

Review article

Waste Management Policy in Four ASEAN Countries: Emerging Contemporary Issues from Research Works

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Abstract

Southeast Asia faced an urgent waste crisis, particularly in Indonesia, Malaysia, Thailand, and the Philippines, threatening severe environmental, ecosystem, and public health consequences. Without a comprehensive waste management policy, conditions deteriorated significantly. This research explored waste management policy studies with a bibliometric lens in four Southeast Asian countries: Indonesia, Thailand, Malaysia, and the Philippines. Using the Scopus database, powered by the VOSviewer software and the bibliometrix-R studio package, this research provided a precise visualization. The findings revealed that four countries exhibited an upward yet fluctuating trend in publication output, with Indonesia emerging as the leading contributor in recent years. Furthermore, most documents studied by scholars, the highest impact documents, and most documents in journal sources were also discussed. Two affiliates in Malaysia were the leading affiliates, followed by two affiliates from Thailand. Moreover, environmental science and social science were areas of interest for scholars. Term network trajectory mapping and thematic maps were comprehensively included. In sum, Indonesia fought hard against plastic waste to minimize climate change, while Malaysia focused on addressing waste emissions and household waste. The Philippines sought to raise awareness about the microplastic problem in the ocean and promote public awareness of waste management. Thailand requires attention to financing waste management equipment, implementing environmentally friendly solutions, and revising waste management rules. Its implications underlined a new complex of waste issues in Southeast Asia, requiring adapted strategies and solutions to address each country's waste challenges and concerns. Current research contributed to the existing state-of-knowledge by providing disaggregated views of national waste management policy in those countries. It also highlighted key potential future hotspots for targeted interventions and resource allocation; thus, future policies and collaborations in waste management might have become more effective and impactful.

Keywords: Waste management policy; Southeast Asia; Circularity; Sustainability.

1. Introduction

Waste, regardless of its type, is an inevitable by-product of human activity. The utilization of by-products gives rise to many types of waste, requiring concerted efforts for their management in order to reduce the rate of waste production. Reflecting on the World Bank report, waste generated per person per day averages 0.74 kilograms but varies from 0.11 to 4.54 kilograms. It is noteworthy that, although high-income countries account for only 16% of the global population, they produce about 34% of the world's waste, or 683 million tons (World Bank, [2025](#)), and alarmingly, if these pressing waste management issues are not addressed, it is projected that global waste production of 2.1 billion tons in 2023 will increase to 3.8 billion tons in 2050 (UN Environment Programme, [2024](#)). Therefore, it appears that waste management is a major issue for current and future environmental protection.

Our planet is highly pressured due to the impact of waste today, many researchers have concentrated on finding ways to improve innovation insights and waste management scenarios, models, and policy patterns of programs that have been implemented at every level, such as composting, landfilling, and incineration (Karak *et al.*, [2012](#)), even to design ideas for management systems that are more sustainable and responsible for the environment and human health, such as circular economy integration approaches and waste conversion into renewable energy (Haas *et al.*, [2015](#); Kalkanis *et al.*, [2022](#); Malinauskaite *et al.*, [2017](#)). In Southeast Asian countries, we critically review the high percentage of waste composition per type (Figure [1](#)), which raises the question of waste management, which is still a major obstacle and needs serious attention because it is considered to be lacking in terms of technical and local expertise and even lacks good waste management infrastructure. Consequently, the need for policy strategies in waste generation and disposal services is paramount; the availability of appropriate technology can also significantly influence



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the effectiveness of waste management policy implementation. For instance, the development of waste recycling technology remains minimal yet is highly necessary, as it offers a promising, cost-effective alternative to high-cost waste incineration (Aziz & Ariffin, 2024; Ng *et al.*, 2023), another example where some regions still lack labelled or colored bin facilities to distinguish the type of waste they produce (Arumdani *et al.*, 2021).

Although all Southeast Asian countries have several sanitary landfills and open dumps, none of them have composting, incineration, or open burning systems, except for Indonesia (Agamuthu & Babel, 2023). Another study revealed that the lack of a sophisticated waste management system in Southeast Asia is a significant cause of severe environmental impacts, as it is a hotspot for receiving waste, especially plastics, from developed countries, but most countries do not have the infrastructure for proper waste management; hence, at the same time, there is a need to formulate policies for unintended consequences, certainly through regulations (Ng *et al.*, 2023). Therefore, scholars are engaged in various studies to explore potential waste management policies that can offer suitable and feasible solutions.

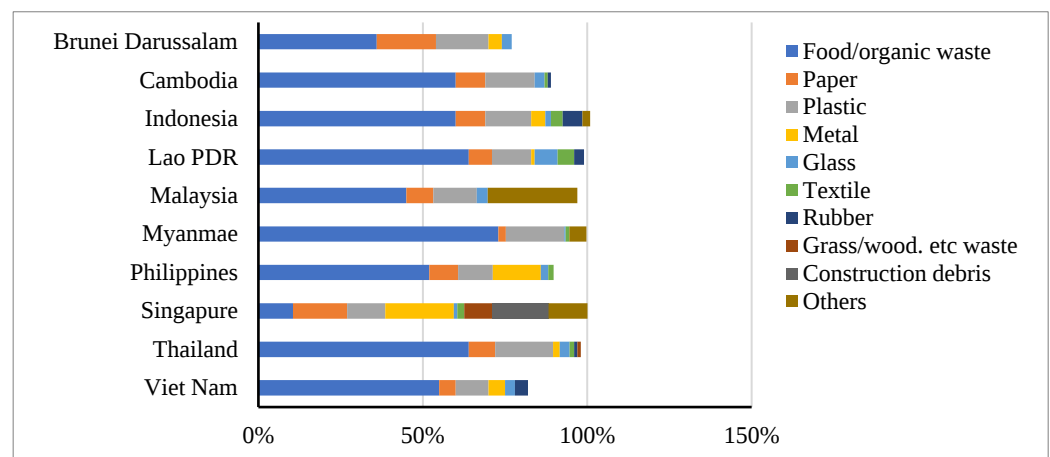


Figure 1. Composition of MSW in ASEAN Countries (Source: UN Environment Programme, (2017), Own elaboration).

Figure 1 highlights the predominant role of food/organic waste, which constitutes the vast majority of waste types within each country, followed by plastic waste, a concern that warrants immediate attention, and other types of waste. Though in the case of plastic waste, several policies at the global/international, regional/national levels have been implemented, such as the 3R policy, plastic trade, and circular economy (Pilapitiya & Ratnayake, 2024). However, the fact remains that these wastes continue to show an increasingly alarming trend in line with the population level and consumption trend of society towards their use. For glass waste, globally, the production surge exceeds 130 million tons every year, yet the recycling practice is below 50% and most of it ends up in landfills. It has presented a serious concern of urgent environmental issues and the need for action to recycle based on circular economy principles (Naik *et al.*, 2024; Wimalasuriya *et al.*, 2025). Other types of waste issues are also haunting every second.

Most countries in Southeast Asia have policies and regulations regarding solid waste management, but the implementation is still ineffective due to the influencing political system, availability of financial and human resources, appropriate technology, and public awareness and participation (Aziz & Ariffin, 2024). Recent regulations, laws, and policy directions have been found to vary in their approaches to waste management policies across Southeast Asian countries. In this context, the most important aspect is that policies play an important role in sustainable waste management. Some examples include and become a case study for this paper: Malaysia developed a biogas policy for renewable energy from organic solid waste that can generate electricity (Amin *et al.*, 2022; Bong *et al.*, 2017); Indonesia implements community-based waste banks (Budiarto *et al.*, 2025; Kubota *et al.*, 2020); macro plastics are found in the Philippines' seas making authorities issue policies to reduce the use of plastics (Galarpe *et al.*, 2021; Mathis *et al.*, 2022); in Thailand, due to high plastic waste, the policy of implementing the 3R (reduce-reuse-recycle) strategy for plastic waste management, and promoting education for relevant stakeholders in the field of plastics and alternative materials (Wichai-utcha & Chavalparit, 2019); however Thailand still needs a large budget allocation for its municipal waste management technology, as the budget provided has yet to cover and adequately manage it sufficiently (Boonpa & Sharp, 2017; Sukholthaman & Shirahada, 2015).

On the other hand, several previous studies have also examined waste management with a bibliometric lens, such as identifying trends in waste management during 1997-2014 (Chen *et al.*, 2015), bibliometrics of municipal waste management within the reach of the circular economy (Tsai *et al.*, 2020), similar to (Ranjbari *et al.*, 2021) on mapped waste management in the context of the circular economy during 2001-2020 by identifying research themes and trends, main characteristics, evolution, and direction of future studies. There is a bibliometric study focusing on demolition waste management in the period from 2007 to 2020 (Li *et al.*, 2022), the same was previously conducted by (Wu *et al.*, 2019) between 1994 and 2017. A review of water waste management studies in the series of 2012-2018 (Durán-Sánchez *et al.*, 2020), plastic waste that was reviewed bibliometrically during 1992-2022 (Rinanda *et al.*, 2023), while other things, there are also multicriteria decision-making-based waste management studies taking data from 1992 to 2022 (Sohail *et al.*, 2023), bibliometric studies are also found for electronic waste (Gao *et al.*, 2019).

After conducting a thorough analysis of several previous works, this paper has not found any research that adequately illustrates the extent to which academics examine trends in waste management policy studies through a bibliometric lens. However, the existing literature predominantly confines its discussion to biometric aspects of waste management from a circular economy perspective, often with a narrow focus on water and plastic waste. This creates a highly urgent research gap, necessitating a sharp spotlight on comprehensive waste management policy studies. Such an investigation is crucial for gaining a complete understanding of policy perspectives across the countries under examination, and it can yield crucial findings regarding each country's adoption and direction of waste management policies. These findings will, in turn, be vital considerations for supporting evidence-based policymaking. Therefore, this study is critically important for understanding the dynamics of waste management policies, particularly across the four Southeast Asian nations of Indonesia, Thailand, Malaysia, and the Philippines, as an example. In doing so, the purpose of this study is to examined a waste management policy studies in the bibliometric lens of publication trends and directions from previous researchers, also emerging points and terms related to policy studies, in which the novelty of this study lies in its role as a foundational element for future research, especially in describing the trajectory of waste management policy research in Southeast Asia, with particular reference to Indonesia, Thailand, Malaysia, and the Philippines.

Thus, this study intends to answer the questions:

- a) What is the annual publication frequency of waste management policy studies in Indonesia, Thailand, Malaysia, and the Philippines?
- b) Who are the authors with the highest number of publications and the most citations, then the highest affiliations and sources, as well as which subject areas with the most frequency in publishing waste management policy studies in Indonesia, Thailand, Malaysia, and the Philippines?
- c) What are the trajectory networks and thematic that have emerged in the study of waste management policies in Indonesia, Thailand, Malaysia, and the Philippines?

2. Research Methods

To obtain a comprehensive result and discussions aligned with the objectives, this research was conducted with a bibliometric approach, which allows this approach to help find downstream citations and create a thesauri (taxonomies) to assess scholarly impact and improve automated searches on topics, helping to find scores and interpret terms that emerge from scoring models (Cooper, 2015). Within results of themes or terms highlighted in bibliometric studies, it encourages institutions and academics to reflect on potential areas for improvement within that subject area (Ball, 2018). In this study, we attempt to categorize and compare each study in each country in capturing the topic of waste management policy, including Indonesia, Thailand, Malaysia, and the Philippines.

The data we used was initiated by the credible source Scopus, choosing Scopus because it is one of the largest curated databases of abstracts and citations and ensures that the sources it indexes go through rigorous selection by an independent advisory board so that in the end the documents indexed by Scopus journals are of good quality (Baas *et al.*, 2020). The specific terms that we focus on when searching for scientific literature in Scopus, as in the period from 2000 to 2024, are focused on the types of documents and articles, with English as the language of introduction of the scientific work. Specifically, the criteria adopted in this article were formulated in English, given its status as the scholarly lingua franca, thereby ensuring broader interpretability across

diverse linguistic backgrounds. The temporal scope was deliberately confined to a twenty-five-year period (2000-2024) to observe prevailing trends, a decision informed by the availability of comprehensive data sources offering an exhaustive overview of waste management policy studies. Furthermore, the exclusive focus on articles as document types was due to their submission to rigorous peer-review processes, attesting to their methodological rigor and high credibility. The terms embedded in the search field were “waste” AND “management” AND “policy”, accompanied by the keywords of each initial stage, with the name of the country for this study. The instruments that have helped us analyze are the Scopus database, from which we export data using the BibTeX format, and then run through the Bibliometrix package in R-Studio and VOSViewer. The use of these two research instruments is because they complement each other’s findings, such as in Bibliometrix, which studies thematic maps, and VOSViewer, which is used to see the trajectory of existing keyword networks or terms. As a result, Derwis’s (2019) study corroborates that Bibliometrix-R focuses not only on data visualization but also on the statistical accuracy and completeness of the results. Likewise, VOSViewer can complement it (Arruda *et al.*, 2022), such as offering flexibility for requests to display better quality graphics.

The data analysis process starts from comparing all data on waste management policy studies in four countries, such as exploring the number of documents published each year, authors who have the highest number of publications, authors who have the highest number of impacts/citations, sources used as references for researchers to publish their scientific work, background affiliations of scholars, frequencies of subject areas, networks analysis and thematic map analysis. This paper then observed and discussed the findings around the core of each country’s waste management policy direction, examining how scholars have revealed the trend of studies through their publications.

3. Results and Discussion

This section presents the results of a bibliometric analysis of waste management policy studies in four Southeast Asian countries, namely Indonesia, Thailand, Malaysia, and the Philippines. Through data visualization, we identified publication trends, the most prolific and impactful authors and institutions, and the most studied research subject areas. Term trajectory analysis and thematic maps have also provided a more in-depth picture of the development of research in this field.

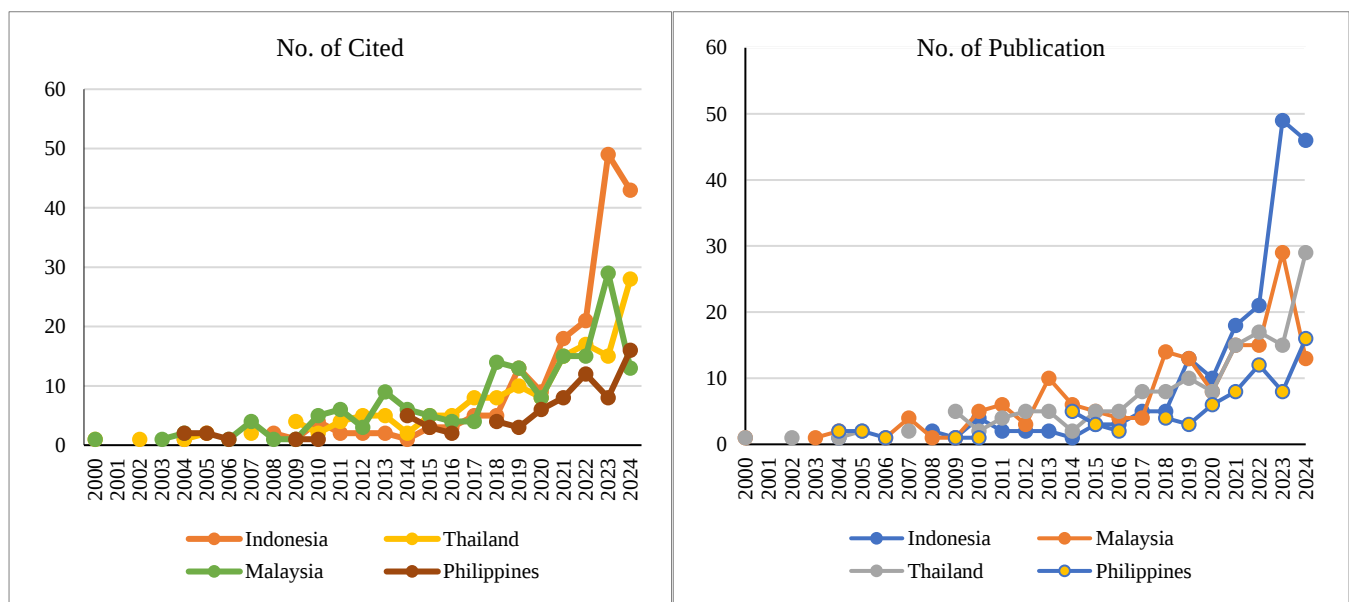


Figure 2. Comparing the Number of Publications and Citations on Waste Management Policy Studies (Source: Scopus academic database, 2025).

The publication frequency of studies on waste management policies is shown in Figure 2, where the four case study countries have their trends. From the data obtained, of the four countries as case studies, Indonesia has 188 total articles, Malaysia has 166 in total, followed by Thailand with 151 publications, and the Philippines with 74 publications. Some highlights need to be underlined to be observed. The four country case studies revealed that Thailand initiated earlier in 2000 and 2002. However, it was not long before scholars who studied waste management policies in Thailand reappeared in 2004 with one published article. The data from the Thai case study fluctuated, with the highest point of the number of publications throughout the year in 2024, with 29

documents. This is in line with the data shown for Malaysia, where publications peaked in 2023 at 29 documents, although in 2024, there was a decline of 13 articles. In the early 2000s, the Philippines initiated studies on waste management policies, beginning in 2004. Although several years of similar research were lost, 2024 saw the highest number of publications released, with 16 documents.

On the other hand, in sum, the annual citations indicate a notable interest among scholars in the study of waste management policy. The number of citations varies among countries, with Thailand and Malaysia having one citation each in 2000 and Indonesia and the Philippines obtaining their first citation in 2004. A similar trend is evident in the number of citations in 2024, with Indonesia having 43 citations, Thailand having 28 citations, Malaysia having 13 citations, and the Philippines having 16 citations. However, when the total number of citations for each country is considered, Indonesia has 184 citations, followed by Malaysia with 158 citations, Thailand with 146 citations, and the Philippines with 74 citations.

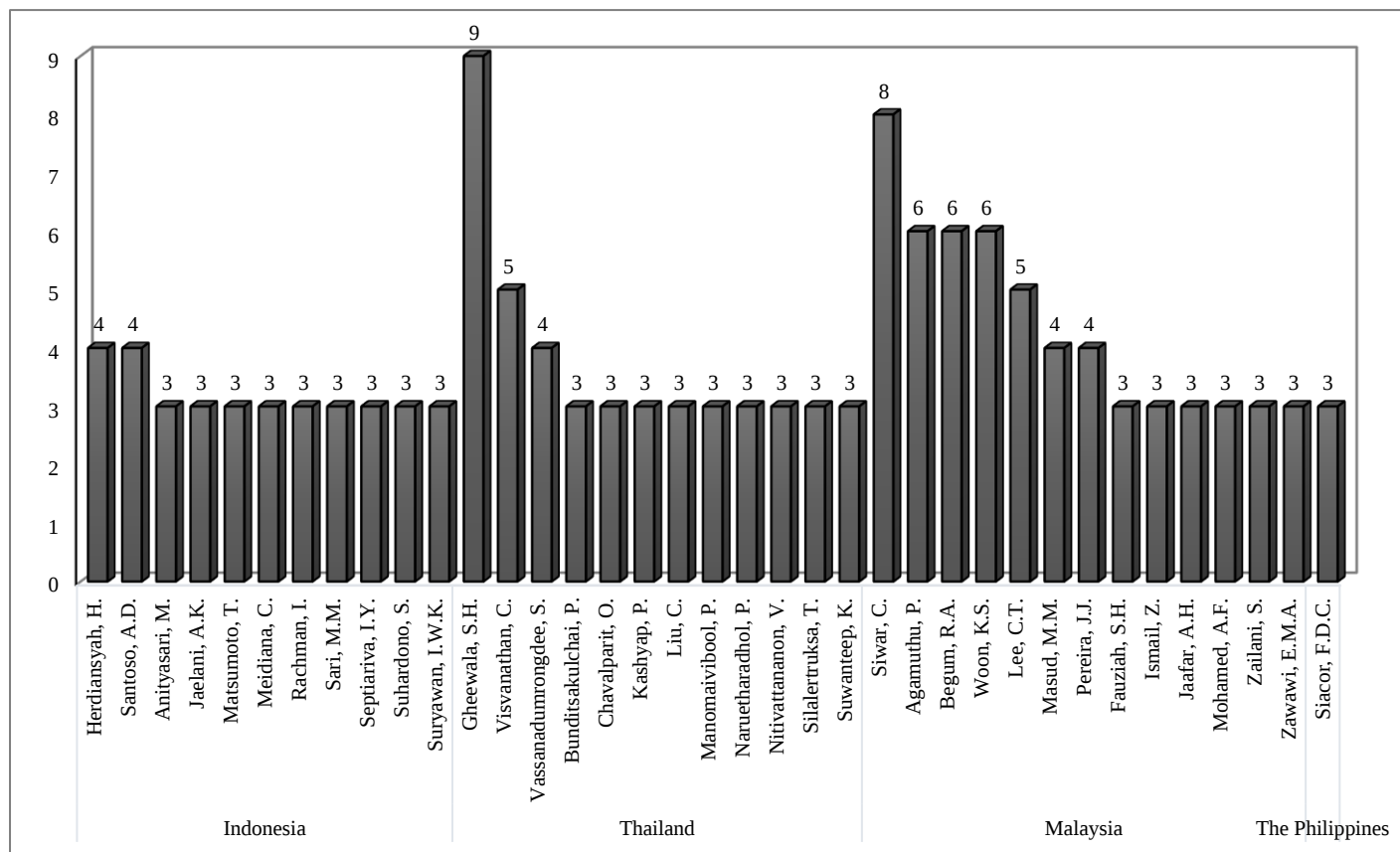


Figure 3. Scholars Productive in Waste Management Policy Studies (Source: Scopus academic database, 2025). Notes: covering at least three publications by the authors.

Some scholars have concentrated on waste management policy studies in four different countries. This paper aims to compile a list of authors who have published at least three times in each country, although many scholars may have fewer publications than this threshold. Among the four countries (Figure 3), Malaysia stands out as the top performer, followed by Thailand, and then the Philippines, indicating that scholars from these countries have varying publication frequencies. Notably, Malaysia plays a significant role in producing publications on waste management policy. However, the highest number of publications was obtained by a scholar from Thailand named Gheewala, S.H., with nine documents published, followed by Siwar, C., from Malaysia with a total of 8 documents released. However, for the Philippines, only one author managed to have a minimum of three publications, named Siacor, F.D.C. This suggests that the Philippines has a significant number of scholars working on waste management policy topics, with only one individual having published three documents.

Each scholar has an extraordinary impact, as evidenced by the number of citations obtained recently, as shown in Table 1. It is appropriate to assess which documents have implications for waste management policy studies in four countries as case study documents. There is an important highlight from the document's authors and case studies in each country. For Indonesian data, the highest citation was obtained from Shekdar AV (2009) with a total of 463 citations. For Thailand,

the highest citation was obtained from Sirisawat P (2018) with 245 citations. Compared to the data from Malaysia, GOH CS, 2010, as the document with the highest citations, has a total of 269 cited. Finally, data from the Philippines, which received 308 citations from the document initiated by Sovacool, B.K., 2010. Therefore, the highest-ranked documents in each country are obtained by Indonesia, the Philippines, Malaysia, and Thailand. Nevertheless, Thailand has the highest total citations per year compared to the other countries.

Table 1. The Most Global Cited Documents.

Country	Paper	Total Citations	TC per Year	Normalized TC
Indonesia	(Shekdar, 2009)	463	27.24	1
	(Sovacool & Brown, 2010)	308	19.25	2.3
	(Sembiring & Nitivattananon, 2010)	158	9.88	1.18
	(Sahide & Giessen, 2015)	120	10.91	2.73
	(Kurniawan <i>et al.</i> , 2023)	99	33	9.29
	(Aleluia & Ferrão, 2017)	82	9.11	3.01
	(Meidiana & Gamse, 2010)	67	4.19	0.5
	(Maalouf & Mavropoulos, 2023)	59	19.67	5.54
	(Praveena & Aris, 2021)	50	10	3.72
	(Sasaki & Araki, 2013)	48	3.69	1.81
Thailand	(Sirisawat & Kiatcharoenpol, 2018)	245	30.63	4.35
	(Intharathirat <i>et al.</i> , 2015)	144	13.09	2.35
	(Yukalang <i>et al.</i> , 2017)	137	15.22	3.01
	(Kamdar <i>et al.</i> , 2019)	131	18.71	3.28
	(Gupt & Sahay, 2015)	109	9.91	1.78
	(Tangwanichagapong <i>et al.</i> , 2017)	105	11.67	2.31
	(Faircloth <i>et al.</i> , 2019)	104	14.86	2.61
	(Yukalang <i>et al.</i> , 2018)	83	10.38	1.47
	(Aleluia & Ferrão, 2017)	82	9.11	1.8
	(Menikpura <i>et al.</i> , 2012)	73	5.21	2.11
Malaysia	(Goh <i>et al.</i> , 2010)	269	16.81	4.13
	(Begum <i>et al.</i> , 2006)	238	11.9	1
	(Periathamby <i>et al.</i> , 2009)	189	11.12	1
	(S. T. Tan <i>et al.</i> , 2014)	151	12.58	3.09
	(Agamuthu & Fauziah, 2011)	106	7.07	2.6
	(Begum <i>et al.</i> , 2007)	99	5.21	1.84
	(Y. D. Tan & Lim, 2019)	94	13.43	4.17
	(Zen <i>et al.</i> , 2013)	87	6.69	4.4
	(Agamuthu & Barasarathi, 2021)	75	15	3.5
	(Fernando <i>et al.</i> , 2018)	72	9	3.71
The Philippines	(Sovacool & Brown, 2010)	308	19.25	1
	(Forsyth, 2005a)	66	3.14	1.2
	(Premakumara <i>et al.</i> , 2014)	64	5.33	3.37
	(Peralta & Fontanos, 2006)	62	3.1	1
	(Ocampo, 2019)	59	8.43	1.45
	(Agaton <i>et al.</i> , 2020)	55	9.17	3.37
	(Praveena & Aris, 2021)	50	10	5.8
	(Forsyth, 2005b)	44	2.1	0.8
	(Premakumara <i>et al.</i> , 2018)	42	5.25	1.93
	(Kumar, 2019)	33	4.71	0.81

Reflecting on the total citations (TC) per year, Kurniawan *et al.* ([2023](#)) study reported the highest TC per year (33.00), demonstrating that even recent publications, which typically have fewer citations than older documents, can achieve high impact. This trend was evident in waste

management policy studies within the Indonesian context, where the normalized TC also reached the highest average value ($\bar{x}=9.29$). Similarly, in waste management policy studies from Thailand, Sirisawat & Kiatcharoenpol (2018) obtained the highest TC per year (30.63) and a normalized TC of $\bar{x}=4.35$, despite their document being among the most recently published. A high TC per year (16.81) was also observed in the Malaysian context, with a normalized TC of $\bar{x}=4.13$ from Goh *et al.* (2010) study, a publication from 2010 that surpassed studies published both before and after it. Interestingly, in the literature concerning the Philippines, although Sovacool & Brown (2010) achieved the highest TC per year (19.25), Praveena & Aris (2021) secured the highest normalized TC ($\bar{x}=5.80$). This indicated that documents with the highest total citations and TC per year do not always correspond to the highest normalized TC. Furthermore, this analysis, based on publication year, suggested that older articles do not consistently have lower TC, TC per year, or normalized TC values compared to more recently published or specific-year documents.

Table 2. The Sources Relied on by Scholars to Publish Waste Management Policy Studies.

Country	Source name	No. of Publication
Indonesia	Global Journal of Environmental Science and Management	9
	International Journal of Sustainable Development and Planning	9
	Sustainability Switzerland	9
	Journal of Material Cycles and Waste Management	8
	Waste Management and Research	8
Thailand	Waste Management and Research	10
	Journal of Environmental Management	7
	Resources Conservation and Recycling	7
	Sustainability Switzerland	7
	Journal of Cleaner Production; Journal of Material Cycles and Waste Management	5*
Malaysia	Sustainability Switzerland	12
	Waste Management and Research	8
	Resources Conservation and Recycling	6
	Journal of Material Cycles and Waste Management	5
	Planning Malaysia	4
The Philippines	EnvironmentAsia	4
	Journal of Cleaner Production	3
	Waste Management and Research	3
	Aims Environmental Science; Applied Environmental Research; Chemical Engineering Transactions; Environment and Natural Resources Journal; Global Journal of Environmental Science and Management; Journal of Material Cycles and Waste Management; Science of the Total Environment; Sustainability Switzerland; Waste Management.	2*

Source: Scopus academic database, 2025. Notes: Thailand data: *there are 5 publications each per source, The Philippines data: *there are 2 publications each per source.

Sources played an essential role in publishing the research outcomes of the scholars, whereas research on waste management policies showed some sources concentrated on this topic, and through this descriptive analysis it was observed that each country had a concentrated interest in publishing papers to publishers (Table 2), such as Indonesia, there were at least several publications that had nine documents from scholars, such as “Global Journal of Environmental Science And Management”, “International Journal of Sustainable Development and Planning”, and “Sustainability Switzerland”. Thailand has a focus on publishing documents with relevant topics in “Waste Management and Research,” with a total of 10 documents. Then, 12 publications have been published in “Sustainability Switzerland” and “Waste Management and Research”, a total of 8 documents from the Malaysian side. Finally, for the Philippines, there is “EnvironmentAsia,” which released 34 publications and was followed by several other sources as well. In this case, it turns out that there is a full concentration of scholars publishing their documents, such as the source “Sustainability Switzerland” being the highest interest by Indonesian and Malaysian researchers, as well as “Waste Management and Research” being the first most published from the Thai side and the second from the Philippines.

Figure 4. It is worth considering the extent to which affiliates contribute to increasing publications on a topic—in this case, relating to waste management policy studies in four countries, namely Indonesia, Thailand, Malaysia, and the Philippines. At least there are affiliates in each country

that have more than five publications per affiliate, where in terms of the number of country affiliates highlighted, Thailand outperforms, followed by Malaysia, Indonesia, and the Philippines. Furthermore, the study of the number of publications per affiliate reveals that “Universitas Kebangsaan Malaysia” leads in producing the highest number of publications on waste management policy, with a total of 13 documents; “University of Malaya” follows in second place with 29 documents. Both affiliates are located in Malaysia, while affiliates in Thailand put “Chulalongkorn University” in third place with 22 articles released, followed by “King Mongkut's University of Technology Thonburi” with 20 documents. As for Indonesia, the most waste management policy studies were produced by “University of Indonesia” with 13 publications and “IPB University” with a total of 11 documents; this is still far behind “Universiti Putra Malaysia” with 19 documents and “Universiti Teknologi Malaysia” with 16 publications. Finally, for the Philippines, the campus with the highest concentration was “University of the Philippines Lao Banos” with nine publications, which is still inferior to the number of “National Research and Innovation Agency” in Indonesia, “Thammasat University” and “Asian Institute of Technology Thailand” in Thailand, and “University Teknologi MARA” and “Universiti Sains Malaysia”.

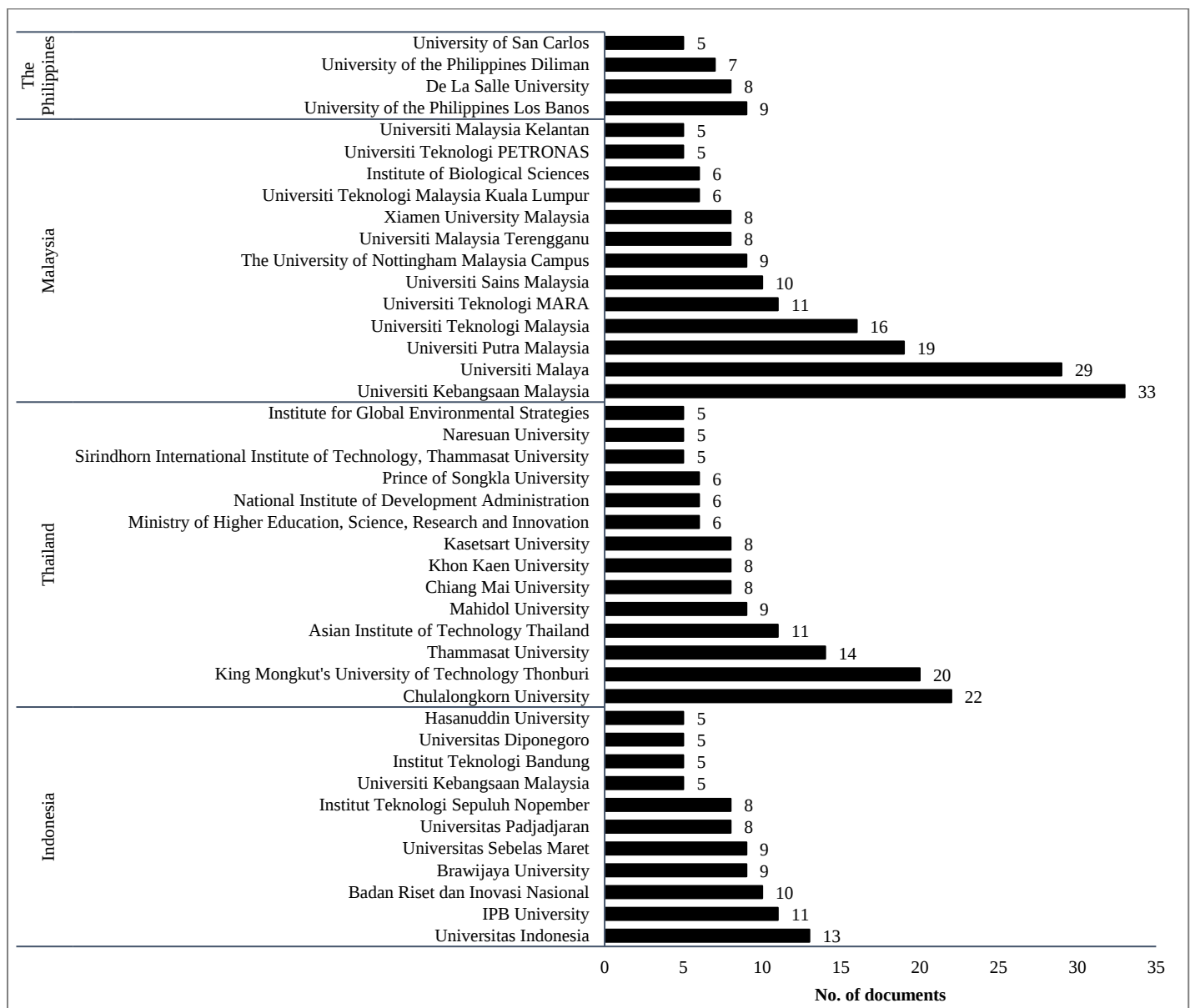


Figure 4. Affiliates Concerned with Research on Waste Management Policy (Source: Scopus academic database, 2025). Notes: Each top affiliate published at least five documents in the sources.

In terms of subject, there are different concentrations of areas addressed by scholars of each country in published documents (Figure 5). As observed from all case study data, environmental sciences are the dominant scholars, followed by social sciences, but changes in the third order have been highlighted by each country, such as the topic of waste management policies in Indonesia and Malaysia, focusing on engineering. In contrast, Thailand focuses on energy, and the

Philippines focuses on agriculture and biological sciences. This means that in the study of waste management policies, there are still many fields of science that need to be improved in each country, rather than becoming dominant in only one scientific subject area.

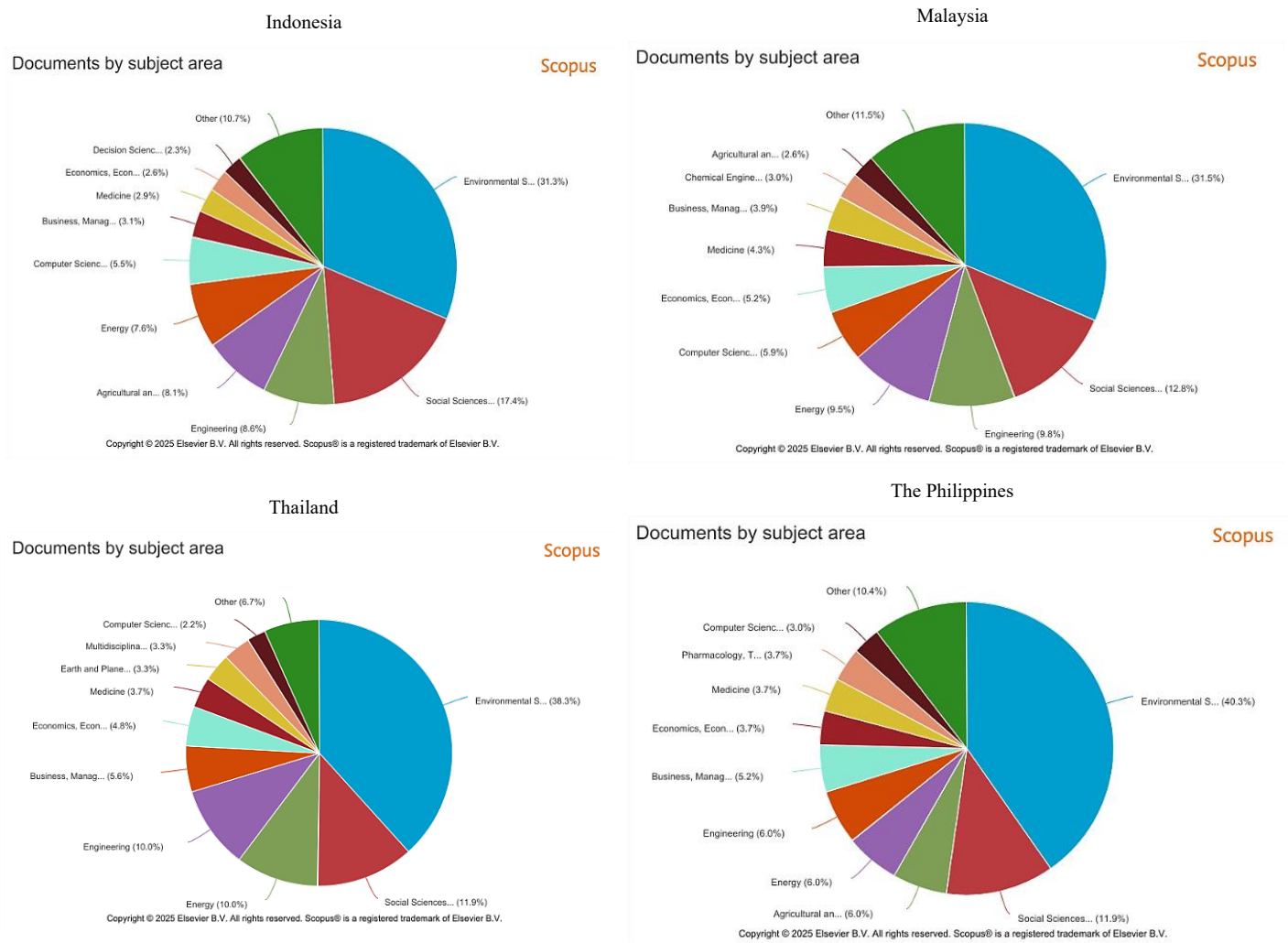


Figure 5. Subject Areas by Country with Research on Waste Management Policy. (Source: Scopus academic database, 2025).

There is a central point to the keywords found in the literature related to waste management policy in Indonesia (Figure 6a), which based on the literature implies that there are terms that are interconnected with each other and have co-occurrence between networks that indicate closeness and relationship in the study of waste management policy as seen from Indonesia, where the term “sustainability” has a relationship with other terms such as relating to how the “scenario” faced by “policymakers” in developing a “model” or “product” in waste management. “Technology” is needed in waste management, and ‘electricity’ plays a strong role in minimizing the occurrence of ‘climate change’ in the future, especially the issue of ‘environmental impact’. As a result, the “source” of “plastic”, which is included in “plastic waste”, needs to be followed up by local governments, such as “local government”, with “recommendations” on how to utilize existing waste. On the one hand, “participation”, “support” mutual “collaboration” between “stakeholders” is needed, so that between “society” and “local government” can carry out “programs”, this also needs to highlight the “behavior” of each actor, so that the “information” obtained can realize “sustainable development”.

The keywords highlighted from the literature of waste management policies in Thailand are also highlighted (Figure 6b), there is the issue of “cost” which is a consideration in the “operation” by the “government”, so that, the “regulation” initiated for “recycling” for “energy” from waste becomes an obstacle, thus requiring “recommendations” for “technology” that has low cost but maintains the sustainability of the “environmental impact” of each “municipality”. Malaysia, has a spotlighted (Figure 6c) on the issue of emissions and solid waste as evidenced by the term that appears, so that in the “development” for “energy” this requires “technology” in processing “food waste” and “emissions”, as well as the need for an important role to minimize “environmental

impact”. The issue of awareness and attitude is a crucial concern for all stakeholders involved in the policymaking process for the waste recycling program. The local authority's assistance to the construction industry is vital for implementing effective waste management policies and promoting sustainable development. The issue played in The Philippines is related to the study of waste management policies (Figure 6d), where the need for “awareness”, “attitude”, and “knowledge” to carry out policies properly, from “stakeholders” to participate in building “technology” in protecting “microplastic” against damage to the “environment”, especially the “seawater” issue.

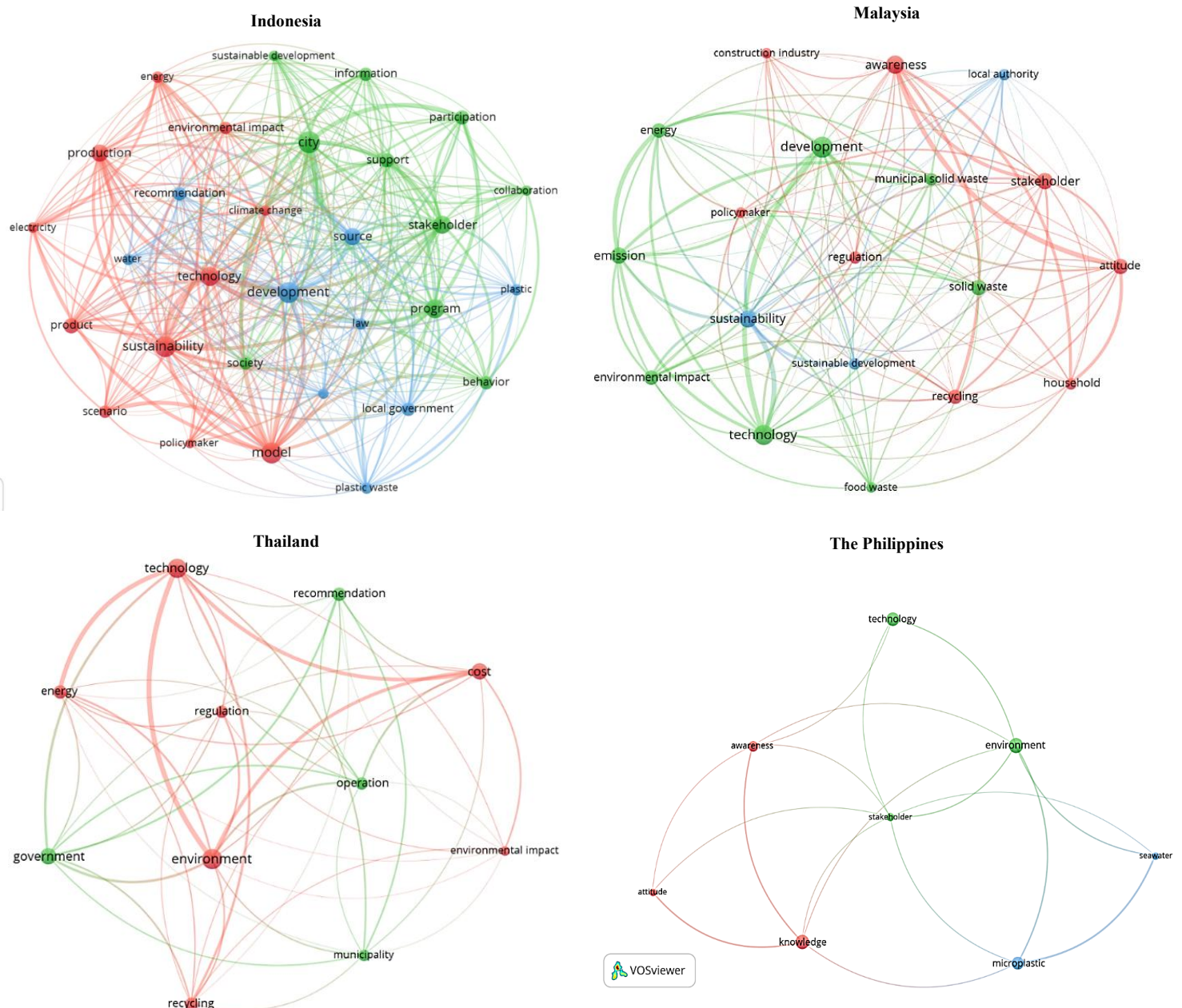


Figure 6. Networks Visualization in Terms of Waste Management Policy Studies (Source: Processed by the authors via VOSViewer).

Subsequently, through thematic analysis of the waste management policy studies (Figure 2), this study explored the thematic patterns that emerged in the waste management policy studies in the four countries and uncovered fundamental differences in the terms or themes that emerged. In brief, “Motor Themes” are defined as themes that exhibit high centrality and intensity in the study. As such, emerging terms have potential significance for advancing the topic and impact under study. In contrast, “Niche Themes” are characterized by low centrality and high intensity, which signifies that those terms in this category are highly specialized, yet may lack the necessary background or be considered unimportant in new concepts for various reasons, and finally, “Emerging or Declining Themes” is a category that exhibits low centrality and intensity. It is conceivable that emerging themes are rare or have the potential to diminish. Finally, “Basic Themes” is represented

as a section that has high centrality and low intensity. In this section, there are a few relevant themes that allow for extensive exploration and tend to be motor themes due to their high centrality.

In the Indonesian data cluster, the Indonesian waste management policy research shows distinct thematic clusters. Motor Themes such as “climate change”, “palm oil”, “waste”, and “waste-to-energy” reflect core, well-established topics driving the field. Niche Themes like “e-waste”, “environment management”, “bioenergy”, and “life cycle assessment” highlight specialized, emerging areas with focused interest. Terms such as “smart city” and “plastic waste” in the Emerging or Declining Themes indicate topics in flux, either gaining relevance or losing traction. Meanwhile, Basic Themes including “sustainability”, “food waste”, “circular bioeconomy”, “plastic pollution”, “recycling”, and “waste bank” form the foundational concepts supporting broader research but with less centrality. Therefore, the dominance of climate change and waste-to-energy suggests these areas are ripe for policy innovation and resource allocation. Emerging areas, such as innovative city initiatives and plastic waste management, require more attention to keep pace with evolving challenges. Strengthening basic themes such as circular bioeconomy and recycling can ensure sustainability principles are embedded across policies to enhance Indonesia’s waste management effectiveness.

In the Thailand data cluster, Thailand’s waste management research covers a broad range of topics distributed across different thematic clusters. Motor Themes like “recycling”, “solid waste management”, and “food waste” represent well-established, central areas driving current research and policy efforts. The Niche Themes, including “marine debris” and “sustainable tourism,” reflect more specialized but growing areas of interest. Emerging topics such as “sustainable development”, “sustainable city”, “public policy”, and “plastic pollution” in the Emerging or Declining Themes suggest evolving focus areas with potential for future expansion. Basic foundational themes like “municipal solid waste”, “life cycle assessment”, and “sustainability” form the core concepts underpinning the research. Notably, terms such as “circular economy”, “plastic waste management”, and “environmental management” occupy intermediate positions, highlighting their role as connecting concepts bridging different themes and signaling opportunities for qualitative exploration. Hence, the prominence of core topics like recycling and solid waste management indicates a strong foundation for Thailand’s waste policies. In contrast, the emerging focus on sustainable development and public policy highlights shifting priorities toward integrated, holistic approaches. The intermediate positioning of “circular economy” and related terms suggests a need for further research to deepen understanding and link these concepts with existing frameworks. Policymakers and researchers should leverage these insights to strengthen interdisciplinary collaboration, enhance policy coherence, and address emerging challenges such as plastic pollution and sustainable urban development.

Instead of the Malaysia data cluster, Malaysia’s waste management policy research reveals a diverse thematic distribution. Motor Themes such as “food waste”, “environmental”, “sustainable”, and “composting” indicate well-developed and central areas that guide the research landscape. The Niche Themes—including “circular economy”, “renewable energy”, “awareness”, and “electronic waste”—reflect emerging areas of specialized interest with potential for deeper exploration. In the Emerging or Declining Themes, terms like “sustainability”, “knowledge”, and “willingness to pay” suggest a growing focus on behavioral and policy-driven factors. Basic Themes such as “solid waste management”, “plastic waste”, “recycling”, “e-waste”, and “construction industry” represent foundational topics that support the broader research but may require further innovation or integration. Consequently, Malaysia’s strong signals indicate an established research base in sustainable waste practices, particularly in food and environmental aspects. The emergence of terms related to awareness, behavior, and economic incentives implies a shift toward public engagement and policy responsiveness. The inclusion of circular economy and renewable energy shows growing interdisciplinary potential. These findings suggest a need to strengthen cross-sectoral collaboration, promote public awareness programs, and integrate behavioral insights into waste management policies for more effective and sustainable outcomes.

For the Philippines data cluster, the thematic clustering of the Philippines’ waste management policy studies shows a balanced distribution across key areas. Motor Themes such as “environmental governance”, “capacity building”, “waste-to-energy”, and “water quality” reflect established and central priorities in policy and institutional development. The Niche Themes—including “climate change”, “cleaner production”, and “waste minimization”—indicate specialized, emerging areas that may benefit from further exploration and integration. The Emerging or Declining Themes section includes terms like “sustainability”, “e-waste management”, “environmental impact”, “plastic pollution”, “microplastics”, and “solid waste”, highlighting topics that were gaining momentum or shifting in focus. Basic Themes such as “solid waste management”,

“recycling”, “knowledge”, “e-waste”, and “circular economy” form the core foundation of ongoing research and practice. Thus, the prominence of environmental governance and capacity building suggests that institutional and policy capacity are central to waste management efforts in the Philippines. The emergence of issues like plastic pollution, microplastics, and e-waste management indicates rising environmental and public health concerns that require proactive regulatory responses. The integration of foundational themes such as circular economy and knowledge suggests a shift toward sustainable, informed policymaking. Policymakers and researchers should capitalize on this thematic diversity by promoting interdisciplinary strategies, strengthening governance structures, and addressing both technical and behavioural aspects of waste management.

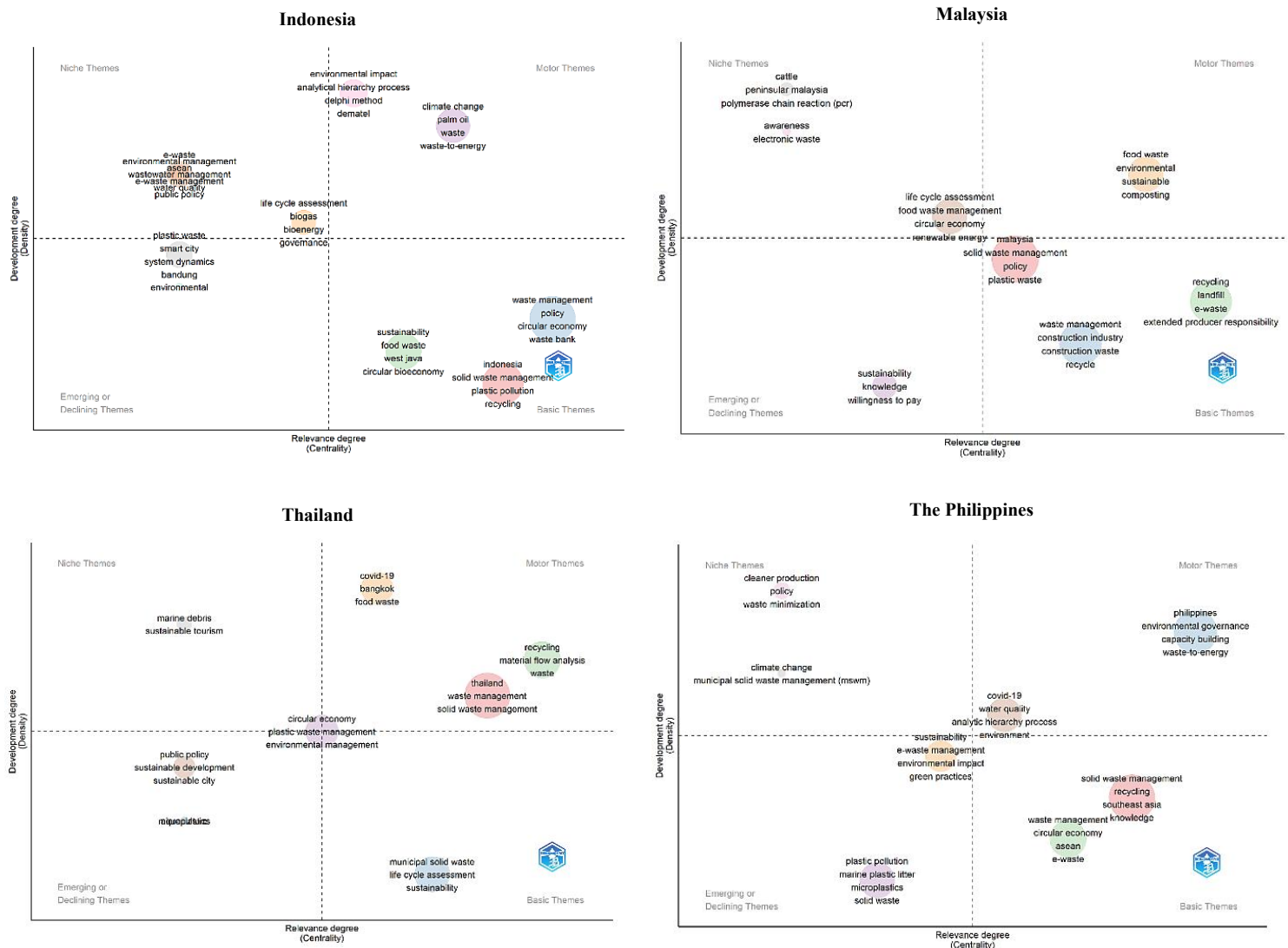


Figure 7. Thematic Analysis of The Waste Management Policy Studies (Source: Processed by the authors via Bibliometrix-R studio).

4. Discussion

Our analysis of the waste management policy literature in Southeast Asian countries, especially Indonesia, Malaysia, Thailand, and the Philippines, has provided valuable insights into the evolution and important roles of scholars in each study, affiliations, sources and areas of expertise that are the dominant focus today, especially with the trajectory and thematic network of terms in waste management policy studies presented. The period from 2000 to 2024 serves as the foundational reference to observe scholarly attention and the categorization of emerging terms. The evident, fluctuating upward trend indicates a dynamic shift, suggesting that waste management policy has increasingly garnered substantial academic interest, particularly from researchers focusing on issues related to waste governance.

In Indonesia, for instance, a few examples of recent studies raising policy scenarios on waste management mitigation (Apriadi *et al.*, 2024), circular economy-based waste management policies (Subekti, 2023), waste bank-based waste management policies (Fatmawati *et al.*, 2022;

Muljaningsih *et al.*, 2023), there is a supply chain study of compost management policies from waste-based materials (Novra *et al.*, 2023), waste management policies through regional partnership schemes (Ridho *et al.*, 2023), not only physical waste but also e-waste has been sought for environmental policies that can reprocess (Rahmanda *et al.*, 2023), and so on. It indicates that recent studies in Indonesia demonstrate a growing interest in diverse waste management policy approaches across the country. In Indonesia, these approaches range from mitigation strategies and circular economy models to waste banks, compost supply chains, regional collaborations, and e-waste reprocessing. The growing body of research in Indonesia reflects an increasing awareness within Indonesia of the complexity of waste issues and the need for multidimensional efforts. Overall, Indonesia's focus on policy innovation highlights the country's commitment to addressing waste challenges through various integrated and context-specific solutions.

In the Malaysian context, several studies have examined different dimensions of waste management. Tan *et al.* (2022) highlight the challenges arising from the lack of uniformity between formal and informal sector policies, while Atchike *et al.* (2022) focus on the policy transition of biogas waste management toward renewable energy utilization. Farrelly and Chitaka (2023) investigate waste trade policies and identify potential gap pathways, and Azri *et al.* (2023) analyze the spatial distribution of recycling points and clustering patterns in the implementation of waste management systems. In this case, in Malaysia, those studies increasingly highlight efforts to improve waste management through diverse approaches, including integration strategies, transitions to renewable energy, trade policy evaluations, and the spatial distribution of recycling infrastructure. However, Malaysia continues to face significant challenges, particularly the lack of uniformity in waste management policies between Malaysia's formal and informal sectors. This policy fragmentation within Malaysia poses a major barrier to achieving cohesive and effective waste management implementation across the country. The Malaysian case thus underscores the urgent need for policy harmonization and stronger coordination mechanisms to ensure that Malaysia's waste management goals can be realistically met and sustained.

In the case of Thailand, a wide range of studies provides diverse perspectives on the evolution of waste management policies. Duangthong and Boonmee (2022) examine stakeholder roles in e-waste management, while Nissapokin *et al.* (2021) analyze industrial waste management and government networks. Other works focus on energy-related dimensions, including electricity generation from waste (2021) and policy frameworks for waste-to-energy initiatives (Peerapong & Limmeechokchai, 2016). Additionally, Chalcharoenwattana and Pharino (2018) explore waste recycling policies and community behavior through the lens of socio-economic factors. In Thailand, the issue of urgency is also very high household solid waste, which requires the attitude of government organizations in providing public facilities for quality household waste management, and the need for adequate financial status for the provision of landfill facilities (Sujaritpong & Nitivattananon, 2009), it is due to the waste management technology innovation that a very large allocation of funds (Boonpa & Sharp, 2017). Thus, by minimizing waste through the use of environmentally friendly technology, the pattern of sustainable development can be significantly improved (Bai *et al.*, 2024).

Likewise, in the Philippines, community involvement is key in the implementation of waste management policies (Camarillo & Bellotindos, 2021), at least the issue of macro plastics in mangrove areas and micro plastics in most marine beaches in the Philippines is very high to burden the country with waste pollution (Bacosa *et al.*, 2024; Natuel *et al.*, 2023; Paler *et al.*, 2022), so this requires immediate urgency in finding policy solutions to address plastic pollution and reduce exposure to humans and the environment (Go *et al.*, 2024). In short, in the Philippines, although community involvement is frequently highlighted as a key factor for the successful implementation of waste management policies, the country continues to struggle with critically high levels of macro- and microplastic pollution. This pollution is especially severe in the Philippines' mangrove areas and marine beaches, which are vital ecosystems. The persistent plastic contamination in these regions exposes significant weaknesses in the Philippines' current policy frameworks and enforcement mechanisms. Moreover, the Philippines' experience underscores the urgent necessity for more comprehensive, adaptive, and effectively enforced policy interventions. Without addressing these systemic challenges, the Philippines risks failing to adequately protect both public health and the environment from the escalating impacts of plastic pollution.

This research's reflection of four case study documents from four Southeast Asian countries highlights the unique challenges each country faces with its waste management policies. This underscores the necessity for proactive measures to eliminate waste problems in each country, such as Indonesia, Malaysia, Thailand, and the Philippines. Addressing the escalating waste crisis necessitates a shift towards a circular economic model, which emphasizes reuse, repair, and upcycling to significantly mitigate pollution and waste, thus extending product lifecycles. Furthermore,

adopting such a model can even facilitate the generation of renewable energy sources (Rahmat *et al.*, 2024). We consider the sustainability of policies that focus on environmental issues and human health to ensure future problem control efforts are effective. In addition to society and the environment, waste management policies should also consider the economy, given its significant value and the potential for effective management through the 3R approach (reuse, reduce, and recycle), along with the circular economy. Relevant stakeholders must address the haunting paradigm of inadequate quality and quantity of resources, which can lead to the optimization of waste handling policies and the generation of alleviation models from various policy perspectives.

5. Conclusion

In sum, this study employed a bibliometric approach, examining four countries as case studies of documents related to waste management policies. The overall number of publications fluctuated from year to year. This means that the study of waste management policies has become a highlight for scholars in finding a variety of discussion findings and implications. Likewise, the author of the Indonesian literature became the foundation of the highest number of publications, followed by Malaysia. While Indonesia and the Philippines led in citations, with Indonesia having the highest, this indicates that authors from these countries have the opportunity to become leaders in waste management policy studies, given the impact of their citations and the benefits their articles offer to other scholars. Cumulatively, Sustainability Switzerland is the source that produces the most studies on related topics. In terms of affiliation, the most documents are produced by affiliates from Malaysia, with two affiliates in second place, followed by Thailand, which has two affiliates in third and fourth place, respectively, after Malaysia. Overall, the most subject areas covered were produced by environmental sciences, followed by social sciences. In terms of network terms, Indonesia and Malaysia have the term “development”, while Thailand and the Philippines have the term “environment”. Thematically, the crucial themes captured from the four countries for which two terms were selected were climate change and waste-to-energy for Indonesia, food waste and recycling for Thailand, food waste and composting for Malaysia, and water quality and waste-to-energy for the Philippines.

The implications of this study highlight that the literature on waste management policy in Indonesia places a greater emphasis on plastic waste, despite its recognized contribution to climate change. It is important to realize that plastic waste can serve as a source of energy and electricity. Therefore, it is essential to integrate plastic waste management policies with national energy strategies through environmentally friendly waste-to-energy technologies, transforming plastic waste from an environmental burden into a sustainable energy source that supports emission reduction and energy security in Indonesia. In the case of Malaysia, the analysis shows a strategic focus on waste emissions and household solid waste, underscoring the country’s commitment to implementing policies and raising public awareness through collaborative efforts with relevant authorities. Hence, it needs to strengthen collaborative policies on household waste and emissions reduction by integrating public education and multi-stakeholder engagement to ensure effective and sustainable waste management. The Philippines highlights microplastic contamination in seawater, insufficient waste management awareness, and the need for comprehensive knowledge and attitudes to inform effective waste management practices. Therefore, it should prioritize stricter regulations on microplastic pollution and invest in national waste education programs to enhance public awareness and promote sustainable waste management practices. Lastly, Thailand faces similar challenges, such as solid waste management issues, especially cost concerns, and the need for a review of regulations governing waste management programs. Consequently, it is essential to review and streamline Thailand’s waste management regulations while implementing sustainable financing mechanisms to overcome cost challenges and enhance program effectiveness.

This study acknowledged several limitations. First, despite employing comprehensive keywords, the exclusion of other potentially relevant keywords may have led to the oversight of pertinent articles exploring similar topics. Second, while Scopus was selected as the sole database due to its reputation for high-quality, peer-reviewed documents, incorporating additional databases like Web of Science could have offered a more exhaustive coverage of the literature. Finally, the analytical tools utilized, specifically VOSViewer and Bibliometrix-R Studio, provided a limited algorithmic perspective on identifying key terms within the dataset. Future research could have benefited from integrating other analytical software, such as CiteNet, HistCite, sciMAT, and NVivo, to corroborate or contrast findings and thus facilitate a deeper exploration of critical terminology related to waste management policy. Building upon the analytical and strategic foundations of prior studies, this research advocates that stakeholders and policymakers adopt a holistic perspective on waste management, transcending national scales to encompass region-specific characteristics. It has been identified that governance and policy formulation vary significantly

across different regions within a single nation, let alone among countries, each possessing unique dynamics driven by local challenges and causes. It is imperative for policymakers to promote innovative circularity concepts as solutions to environmental and health threats. Furthermore, this research underscores the importance of refining cross-actor collaborative approaches and optimizing human resource competencies at the local level. It is acknowledged that policy effectiveness is highly dependent on active grassroots participation. Additionally, preventative campaigns regarding food waste should be intensified, alongside the strengthening of waste sorting technologies and processing management.

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Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data is available upon Request.

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