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A Study of Municipal Solid Waste Management & Perception through Bibliometric Analysis.

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Abstract:

The management of Municipal Solid Waste (MSW) represents a complex activity that makes reference to innovative solutions and inclusiveness, considering the new realities of waste. The bibliometric analysis provides a powerful navigation tool for going through the vast literature that is accumulating on MSW and public perception through knowledge integration into research and practice, making it helpful to foster collaboration, stimulate innovation, and strengthen communities in moving toward adopting sustainable behaviours which support greater environmental sustainability as well as healthier, resilient societies. This paper uses bibliometrics to analyse the global literature based on MSW management to identify common practices, significant countries, notable organisations and thematic foci that characterise the discipline and which would enable a holistic appreciation of this subject matter. It contributes to the newly emerging body of discussions towards sustainable waste management in so far as this research takes extensive bibliometric regarding MSW and Public Perceived by Knowledge Integration into research and practice.

Keywords: *Bibliometric Analysis, Municipal Solid Waste, Public Perception, Scopus & Vos Viewer.*

Introduction

The management of MSW has emerged as one of the significant environmental challenges during the 21st century. The global challenge of MSW continues to be pressing as a result of the increase in urbanisation, population growth, and the change in the patterns of consumption. Municipal solid waste refers to most of the components of everyday waste: biodegradable waste, recyclable materials, hazardous waste and non-recyclable waste. Adequate treatment is crucial so that the ideal conditions of public health are maintained, ecosystems are conserved, and sustainable development goals are reached.

On the other hand, the management of MSW is also not only technological and infrastructural. The extent to which waste management practices will be implemented largely depends on the

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community and how it perceives waste in the first place. Waste habits, culture and individual conduct influence the processes of waste generation, segregation, disposal and recycling. Making an attempt to comprehend the motivators of public perception is important in ensuring the design of an effective and inclusive waste management measure.

The Need for a Bibliometric Approach

The distribution of Municipal Solid Waste (MSW) and studies regarding public perception are relatively new, gaining popularity among scholars who discuss aspects such as policy frameworks, technological innovation and its socio-economic impact in recent years. In order to represent this broad and multifaceted expertise, bibliometric analysis appears to be an important tool for integration. Bibliometrics is the statistical analysis of literature which has been published and enables readers to trace certain trends within researched topics, key studies within the discipline, major scholars and subject areas which are yet to develop. As stated, through bibliometric analysis, the research landscape is mapped out, various research initiatives are proposed, and most importantly, policy formulation is rigorously based on existing practices.

This paper employs bibliometrics in the analysis of the worldwide body of literature on MSW and public perception with a view to recognising common practices, major countries, notable organisations and thematic foci that define the discipline and allow for a holistic understanding of this subject matter. Science is hoping that doing this will bring science closer to practice; that is, theories work in practical scenarios. It then seeks to address the gap in municipal solid waste management.

Management of MSW is essential in attaining environmental sustainability. Unchecked accumulation of waste leads to several negative consequences, such as pollution of soil and water bodies, air pollution, and emissions of greenhouse gases. Badly disposed hazardous wastes lead to severe human health implications and biodiversity loss. Further, inefficient waste management systems are prone to causing overload to the urban infrastructure, which accelerates resource scarcity and climate change problems.

Sustainable waste management is a holistic approach encompassing environmental, economic, and social considerations. Some of the major approaches are source reduction, segregation and recycling, energy recovery, and advocating for the principles of a circular economy. The model under the circular economy reduces waste generation through reuse and recycling, thus reducing raw resources and minimising environmental degradation.

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Role of Public Perception

Public perception plays a fundamental aspect of a fully effective system of waste management. People and communities are neither mere observers nor acting parties involved in activities to separate, recycle, or dispose of waste. Attitudes and beliefs toward anything are expected to support sustainable practice success or work toward the failures of that intention. For instance, a higher level of awareness and a more positive attitude toward recycling will translate to a higher percentage of participation in waste segregation activities. On the other hand, misconceptions, apathy, or resistance to change can easily defeat even the best-designed policies and technologies.

Some of the factors that influence public perception of MSW management include:

1. Awareness and Education: Public attitude and behaviour regarding improper waste management's environmental and health impact are determined by knowledge about it. Public awareness and education campaigns effectively promote the right attitudes and behaviours toward sustainability.
2. Socio-Economic Factors: Income, availability of resources, and cultural practices will determine whether people can and are willing to participate in a waste management program.
3. Policy and Government: Clear and inclusive policies create trust and cooperation among citizens, hence enhancing participation in waste management.
4. Infrastructure and Accessibility: The degree of public compliance is determined by whether waste management systems are accessible and user-friendly.

Understanding these factors is the essence of policymakers, researchers, and practitioners being able to design strategies that resonate with public expectations and needs.

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Research Trends in MSW management and Public Perception

Growing research on MSW and public perception reflects rising awareness about their interdependencies. It has explored myriad dimensions, including:

- Behavioural insights: Motives and disincentives against behavioural changes in waste management at household and community level.
- Collaboration amongst stakeholders: Governments, the corporate world and civil society vis-à-vis sustainable practices of waste management.
- Technological Interventions: To determine how those innovations, like smart bins, waste-to-energy technologies, and automated segregation systems, will influence public attitude and utilisation.
- Policy Analysis: Determine whether penalties, incentives, or restrictions influence public attitude and behaviour.

A bibliometric analysis provides a systematic way of looking at such diverse themes and can reveal trends and priorities of global efforts. The citation of leading studies, leading researchers, and collaborative networks can cast light on the intellectual bases of the field.

Research Questions/ Objectives of the Study

The principal objectives of this bibliometric analysis are to:

1. Analyse trends in MSW research as well as public perception over time.
2. To point out key contributing countries, institutions, and researchers to the field.
3. To trace the recurring topics and new developing areas of interest.
4. To quantify the public perception-innovation interface of MSW management.

By focusing on these objectives, the research shall contribute to the advancement of integrated and evidence-based approaches in the management of MSW.

Importance of Bibliometric Analysis

Several benefits can be derived in the study of such a complex and interdisciplinary area as MSW and public perception through the application of bibliometric analysis:

- It captures the evolutionary trend of the research focus, thereby giving the focus shifts and emerging themes.
- Highly cited works identify the studies and researchers with considerable influence.
- This means collaboration mapping, which illustrates networks of collaboration among the countries, institutions, and researchers, which encourages mutual knowledge sharing.

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- Gap Identification: It identifies gaps which have to be filled through research.
- An examination of the bibliometrics in the context of MSW provides a view at the macro-level complementing qualitative and case-based studies. This helps researchers and policymakers understand larger trends in the field to make sure that local interventions stay in tune with international trends and best practices.

Bridging Research and Practice

Another important challenge is the gap between research in the academy and the practical application of such findings. It has been noted that scholars can generate a good amount of value through research on waste management technologies, behavioural interventions, and policy frameworks, yet such research findings hardly ever translate into practical applications. This calls for improved coordination among researchers, policymakers, and community stakeholders.

An adequate link in this chain exists in public perception. Connecting scientific knowledge with public involvement enables stakeholders to co-generate more effective and acceptable solutions. It can be seen in numerous cases of participatory approach successes, such as community-driven recycling programs, which had managed to align technical feasibilities with social acceptability.

Methods & Methodology

Data Collection

The bibliometric analysis in this study used data from the Scopus database. The keyword "MSW" (Municipal Solid Waste) & public perception was used to extract a data set of 334 relevant records by searching through article titles, abstracts, and keywords. Filters were applied to ensure that only articles written in English and classified under the Environmental Sciences, social science, engineering, multidisciplinary and psychology discipline were included. However, no date constraints were placed on the publication date, thereby allowing for the longitudinal study of the subject. Also, only research articles were considered in the selection process, and even those classified as "articles in press" were included. Another search was done with similar parameters but with a focus on articles concerning India.

Data Processing

The extracted data was exported in CSV format to a file for further cleaning up. This included removing duplicate records, irrelevant studies, and entries with no complete bibliographic information. The cleaned dataset of 219 documents was thereafter analysed using a VOS viewer, as described by Sarquah [20] [**Fig. 1**].

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Data Analysis

A series of key bibliometric parameters were examined using VOS viewer, an accepted tool that is highly regarded for its user-friendly interface and high quality in data visualisation. Metrics included total publications, prolific authors, the leading countries in scientific contributions, and keyword co-occurrence patterns. This tool proved very important for producing uniform data mapping and clustering to create meaningful visualisation of the research landscape.

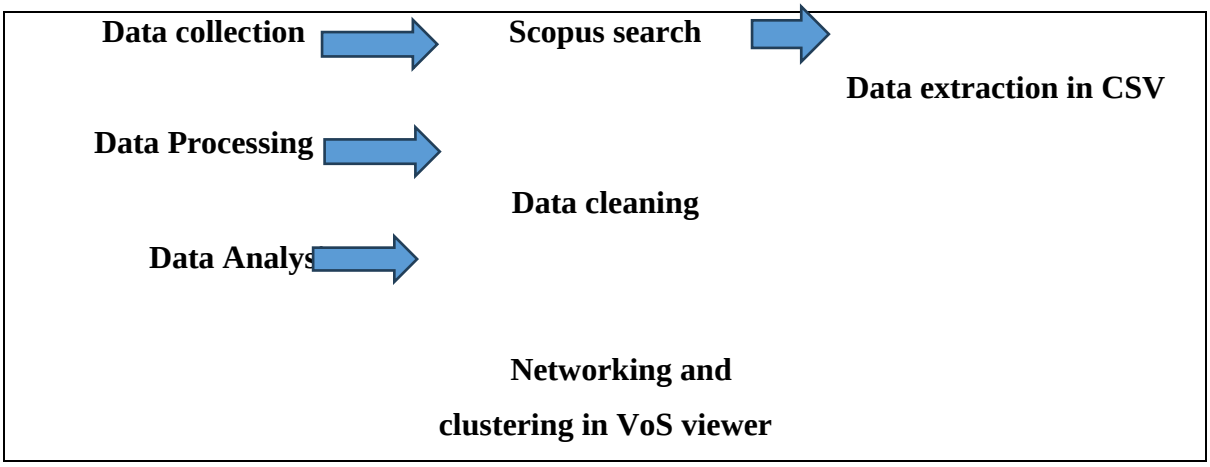

Fig. 1: Flow chart of methodology used in bibliometric analysis

Result and Discussions

Trends in Municipal solid waste and public perception publications

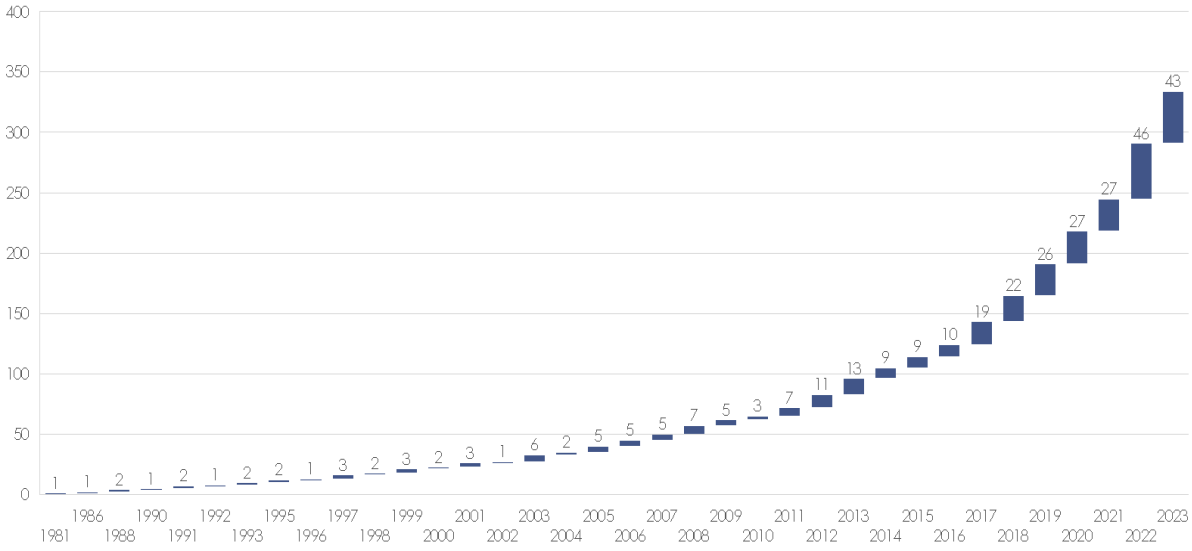

Fig. 2:

Journal's Articles published on MSW management and Public perception (1981-2023)

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The graph [**Fig. 2**] shows the pattern of publications in municipal solid waste management and public perception from 1981 to 2023. From the data obtained, there is a gradual pick-up, with barely any annual publications until the early 2000s; this could be an indicator of limited research activity or awareness of this domain up to earlier decades. In the case of 2005 and onwards, there was a gradual increase in publications, in line with global concern regarding waste management and sustainability. A notable increase can be seen after 2015, which is in sync with the adoption of international frameworks such as the Sustainable Development Goals (SDGs). The peak in 2023, with 43 publications, indicates growing academic and social interest in addressing the challenges of waste through public perception and community involvement. This upward trend indicates increased recognition of the significance of interdisciplinary research in the sustainable management of municipal solid waste.

Contributing nations in waste management & public perception.

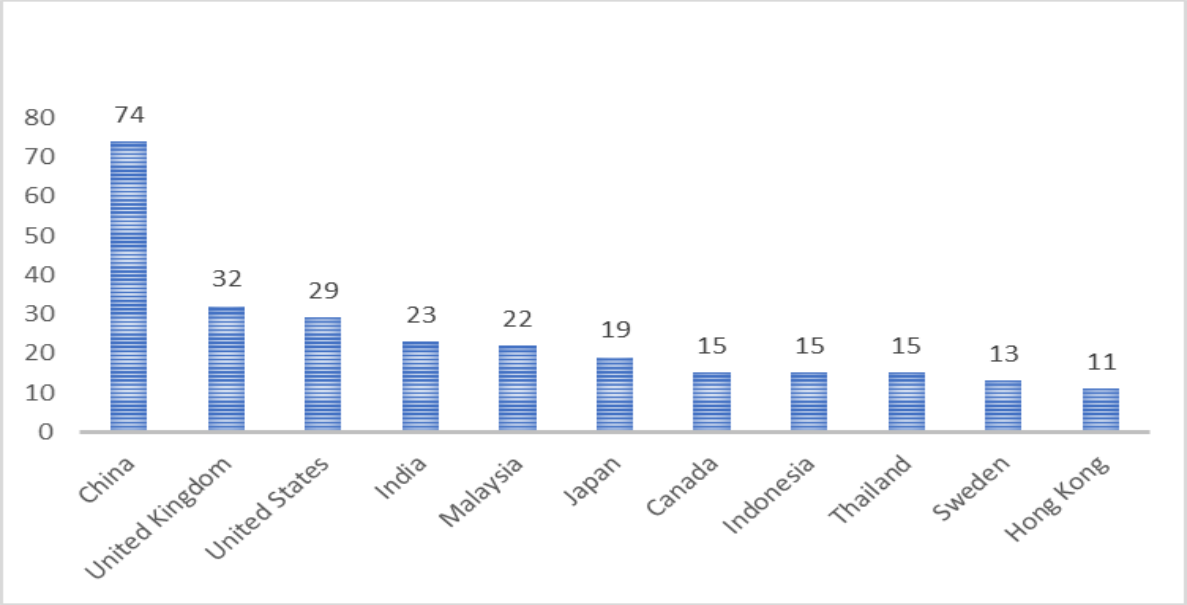

Fig. 3: Top 10 Contributing nations in waste management & public perception publications.

Analysis of the top 10 contributing nations for the research on Municipal Solid Waste and public perception presents worldwide participation, where the number of contributions from China reaches 74 publications. Other countries that contribute at great levels are the United Kingdom, with 32 contributions, and the United States, with 29 contributions, evidencing their strong involvement in matters of waste management issues. Other notable contributors include India with 23, Malaysia with 22, and Japan with 19. It presents a diversified view of regional efforts [**Fig. 3**]. Network

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visualisation with VOS viewer indicates the existence of intense research collaboration centred around China, which shows extensive connectivity with the United States, the United Kingdom, and India [**Fig. 4**]. This interlinkage highlights the global relevance of MSW research with knowledge sharing and international cooperation being a crucial factor for the advancement of sustainable waste management practices. The overlay suggests that the focus of the research has increased over the years, especially after 2015, in step with the heightened global concern for sustainability and waste reduction strategies.

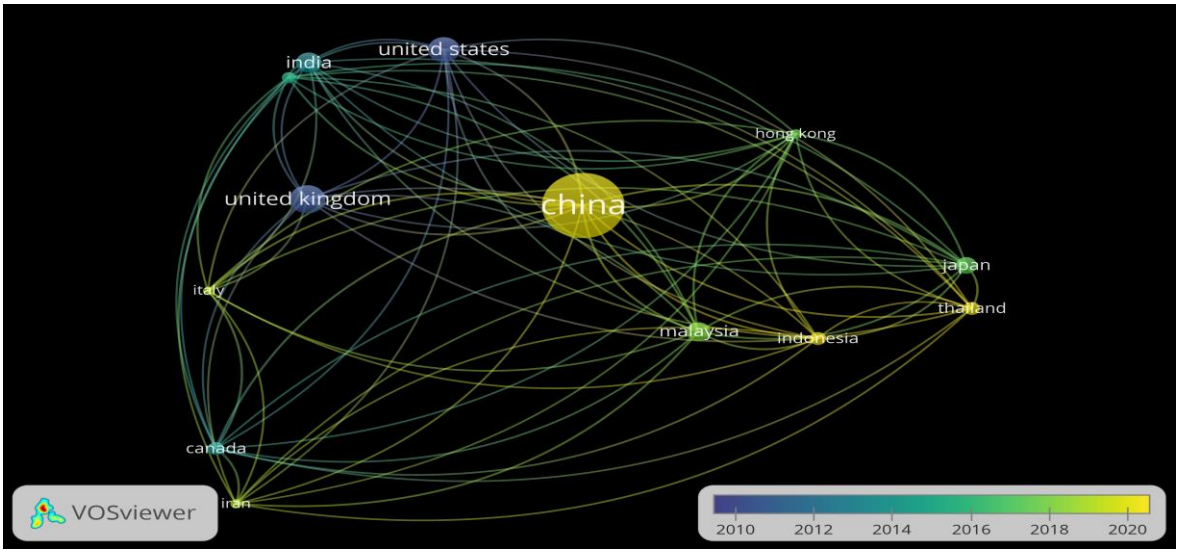
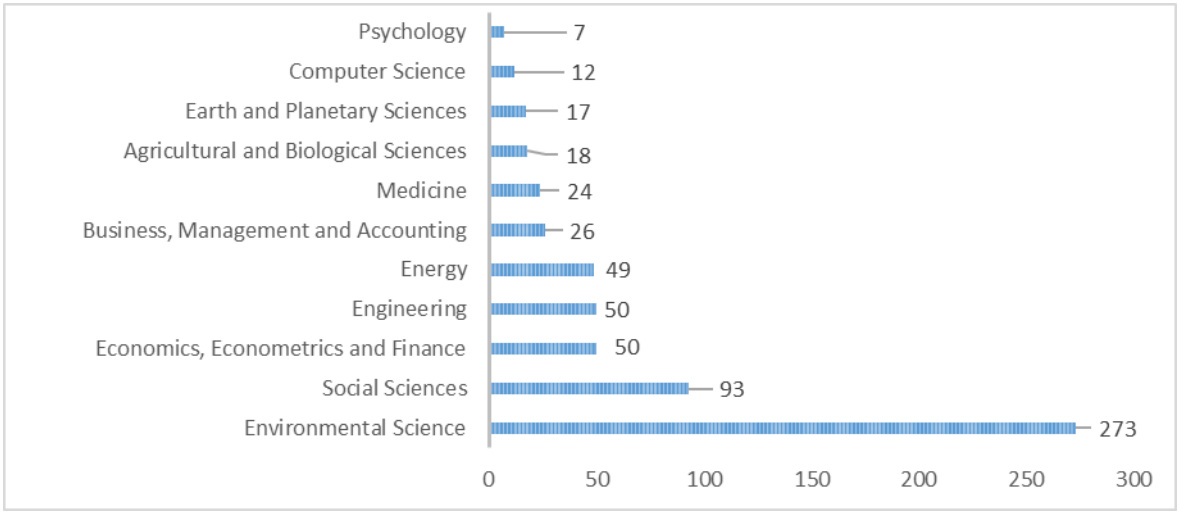


Fig. 4: Network visualisation of collaborating countries with VOS viewer

Academic disciplines towards public perception and waste management

Fig. 5:



Interdisciplinary Approaches in public perception and waste management.

The graph [**Fig. 5**] displays the distribution of academic disciplines towards public perception and waste management issues. Environmental Science remains at the top, with 273

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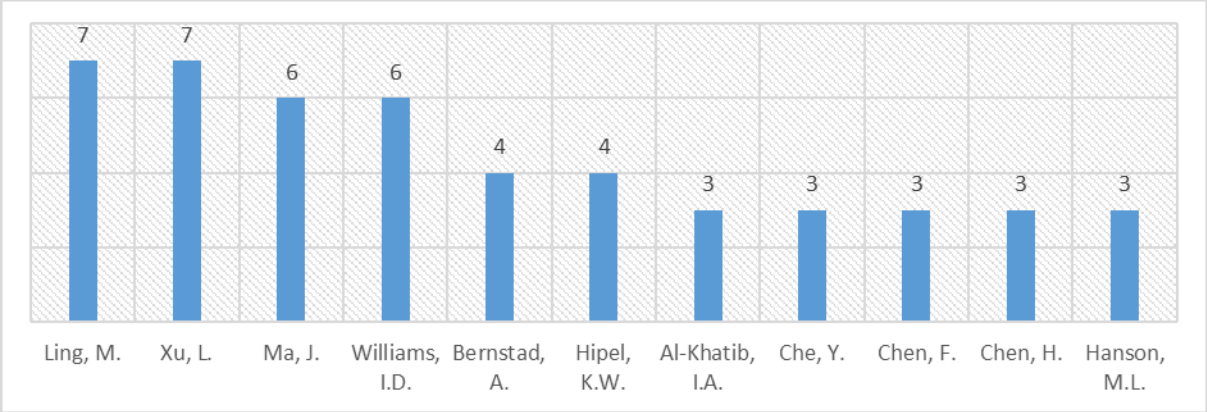
contributions, as waste-related challenges and solutions will always be at the forefront of the study. It is followed by Social Sciences, with 93 entries, to emphasise human behaviour, societal impacts, and community engagement in waste management. Economics, Engineering, and Energy each contribute moderately with about 50 each, showing their importance in resource efficiency, technological innovation, and sustainable energy recovery. Business, Medicine, and Earth Sciences have fewer studies, indicating niche but important intersections with waste management. Psychology has the least contributions, with 7, and Computer Science has 12, indicating underexplored opportunities in behavioural studies and digital solutions for waste issues. This distribution calls for interdisciplinary approaches in dealing with the multi-dimensional nature of waste and public perception.

Major contributing researchers

Fig. 6: Top 10 contributor in public perception and waste management.



The graph [**Fig. 6**] illustrates the top 10 contributing researchers in public perception and waste management studies. Ling, M. and Xu, L. lead the group with seven contributions each, showing the extensive involvement of the researchers in this field of study. Next in line are Ma, J. and Williams, I.D., who also have six contributions each, thus demonstrating their active roles in advancing the field. Bernstad, A., and Hipel, K.W. The contributors have contributed Four studies each, reflecting a steady commitment. The remaining contributors, including Al-Khatib, I.A., Che, Y., Chen, F., Chen, H., and Hanson, M.L., have three publications each. This distribution indicates a mix of highly specialised researchers with varying degrees of focus on the subject. The prominence of these researchers emphasises their influence in shaping the discourse on waste management and public perception, and the diversity of contributors reflects the field's interdisciplinary nature.

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Top contributing institutions

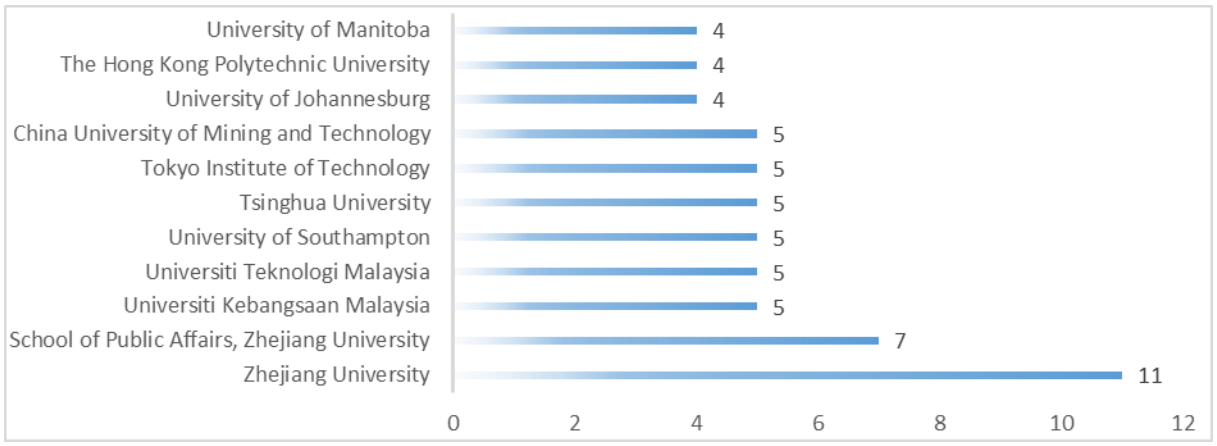

Fig. 7: Top 10 contributing institutions by their engagement in public perception & MSW management

The figure [**Fig. 7**] above ranks the top 10 contributing institutions by their engagement with a particular research domain or collaborative undertaking. Zhejiang University leads with 11 contributions, significantly higher than the School of Public Affairs at Zhejiang University, which has 7 contributions. Universiti Kebangsaan Malaysia, Universiti Teknologi Malaysia, and the University of Southampton tie at 5 contributions. The University of Manitoba, The Hong Kong Polytechnic University, and the University of Johannesburg contribute the least within the top 10, with each having 4 contributions. This data shows how Zhejiang University dominates while the rest of the institutions are relatively evenly distributed

Top Publishers in waste management and public perception

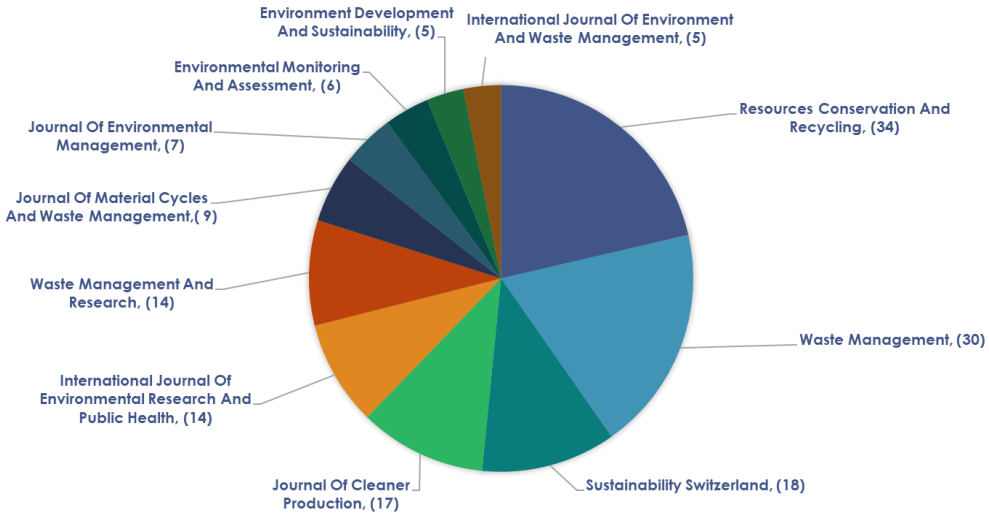

Fig. 8: Top 10 publishers in waste management and public perception

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The pie chart [**Fig. 8**] provides the top 10 contributing publishers in a particular discipline, giving relative publication counts. “Resources Conservation and Recycling” is at the top with 34 articles, followed by “Waste Management” with 30. Other contributors also include “Journal of Cleaner Production” with 17 and “Sustainability Switzerland” with 18 publications. “Waste Management and Research” and “International Journal of Environmental Research and Public Health” follow with 14 articles from each. Other journals like “Journal of Material Cycles and Waste Management” (9), “Journal of Environmental Management” (7), and “Environmental Monitoring and Assessment” (6) have smaller yet substantial contributions. The two least represented journals, namely, “International Journal of Environment and Waste Management” and “Environment Development and Sustainability”, were responsible for 5 publications, respectively. This distribution underlines the eminent position of some special journals in the literature, but it also points to a broader, even though less substantial, contribution from others.

Map of Research Themes

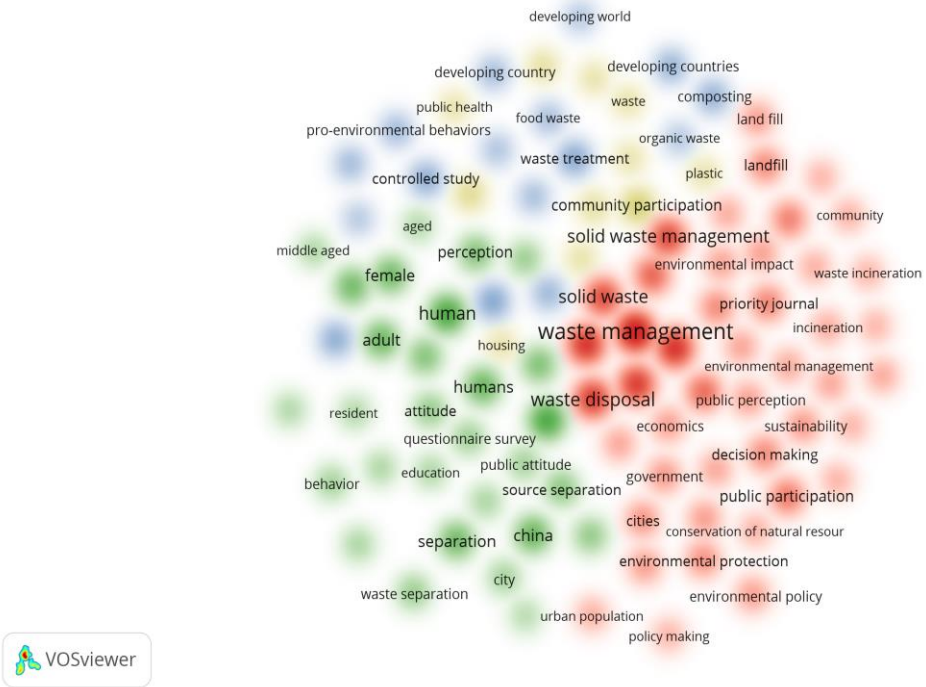

Fig. 9: a VOS viewer visualisation & Cluster analysis

This is a VOS viewer visualisation [**Fig. 9**], which probably represents some kind of bibliometric analysis of themes of research in waste management and public perception. As can be seen, it is divided into clusters called red, green, and blue, each representing various yet interconnected

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research domains. The red cluster mainly refers to technical and policy-oriented things like "waste management," "waste disposal," and "solid waste management.". The green cluster focuses on human and behavioural factors, such as "attitude," "behaviour," and "waste separation," which reflects the importance of social participation in waste-related practices. The blue cluster is relatively smaller and may represent demographic or contextual factors, such as "developing countries" or "pro-environmental behaviours." Overall, this map emphasises the multidisciplinary nature of waste management research, connecting technical, policy, and social dimensions. It also identifies the future research areas related to increasing public participation and region-specific policies.

Correlating Areas with Public Perception.

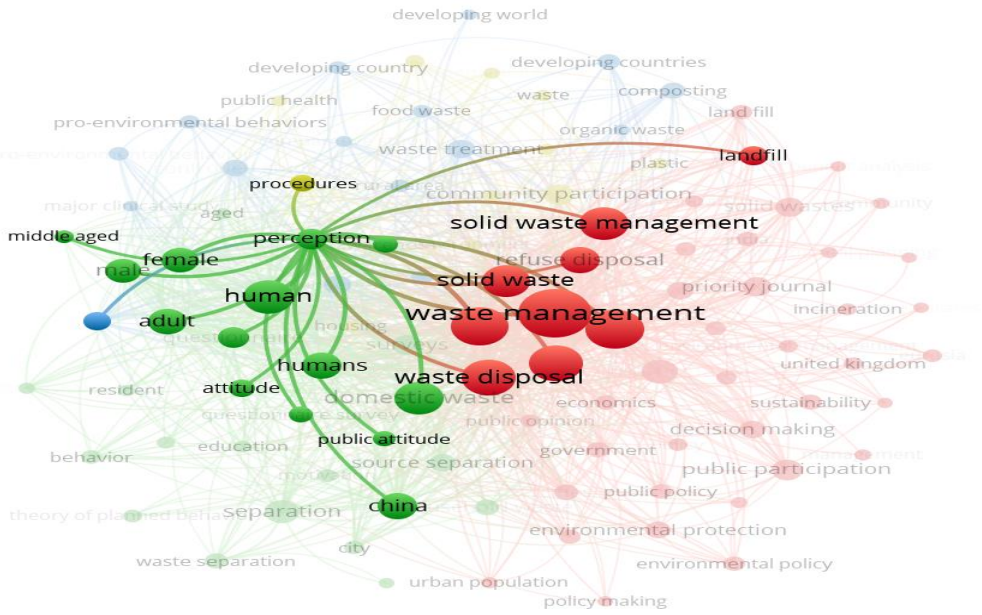

Fig. 10: Network visualisation of the correlation of research themes through VOS viewer.

A VOS viewer network visualisation of the correlation of research themes and public perception within the domain of waste management. This map [**Fig. 10**] has three separate clusters, denoted as red, green, and blue nodes. The red cluster contains technical and policy-driven themes, such as "solid waste management," "waste disposal," and "landfill," since they lie at the core of the body of waste management research. The green cluster focuses on social and behavioural factors, which include "public attitude," "perception," and "waste separation," indicating that public engagement in waste-related practices is of significance. The blue cluster indicates demographic factors like

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"female," "adult," and "middle-aged," which seems to suggest that the researchers have analysed how different segments of populations perceive and participate in waste management practices. This illustration clearly shows that technical, social, and demographic aspects of waste management should be understood to facilitate a multidisciplinary approach to improve it and orient it with people's perceptions and behaviour.

Conclusion

MSW management is a complex activity that requires innovative and inclusive solutions responding to the new realities of waste. At a time when escalating crises of waste around the globe are of great concern, understanding the interrelation between technical progress and popular perception is of growing interest. Bibliometric analysis can offer powerful navigation tools for going through the vast literature accumulated on MSW, showing trends, themes, and gaps. It makes a contribution towards the burgeoning body of discussions about sustainable waste management in that this research does extensive bibliometric analysis on MSW and public perception through knowledge integration into research and practice, making it helpful to foster collaboration, stimulate innovation, and strengthen communities in moving towards adopting sustainable behaviours which support greater environmental sustainability as well as healthier, resilient societies.

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Conflict of interest

No potential conflict of interest was reported by the author(s).

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