



Climate Change Mitigation in the Waste Sector: Policies and Measures in Different Countries and the Way Forward for Thailand

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Abstract

This study performed a non-systematic review of climate change mitigation policies in the waste sector across nine selected countries (Thailand, the UK, Germany, Belgium, France, Denmark, Indonesia, China, and Japan). The review aimed to examine the existing policies and measures, identify potential areas of improvement in Thailand's waste sector compared to the selected countries and propose levers of transformation of the policy recommendations for Thailand. Based on the review of waste management policies and measures in nine countries, twelve policies have been implemented in other countries but are not mentioned in Thailand's reviewed documents. Some of the significant policies and measures identified as potential areas of improvement in Thailand's waste sector related policies and measures include introducing waste taxation, implementing the Internet of Things (IoT) and Extended Producer Responsibility (EPR), and promoting waste electrical and electronic equipment (WEEE) recycling focusing on solar panel wastes. Recommendations have been provided through the designation of the levers of transformation (governance, economy and finance, individual and collective action, and science and technology). The findings provide valuable insights into strengthening the climate change mitigation efforts specific to the waste sector in Thailand by aligning with international practices. By identifying the areas of improvement and potential policy recommendations analyzed through the lenses of the levers of transformation, Thailand can optimize its waste management strategies, reduce greenhouse gas emissions, and contribute to a sustainable future.

Keywords : Climate change mitigation; Levers of transformation; Non-systematic review;
Policy recommendation; Waste sector

Introduction

The waste sector is one of the major contributors to greenhouse gas emissions globally, including Thailand [1]. The total greenhouse gas (GHG) emission of Thailand in 2018 was 372,648.77 GgCO₂-eq and the waste sector contributed 4.5% of the emissions (16,703.68 GgCO₂-eq) [2]. The government of Thailand along with other countries worldwide is being urged to establish effective policies and actions in a variety of sectors including waste to mitigate climate change [1-3]. Efforts made for efficient waste management can substantially help in lessening climate change problems. The waste management sector of Thailand currently faces challenges due to the rapid waste generation with population growth and the subsequent improper disposal, despite governmental initiatives like the National 3R Strategic Plan and the Solid Waste Management Master Plan [18]. This highlights a critical gap between policy and implementation. Hence, the issue of waste management in Thailand is centered on establishing sustainable consumption and production practices while effectively addressing problems related to rapid waste generation, inadequate infrastructure for waste collection and disposal leading to environmental pollution and health impacts, and proper implementation of regulations and policies to minimize waste generation, promote waste segregation, recycling and proper waste treatment [19]. Aligning with Sustainable Development Goal 12 (SDG12), a comprehensive review of the policies related to the waste management sector is necessary [19]. This study aims to review and compare the available waste sector-related climate change mitigation policies and measures in Thailand and other countries that vary in socioeconomic context, cultural background, waste management practices, and governmental construct. This approach will be beneficial in identifying the successful strategies and potential policy gaps in the waste sector of Thailand when compared with other countries. By focusing on the areas where Thailand lags, valuable insights can be obtained by developing policy recommendations to enhance the country's climate change mitigation efforts in the waste sector. Overall, this study aims to contribute to the global understanding of climate change mitigation policies in the waste sector and provide practical insights to support

Thailand's efforts in achieving low carbon sustainable waste management practices.

Methodology

The climate change mitigation policies and measures in the waste sector of nine countries, namely Thailand, the UK, Germany, Belgium, France, Denmark, Indonesia, China, and Japan have been reviewed and compared in this study. The countries were selected based on the Environmental Performance Index (EPI) and the SDG Index rankings [20, 21]. The EPI ranks countries based on their environmental performance while the SDG Index ranks countries based on their progress towards achieving SDG 12. The eight selected countries entail wide variations in rankings for both indices, facilitating a comprehensive analysis (**Table 1**). Developed countries that rank high (Germany, the UK, France, and Denmark) provide insights on the optimum policies for waste management. Developed or developing countries that rank lower (China, Japan, Thailand, and Indonesia) provides insights on the potential strategies of waste management. The inclusion of diverse countries globally enables a comprehensive analysis of waste management policies and measures across various socioeconomic, cultural and governmental contexts. A non-systematic (purposive) review involves selecting and reviewing relevant literature based on predefined objectives to address specific research questions [16]. A non-systematic (purposive) review of available reports on climate change-related policies was conducted, focusing on the waste sector. All climate change mitigation policies and measures specific to the waste sector were compiled and identified from governmentally published official policy documents, reports, or other relevant literature sources, including (but not limited to) national climate change long-term strategies and national adaptation plans. The policies and measures were grouped into the specific waste sector and compared between the countries. This comparative analysis served as the basis for identifying the strengths and weaknesses in Thailand's waste sector policies and measures when compared to other countries. The procedures helped in providing specific policy recommendations and identifying their levers of transformation as key drivers in achieving sustainable waste management in Thailand.

Table 1 Environmental and Sustainable Development Performance Rankings of Selected Countries

Country	EPI [20]	Rank	SDG Index [21]	Rank
Thailand	28.5	100	74.74	43
UK	62.6	26	81.65	11
Germany	69	11	83.36	4
Belgium	68	14	79.46	19
France	63.8	21	82.05	6
Denmark	68.3	13	85.68	3
Indonesia	29.5	96	70.16	75
China	28.6	98	72.01	63
Japan	52.8	47	79.41	21

Results and Discussion

1. Review of country-specific policies and measures

The waste sector-related policies and measures in the selected countries have been discussed. Thailand has attempted to address the problem of waste management by developing national management frameworks, such as the National Solid Waste Management Master Plan (2022-2027) and the Roadmap on Plastic Waste Management (2018-2030) [1]. The Zero Industry Waste to Landfill policy and the “Green Industry Mark” for environmentally friendly processes were adopted to reduce industrial waste generation [2, 3]. Thailand will continue to manage the waste and wastewater sector and reduce its GHG emissions by reducing waste generation, increasing recycling, increasing biogas production from industrial wastewater, and improving efficiency in industrial and municipal wastewater management. Japan aims to ensure decarbonization in local regions through 1) “reuse” of used products to become a common practice instead of discarding them as waste; 2) electricity, heat, CO₂, biogases, etc., derived from waste treatment and sewerage systems in the local regions; and 3) driving efficiency improved by utilizing IoT (Internet of Things) technology in waste treatment facilities [4, 5]. In Indonesia, the long-term pathway considers both historical trends and projections of future waste management activities, particularly methane gas (CH₄) from the waste treatment of municipal solid waste (MSW), domestic wastewater, and industrial waste [7]. In China, strategic priorities and policy orientations aim to establish low GHG emissions in MSW, agricultural wastes, and industrial wastes [8]. In the United Kingdom, the Resources and Waste Strategy (RWS) 2018 specifies that the country will transition to a more

circular economy, including key reforms to enable more efficient waste management, reduce the amount of waste created by society, and ensure more efficient resource use. The draft Waste Prevention Programme for England (WPP) sets out the overall approach to improving resource efficiency across all key sectors and announces the government’s intention to consult on the introduction of extended producer responsibility across a range of sectors. The Industrial Decarbonization Strategy outlines ambitious targets for resource efficiency measures across the industry [9]. Belgium plans a gradual but complete phase-out (in Flanders and Brussels), or at least a very large reduction in landfilling or incineration of waste by 2050, eliminating virtually all GHG emissions [10]. Denmark’s Climate Plan for a green waste sector and circular economy includes a vision for a carbon-neutral waste sector by 2030 and for eliminating the incineration of 80% of Denmark’s plastic waste by 2030, as well as for turning the waste curve toward less waste, less wastage, and more recycling. There are several initiatives for better and more rational waste separation, more recycling, and adjustment of incineration capacity [11, 12]. France has a National Waste Management Plan to implement the European waste management hierarchy: prevention, reuse, recycling, recovery, and disposal. The circular economy roadmap (2017 and 2018), followed by the anti-waste law for a circular economy (2020), focuses on eliminating the different forms of waste, strengthening consumer information, mobilizing industry to change production methods, improving waste collection, and sorting, and eliminating illegal dumping [13, 14]. To extend the useful life of products and avoid waste, the German government will consider measures and specific instruments for implementation.

2. Comparison of policies and measures in the waste sector

A comprehensive overview of the availability of different waste stream-specific policies and measures in the reviewed literature and their implementation status have been compiled and compared between the nine countries in **Table 2**. The purposive review process involved identifying government-issued reports on national climate change strategies and plans. Subsequently, the identified documents were reviewed to extract information regarding policies and measures related to the waste sector within the context of climate change mitigation. The results highlight that the selected reports for review on climate change mitigation strategies in this study may not be extensively detailed regarding the waste sector-related policies and measures. The information available on waste sector-specific policies and measures varies across the selected countries due to factors such as varying national priorities, the waste sector is already performing well or their contribution to the overall climate change impact might be less significant. The differences in the reporting practices can also influence the level of detail provided for the waste sector in different country's climate change-related policy reports. Hence, the unavailability of specific waste sector-related policies for specific countries (in **Tables 2** and **3**), cannot be interpreted as an absolute confirmation that the specific policy does not exist within that country, but it indicates that the policy was not definitively mentioned in the reviewed climate change mitigation reports.

3. Areas of improvement in the policies and measures of Thailand in comparison with other countries

The waste sector-specific policy and measures have been compiled and compared in terms of the implementation status in Thailand (**Table 3**). A broad perspective of the status of different waste sector-specific policies has been provided in **Table 2** and **Table 3** building upon this foundation to focus on individual policies and measures, highlighting Thailand's status of policy implementation. Based on the review of waste management policies and measures in nine countries, including Thailand, a total of twenty-four policies and measures were compiled. Three policies have already been implemented in Thailand and six policies have been proposed for implementation in Thailand. Three policies are not applicable or

practical to be implemented in the context of Thailand. Currently, twelve policies have been implemented in other countries but are not mentioned in Thailand's reviewed documents, indicating the potential areas of improvement in existing waste sector-related policies and measures in Thailand.

4. Levers of transformation and policy recommendations for Thailand

Based on the review of policies and measures related to the waste sector in nine countries, twelve areas of improvement were identified in Thailand's current policies and measures compared to other countries (see **Table 3**). Some of the significant policies and measures identified as current areas of improvement in Thailand's waste sector related policies and measures include adopting renewable energy generation by utilizing waste; investing IoT in the waste sector and recycling technologies; collecting recyclable waste; disposing biodegradable waste to landfills; introducing producers for responsibility of plastic wastes; adding tax on wastes; promoting increased share of recycled plastic to replace virgin material; decarbonizing industrial wastes; enhancing waste-to-energy initiatives; and strengthening regulatory framework GHG emission reduction in waste sector. All twelve policies and measures are recommended to enhance the waste sector-related policies of Thailand. Amongst the twelve policies and measures, four have been discussed in detail considering the economic feasibility in the context of Thailand and to expedite the progress towards achieving the 2030 target for the national waste management goals. This prioritization ensures the proposed measures are impactful, financially viable and implementable in the current timeframe (**Table 4**).

Measure 1: Introducing waste taxation for waste minimization

Introducing waste taxation to reduce waste generation and promote recycling amongst both producers and consumers by informing them about the environmental and economic significance of waste. Utilizing the revenue generated from the tax to support sustainable waste management initiatives, including recycling infrastructure development, waste-to-energy projects, and research on innovative waste management technologies. The scheme should ensure equitable implementation by targeting

specific groups responsible such as the large-scale producers and high-waste consumers through a differentiated tax structure, without placing an economic burden on low-income groups.

Measure 2: Implementing the Internet of Things (IoT) in the waste sector

Implementing the benefits of IoT technology by digitizing Thailand's database and supporting data-driven decision-making to improve waste management systems, improve data collection and monitoring, support research, improve transparency and accountability, and improve operational efficiency by optimizing the allocation of resources for waste collection, workforces, equipment, recycling, data analysis, etc.

Measure 3: Implementing Extended Producer Responsibility (EPR) for wastes

Establishing regulations and mechanisms to hold producers accountable for the entire life cycle of products, including collection, recycling, replacing virgin material manufacturing, and safe disposal.

Measure 4: Promoting waste electrical and electronic equipment (WEEE) recycling focusing on solar panel wastes

Implementing efficient methods for the collection, recycling, and end-of-life disposal of WEEE responsibly, including solar panel wastes for effective management of hazardous materials, minimization of environmental pollution, and maximization of resource recovery for new economic opportunities for recycling and material recovery-related sectors

These recommendations have been deduced as potential advancements in the waste sector-related policies and measures for Thailand through the designation of the levers of transformation (governance, economy and finance, individual and collective action, and science and technology) (**Table 3**). The lever of transformation is a policy tool that can be used for many purposes, including understanding the policy landscape and identifying essential drivers for driving policies [17]. The recommendations are intended to help Thailand to improve its waste management policies and measures in a significant way.

5. Limitations and scope for future improvement

The purposive review in this study facilitated a focused analysis by allowing the selection of literature based on the researcher's judgement focusing on keywords related to climate change mitigation in the waste sector. This approach limits the analysis by introducing potential biases. Future studies should focus on specifying clear criteria for selecting literature that is comprehensive to mitigate such biases. While the nine countries selected in this review offer a comparative perspective, they may not provide a diverse and comprehensive global understanding of waste management policies and measures. The study relied on governmentally published official reports on climate change mitigation strategies with a focus on the waste sector which ensures reliability, nonetheless, it limits the scope of this review due to the exclusion of the full spectrum of data available on waste management policies. The specific focus on climate change mitigation policies and measures within the waste sector might have resulted in excluding other relevant waste management-related policies that are not explicitly mentioned in the context of climate change. Further, variations in national priorities and reporting practices can influence the level of detail provided in different country's climate change-related policy reports. The categorization of policies and measures in **Table 2** provides a general overview and future research can focus on reviewing the details of policy implementation such as specific provisions, level of government responsibility and progress or effectiveness of the policy. Further, GHG emission profiles of various waste sectors have not been explored in this study, which limits the potential to directly compare the status of waste sector of Thailand with other countries. Including such comprehensive analysis of waste sector-specific emission will be a valuable addition for future research efforts to support evaluating policy effectiveness. Future studies could benefit from adopting a systematic approach with extensive data collection processes, detailing the effectiveness of various policies and measures. Despite these limitations, this review offers a foundation for identifying areas of improvement in Thailand's waste management strategies.

Table 2 Status of different waste sectors compared between different countries and Thailand

Country	Thailand	Japan	Indonesia	China	United Kingdom	Belgium	Denmark	France	Germany
Food Waste									
Plastic Waste									
Landfill Waste									
Marine Waste									
Agricultural Waste									
Industrial Waste									
Municipal Solid Waste (MSW)									
Wastewater									
Waste Electrical and Electronic Equipment (WEEE)									

- Policies and measures have been enacted.
- Policies and measures have been implemented/executed.
- Policies and measures have been proposed with targets for the future.
- Policies and measures are unavailable in reviewed literature.

Table 3 Status of waste sector-related policy/measures implementation

No.	Policy/Measure	Implementing countries	Thailand Status
1	National Plan for waste management	Indonesia and France	Implemented (National Solid Waste Management Master Plan (2016-2021)) [1,2]
2	Plan for plastic waste management	Japan, United Kingdom, and Denmark	Implemented (Roadmap on Plastic Waste Management (2018-2030)) [1,2]
3	Biofuel from biowastes	China	Implemented (Alternative Energy Development Plan (2018-2037)) [2,3]
4	Promotion of circular economy	China, United Kingdom, Denmark, France, and Germany	Proposed (BCG Model) [1,2]
5	3R Principle	Japan, Indonesia, China, United Kingdom, Denmark, France, and Germany	Proposed (Draft National Waste Management Action Plan (2022-2027)) [1,3]
6	Food waste reduction/sustainable consumption	Japan and United Kingdom	Proposed (reduce food waste by 50% in 2030) [2,3]
7	Zero waste to Landfill	United Kingdom, Belgium, and France	Proposed (Zero Industry Waste to Landfill policy) [2,3]
8	Waste to Energy	Indonesia and Japan	Proposed (NDC Sectoral Action Plan for the Waste Sector 2021 – 2030) [1,2]
9	Public Private Partnership	Japan and Denmark	Proposed (NDC Sectoral Action Plan for the Waste Sector 2021 – 2030) [1,2]
10	Anti-waste Law for Circular economy	France	Not applicable for Thailand
11	Sewerage system installation (replacing septic tank)	Denmark	Not applicable for Thailand
12	Elimination of incineration of waste	Belgium, Denmark, and France	Not applicable for Thailand
13	IoT in waste sector	Japan	Identified as potential area of improvement
14	Investment in recycling technology	Japan and Germany	Identified as potential area of improvement
15	Elimination of biodegradable MSW to Landfill	United Kingdom, France, and Germany	Identified as potential area of improvement
16	Renewable energy technology in wastewater	Japan, Indonesia, and United Kingdom	Identified as potential area of improvement
17	WEEE recycling	Japan	Identified as potential area of improvement
18	Increase septic tank for biogas recovery (Decentralized sewage treatment)	Indonesia and China	Identified as potential area of improvement
19	Extended producers' responsibility (EPR) for plastic wastes	United Kingdom, Denmark, and France	Identified as potential area of improvement
20	Plastic Packaging Tax	United Kingdom	Identified as potential area of improvement
21	Landfilling waste Tax	United Kingdom, Denmark, and France	Identified as potential area of improvement
22	Climate Plan for green waste sector	Denmark	Identified as potential area of improvement
23	Increase share of recycled plastics in manufacturing	United Kingdom and Denmark	Identified as potential area of improvement
24	Industrial Decarbonization Strategy	United Kingdom and China	Identified as potential area of improvement

Table 4 Policy recommendations for Thailand for the respective levers of transformation

Lever of transformation	Measure 1: Introducing waste taxation for waste minimization	Measure 2: Implementing the Internet of Things (IoT) in the waste sector	Measure 3: Implementing Extended Producer Responsibility (EPR) for wastes	Measure 4: Promoting WEEE recycling focusing on solar panel wastes
Governance	Establish a national waste management plan that is routinely and rigorously monitored by an authority specifically responsible for the effective enforcement of the waste management measures.	Establish independent monitoring authorities to oversight adherence to regulatory guidelines and adequate utilization of resources of IoT systems. Establish an integrated multi-stakeholder collaborative approach in policy development and knowledge sharing fostering transparency and accountability.	Set standards that require producers to take responsibility for the proper collection and recycling at the end of life of their wastes.	Develop and enforce regulations and standards for WEEE stipulating the accepted treatment methods, licensing of facilities and penalties for non-compliance or environmentally unsafe dumping practices.
Economy and finance	Introduce tiered tax system on different types and amounts of wastes to curb waste generation by inculcating responsibility for waste minimization and generate revenue to support recycling initiatives.	Public-Private Partnerships (PPPs) via cost sharing models where public sector collaborates with private sector as an optimized route for cost saving. Public sector provides the infrastructure while private sector invests and maintains the IoT technology.	Introduce market-based incentives to support the EPR scheme such deposit-refund approach where the deposit paid for the purchase of specific products will be refunded after returning for proper recycling.	Establish recycling funds financially supported by businesses producing WEEE. The revenue collected via waste tax can also be allocated to subsidize establishing and operating the WEEE recycling facilities.
Individual and collective action	Educate, encourage, and facilitate the public about individual responsibility for reducing waste or separating different wastes before discarding via public awareness campaigns.	Develop a transparent platform to update the public and private sectors on their waste collection and recycling via a tracking app or website.	Develop a “one stop service hub” where all producers, waste collectors, and recyclers can be connected easily and transparently.	Form a network for WEEE recycling centers that are community based and are staffed with volunteers who also provide training for WEEE recycling.
Science and technology	Invest in research and development of new technologies tailored to treat specific types of wastes and recover resources from wastes.	Invest in research and development in IoT to track the waste collection, monitor the waste composition and provide real time information to waste managers to improve efficiency in waste sector.	Invest in research and development in EPR schemes that are tailored to address the requirements of that are specific to the different industries and the types of waste they produce.	Invest in research and development in recycling technologies that are environmentally sound and economically viable, considering that it is expensive to recycle WEE and require special handling as they are hazardous.

Conclusions

Climate change mitigation related policies and measures specific to the waste sector were reviewed for Thailand and other countries (the UK, Germany, Belgium, France, Denmark, Indonesia, China, and Japan). The comparative analysis revealed that Thailand has made progress in terms of climate change mitigation policies in the waste sector, but there are still areas that require attention and improvement. To address these potential areas of improvement and foster transformation in the waste sector, the recommendations have been categorized into four levers of transformation (governance; science and technology; economy and finance; and individual and collective action). These levers have the potential to advance sustainable waste management practices in Thailand, reduce greenhouse gas emissions, and promote circular economy principles in the waste sector. Future studies are essential to explore the detailed, specific mechanisms of the described lever (of each policy recommendation) to realize the full potential of the policy recommendations. The recommendations proposed in this study are intended to assist policymakers in formulating effective policies and strategies for the waste sector in Thailand. By implementing these recommendations, Thailand can reinforce climate change mitigation efforts, improve waste management practices, and contribute to the global transition towards low-carbon and sustainable waste management.

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References

- [1] ONEP. 2022. Thailand's long-term low greenhouse gas emission development strategy. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.
- [2] ONEP. 2022. Thailand fourth biennial update report. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/Thailand_BUR4_final_28122022.pdf.
- [3] Thailand's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change. [Accessed July 18, 2023]. Available from: <https://unfccc.int/sites/default/files/resource/Thailand%20TNC.pdf>.
- [4] Government of Japan. 2021. The Long-Term Strategy under the Paris Agreement. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/Japan_LTS2021.pdf.
- [5] Japan on Japan's National adaptation plan and its associated policy framework. [Accessed July 18, 2023]. Available from: https://unfccc.int/documents/47072?gclid=CjwKCAjwp6CkBhB_EiwAlQVyXUr69wUdI-6lCNIDSbZfRj2ai9w49moS5kgdnqBKLEsj42CRGCsjTRoCGyYQAvD_BwE.
- [6] Japan's seventh national communication under the United Nations framework convention on climate change. 2017. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/4092715_Japan-NC7-2-NC7-JPN-E.pdf.
- [7] Long-Term Strategy for Low Carbon and Climate Resilience 2050 (Indonesia LTS-LCCR 2050). 2021. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/Indonesia_LTS-LCCR_2021.pdf.
- [8] China's Mid-Century Long-Term Low Greenhouse Gas Emission Development Strategy. [Accessed July 18, 2023]. Available from: <https://unfccc.int/sites/default/files/resource/China%E2%80%99s%20Mid-Century%20Long-Term%20Low%20Greenhouse%20Gas%20Emission%20Development%20Strategy.pdf>.
- [9] Net Zero Strategy: Build Back Greener. 2021. [Accessed July 18, 2023]. Available from:

- <https://unfccc.int/sites/default/files/resource/UK%20Net%20Zero%20Strategy%20-%20Build%20Back%20Greener.pdf>.
- [10] Belgium's long-term strategy. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/LTS_BE_EN_summary.pdf.
- [11] Climate Programme 2020 Denmark's Mid-century, Long-term Low Greenhouse Gas Emission Development Strategy. 2020. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/ClimateProgramme2020-Denmarks-LTS-under-the%20Paris Agreement_December2020_.pdf.
- [12] Danish strategy for adaptation to a changing climate. 2008. [Accessed July 18, 2023]. Available from: https://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf.
- [13] Revised national low carbon strategy of France. 2020. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/en_SNBC-2_complete.pdf.
- [14] French National Climate Change Impact Adaptation Plan 2011 – 2015. [Accessed July 18, 2023]. Available from: <https://faolex.fao.org/docs/pdf/fra181678.pdf>.
- [15] Update to the long-term strategy for climate action of the Federal Republic of Germany. [Accessed July 18, 2023]. Available from: https://unfccc.int/sites/default/files/resource/Anlage%202_Update%20to%20the%20long-term%20strategy%20for%20climate%20action%20of%20the%20Federal%20Republic%20of%20Germany_02Nov2022_0.pdf.
- [16] D. A. Cook. 2019. Systematic and nonsystematic reviews: Choosing an approach. *Healthcare Simulation Research*, 55-60.
- [17] United Nations. 2019. Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development. [Accessed July 18, 2023]. Available from: https://sdgs.un.org/sites/default/files/2020-07/24797GSDR_report_2019.pdf.
- [18] Babel, S., Ta, A. T., & Habarakada Liyanage, T. U. 2020. Current situation and challenges of waste management in Thailand. *Advances in Environmental Engineering and Green Technologies*, 409-440. Available from: 10.4018/978-1-7998-0198-6.ch017.
- [19] United Nations. 2015. Sustainable Development Goal 12: Ensure sustainable consumption and production patterns. [Accessed April 18, 2024]. Available from: <https://sdgs.un.org/goals/goal12>.
- [20] Yale University. 2022. Environmental Performance Index (EPI) 2022: Waste Management. [Accessed April 18, 2024]. Available from: <https://epi.yale.edu/epi-results/2022/component/wmg>.
- [21] SDG Index and Dashboards. n.d. Sustainable Development Goal Index: SDG 12. [Accessed April 18, 2024]. Available from: <https://dashboards.sdgindex.org/map/goals/SDG12>.

