

## A SYSTEMATIC LITERATURE REVIEW OF SOLID WASTE MANAGEMENT POLICY IMPLEMENTATION IN SOUTHEAST ASIA

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### Highlights:

- A systematic literature review (SLR) on implementing Southeast Asia's solid waste management (SWM) policies.
- The content analysis of 17 selected articles highlights the current SWM situation and four main themes in the challenges in SWM policy implementation.
- Inclusion of elaboration on the challenges, e.g., political system, adequate resources, appropriate technology, and public awareness and participation.

### Abstract

Rapid urbanisation, population growth, economic development, and changing consumption patterns have increased waste generation worldwide. In many urban areas of Southeast Asia, waste is the most visible environmental issue, as waste generation has increased rapidly over the last decade. Effective implementation ensures that the outcomes correspond to policy goals. Most Southeast Asian countries have policies and regulations on solid waste management (SWM). However, the policies lack efficient implementation processes and enforcement. (1) political systems influence SWM effectiveness, (2) adequate resources, (3) appropriate technology, and (4) public awareness and participation. Even though many studies have been conducted on SWM implementation, very few focused on the Southeast Asian region. A systematic literature review of research articles retrieved from the Web of Science and Scopus databases was conducted. This study analysed 17 articles from 598 articles initially retrieved to answer the research questions. The analysis found that multiple stakeholders participated in the SWM system, and a set of challenges revealed the leading causes of policy failure. The analyses served as guidelines to plan for the effective implementation of SWM policies.

Keywords: Policy implementation, public policy, solid waste management, Southeast Asia, systematic literature review.

Abbreviations: Act 672 (Solid Waste Management and Public Cleansing Act 2007), BSM (Waste Bank Society), CCTFI (Cebu Common Treatment Facility Inc.), CESET (Cebu Environmental Sanitation and Enforcement Team), DENR (Department of Environment and Natural Resources), EFW (energy-from-waste), LGU (local government unit), PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), RA 9003 (Republic Act 9003), SLR (Systematic Literature Review), SW (solid waste), SWM (solid waste management), WoS (Web of Science).

### Introduction

Rapid urbanisation, population expansion, economic development, and changing consumption patterns have increased global waste generation (Agamuthu *et al.*, 2020). Solid waste management (SWM) is becoming a crucial aspect of developed and developing countries to minimise the negative impacts of

waste mismanagement on the environment and public health (Kaza *et al.*, 2018; Agamuthu *et al.*, 2020). Globally, the environment's quality has worsened due to unsustainable approaches in SWM (Ferronato & Torretta, 2019; Agamuthu *et al.*, 2020). Governments and societies acknowledge the importance of an

effective SWM system to address the negative impacts of waste mismanagement. However, finding the appropriate approaches for its adoption is challenging. High waste generation, poor quality of SWM services, open dumping and burning, littering, and lack of technologies in SWM are common issues in low-income countries. Therefore, strategies for effective SWM are crucial to address these situations. These strategies are translated into public policies to achieve planned outcomes. Policies must implement concerted actions of relevant policy actors to achieve the intended goals (Howlett, 2019). The implementation process is the only stage where the policies' goals can materialise. However, the tasks are complex and challenging. Various situations exemplify the failure of public policies due to weak structures and a lack of consideration in the implementation process (Khan, 2016; Howlett, 2019). However, there has recently been increasing attention on the SWM policy in the academic realm (Shin *et al.*, 2020; Trinh *et al.*, 2021).

In Southeast Asia, waste management has become a prominent issue that has received attention from policymakers and academicians (Kamaruddin *et al.*, 2022). Numerous studies have been conducted. The governments in the region have developed various plans and strategies to address the situation (United Nations Environment Programme, 2017). However, the outcomes of the implementation process had mixed results. Not all the policies achieved the intended outcomes and only slightly improved the region's SWM crises. Southeast Asia is experiencing a continuous increase in population and urbanisation rates, resulting in increased waste generation. These realities have affected the capacity and capability of the government to manage such situations. Currently, most countries in the regions have yet to adopt sustainable approaches to handling waste treatment and disposal, which has negatively affected the quality of the environment and public health (Ng *et al.*, 2023).

Like other regions, Southeast Asia has witnessed various SWM policies established

by national governments. However, although these policies were implemented, the SWM situation in Southeast Asia remains the same, and only slight improvement has been observed. The success and failure of policies are highly dependent on the implementation process (Drucker, 2018; Hudson *et al.*, 2019). Although policy implementation is regarded as a crucial issue in low-income countries, the field is still under-researched, resulting in scarce information on matters related to SWM policy implementation.

Several studies have identified the implementation process's importance in developing an effective SWM system. Ferronato and Torretta (2019) argued that the weak implementation process is a weakness in improving the SWM circumstances in developing countries. Moreover, Mir *et al.* (2021) propounded that the lack of resources and government capacity at the implementation stage of SWM has led to unsuccessful policy implementation in major cities in India. A similar state of affairs occurred in Sri Lanka, whereby the country has had difficulties managing SWM due to weak policy and implementation processes (Fernando, 2019). Therefore, strengthening the policy implementation process may lead to better SWM (Fernando, 2019; Ferronato & Torretta, 2019; Mir *et al.*, 2021). While many studies acknowledged that SWM is a complex sustainable challenge in developing countries, there is still a lack of research focusing on SWM policy implementation due to information scarcity (Agamuthu *et al.*, 2020).

Government policies address issues that impact the administration and society (Klimczuk, 2015). The government also considers public policy a problem-solving activity (Pal, 1997). Therefore, the government plays a crucial role in the policymaking process. Public policies range from legislation, strategies, plans, and principles that provide direction in environmental protection (Vig & Kraft, 2019). These SWM policies include environmental laws and regulations to regulate waste cycle activities such as generation, separation,

collection, treatment, recycling, and disposal. SWM is a technically complex task requiring multiple stakeholders to be involved in order to achieve sustainability (Fatimah *et al.*, 2020).

This paper aims to provide an overview of the SWM policy implementation in Southeast Asia, an important region with a rise in SW generation due to an exponential increase in population, evolving consumer behaviours, urbanisation, economic growth, and industrialisation. Effective strategies are crucial to address the rising SW generation and the negative consequences of SW mismanagement. Addressing the policy implementation issues is vital as an effective implementation process may lead to effective SWM. To date, SWM policy implementation in Southeast Asia countries is an under-researched topic. Therefore, the aim of this systematic review is twofold. The study intends to provide an overview of SWM in Southeast Asia countries and identify the significant challenges regarding implementing SWM policies in the region.

### Methodology

Articles regarding challenges in implementing SWM policies in Southeast Asian countries were retrieved. A systematic literature review (SLR) is used to synthesise empirical evidence from previous studies to provide an overview of the implementation of SWM policies in Southeast Asia and to describe the direction for future research. SLRs have been widely used in other research fields but are lacking in SWM research (Abdallah *et al.*, 2020). Adopting a systematic review offers an elaboration of the studied topic and ensures an unbiased review strategy, leading to credibility and comprehension of results (Panchal *et al.*, 2021). This study aims to fill the limited SLR gap in SWM research, particularly in policy implementation. The SLR adopted in this study followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to ensure transparency in reporting (Liberati *et al.*, 2009).

### Prisma

This article followed an evidence-based PRISMA approach to identify and summarise the challenges of SWM policy implementation in Southeast Asian countries. The present study reviewed the challenges of implementing SWM policies in Southeast Asian countries. PRISMA provides a sequential process for choosing the literature items reviewed and reported via a checklist and used to validate the research process (Liberati *et al.*, 2009). This study has fulfilled several critical items under the checklist: title, abstract, introduction, methods, results, and discussion. The PRISMA includes four SLR processes: identification, screening, eligibility, and inclusion (Liberati *et al.*, 2009).

### Identification

In the first step, several keywords were determined as search strings to search for relevant literature from databases. The following databases were used to search the literature tools for this study: Web of Science (WoS) and Scopus. They were selected due to strength and credibility as impact factor articles indexed in both databases were measured by the Journal Citation Reports (JCR) (Pranckutė, 2021). The latter is known for having the most extensive peer-reviewed articles in its circulation. The selection of the two databases alleviated the fact that no single database can provide a comprehensive scope to support a study. Combining these databases enabled broader coverage of topics, journals, and study areas and are arguably the most extensive scientific databases for social sciences (Singh *et al.*, 2021). Boolean operators (“AND” and “OR”) were employed to combine different combinations of keywords as suggested by Armenise *et al.* (2021) to ensure the appearance of at least one term between parenthesis. The identified keywords, including their synonyms, were commonly used in the SWM field literature to find relevant research articles (Table 1). All 11 countries were included in the search strings to focus the study on Southeast Asia.

Table 1: Query strings employed in the database

Database	Keywords
Scopus	TITLE-ABS-KEY(("waste management" OR "solid waste" OR "solid waste management" OR "municipal waste" OR "municipal solid waste" OR "municipal solid waste management" OR "urban waste" OR "urban solid waste" OR "urban solid waste management" OR "domestic waste" OR "domestic waste management" OR "household waste" OR "household waste management") AND ("polic*" OR "practic*" OR "approach*" OR "strateg*" OR "law*" OR "rule*") AND ("implement*" OR "execut*") AND ("Malaysia" OR "Singapore" OR "Thailand" OR "Indonesia" OR "Philippines" OR "Laos" OR "Myanmar" OR "Cambodia" OR "Brunei" OR "Vietnam" OR "Timor Leste"))
Web of Science	TS(("waste management" OR "solid waste" OR "solid waste management" OR "municipal waste" OR "municipal solid waste" OR "municipal solid waste management" OR "urban waste" OR "urban solid waste" OR "urban solid waste management" OR "domestic waste" OR "domestic waste management" OR "household waste" OR "household waste management") AND ("polic*" OR "practic*" OR "approach*" OR "strateg*" OR "law*" OR "rule*") AND ("implement*" OR "execut*") AND ("Malaysia" OR "Singapore" OR "Thailand" OR "Indonesia" OR "Philippines" OR "Laos" OR "Myanmar" OR "Cambodia" OR "Brunei" OR "Vietnam" OR "Timor Leste"))

**Screening**

The query strings retrieved 478 and 257 records from Scopus and WoS, respectively. There were 137 redundant articles eliminated during the screening. The primary body of literature was made of 598 articles. Table 2 shows the inclusion and exclusion criteria conditions for both databases. For this study, only papers written in English were considered. All eligible papers were available from 2012 until 2021. Subsequently, the exclusion criteria were extended to eliminate articles that were non-relevant to the systematic literature review’s topic by reviewing the title, abstract, and keywords.

**Eligibility**

After the screening process, the body of literature was reduced to 224 articles. During the eligibility process, through the review of the title, abstract, and keywords, 191 articles were removed due to being non-relevant to this systematic literature review’s topic, thus reducing the body to 33 articles. A full-text assessment was conducted on the remaining body of literature. Two articles were excluded for not providing empirical findings, ten were rejected as being out of the study area, and four were excluded as the full text was unavailable.

Table 2: Eligibility criterion

Criterion	Eligibility
Literature accessibility	Open access journals.
Literature type	Journal articles.
Language	Papers are written in English.
Areas	All areas include a wide range of fields (like economics, engineering, and agriculture) because it intends to investigate policy implementation challenges from various perspectives.
Timeline	All papers available on the selected databases from 2012 to 2021 (10-year period) regarding policy implementation concerning SWM.
Type of waste	Specific types of waste (e.g., hazardous, healthcare, nuclear) were excluded because of their peculiarities in handling and treatment.

**Inclusion**

A total of 17 articles were considered as the final body of literature. The study selection process is summarised in Figure 1. Haris *et al.* (2020) recommended including 10 to 50 papers for a systematic review. A few papers, such as Alvino *et al.* (2021) and Exposto & Januraga (2021), were acceptable to conclude a specific area of inquiry through systematic reviews. The initial literature search produced a considerable number of articles. However, only several articles in the final stage focused on implementing SWM policies in Southeast Asian countries. Even though the number of articles for systematic review was small, the articles were considered

relevant and sufficient as determined by the screening and eligibility process.

The systematic review was conducted qualitatively using content analysis. According to Bhatt *et al.* (2020), content analysis assists researchers in extracting a study’s insights and objectives. In analysing the literature, the researchers followed six stages of content analysis suggested by Kleinheksel *et al.* (2020), which involved analysing the data, developing categories and a coding scheme, testing the coding scheme, assessing coding consistency, coding all the data, developing a theme, and reporting the findings—the developed coding is shown in Table 3.

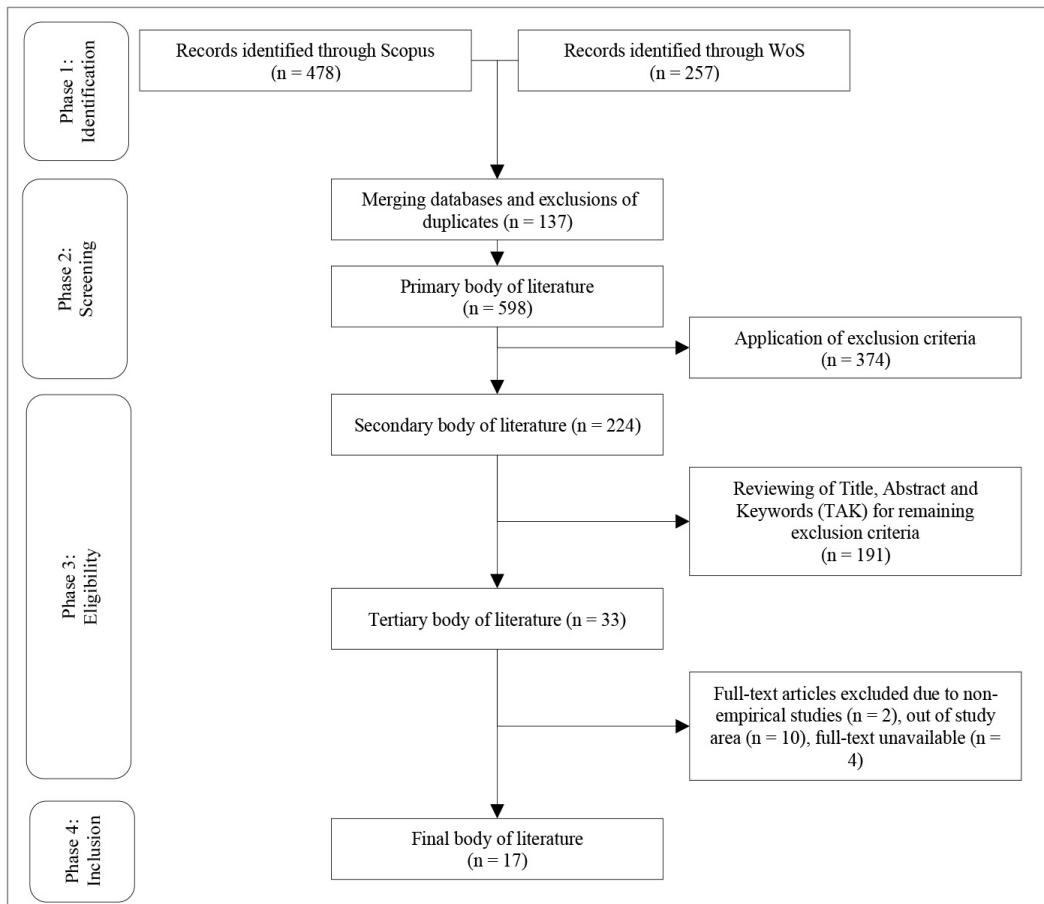


Figure 1: Selection of articles flow diagram

Adapted from the PRISMA Statement For Reporting Systematic Reviews and Meta-Analyses of Studies that Evaluate Health Care Interventions: Explanation and Elaboration (Liberati *et al.*, 2009)

Table 3: Codification of the research for data analysis

Coding of the Parent Category		Coding of sub-categories	
1	Year of research	A	2021
		B	2020
		C	2019
		D	2018
		E	2017
		F	2016
		G	2015
		H	2014
		I	2013
		J	2012
2	Type of case study	A	Single case study
		B	Multiple case study
3	Method of research	A	Quantitative
		B	Qualitative
		C	Mixed
4	Country of study	A	Brunei
		B	Cambodia
		C	Indonesia
		D	Laos
		E	Malaysia
		F	Myanmar
		G	Philippines
		H	Singapore
		I	Thailand
		J	Timor Leste
		K	Vietnam
5	Main barriers to implementing SWM policy	A	Political system
		B	Adequate resources
		C	Public awareness and participation
		D	Appropriate technology

## Results

In analysing 17 selected articles, a single case study dominated the articles. Four case studies were conducted in Indonesia ( Nuzuli *et al.*, 2015; Kerstens *et al.*, 2016; Rachmawati *et al.*, 2019; Muliawaty *et al.*, 2021). Four case studies were conducted in the Philippines (Ancog *et al.*, 2012; Premakumara *et al.*, 2014; Camarillo & Bellotindos, 2021; Gonzales *et al.*,

2021), followed by three Srarticles in Malaysia (Abas & Wee, 2020; de Oliveira, 2019; Victor & Agamuthu, 2013), Thailand (Wannawilai *et al.*, 2017; Yukalang *et al.*, 2018; Chenboonthai & Watanabe, 2019), and Vietnam (Nguyen & Watanabe, 2020; Nguyen *et al.*, 2020; Trinh *et al.*, 2021). No articles represented Brunei, Cambodia, Laos, Myanmar, Singapore, and



Timor Leste. Such a gap is due to the lack of studies on SWM policy implementation in Southeast Asia compared to other regions.

Furthermore, ten articles used qualitative methods, four employed mixed methods, and three adopted quantitative research methods. The selected articles were published between 2012 and 2021. There were increasing numbers of publications towards the end of the study period. 71% of articles were published between 2017 and 2021, and 29% were published from 2012 to 2016 (Figure 2).

### Main Findings

The 17 articles were included in the final stage. Apart from the identified themes of the challenges of SWM policy implementation, these articles were also analysed to examine the current situation of SWM in Southeast Asian countries. Table 4 summarises the codified empirical findings and themes from the analysis process. This study has identified several coding grouped into four main challenges in implementing SWM policies. The challenge themes were (i) political system, (ii) resources, (iii) appropriate technology, and (iv) public awareness and participation.

### SWM Situation in Southeast Asia

A significant issue has arisen with soaring waste generation in developing countries (Agamuthu *et al.*, 2020). Economic growth, trading activities, and changes in population consumption patterns

influence the surge of SW generated (Ferronato & Torretta, 2019). In 2016, over 1,200 million tonnes of SW were generated in the Pacific and Asia, which is expected to increase further (Kaza *et al.*, 2018). Southeast Asian countries also face a significant increase in SW generation. For instance, the Philippines produces over 40,000 tonnes of SW daily (Camarillo & Bellotindos, 2021). Households, commercial centres, institutions, industries, and medical facilities were familiar SW sources in the Philippines (Premakumara *et al.*, 2014). Malaysia generated 15.6 million tonnes of SW in 2020 (Victor & Agamuthu, 2013). The increase in SW volume has been driven by the expansion of economic activities and increased demand for products and services (Abas & Wee, 2020).

Furthermore, in their findings, Rachmawati *et al.* (2019) and Nuzuli *et al.* (2015) asserted that waste has become a national problem due to population growth and changing societal consumption patterns. In Thailand, waste generation increased from 24 million tonnes in 2008 to 27 million in 2016 (Yukalang *et al.*, 2018). This was validated by Wannawilai *et al.* (2017) through their findings, as the nation's SW generation rate was about 1.46 to 1.66 kg/person/day. Furthermore, SW has become a significant problem in Vietnam as the country saw a rise in SW generation by 8.4%, with only 14% being recycled annually (Nguyen *et al.*, 2020). Landfilling was widely used as the region's waste disposal approach, which caused significant contamination of the

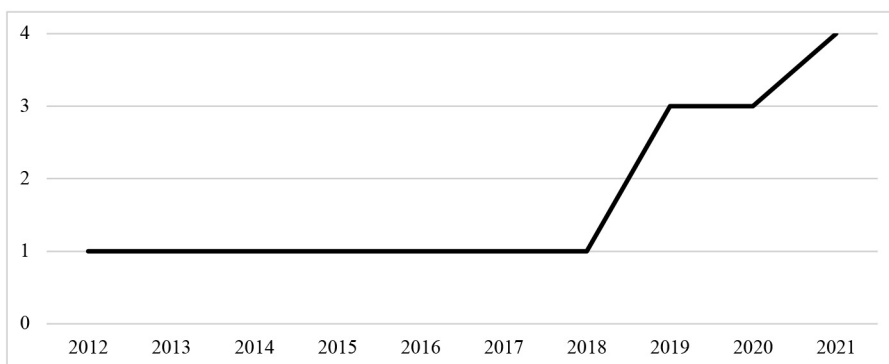


Figure 2: Year of publication

Table 4: Classification of selected articles

Article	Year of Research	Case Study Type	Research Method	Country of Study	Challenges to Implementing SWM Policy
Abas & Wee	1B	2A	3A	4E	5A; 5B
Ancog <i>et al.</i>	1J	2A	3A	4G	5A; 5C
Camarillo & Bellotindos	1A	2A	3B	4G	5A; 5B; 5C; 5D
Chenboonthai & Watanabe	1C	2A	3B	4I	5A
Gonzales <i>et al.</i>	1A	2A	3B	4G	5A; 5B; 5C
Kerstens <i>et al.</i>	1F	2A	3B	4C	5A; 5B; 5C; 5D
Muliawaty <i>et al.</i>	1A	2A	3B	4C	5A; 5C
Nguyen & Watanabe	1B	2A	3C	4K	5C
Nguyen <i>et al.</i>	1B	2A	3C	4K	5A; 5C
Nuzuli <i>et al.</i>	1G	2A	3B	4C	5C
Premakumara <i>et al.</i>	1H	2A	3B	4G	5A; 5B; 5D
Puppim de Oliveira	1C	2A	3B	4E	5A; 5B
Rachmawati <i>et al.</i>	1C	2A	3C	4C	5B
Trinh <i>et al.</i>	1A	2A	3B	4K	5A; 5B; 5C; 5D
Victor & Agamuthu	1I	2A	3C	4E	5C
Wannawilai <i>et al.</i>	1E	2A	3A	4I	5A; 5B; 5C; 5D
Yukalang <i>et al.</i>	1D	2A	3B	4I	5A; 5B; 5C

region's environment. The situation worsened due to increased waste generation and improper SWM. The identified themes from the analysis of selected articles will be discussed in the following subsections.

In terms of SW governance, most of the countries in Southeast Asia have established policies to address SWM-related matters. For instance, the Philippines enacted the Republic Act 9003 (RA 9003) (Ancog *et al.*, 2012; Premakumara *et al.*, 2014; Camarillo & Bellotindos, 2021). Indonesia enacted Law No. 18 Year 2008 on Solid Waste Management (Nuzuli *et al.*, 2015; Rachmawati *et al.*, 2019; Muliawaty *et al.*, 2021). Malaysia implemented the Solid Waste Management and Public Cleansing Act 2007 (Act 672) (Abas & Wee, 2020; de Oliveira, 2019; Victor & Agamuthu, 2013) and Thailand has the Roadmap for Municipal and Hazardous Plan 2015 (Wannawilai *et al.*, 2017; Chenboonthai & Watanabe, 2019). Vietnam established the Law

on Environmental Protection 2014 (Nguyen & Watanabe, 2020; Nguyen *et al.*, 2020; Trinh *et al.*, 2021).

This study provides an SLR on previous research covering the implementation of SWM policies in Southeast Asia. The literature is limited to SWM policy implementation. The review of SWM policies established by Southeast Asian countries revealed significant gaps between policy formulation and implementation with the intended outcomes. The SLR revealed that the political system, resources, public awareness and participation, and appropriate technology significantly affected the effective implementation of the SWM policy in Southeast Asia.

### **Political System**

Political systems affect policy implementation (Howes *et al.*, 2017; Kraft, 2018). Politics and administration are inseparable in policy



implementation (Pülzl & Treib, 2017). Vig & Kraft (2019) stated that the political system significantly influences policymaking. The review revealed that politics is critical in implementing SWM policies in Southeast Asia. The influence of politics can be seen in terms of the priority given by the policymakers in addressing SWM issues. Most Southeast Asian countries have formulated and implemented SWM policies to establish effective SWM systems. According to Abas & Wee (2020), the institutions created to support a sustainable SWM system require effective policies to provide the goals and directions to achieve them. These policies are essential in assisting the relevant stakeholders in the implementation process to achieve the intended outcomes.

Insufficient formulation and ineffective policy are typical causes of failed SWM programmes (Ferronato & Torretta, 2019). Howes *et al.* (2017) asserted that involving the public in the policymaking process can increase their acceptance and support of the SWM policy. In Vietnam, Nguyen *et al.* (2020) observed that the public had few opportunities to participate in policymaking, and stakeholders' roles were unclear due to a lack of information and clarity.

Based on the findings, most countries have formulated policies related to SWM. Fernando (2019) asserted that enforcing laws and regulations was crucial to support effective SWM. For instance, Local Government Units (LGUs) implemented and enforced local laws and regulations in the Philippines (Gonzales *et al.*, 2021). The Cebu Environmental Sanitation and Enforcement Team (CESET) was created to improve law enforcement in Cebu and enforce the SWM policy (Camarillo & Bellotindos, 2021). SWCorp was established in Malaysia to implement SWM regulations (Abas & Wee, 2020).

Effective SWM requires a transparent and adequate institutional framework with clear roles and responsibilities for stakeholders involved in the implementation process (Agamuthu *et al.*, 2020; Riaz *et al.*, 2023). Weak institutional structures impede a formal regulatory and

legislative framework. Decentralisation between different levels of government may enhance the effectiveness of policy implementation. In the Philippines, RA 9003 requires LGUs to enforce SWM laws (Premakumara *et al.*, 2014). Decentralised institutional structures increase agency cooperation to strengthen the LGUs' ability to enforce regulations and implement SWM policies (Ancog *et al.*, 2012). In a highly centralised country, de Oliveira (2019) found that centralisation led to coordination issues in policy implementation between intra and inter-governmental agencies in Malaysia. He added that formal and informal institutions should define their responsibilities and roles to coordinate and implement the policy.

Implementation requires effective policy. Involving relevant stakeholders in formulating a clear and comprehensive policy will allow for future improvements (Howes *et al.*, 2017). A clear policy should provide information for the implementation process. For instance, in their research, Yukalang *et al.* (2018) suggested that Thailand still lacks a local strategic plan for SWM. They added that municipalities have challenges implementing and guiding staff due to unclear policies. Trinh *et al.* (2021) found that collaboration among agencies was unattainable due to unclear task division and ambiguous responsibilities from the vague policy. Hence, policy clarity may increase key stakeholders' willingness to cooperate.

Furthermore, robust formal institutions can develop stakeholders' capacity to support policy implementation (Abas & Wee, 2020). For instance, an adequate institutional framework has been advantageous for the Cebu City Government in the Philippines to implement strategies and enforce regulations (Ancog *et al.*, 2012). This institutional framework is strengthened by fostering the partnership between the LGUs and the Department of Environment and Natural Resources (DENR) to achieve the implementation outcomes (Camarillo & Bellotindos, 2021). Trinh *et al.* (2021) revealed that the failure of waste treatment through composting in Hanoi, Vietnam, was

due to a fragmented communication network. Chenboonthai & Watanabe (2019) explained that stakeholder cooperation is crucial for pooling resources and disseminating information during implementation.

Agamuthu *et al.* (2020) and Riaz *et al.* (2023) suggested including the private sector in an adequate institutional framework. In the Philippines, Premakumara *et al.* (2014) found that engagement with the private sector has fostered effective implementation of the SWM plan in barangays. Similarly, the partnership between local governments and the private sector in Thailand helped address the cities' SW issues (Wannawilai *et al.*, 2017). The inclusion of private concessionaires in managing SW in Malaysia initially aimed to improve the quality of SWM services in the country (de Oliveira, 2019).

### ***Adequate Resources***

Kaza *et al.* (2018) revealed that developing countries allocated 20 to 50% of the annual budget to managing SW. Financial sustainability is the key to ensuring the effectiveness of public policy through the efficient use of resources in collaborative networks among the key stakeholders involved in the implementation process (Ferronato & Torretta, 2019).

Most articles suggested that financial constraints are a challenge for the authorities in enforcing the regulation and implementing the policy effectively. In Indonesia, limited funding has slowed the implementation of the Waste Bank Society (BSM) programme (Nuzuli *et al.*, 2015; Rachmawati *et al.*, 2019). Kerstens *et al.* (2016) argued that the limited funding is due to a lack of planning as a guideline for budget allocation. Yukalang *et al.* (2018) found that Thailand's SWM operating costs exceeded the municipalities' income. Thus, an effective implementation process may lead to a cost-effective SWM system in the country (Wannawilai *et al.*, 2017). Trinh *et al.* (2021) mentioned that financial support was crucial in ensuring effective policy implementation. However, due to a lack of funding, local

authorities suspended waste collector subsidies, affecting the policy outcomes (Nguyen & Watanabe, 2020). Consequently, municipalities resorted to maintaining conventional waste disposal methods, such as open dumping, as adopting new technology required higher investment (Camarillo & Bellotindos, 2021).

In Malaysia, the coordination problem between the three levels of government led to the distribution issue of resources. De Oliveira (2019) addressed the lack of state and local government resources due to the federal government's substantial level of authority and resource control. The incapability to invest in human capital development and infrastructure to support implementation affected the institution's competency (Abas & Wee, 2020). In the Philippines, the implementation of RA 9003 was affected by the lack of human capital, which prevented good policy outcomes (Premakumara *et al.*, 2014). Similarly, Wannawilai *et al.* (2017) observed that insufficient human resources with technical know-how diminished public confidence in the authority for managing SW.

### ***Appropriate Technology***

Southeast Asia is still in the infancy stage of utilising SW treatment and disposal technologies (So *et al.*, 2019). Open dumping and burning are common in the Philippines (Premakumara *et al.*, 2014). Similarly, Nuzuli *et al.* (2015) reported that open dumping is prevalent for waste disposal in Indonesia. In Vietnam, only 20% of the total landfills were sanitary landfills (Trinh *et al.*, 2021). Furthermore, limited landfill capacity is an issue that should be addressed. The Thai Government invested in energy-from-waste (EFW) to reduce the amount of SW sent to landfills (Chenboonthai & Watanabe, 2019). Similarly, municipalities and barangays in the Philippines adopted waste segregation and composting programmes to address limited landfill capacity issues (Camarillo & Bellotindos, 2021).

The Malaysian Government emphasises using advanced technologies and infrastructures to improve SWM (de Oliveira, 2019).

Nonetheless, advanced technologies and infrastructures require significant investments. For instance, Nuzuli *et al.* (2015) reported that two billion rupiahs were allocated to construct a sanitary landfill in Banjarbaru. On the other hand, the increased amount of SW generated has resulted in higher operating costs in Vietnam (Trinh *et al.*, 2021). Furthermore, limited funding has restrained municipalities from investing in advanced SW treatment and disposal facilities. Wannawilai *et al.* (2017) argued that Bangkok's inefficient SWM was due to outdated facilities and technologies.

Nevertheless, choosing the appropriate technologies for local needs is crucial. Khan *et al.* (2022) suggested that technologies and infrastructures should be flexible, adaptive, and robust to meet dynamic conditions. The Cebu City Government has implemented vermicomposting as the city waste composition was high in organic content (Ancog *et al.*, 2012). Nguyen *et al.* (2020) found that anaerobic digestion failed in Vietnam due to its technical complexity and high costs. The study found that composting was more appropriate due to lower costs and the low technical expertise required to operate it.

### ***Public Awareness and Participation***

Public awareness and participation are fundamental aspects of policy implementation. Ferronato & Torretta (2019) stated that shaping human behaviour may address environmental issues. Similarly, Agamuthu *et al.* (2020) argued that altering public behaviour can lead to compliance with practising proper SWM. For instance, the City Government of Bandung in Indonesia has developed programmes encouraging public participation in proper SWM (Rachmawati *et al.*, 2019). Nuzuli *et al.* (2015) found that BSM implemented in Banjarbaru, Indonesia, aimed to promote societal recycling behaviour.

Public awareness may increase participation and support in policy implementation (Hălbac-Cotoară-Zamfir *et al.*, 2019). Gonzales *et al.* (2021) found that a lack of community

awareness and participation prevented the effective implementation of waste segregation and composting programmes. On the other hand, there has been a significant improvement in environmental awareness in Vietnam due to continuous programmes and initiatives by the government over the past few years (Trinh *et al.*, 2021). Nguyen *et al.* (2020) agreed that public awareness of the environment was increasing, and they believed it should be intensified through training and campaigns. Apart from that, Wannawilai *et al.* (2017) found that Thailand's authority has utilised mass media to increase public awareness and participation in SWM programmes. However, the strategy could not target the whole society, especially in educating the children on the importance of sustainable SWM.

Active authorities' intervention may enhance public awareness and participation. In their study, Wannawilai *et al.* (2017) suggested that addressing SWM issues necessitates a partnership between the public and private sectors. Their study in Bangkok showed that the involvement of the private sector helped implement waste management programs. Private sector participation is also necessary to help authorities secure additional funds to develop advanced waste disposal facilities in Thailand (Chenboonthai & Watanabe, 2019). Nguyen & Watanabe (2020) found that authority support in the community-based composting programme motivated public waste separation behaviour in Vietnam. However, the lack of awareness programmes and campaigns organised by the authorities in the Philippines resulted in low participation in the waste separation initiatives (Camarillo & Bellotindos, 2021).

Understanding the local context is essential to ensure effective policy implementation. For instance, Yukalang *et al.* (2018) study in Thailand asserted that the changing behaviour of the older generation towards proper SWM had prompted intensive education programmes by the authorities. They added that the implementation and monitoring process should include the local community, such as monks, for

better policy outcomes. In Vietnam, the increase in organic waste was due to changing local cultural habits (Nguyen *et al.*, 2020). Camarillo & Bellotindos (2021) found that cultural and behavioural norms negatively affected the waste segregation programme in the Philippines.

## Discussion

This study provides an SLR on previous research regarding implementing SWM policies in Southeast Asia. The literature is limited to SWM policy implementation. The review of SWM policies established by countries in Southeast Asia revealed significant gaps between policy formulation and implementation with the intended outcomes. The SLR revealed that policy, governance, and institutional issues; resource management; culture, awareness, and participation; and infrastructure and technology significantly influenced the effectiveness of SWM policies in Southeast Asia.

The review revealed that politics is critical in implementing SWM policies in Southeast Asia. The influence of politics can be seen in terms of the priority given by the policymakers in addressing SWM issues. Most Southeast Asian countries have formulated and implemented SWM policies to establish effective SWM systems. However, from the review, there were gaps between the policy's objectives and the outcomes of the implementation process. Muliawaty *et al.* (2021) highlighted the need to revisit existing policies for review and adjustment to improve the implementation process. According to Abas & Wee (2020), the institutions created to support a sustainable SWM system require effective policies to provide the goals and directions to achieve them. These policies are essential in assisting the relevant stakeholders in the implementation process to achieve the intended outcomes.

Apart from providing directions for the implementation process, an effective policy provides an institutional structure essential to support successful implementation. In their study, Kaza *et al.* (2018) asserted that implementing SWM-related policies requires

an effective institutional structure. These institutions are responsible for developing and implementing strategies and solutions to address SWM issues. A sound institutional framework, which incorporates different government levels, must be developed. In La Paz, Bolivia, the disintegration of different levels of government in SWM has been identified as one of the policy implementations at the local level (Ferronato *et al.*, 2018). This is also the case for developing countries such as Malaysia, as ineffective institutional frameworks developed overlapping jurisdictions and unclear responsibilities of agencies from different levels of government in the implementation process (Abas & Wee, 2020).

As the policies often provide a new institutional framework to address SWM issues, ministries, departments, and agencies are established to support the sustainable development of the SWM system. Private sector partnerships are crucial in sustainable SWM (Agamuthu *et al.*, 2020). This argument supports the idea of Oh & Hettiarachchi (2020) that coordinating these institutions into collective actions is essential in SWM. However, the lack of effective coordination between agencies of different levels of government is another challenge in managing SW in the region, impeding policy outcomes. Institutions working independently without clear roles and responsibilities may lead to poor coordination among implementing agencies and affect policy outcomes. Serge Kubanza & Simatele (2020) argued that institutional failure in SWM impairs the city's economic growth and affects the quality of the environment and public well-being. This situation also affects Thailand's EFW initiative, which has been weakened by feeble coordination among governing institutions (Chenboonthai & Watanabe, 2019). In Malaysia, the weak implementation process is reflected by the poor coordination of various SWM governing institutions.

In addition, the SLR unearthed that Southeast Asian countries lack adequate resources to address SWM issues. Resources are needed to support effective policy implementation

(Ferronato & Torretta, 2019; Agamuthu *et al.*, 2020). As argued by Fernando (2019), limited funding for SWM is inevitable in many developing countries, constraining the efficiency of the SWM system and services. The authors argued that inadequate funding in Indonesia and the Philippines thwarted the government's efforts to establish sustainable SWM systems. The situation reflected the financial sustainability of Southeast Asian governments in providing quality SWM services to the public while coping with the issues of rising SW generation. Moreover, Spoann *et al.* (2018) held a similar view to Kaza *et al.* (2018), stating that less priority was given to implementing SWM as the sector received a small portion of the budget due to limited funding. Similarly, other developing countries such as Argentina obtained assistance from international funding organisations such as the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) to implement initiatives to support sustainable SWM (Agamuthu *et al.*, 2020).

Apart from funding, the availability of human capital with technical expertise in SWM is crucial in sustainable SWM. According to Abdallah *et al.* (2020), SWM is a complex task requiring individuals with technical expertise familiar with operating and maintaining waste-related technologies and infrastructure. Similarly, Ferronato & Torretta (2019) and Agamuthu *et al.* (2020) held the same view that the failure of SWM policies in developing countries was due to a lack of technical knowledge among the implementers in tackling complicated and complex operation and maintenance in SWM. The authors argued that progress in enhancing technical knowledge and developing local expertise is still lacking in Southeast Asia. Therefore, relying on external expertise to advise on strategies and technologies in SWM is inevitable. For instance, an expert team from Japan addressed food waste issues in Vietnam (Nguyen & Watanabe, 2020). In the Philippines, the lack of local experts forced the government to rely on experts from United States Agency for International Development (USAID) to

implement a biogas digester plant in Cebu City (Ancog *et al.*, 2012).

In the context of policy implementation, Khan *et al.* (2022) suggested that addressing the complex issues of SWM requires technology development. For instance, China is developing effective SWM technology to modernise its SWM systems due to high population and economic growth (Khan *et al.*, 2022). In Southeast Asia, rising population and urbanisation have significantly influenced the SW generation and affected the government's capacity to manage SW. Based on the review, Southeast Asia countries still lack advanced technologies for managing SW. Landfilling has been the primary technology for treating SW in the region. Due to high SW generation, these landfills are reaching maximum capacity and developing challenges for authorities with limited open space due to population density. Nuzuli *et al.* (2015) highlighted that pollution and disease growth have affected residents living near the landfill areas. In Vietnam, pollution caused by landfill mismanagement created grave consequences for the environment and public well-being (Nguyen *et al.*, 2020).

Wannawilai *et al.* (2017) suggested that the government must adopt appropriate SWM technologies to establish a sustainable SWM system in Bangkok, Thailand. Apart from adopting appropriate technologies, substantial investment in developing these technologies is a significant challenge for Southeast Asian countries. Modernising landfill management by developing sanitary landfills may solve the problem of insufficient space, as sanitary landfills have a longer lifespan than unsanitary landfills, which would be cost-effective in the long run. These findings resonate with Nuzuli *et al.*'s (2015) study, as insufficient funding has delayed the transition to sanitary landfills from open dumping in Banjarbaru, Indonesia. Regarding this, integrated approaches such as collaboration with private sectors and international organisations are established to provide financial assistance for the implementation process. This is the case



in Malaysia; the involvement of the private sector enables the government to improve SWM performance through their technical expertise and resources in improving service delivery (de Oliveira, 2019). In the Philippines, the implementation of Cebu Common Treatment Facility Inc. (CCTFI) showed how partnerships among the business sector, city government, and a funding agency could be pooled together to implement an essential environmental project for the benefit of all (Ancog *et al.*, 2012).

The findings asserted that there was compelling evidence that Southeast Asian countries adopted and implemented ineffective, complicated, expensive technology designed in developed countries. Fernando (2019) highlighted the importance of adopting economically viable, socially accepted, and environmentally effective technology to support a sustainable SWM system. Agamuthu *et al.* (2020) exemplified the failure of technology adoption by other Asian countries, such as India, due to failure to understand SWM issues and local conditions. The statement correlates with Nanda and Berruti's (2021) study that incineration technology in India is impractical as the waste contains high moisture and organic content, which is costly and demands more energy to burn. The review asserted that several authors such as Kerstens *et al.* (2016), Nguyen *et al.* (2020), Victor & Agamuthu (2013), and Yukalang *et al.* (2018) had emphasised the importance of investing in technologies that complement the local context. In Malaysia, anaerobic plants fail to process organic waste due to the required technical expertise and high financial investment (Nguyen *et al.*, 2020).

Overall, the finding attested that public awareness and participation significantly influence the successful implementation of SWM policies. Riaz *et al.* (2023) asserted that effective, sustainable SWM requires environmental awareness, support, and engagement from society. The Cebu City Government in the Philippines has recognised that the SWM program's success depends on society's heightened awareness to ensure their active

participation. Increasing society's attention on government policy implementation can result in programs running effectively (Rachmawati *et al.*, 2019). As Victor & Agamuthu (2013) argued, environmental awareness positively affects environmental behaviour, such as waste recycling, which the authors argued is still lacking in Southeast Asian society.

According to Camarillo & Bellotindos (2021), environmental awareness can be imparted through campaigns, education, and projects that disseminate information on waste separation, recycling, collection, and disposal. Additionally, Chenboonthai & Watanabe (2019) asserted that engaging various stakeholders, including the public, provides crucial feedback for policymakers in policy formulation and implementation. In Malaysia, de Oliveira (2019) asserted that the limited opportunity of the public to participate in the policymaking process resulted in weak support towards recycling behaviour. This is not the case in developed European countries, as active public participation enables the country to modernise the SWM systems successfully (Knickmeyer, 2020).

Furthermore, the findings affirmed that the region's public awareness of SWM is still low. Waste separation and recycling are critically important in implementing sustainable SWM. Several Southeast Asian countries, such as Malaysia (de Oliveira, 2019) and the Philippines (Premakumara *et al.*, 2014), have regulated a specific law for the public to separate their waste. Concerning this, Fernando (2019) asserted that the better-informed public has a greater propensity to participate in waste separation and recycling than those who are not as well-informed. In the case of Southeast Asian countries, the outcomes of waste separation and recycling were unlikely as the recycling rate in the region is still minimal. The results supported the idea that the level of information about waste separation and recycling was a significant factor in determining the public participation (Suškevičs *et al.*, 2023). Effective policy implementation can contribute to a



sustainable SWM system (Fernando, 2019). Policy implementation has been an essential stage in the public policy process in translating the actions into intended outcomes (Howlett, 2019; Khan, 2016).

### Conclusion

The findings of the present review suggested that research on SWM in Southeast Asia, focusing on policy implementation, is obscure. SWM is a complex process as it requires effective policies to support a successful implementation process. This SLR is guided by the specific objective of examining the implementation of SWM policies in Southeast Asia; the review found that political systems, resources, public awareness, participation, and appropriate SWM technology significantly affect the success of SWM implementation. The increasing SW generation and poor SWM situation reflect the weakness of the implementation process in Southeast Asia. Despite the dearth of research, policy implementation is crucial in mitigating SWM issues. A few studies have indicated the lack of research on the implementation process outcomes due to scarce information. However, further study is needed to provide more insight into the challenges with recent evidence on the implementation process in the region.

Inefficiency in policy implementation in SWM has also been found in other Asian countries. Although the challenges of the implementation process are similar, the solutions by countries vary. These findings provide valuable information for Southeast Asian governments to generate more ideas to solve the issues. Effective implementation of SWM policy means improved environmental quality and the gradual resolution of waste issues towards sustainability. There is a limited number of articles on the topic in Southeast Asia; only two databases were deployed for the SLR. Few countries are unrepresented in the current systematic review, implying that it receives moderate attention when studying SWM policy implementation in Southeast Asia. Research on SWM policy implementation should use a broader range of

databases to identify a wider perspective on the challenges of implementing SWM in Southeast Asia.

### Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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