.J.	Frontiers in Water.	2021	15
Promoting green infrastructure in Mexico's northern border: The Border Environment Cooperation Commission's experience and lessons learned	Giner, M.-E., Córdova, A., Vázquez-Gálvez, F.A., Marruffo, J.	Journal of Environmental Management	2019	15
Probabilistic modeling of sustainable urban drainage systems	Raimondi, A., Di Chiano, M.G., Marchioni, M., Sanfilippo, U., Becciu, G.	Urban Ecosystems	2023	11
Comparative performance and cost-integrated life cycle assessment of low impact development controls for sustainable stormwater management	Abdeljaber, A., Adghim, M., Abdallah, M., Chamina, R., Aljassem, F.	Environmental Impact Assessment Review	2022	9

Research question 6 :

What are the most cited articles in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area ?

Table 1 highlights the top 5 most cited articles in the field of Sustainable Urban Drainage Systems (SUDS) and their adaptability to climate change. The article 'Urban Regeneration: Green Urban Infrastructure as a Response to Climate Change Mitigation and Adaptation' leads with 20 citations, demonstrating its influence. 'The Impacts of Climate Change and Porous Pavements on Combined Sewer Overflows, A Case Study of the City of Buffalo, New York, USA' and 'Promoting green infrastructure in Mexico's northern border: The Border Environment Cooperation Commission's experience and lessons learned ' follow closely with 15 citations each, contributing significantly to research in the area. The remaining articles listed in Table 1 have made substantial contributions to the understanding and advancement of research in this topic ,

Research question 7 :

Which research keywords have been the most frequently used over the past ten years in The capacity of Sustainable Urban Drainage Systems in Adapting to Climate Change research area?

The bibliometric analysis focused on the most commonly used keywords, using 'Co-occurrence' as the analysis type and 'all keywords' as the unit for this analysis. A minimum of 2 keyword occurrences was set to identify influential keywords. The initial analysis identified 27 keywords from the dataset, as seen in the Figure 2.

When Figure 2 is examined, the top 5 used keywords in the studies listed as “Sustainable urban drainage systems” ( “0c” = 8), “Climate change” (0c = 7), “storms” (0c = 5), “Stormwater management ” (0c = 4), “Drainage” (0c = 3).

Discussion

A bibliometric analysis of 12 research publications retrieved from the Scopus database was conducted to assess the current state of SUDS research in the context of climate change adaptation. The analysis revealed a limited focus on this research area, despite its recognized importance. The review highlighted a research gap in this topic, as evidenced by the relatively low number of published articles.

Despite the limited body of research, Spain emerged as a significant contributor, accounting for approximately 25% of the analyzed literature. This study identified a narrow research focus on SUDS as a strategy primarily aimed at mitigating runoff and stormwater management, with limited exploration of its potential as a comprehensive climate change adaptation measure.

Conclusion

Climate change poses challenges, necessitating innovative strategies like sustainable urban drainage systems. Despite their significance, research on this topic remains limited and scarce, with only 12 publications in the past decade which highlights a research gap. In this purpose, this study aims to address this gap by encouraging researchers to publish in this area, to address this deficit, fostering a comprehensive understanding of global trends in sustainable urban drainage systems and their role in climate change adaptation.

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