When selecting drought indices, users should consider the regional climate of the study area.

Temperature- and evapotranspiration-based indices are highly recommended for arid regions, while vegetation-based indices are more effective in detecting drought hazards in humid and tropical areas.

SITE-SPECIFIC SUITABILITY OF DROUGHT INDICES: A SYSTEMATIC REVIEW

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Abstract

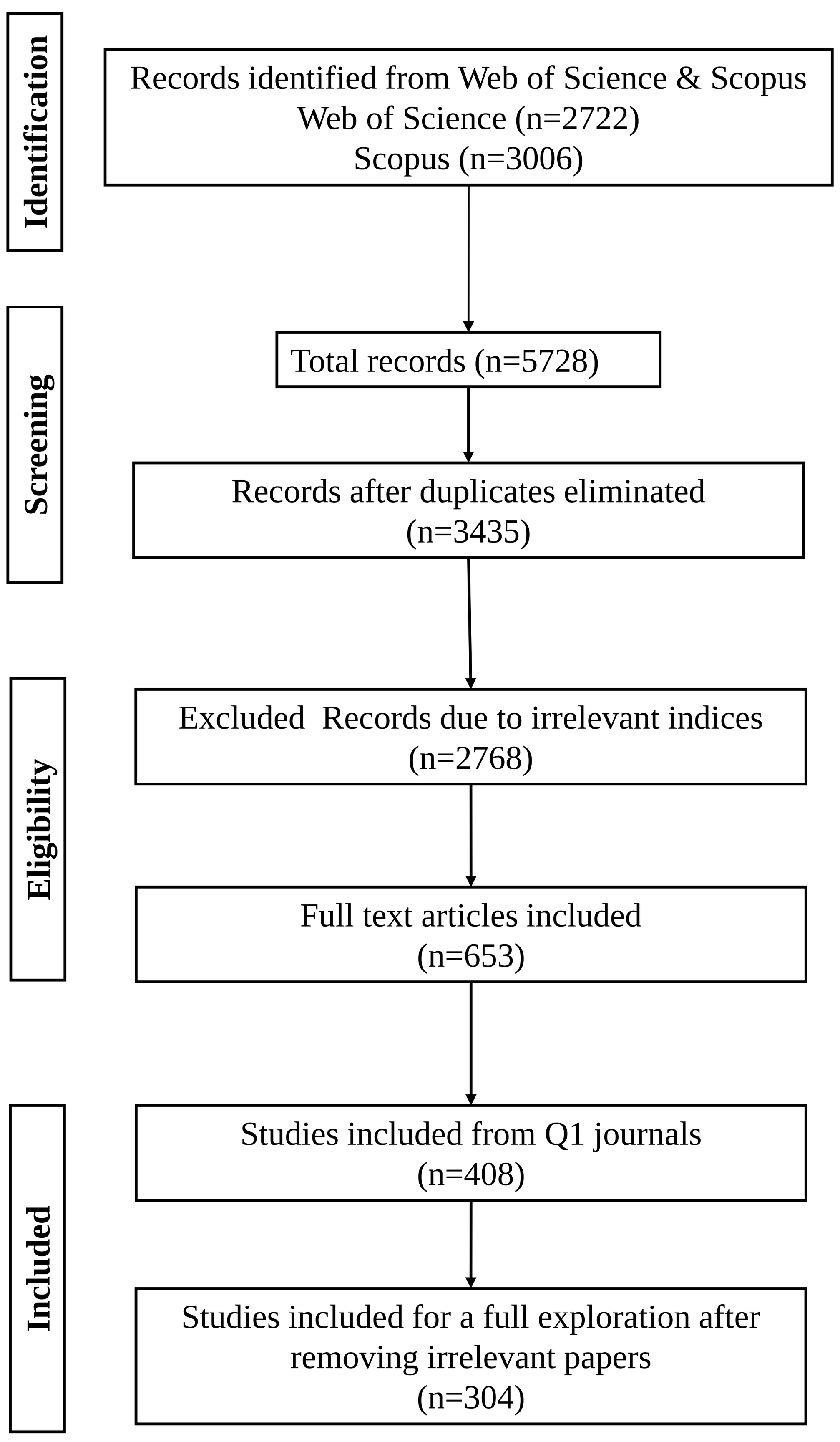
- It is essential to understand how important the regional climate and other characteristics are for the appropriate selection of drought indices, as features of each climate type are very different, and the response of indices to climate plays a vital role in drought indices performance.
- This systematic review addresses the critical gap by providing the simplicity of usage of the 17 common drought indices in four groups including meteorological, agricultural, hydrological, and vegetation-based drought indices.

Introduction

- Increasing publications focus on drought hazard assessment using various indices, reflecting growing research interest over recent decades.
- Previous studies reviewed definitions, calculation methods, limitations, and the evolution of drought indices. However, many did not specify their review methodology. Despite 41 review articles identified, there is a shortage of systematic reviews to evaluate the suitability of drought indices for various environmental settings on a global scale.
- The study's novelty lies in its valuable insights into selecting the most appropriate indices for different climatic contexts, such as tropical, humid, arid regions.

Method

- The study adhered to the guidelines of a non-Cochrane systematic review (Bearman et al., 2014), concentrating on the evaluation of 17 drought indices (including DI, CMI, EDI, PDSI, ETDI, SMDI, SMI, SDI, SMADI, TVDI, SDI, SWSI, threshold level method, NDVI, VHI, VCI, FAPAR) through an extensive review of peer-reviewed literature from Scopus and Web of Science up to March 2022.
- Following the screening of 5728 articles and the selection of 304 eligible studies, the analysis synthesized findings to assess the applicability of these indices across four principal climatic types as defined by the Köppen classification.



Results

A drought index is computed from various indicators like precipitation, temperature, evapotranspiration, and runoff to evaluate a drought phenomenon for a specific region but significant fluctuations or extremes in these parameters can lead to a misinterpretation of drought severity. Therefore, it is crucial to consider the climatic characteristics of a region when selecting an appropriate drought index.

Group A: Tropical climate

- Tropical climates are described by modest seasonal fluctuations of temperature and highly variable regimes of precipitation.
- A drought index with purely input of precipitation or temperature might not perform well the drought monitoring in a tropical climate while a vegetation-based index (e.g., VCI) is more suitable because it excludes the changeable temperature and associated evaporative demand.

Group B: Arid climate

- Arid climates are characterized by low precipitation and extreme temperature throughout the year together with high evapotranspiration due to windy conditions (John Arnfield, 2017).
- In such an arid climate, a drought index based on exclusively precipitation (e.g., DI, EDI) can lead to misleading evaluation due to too many zero values of rainfall and are not effective to detect drought in arid regions compared with evapotranspiration based- drought indices.
- Evapotranspiration and temperature-based indexes (e.g., SPEI) and Vegetation indices (e.g., TVDI, VHI, VCI), are more suitable for accurate drought detection in the arid zone.

Group C & D: Temperate climate and continental climate

- Midlatitude climates (Types C and D) vary by seasonal dryness, characterized by high precipitation and humidity, especially in summer.
- In dense vegetation areas like humid tropical zones, vegetation-based indices (e.g., VHI) are more effective for drought detection.
- Indices relying solely on PET are less suitable in humid zones because positive PET anomalies do not necessarily indicate drought.

Conclusions

- Policymakers should recognize that no single drought index is universally effective because drought indices respond differently to various types of climates, land uses and their performance depends on the purpose of the application.
- Using inappropriate indices can lead to inaccurate drought assessment and monitoring accuracy.
- Facilitate the development and distribution of high-quality, well-documented code for calculating drought indices to achieve a simplicity usage of more appropriate indices.
- While remote sensing products simplify data collection, essential variables like discharge and groundwater are still crucial for accurate drought assessment.
- Despite the majority of research using rainfall anomaly-based indices because of its simplicity, a careful evaluation of rainfall anomaly-based indices in catchment systems where the river discharge is dominated by snow-groundwater interrelationships. Because the snowmelt in such regions will reflect more accurately about a water balance than rainfall.
- In arid climates, indices based on temperature and evapotranspiration are more appropriate due to their direct relevance to the water budget, offering more accurate drought assessments.
- In humid and tropical climates, where there are dense canopies of vegetation, vegetation-based indices are preferable.
- Temperature-based indices should be used carefully in cold climates in mountainous areas as high temperatures in such climates benefit vegetation growth.
- Support research into how topography, biophysical characteristics, and human activities influence drought index performance, to enhance drought management strategies and policies.

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