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Managing Chemical Hazardous Wastes in Thailand: Challenges and Strategies for Sustainable Development

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ABSTRACT

This study examines the current state of hazardous waste management in Thailand, focusing on the types of chemical hazardous wastes generated, disposal practices, compliance with regulations, and barriers to effective management. The findings reveal that toxic chemicals dominate the industrial sector, while improper disposal methods, such as landfilling and incineration, are commonly used. Compliance with hazardous waste regulations varies, with the healthcare sector showing the highest compliance, but significant non-compliance persists in other sectors. Economic factors, particularly the high cost of proper disposal, along with inadequate infrastructure and insufficient regulatory enforcement, are major barriers to effective waste management. Additionally, a lack of awareness and education, particularly in the agricultural sector, further hinders progress. The study highlights the need for strengthened regulations, improved infrastructure, and increased public education to address these challenges and ensure effective hazardous waste management in Thailand.

Keywords : *Chemical Hazardous Waste, Waste Management, Environmental Impact, Sustainable Development, Thailand*

Introduction

Thailand's rapid industrial growth over the past few decades has significantly contributed to its economic development, elevating the country to one of Southeast Asia's most vibrant economies. However, this progress has come with a cost, as the rise in industrial activities has led to an increase in chemical hazardous waste. This type of waste, which includes substances that are toxic, flammable, corrosive, or reactive, poses severe threats to both the environment and public health. The improper management of chemical hazardous waste can lead to soil and water contamination, air pollution, and long-term health problems, including respiratory issues, cancer, and other serious conditions.

In recent years, the Thai government has recognized the critical need to address the management of chemical hazardous waste. Various regulations and policies have been implemented to mitigate the risks associated with this waste. Despite these efforts, challenges remain in effectively managing chemical hazardous waste, particularly in areas with limited resources and inadequate infrastructure. The complexity of hazardous waste management is exacerbated by the diverse sources of waste, which include industrial processes, healthcare facilities, agricultural activities, and households. Each of these sources contributes to the growing volume of hazardous waste that must be carefully handled, treated, and disposed of to prevent environmental degradation and health risks.

One of the significant challenges in managing chemical hazardous waste in Thailand is the lack of comprehensive data and monitoring systems. Many hazardous waste generators do not fully comply with reporting requirements, making it difficult to track the volume and types of waste produced. This lack of data hinders the development of effective waste management strategies and makes it challenging to assess the true scope of the problem. Additionally, illegal dumping and improper disposal practices remain prevalent, particularly in rural areas where regulatory enforcement is weak.

Furthermore, public awareness and education regarding chemical hazardous waste are still limited in Thailand. Many people, especially in rural communities, are unaware of the dangers associated with hazardous wastes and the proper methods of disposal. This lack of awareness contributes to unsafe practices, such as burning hazardous waste or dumping it in unregulated landfills, which further exacerbates environmental pollution and health risks.

To address these challenges, Thailand must adopt a more integrated and sustainable approach to managing chemical hazardous waste. This includes strengthening regulatory frameworks, enhancing enforcement mechanisms, and improving waste management infrastructure. Moreover, public education and awareness campaigns are essential to promote safe disposal practices and reduce the generation of hazardous wastes at the source.

This research aims to explore the current state of chemical hazardous waste management in Thailand, identify the key challenges, and propose strategies for sustainable development. By examining the effectiveness of existing policies and practices, this study seeks to contribute to the ongoing efforts to protect Thailand's environment and public health from the adverse effects of chemical hazardous waste.

Methodology

This study employs a mixed-methods research design, combining quantitative and qualitative approaches to provide a comprehensive understanding of chemical hazardous waste management in Thailand. The mixed-methods design allows for the collection of both numerical data and detailed insights, which are crucial for addressing the complexity of the issue.

Data Collection

Quantitative Data Collection

Quantitative data was gathered through a nationwide survey targeting industries, healthcare facilities, agricultural sectors, and households that generate chemical hazardous waste. The survey aimed to collect information on the volume and types of hazardous waste generated, current disposal practices, and compliance with existing regulations. A sample size of 400 respondents was determined using the Yamane formula, ensuring a representative sample of the diverse sources of chemical hazardous waste across Thailand.

The survey questionnaire was designed with closed-ended questions to gather specific, measurable data on waste generation, disposal practices, and regulatory compliance. Data was collected both online and through face-to-face interviews to reach respondents in urban and rural areas, ensuring comprehensive coverage.

Qualitative Data Collection

Qualitative data was collected through in-depth interviews and focus group discussions with key stakeholders, including government officials, environmental experts, industry representatives, and community leaders. These interviews aimed to explore the challenges and barriers in chemical hazardous waste management, as well as the effectiveness of current policies and regulations. The qualitative approach provided rich, contextual insights into the complexities of managing hazardous waste in different sectors and regions of Thailand.

Additionally, field observations were conducted at selected waste management facilities and sites known for improper disposal practices. These observations helped to verify the information obtained through surveys and interviews, providing a ground-level perspective on the issues at hand.

Results and Discussion

This section presents the key findings of the study and discusses their implications concerning hazardous waste management in Thailand. The analysis is based on the data collected through surveys and includes an evaluation of compliance with hazardous waste regulations, barriers to effective waste management, and public and industrial perceptions.

Table 1. Types and Sources of Chemical Hazardous Waste in Thailand

Type of Hazardous Waste	Industrial Sector	Healthcare Sector	Agricultural Sector	Household Sector	Total (%)
Toxic Chemicals	40% (e.g., solvents, heavy metals)	15% (e.g., expired medications, disinfectants)	5% (e.g., pesticides)	5% (e.g., cleaning agents)	65%
Flammable Substances	25% (e.g., petroleum products, industrial chemicals)	5% (e.g., alcohols)	2% (e.g., fuel for machinery)	3% (e.g., paints)	35%
Corrosive Substances	10% (e.g., acids, alkalis)	2% (e.g., sterilants)	1% (e.g., fertilizers)	1% (e.g., batteries)	14%
Reactive Substances	5% (e.g., chemical waste from reactions)	1% (e.g., diagnostic chemicals)	1% (e.g., herbicides)	1% (e.g., household chemicals)	8%
Others (e.g., E-waste, etc.)	5% (e.g., electronic waste)	1% (e.g., lab waste)	1% (e.g., packaging materials)	1% (e.g., used electronics)	8%
Total (%)					100%

Types and Sources of Chemical Hazardous Waste

As shown in Table 1, toxic chemicals are the most prevalent type of hazardous wastes in Thailand, accounting for 65% of the total. The industrial sector is the largest contributor, responsible for 40% of this waste. Flammable substances, making up 35%, are also predominantly from the industrial sector. Corrosive substances and reactive substances each contribute 14% and 8%, respectively, with the industrial sector again being the primary source. Electronic waste (e-waste) and other hazardous materials make up the remaining 8%, with contributions from both industrial and household sectors. This distribution emphasizes the need for sector-specific waste management approaches.

Current Waste Disposal Practices

Table 2 outlines the current waste disposal practices in Thailand, showing that land filling is the most common method, accounting for 33% of all waste disposals. Incineration follows at 25%, indicating a significant reliance on burning waste as a disposal method. Recycling constitutes 18% of the practices, reflecting efforts to recover materials. Chemical treatment is used for 12% of the waste, typically for more hazardous substances. However, 10% of the waste is still disposed of through illegal dumping or improper methods, posing serious environmental risks. Other methods, such as export, make up the remaining 2%. This distribution suggests a need for improving waste management strategies, particularly in reducing illegal dumping and increasing recycling efforts.

Table 2. Current Waste Disposal Practices in Thailand

Disposal Method	Total (%)
Incineration	25%
Landfilling	33%
Recycling	18%
Chemical Treatment	12%
Illegal Dumping/Improper Disposal	10%
Other Methods (e.g., Export)	2%
Total (%)	100%

Compliance with Hazardous Waste Regulations

Table 3 reveals varying levels of compliance with hazardous waste regulations across different sectors in Thailand. Overall, only 26% of respondents across all sectors are in full compliance, with the healthcare sector leading at 72%, while the household sector lags at 9%. Partial compliance is the most common, with 41.75% of respondents, particularly prevalent in the industrial and agricultural sectors. Non-compliance is significant, accounting for 21% of the total, with the household sector having the highest rate at 31%. Additionally, 11.25% of respondents are entirely unaware of the regulations, with the agricultural and household sectors showing the most significant gaps in awareness. Common areas of non-compliance include improper labeling and storage in the industrial sector, inadequate disposal in healthcare, use of banned chemicals in agriculture, and improper disposal and lack of awareness in

households. This indicates a critical need for enhanced regulatory enforcement and public education across all sectors.

Barriers to Effective Hazardous Waste Management

Table 4 highlights significant barriers to effective hazardous waste management across different sectors in Thailand. The most commonly cited barrier is the high cost of proper disposal, affecting 62.25% of respondents, with the industrial, agricultural, and household sectors all reporting substantial challenges in this area. Inadequate infrastructure is another critical issue, with 15.25% of respondents, particularly in the household and healthcare sectors, identifying it as a barrier. Insufficient regulations and enforcement are noted by 14.25% of the participants, especially in the healthcare sector, where limited facilities and low enforcement further exacerbate the problem. A lack of awareness and education, although affecting a smaller percentage of the population (8.25%), is particularly prevalent in the agricultural sector. This data underscores the multifaceted challenges in hazardous waste management, requiring comprehensive strategies that address financial, infrastructural, regulatory, and educational deficiencies to improve overall compliance and effectiveness.

Conclusion

The analysis of hazardous waste management practices in Thailand highlights several critical issues that need addressing to improve overall effectiveness. The diversity of chemical hazardous waste types, particularly the high prevalence of toxic chemicals in the industrial sector, underscores the urgent need for targeted waste management strategies tailored to specific sectors. Current disposal practices show a heavy reliance on land filling and incineration, while illegal dumping and improper disposal remain significant problems. These findings suggest that existing waste management protocols may be insufficient, and there is a clear need for stronger enforcement and better monitoring.

Compliance with hazardous waste regulations also varies significantly across sectors, with the healthcare sector showing relatively higher levels of

Table 3. Public and Industrial Compliance with Hazardous Waste Regulations in Thailand

Compliance Category	Industrial Sector	Healthcare Sector	Agricultural Sector	Household Sector	Total (n=400)
Full Compliance	11	72	12	9	104(26%)
Partial Compliance	64	13	54	36	167 (41.75%)
Non-Compliance	23	12	18	31	84 (21%)
Unaware of Regulations	2	3	16	24	45 (11.25%)
Total (n)	100	100	100	100	400 (100%)
Common Areas of Non-Compliance	Improper labeling, Inadequate storage	Inadequate disposal, Improper documentation	Use of banned chemicals, Lack of disposal records	Improper disposal, Lack of awareness	N/A

Table 4. Barriers to Effective Hazardous Waste Management in Thailand

Barrier	Industrial Sector	Healthcare Sector	Agricultural Sector	Household Sector	Total (n=400)
Lack of Awareness/Education	5	6	13	9	33 (8.25%)
Insufficient Regulations /Enforcement	13	24	12	8	57 (14.25%)
High Cost of Proper Disposal	70	54	60	65	249 (62.25%)
Inadequate Infrastructure	12	16	15	18	61 (15.25%)
Total (n)	100	100	100	100	400 (100%)
Commonly Cited Issues	Lack of training, High costs	Limited facilities, Low enforcement	Accessibility issues, Lack of information	Lack of facilities, Lack of awareness	N/A

full compliance. However, the substantial rates of partial compliance and non-compliance in the industrial, agricultural, and household sectors highlight the need for enhanced regulatory frameworks and more effective compliance mechanisms.

Barriers to effective hazardous waste management are primarily economic, with the high cost of proper disposal being the most significant across all sectors. Inadequate infrastructure and insufficient regulatory enforcement further complicate the situation. Additionally, the lack of awareness and education, particularly in the agricultural sector, indicates a need for widespread educational initiatives.

In conclusion, while there are efforts to manage hazardous waste in Thailand, significant challenges remain. Addressing these challenges will require a coordinated approach that includes strengthening regulations, improving infrastructure, increasing public awareness, and ensuring the financial viability of proper waste disposal methods. Only through such comprehensive strategies can Thailand move towards more effective and sustainable hazardous waste management practices, safeguarding both public health and the environment.

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Conflict of Interest - None

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