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Scoping Review of Multicriteria Decision-Making/Analysis Methods to Assess Urban Quality of Life

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SCOPING REVIEW OF MULTICRITERIA DECISION-MAKING/ANALYSIS METHODS TO ASSESS URBAN QUALITY OF LIFE.

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Abstract

This paper employs the Scoping Review Method to explore recent literature on Urban Quality of Life (UQoL) and Sustainable Cities, identifying gaps in the field. The study successfully generated a significant number of articles using selected keywords, highlighting leading countries in relevant research, including China, Iran, Turkey, and India. The research identified the Analytic Hierarchy Process (AHP) and Techniques for Order Preference by Similarity to Ideal Solutions (TOPSIS) as the most common Multiple Criteria Decision-Making/Analysis (MCDM/A) methods used. The study extracted 70 Key Performance Indicators (KPIs) related to urban environmental quality, categorized into Environmental, Infrastructure/Physical, and Social dimensions. These indicators can be effectively integrated with MCDM/A methods within a Geographic Information System (GIS) environment, providing valuable insights into urban sustainability. The findings present significant opportunities for urban planners and policymakers, guiding the development of more sustainable and resilient urban environments. The study underscores the importance of using a comprehensive set of indicators and sophisticated decision-making methods to address the complex challenges of urban sustainability. It contributes to a deeper understanding of the current research landscape and provides a robust foundation for future studies.

Keywords: Sustainable Cities, GIS Applications, Environmental Indicators, Urban Planning

1 INTRODUCTION

The expansion of urbanization in cities has raised concerns about socio-environmental issues and the overall well-being of urban residents. The New Urban Agenda and Sustainable Development Goal 11 [1] underscore the importance of cities that are environmentally sustainable, resilient, socially inclusive, safe, and economically productive. Monitoring and evaluating urban performance through indicators is crucial for improving the quality of life (QoL) in urban areas. Evaluations of Urban QoL (UQoL) often focus on objective quantitative measures, neglecting subjective dimensions such as personal relationships and self-realization. Therefore, this paper examines the assessment criteria adopted in recent literature. The method used for this analysis is a Scoping Review.

This paper presents a framework that incorporates a more comprehensive set of Key Performance Indicators (KPIs). It concludes with policy implications and several insights. A scoping review, conducted from 2019 to 2022 and utilizing the Web of Science repository, is also detailed in this paper. The review emphasizes the critical analysis of Multicriteria Decision Making/Analysis (MCDM/A) applications, which use spatial analysis in a Geographic Information System (GIS) environment, and Environmental Urban Quality of Life (EUQOL). MCDM/A is a beneficial approach for decision-making in complex urban management scenarios that involve conflicting objectives.

By conducting this review, scholars and public management practitioners can identify the main features in the recent literature, released from 2019 to 2022, on sustainable urban development and sustainable cities.

2 SUSTAINABLE CITIES

Sustainable cities, also referred to as eco-cities or green cities, are urban environments that prioritize the integration of social, economic, and environmental factors to achieve long-term sustainability. Ideally, these cities should minimize negative impacts on the environment, promote social equity, and foster inclusive economic prosperity[2][3]. However, sustainable cities can encompass multiple dimensions, including urban planning, efficient transportation, clean and renewable energy sources, waste management, water conservation, green spaces, and social inclusion. These cities favor compact and mixed land-use development patterns to reduce the ecological footprint and promote efficient resource utilization. Such aspects can heighten the complexity of public management issues related to Urban Quality of Life (UQoL). This complexity arises from the pressures to transform existing cities into sustainable ones, which involves striving to foster social inclusivity and providing equal access to essential services, housing, and infrastructure for all residents [1] [4]. This transformation also requires community engagement, participatory decision-making processes, and equitable distribution of resources and opportunities. By adopting sustainable practices and addressing social inequalities, sustainable cities aim to create healthier, more resilient, and livable urban environments for both present and future generations [5].

3 METHODOLOGY

3.1 Scoping Review

The Scoping Review Method [6]–[8] is a systematic technique employed in scientific research to map the existing literature on a specific topic, offering an overview of the available evidence. This method differs from a traditional systematic review as it focuses on breadth rather than depth, with the aim of identifying key concepts, primary sources, and knowledge gaps. In a scoping review, researchers strive to survey the literature comprehensively to gain a broad understanding of the research field.

The process of conducting a scoping review involves several essential steps. Initially, researchers establish the research question or objective and set the inclusion and exclusion criteria. This helps in determining the studies relevant to the review. Subsequently, a comprehensive

search strategy is developed, typically involving the search of multiple databases and sources to identify pertinent publications. The chosen studies are then screened based on predetermined criteria, and data is extracted and analyzed to identify common themes, patterns, and research gaps.

The primary advantages of the Scoping Review Method encompass providing an overview of a research area, pinpointing knowledge gaps, and assisting researchers in determining the necessity for further research. By mapping the existing literature, researchers can ascertain the breadth and depth of available evidence, define the scope of a specific topic, and underscore areas requiring further investigation. Scoping reviews are especially beneficial in emerging fields or areas with limited prior research, such as Sustainable Cities and UQoL. These reviews can lay the groundwork for future studies and guide research agendas.

4 RESULTS

In the preliminary round of the survey, a search was performed using a set of keywords in the ScienceDirect database, yielding 783 articles. Following the previously outlined steps, the initial round of screening involved reviewing the abstracts of these articles. After this review, the total number of articles decreased from 783 to 563. Subsequently, in the second round, a full-text review was conducted and the exclusion criteria applied, further reducing the number of articles to 47, deemed relevant for the analysis.

The remaining 47 articles underwent detailed analysis to extract and scrutinize the indicators and Multi-criteria Decision-Making/Analysis (MCDM/A) methods typically used for assessing urban environmental quality.

The scoping review pinpointed a set of methods frequently reported in the literature, commonly applied to address various issues related to waste management, eco-efficiency, and urban transportation. Among these methods, the two most recurrent ones were the Analytic Hierarchy Process (AHP) and Techniques for Order Preference by Similarity to Ideal Solutions (TOPSIS).

Beyond AHP and TOPSIS, the scoping review also identified and analyzed several other methods. These methods encompass a diverse array of approaches used in the evaluation and decision-making processes related to the aforementioned topics. The complete set of methods provides a succinct listing of the identified and analyzed methods.

By scrutinizing the application of these methods in the literature, the scoping review aims to glean insights into the suitability and effectiveness of different approaches in addressing waste management, eco-efficiency, and urban transportation challenges. The analysis of these methods will contribute to a comprehensive understanding of the existing research landscape and may potentially guide future studies in these domains.

1. Analytic Hierarchy Process (AHP) and variations [9], [10], [19]–[24], [11]–[18]
2. Techniques for order Preference by Similarity to Ideal Solutions (TOPSIS) and variations [13], [16], [30], [31], [17], [18], [24]–[29].
3. Cocoso / Dumbi Cocoso [26], [32], [33]
4. BWM /Fuzzy BWM /Bayesian BWM 'Best Worst Method'[34]–[36]
5. The Weighted Aggregates Sum Product Assessment(WASPAS) [14], [26]
6. PROMETHEE/ PROMETHEE II [23], [24], [28], [37], [38]
7.]Elimination and Choice Translating Reality (ELECTRE)[17], [18]
8. Multi-Attribute VALUE Theory (MAVT) [39], [40]

Significant advancements have been observed in the application of MCDM/A methods within a Geographic Information System (GIS) environment for evaluating urban sustainability in research. The years 2021 and 2022 saw a surge in publications focusing on indicators for assessing sustainability in urban areas and the use of Multiple Criteria Decision-Making/Analysis (MCDM/A) methods. The Analytic Hierarchy Process (AHP) is one such MCDM/A method that has emerged to tackle the complexity of decision-making processes. It organizes objectives, attributes, criteria, and stakeholders, providing a comprehensive overview. The AHP methodology employs paired comparisons and a relative scale to create a comparison matrix. The AHP has been applied in various studies, such as the development of a Sustainable Cities Index in Turkey[12] and the assessment of environmental quality in Ernakulam, India [44].

As for TOPSIS, this method was developed by Hwang and Yoon in 1981 [45]. It ranks alternatives based on their proximity to the positive ideal solution and their distance from the negative ideal solution. Known for its simplicity, TOPSIS has been utilized in studies examining urban health in Qom, Iran [46], and sustainability indices [13], [25].

The survey's findings revealed a total of 70 Key Performance Indicators (KPIs) related to urban environmental quality in the articles examined. These indicators were divided into three dimensions: Environmental (Ev), Infrastructure/Physical (In), and Social (S). Within the Environmental dimension, 24 indicators were identified, including air quality/pollutants, particulate matter, water quality, waste management, and renewable energy. The Infrastructure/Physical dimension comprised 29 indicators, such as green urban spaces, accessibility, green areas, transportation, and healthcare facilities. The Social dimension included 17 indicators, encompassing population, urban population density, employment rate, GDP per capita, crime ratio index, and public security.

5 CONCLUSIONS

This paper employed the Scoping Review Method to map recent literature on Urban Quality of Life (UQoL) and Sustainable Cities, uncovering gaps in this field. The chosen keywords successfully generated a satisfactory number of articles and pinpointed leading countries in relevant research. Among the MCDM/A methods encountered, the Analytic Hierarchy Process (AHP) and Techniques for Order Preference by Similarity to Ideal Solutions (TOPSIS) were the most common. China and Iran emerged as the countries with the highest number of publications, followed by Turkey and India.

The 70 extracted indicators, encompassing various dimensions and biogeographical factors, can be effectively integrated with MCDM/A methods within a Geographic Information System (GIS) environment, offering valuable insights into urban sustainability. These indicators, covering environmental, infrastructure/physical, and social dimensions, provide a comprehensive framework for assessing and improving urban quality of life.

The findings of this study present significant opportunities for urban planners and policymakers. The identified indicators and methods can guide the development of more sustainable and resilient urban environments. They can be used to monitor and evaluate urban performance, inform decision-making processes, and prioritize interventions.

Furthermore, the identified gaps in the literature highlight areas for future research, particularly in emerging fields such as sustainable cities and UQoL.

In conclusion, this study contributes to a deeper understanding of the current research landscape and provides a robust foundation for future studies. It underscores the importance of using a comprehensive set of indicators and sophisticated decision-making methods to address the complex challenges of urban sustainability. As cities continue to grow and evolve, such research will be increasingly crucial in guiding their sustainable development and improving the quality of life for their residents.

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