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Study on the use of Single Use Plastic, Packaging and Waste Management in the tourism sector and municipalities with a focus on the destination sites Trang and Koh Tao in Thailand

Part B: Plastic Waste in the Municipality Sector

Final Report

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Workplan A: Desk research on Plastic Waste in Thailand

1. Overview of Plastics Waste Management in Thailand

The problem of plastic waste has been a longstanding issue with far-reaching impacts globally. Every year, over 430 million tons of plastic waste are produced worldwide, with only 15% being recycled, amounting to approximately 64 million tons (UN, 2023). The substantial amount of plastic waste generated has detrimental effects on life both on land and in the oceans.

In Thailand, like many other countries, the issue of plastic waste is significant. In the year 2021, Thailand generated approximately 24.98 million tons of municipal waste. According to a report on waste disposal facilities in Thailand in 2022 it was found that the average rate of waste generation per person per day in Thailand is about 1.03 kilograms. Within this amount of waste, 24.98 million tons, approximately 2.76 million tons consist of plastic waste. However, only 0.5 million tons of this plastic waste can be recycled.

Based on this information, Thailand has implemented policies to reform waste management in the country to address the increasing problem of plastic waste. Over the years, various policies related to waste management have been established by the government. National solid waste management was designated as a national agenda in 2014 (BE 2557), and a master plan for solid waste management in the country was developed in 2016 (BE 2559). The Ministry of Natural Resources and Environment is the primary agency responsible for implementing waste management in Thailand.

Additionally, there are also plans for the management of plastic waste in both phase 1 and phase 2 (BE 2563 - BE 2570) issued by the Ministry of Natural Resources and Environment. These plans serve as frameworks and directions for preventing and solving the problem of plastic waste management in the country. They involve the participation of all sectors in driving operations according to the action plans comprehensively, from production and distribution to consumption and post-consumption management. The goal is to reduce environmental impacts on both land and sea responsibly.

Both government agencies and the private sector collaborate to promote public relations campaigns on plastic waste management and to develop business models for benefiting from plastic waste at both local and organizational levels.

Meanwhile, on the private sector side in Thailand, various organizations have come together to help address the plastic waste problem in the country. One example is the Public-Private Partnership for Sustainable Plastic and Waste Management, or PPP Plastics, established by the Federation of Thai Industries and the Thailand Business Council for Sustainable Development (TBCSD). This group, along with the plastic industry, collaborates with the government, private sector, and civil society to develop a roadmap for managing plastic waste in Thailand.

1.1 Plastics Waste Generation and Disposal in Thailand

According to the data from the Department of Pollution Control, in 2021, Thailand generated approximately 24.98 million tons of municipal waste, with 2.76 million tons being plastic waste and the amount of recycled plastics waste is 0.5 million tons. Plastic waste comprises several types of resins which are used in different types of products. According to the Thailand Plastics Waste Database of the Plastics Instituted of Thailand, the composition of plastic waste in MSW is shown in the Figure 1. Polyethylene (PE) accounts for the highest share of total plastic waste at 60% followed by Multilayers (15%), PP (11%), PET (10%), Polystyrene (PS) (3%) and Others (1%).

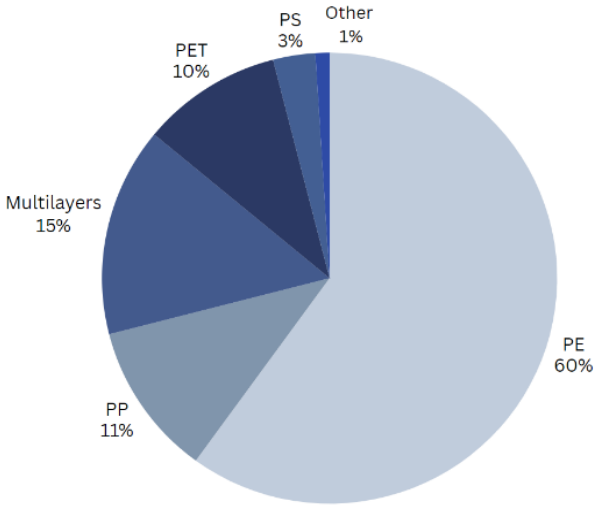

Figure 1 Plastics Waste Composition by Resin Types

1.2 Existing legislation to ban single-use plastics

1.2.1 Thailand's Action Plan on Plastic Waste Management

Thailand's Action Plan on Plastic Waste Management represents a comprehensive and ambitious roadmap aimed at addressing the environmental challenges posed by plastic waste. This plan combines international commitments, innovative sustainability models, and collaborative strategies to foster a circular economy and reduce the adverse impacts of plastics.

Phase 1 (2020–2022) aims to reduce and discontinue the use of plastic by utilizing environmentally friendly alternative materials. The targets include discontinuing the use of three types of plastic by the year 2019: 1) plastic cap seals for bottled water, 2) plastic products containing oxo-degradable additives, and 3) microbeads. Additionally, by the year 2022, the discontinuation targets expand to four more types of plastic: 1) plastic bags with thickness less than 36 microns, 2) foam food containers, 3) single-use plastic cups, and 4) plastic straws. The initial phase focused on reducing Single-Use Plastics (SUP) and integrating recycling practices into a circular economy framework. Efforts included:

- Promoting public awareness campaigns to encourage waste reduction.
- Introducing compostable plastics as eco-friendly alternatives.
- Developing recycling networks and innovative business models.

However, challenges such as limited regulations, high contamination of recyclable plastics, and increased SUP consumption during the COVID-19 pandemic hindered full success.
Phase 2 (2023 – 2027) represents a critical evolution in the nation's environmental strategy. Building upon the achievements and lessons learned from Phase 1, this phase adopts a systematic and holistic approach to addressing the complexities of plastic waste management. Anchored by principles of circular economy and sustainable development, Phase 2 aims to integrate plastic waste management across the entire lifecycle of plastic products, from production and consumption to disposal and recovery.

The overarching vision of Phase 2 is to achieve sustainable plastic management through the circular economy. This vision is operationalized through a dual framework: Waste Management Hierarchy: Prioritizes waste prevention, reduction, reuse, and recycling, followed by recovery and safe disposal. Lifecycle Management Approach: Addresses plastic waste at every stage, ensuring sustainability from product design to final disposal.

This phase aligns with Thailand's national policies, including the Bio-Circular-Green (BCG) Economy Model, and international commitments such as the Sustainable Development Goals (SDGs) and the ASEAN Framework of Action on Marine Debris.

Action Plan on Plastic Waste Management Phase 2 (2023–2027) establishes specific, measurable targets to guide its implementation:

1. Eliminate 100% of certain plastics from landfills by 2027:
    - Targeted items include plastic bottles, caps, mono-layer film packaging, plastic bags, and cups.
2. Recover all targeted plastic products for recycling:
    - Ensure these plastics are reintegrated into the production cycle.
3. Reduce marine plastic waste leakage by 50%:
    - Address land-based and ocean-based sources of plastic debris.
4. Develop critical tools and systems for efficient waste management:
    - These include standards for recycled content, digital platforms for recycling, and eco-design guidelines.

The strategy for Phase 2 encompasses the entire lifecycle of plastic products, with a focus on key areas:

1. Production of Eco-Friendly Plastics
    - Eco-Design Standards: Mandate at least 30% recycled content in plastic products and encourage mono-material packaging for easier recycling.
    - Phasing Out Non-Recyclable Products: Reduce reliance on materials such as Styrofoam and non-compostable plastics.
    - Certification Systems: Implement mandatory standards for compostable plastics and food-grade packaging.
2. Sustainable Consumption
    - Public Awareness Campaigns: Promote the use of eco-friendly alternatives and educate consumers on waste sorting and recycling.
    - Incentives for Businesses: Provide tax benefits and other incentives to encourage the adoption of sustainable materials and practices.
    - Behavioral Change Initiatives: Shift consumer behavior towards reusable and recyclable packaging through labeling and awareness.

3. Recycling and Resource Recovery
    - Infrastructure Development: Establish nationwide systems for waste segregation and sorting to enhance recycling efficiency.
    - Innovation in Recycling: Support projects that transform plastic waste into valuable products, such as construction materials and textiles.
    - Energy Recovery: Utilize non-recyclable plastics for energy production, reducing reliance on fossil fuels.
4. Marine Plastic Waste Prevention
    - Coastal Waste Management: Deploy advanced technologies such as litter traps and collection booms to prevent plastic waste from reaching the oceans.
    - Community Collaboration: Engage local communities in coastal regions to adopt better waste management practices.

1.2.2 Thailand's Roadmap on Plastics Waste Management

Figure 2 Thailand's Roadmap on Plastics Waste Management 2018 - 2030

Thailand has developed a strategic roadmap that provides a comprehensive framework for plastic waste management from 2018 to 2030. This roadmap aims to mitigate the detrimental environmental impacts of plastic waste through systematic measures aligned with the principles of the circular economy and international sustainability standards.

The roadmap's objectives are articulated through two primary targets:

1. Eliminate and replace single-use plastics (SUPs): Transition from SUPs to environmentally friendly alternatives.
2. Achieve 100% circular economy integration for target plastics by 2027: Ensure all targeted plastics are either recycled or repurposed, reducing their environmental impact.

Phase 1 (2018–2019): This foundational phase established the groundwork for Thailand's plastic waste management journey. It focused on:

- Banning Harmful Plastics: SUP items such as microbeads, cap seals, and oxo-degradable plastics were prohibited.
- Raising Awareness: Public campaigns were launched to educate consumers about the environmental impacts of plastics and the benefits of sustainable alternatives.
- Setting the Policy Framework: Regulatory and institutional structures were developed to support the roadmap's long-term goals.

Phase 2 (2019–2022): Building on the success of Phase 1, this phase focused on broadening the scope of plastic waste management efforts. Key actions included:

- Plastic bags thinner than 36 microns, foam food containers, plastic cups under 100 microns, and plastic straws were targeted for elimination by 2022.
- Enhancing Recycling Systems: Investments were made to expand waste segregation, sorting, and recycling infrastructure.
- Promoting Sustainable Alternatives: Businesses and consumers were encouraged to adopt reusable and eco-friendly products through incentives and public campaigns.
- Strengthening Collaboration: Partnerships between government agencies, private sector stakeholders, and communities were fostered to implement recycling and waste management initiatives effectively.
- Phase 3 (2023–2030): The final phase focuses on ensuring the long-term sustainability of plastic waste management practices. It aims to:

- Achieve 100% Recycling of Target Plastics by 2027: All targeted plastics, such as bottles, caps, monolayer films, and bags, are to be fully integrated into the circular economy.
- Halve Marine Plastic Waste Leakage: Through enhanced waste management and prevention measures, plastic waste entering the ocean will be reduced by 50%.
- Promote Innovation and Monitoring: Advanced technologies and robust monitoring systems will be developed to track progress and ensure continuous improvement.

2. Current Programs to Promote Waste Reduction in Trang City and Koh Tao

2.1 Current Programs to Promote Waste Reduction in Trang:

Regarding the Ministry of Natural Resources and Environment has established a Roadmap for Plastic Waste Management for the years 2018 – 2030. The governor of Trang province has adopted and announced align the National policy by “Community solid waste management action plan, clean province”. The mission is as follows:

1. Drive and support the implementation of community waste management solutions in accordance with government policies, Prime Minister's directives, the National Master Plan for Waste Management (2016-2021), the 20-Year National Strategy, the 12th National Economic and Social Development Plan, and other relevant laws related to community waste management.
2. Promote waste reduction through all means, starting from the efficient use of existing resources, emphasizing the reduction of plastic and foam usage, promoting environmentally friendly products, and encouraging segregation at the source, following the principles of 3Rs: Reduce, Reuse, and Recycle.
3. Support efforts to enhance the efficiency of community waste collection, sorting, and transportation, ensuring proper handling in accordance with academic standards.
4. Support and promote the formation of waste management clusters by local government organizations and assign private entities to collect, transport, and manage waste within their designated areas.
5. Promote participation in waste management by the government sector, private sector, and civil society/community sector.

Guidelines for community waste management in Trang province, focuses on Community waste sorting Managing hazardous community waste, Encouraging the formation of local waste management clusters by local government organizations to yield effective operational outcomes, Promoting the establishment of regulations and information systems as tools for waste management efficiency within local government organizations.

Trang province adopts key policy frameworks of the government to guide its operational strategies by they will have the measure to become foam-free, reduce plastic usage, promote a green economy, and lead the way in clean operations. This includes managing waste from its source, along transportation routes, and at its destination, all under the Sustainable Development Plan. Additionally, there will be campaigns to raise public awareness about environmental issues caused by single-use plastic disposal, leading to pollution and threatening living organisms.

The Andaman Foundation, in collaboration with the Environmental and Health Direction Committee (EHDC), is one of the agencies that initiated the project in response to government policy. They have initiated a project to reduce health and environmental hazards from plastic waste in the marine environment within three provinces: Krabi, Trang, and Satun. This initiative involves cooperation with local communities, local administrative organizations, and sub-district health promotion hospitals to study and develop concepts, economic measures, and policy proposals regarding the liability of polluters and health hazards from foam and plastic waste in the sea. They arrange the meetings of the Sustainable Trang Steering Committee, which aims to promote environmental responsibility, provincial policies, and practices, have been conducted on 23-25 April 2023 in Trang and Krabi province. This includes reports on policy implementation at the provincial and district levels, promoting foam-free zones, reducing, discontinuing, and transitioning away from single-use plastic.

2.2 Current Programs to Promote Waste Reduction in Koh Tao:

- Reduction of Plastic Products and Foam Containers: Local citizens and business operators collaborate to decrease the use of plastic products and foam containers, replacing plastic straws with alternatives like bamboo tubes, paper straws, and stems of morning glory. Cotton bags are used instead of plastic bags, and biodegradable food containers are promoted.
- Save Koh Tao Community Group: Established in 2000, this group aims to conserve natural resources, address environmental concerns, and educate the community to work towards sustainable tourism.

Figure 3 Save Koh Tao Community Group

- Recycling Initiatives: Many businesses participate in recycling programs, including banning single-use plastic items like straws and bags, and separating waste products for recycling.
- Beach Clean-Up Activities: Regular clean-up events are organized to maintain the island's natural beauty and engage both locals and visitors in conservation efforts.
- The Funky Turtle
- These initiatives reflect Koh Tao's commitment to environmental preservation and sustainable tourism practices.

Both Trang City and Koh Tao serve as exemplary models of proactive approaches to waste reduction, showcasing how community engagement and sustainable practices can drive meaningful environmental change. These regions have implemented targeted programs that address their unique waste challenges, focusing on collaboration between local governments, businesses, and residents to create lasting solutions.

In Trang City, the emphasis is on integrating waste reduction into daily life through structured campaigns and policies. Programs like the Trang Sustainability Project: Green City & Waste Reduction actively involve stakeholders from all sectors, including government agencies, environmental organizations, and the public. Initiatives such as the systematic reduction of single-use plastics, bans on foam and plastic packaging, and the promotion of waste segregation not only reduce the environmental footprint but also foster a culture of shared responsibility. These efforts aim to eliminate plastic and foam packaging, reduce water pollution in coastal and river systems, and protect public health from chemical contamination.

Meanwhile, Koh Tao has leveraged its status as a popular tourist destination to spearhead innovative waste management strategies. Programs spearheaded by groups like the Save Koh Tao Community Group emphasize conservation and education, targeting both locals and visitors. The island has adopted practical measures such as replacing plastic straws with bamboo, paper, or plant-based alternatives and encouraging the use of biodegradable food containers and reusable cotton bags. Regular beach clean-ups and recycling initiatives are integral parts of the community's efforts to preserve Koh Tao's natural beauty, enhance marine conservation, and sustain its vibrant tourism industry.

Both locations underline the importance of behavioral change and infrastructure development as key elements in waste reduction strategies. By integrating public education, innovative waste management systems, and eco-friendly alternatives, Trang City and Koh Tao are setting benchmarks for sustainability. Their proactive and inclusive approaches not only protect their local environments but also contribute to global efforts to combat plastic pollution and promote sustainable living. These models demonstrate that through collective action, small communities can achieve substantial environmental impact and serve as inspirations for broader implementation elsewhere.

Workplan B: Assessment of plastic waste consumption and handling in the project sites

3. Municipality level assessment

PITH focused specifically on the collection of data related to Municipal Solid Waste (MSW) generation and its composition. This effort involved compiling statistical data from existing national and regional databases. To enhance the comprehensiveness of this dataset, PITH also gathered supplementary information from local and regional sources. This included direct data retrieval from municipalities, landfill operations, and various waste-handling contractors. By integrating these diverse data streams, PITH aimed to create a detailed and accurate picture of MSW dynamics across different regions, thereby facilitating more effective waste management strategies and policies.

3.1 Overview of the Current Waste Management in Trang City

Trang Municipality covers an area of 14.77 square kilometers and is home to a population of 94,771. The urban community within this municipality is characterized by a diverse array of residential and commercial features, including single-family homes, townhouses, shops, businesses, and bustling local markets. Currently, Trang Municipality generates nearly 50 tons of waste per day (TPD). This waste is categorized into general waste (41%), biodegradable waste (30%), recyclable waste (30%), and hazardous waste (0.03%), as illustrated in Figure 10.

The collected waste is transported to the municipal landfill located near Nang Noy Canal, which is a natural water source that eventually flows into the Trang River. Despite substantial budget allocations for waste management, the municipality faces ongoing challenges. Improper waste disposal practices lead to pollution in public areas and waterways, causing blockages and significant environmental concerns. Addressing these issues is crucial for improving the municipality's waste management system and ensuring the health and cleanliness of the urban environment.

3.1.1 Waste Infrastructure, Waste Flow, and Management in Trang City

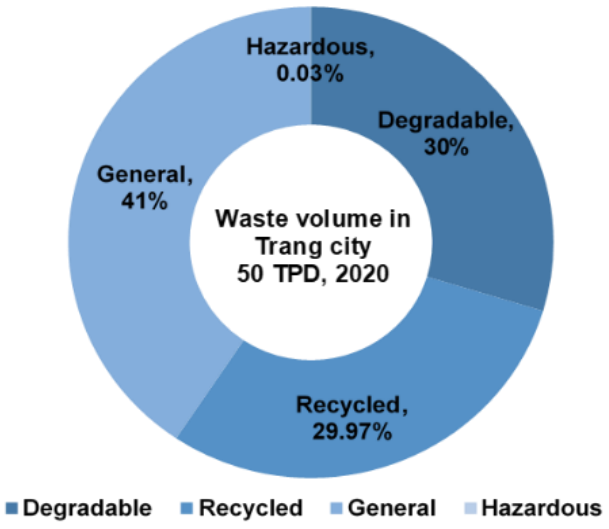

Figure 4 Waste Volume in Trang City

Source: Information from the Department of Public Health and Environment, 2020

To provide a comprehensive overview of the waste infrastructure in Trang Province, we have conducted a thorough review of all disposal sites listed in the Pollution Control Department database. The findings from this review are summarized and visualized in Figure 5.

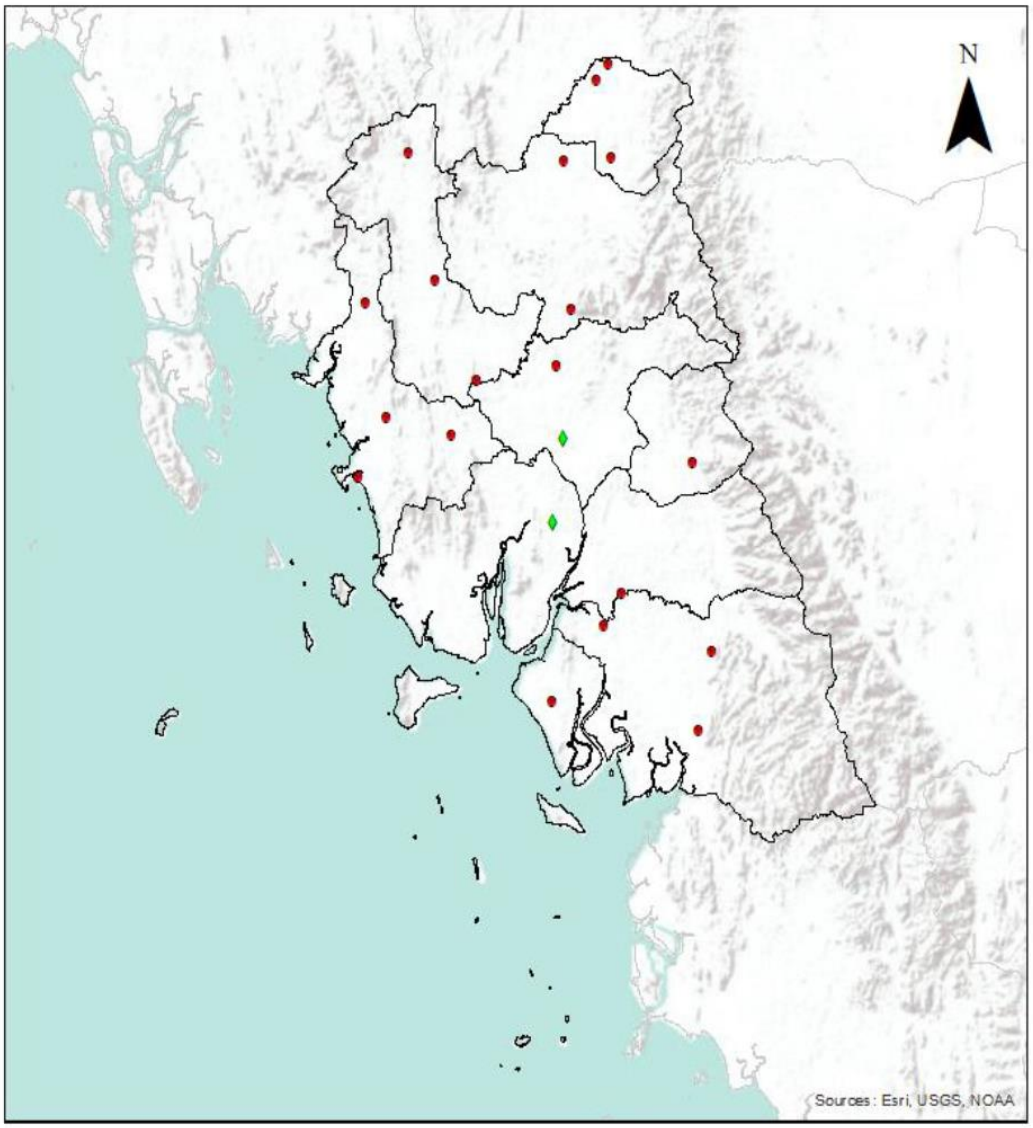

Figure 5 Waste Infrastructure in Trang Province

According to the Pollution Control Department, Trang Province has a total of 23 landfills. These include 2 engineered landfills designed with specific structural measures to manage waste effectively and minimize environmental impact. Additionally, there are 5 incinerators that operate without air treatment systems, raising concerns about potential air pollution. The majority, comprising 14 sites, are open dumps, which lack proper containment and pose significant risks to the environment and public health. Furthermore, there are 2 landfills that are currently not operational. This distribution of waste management facilities is detailed in the accompanying table. Addressing the environmental and health implications of these diverse waste disposal methods is essential for improving the overall waste management infrastructure in Trang.

Table 1 Disposal Site in Trang City

No.	Disposal Site	Size (Rai)	Disposal System	Waste Input (Tons/Day)
1.	Trang Municipality	119	Engineering Landfill	110
2.	Khlong Teng SAO	8	Open Dump	4
3.	Kantang Municipality	102	Engineering Landfill	33
4.	Bang Pao SAO	8	Open Dump	
5.	Tham Kham SAO	2	Open Dump	
6.	Thung Yao SAO	29	Open Dump	5
7.	Palian SAO	8	Open Dump	3
8.	Ban Na SAO	6	Open Dump	5
9.	Yan Da Khao SAO	18	Open Dump	12
10.	Sikao SAO	7	Incinerator without air treatment system	1
11.	Khuan Kun SAO	3	Open Dump	1.5
12.	Na Mueang Phet SAO	10	Incinerator without air treatment system	2.2
13.	Mai Fad SAO	15	Open Dump	2.6
14.	Samphra SAO	15	Open Dump	2.2
15.	Huai Nang SAO	11	Incinerator without air treatment system	1.4
16.	Wang Wiset SAO	12	Open Dump	3
17.	Khao Wiset SAO	0.75	Incinerator without air treatment system	3
18.	Ao Kong SAO	3	Open Dump	1
19.	Chong SAO	10	Incinerator without air treatment system	2.1
20.	Khlong Pang SAO	119	Open Dump	4.5
21.	Khlong Pang SAO	8	Open Dump	2.3
22.	Nong Prue SAO	102	Open Dump	2.3
23.	Hat Samran SAO	8	Open Dump	3

*SAO is Subdistrict Administrative Organization

To streamline the focus area, the Ministry of Interior has grouped disposal sites into clusters. This strategic consolidation aims to enhance the efficiency and effectiveness of waste management systems within each province. By clustering disposal sites, the Ministry intends to improve resource allocation, management practices, and infrastructure development. For Trang Province, the disposal sites have been organized into specific clusters, as detailed in Table below. This approach is designed to facilitate more coordinated and comprehensive waste management efforts across the region, addressing both current challenges and future needs.

Table 2 Landfill Cluster in Trang City

Cluster	Responsible LAO	Waste Input (Ton/Day)
Cluster 1	Trang City Municipality	220.25
Cluster 2	Kantang Town Municipality	113.30
Cluster 3	Trang Provincial Administrative Organization	366.03

The focus area within Trang City is concentrated in the Mueang Trang District, which features a single disposal site: the Trang Municipality Disposal Site. This site is located in Bangrak Subdistrict and operates using an Engineering Landfill System. It handles approximately 110 tons of municipal waste per day. The site is financially supported by the Ministry of Science, Technology, and Environment, as part of the Provincial Environmental Management Operation Plan, with a total allocated budget of 92.70 million Baht.

The infrastructure at the disposal site includes various essential facilities: a landfill area, an office building, a weighing station, a wastewater treatment pond, and necessary machinery. To manage the waste effectively, the municipality charges a disposal fee of 500 Baht per ton. This setup aims to ensure efficient waste management and environmental protection in the Mueang Trang District.

Figure 6 Engineering Landfill in Trang City

Source: https://www.tranglocal.go.th/datacenter/doc_download/a_051022_141528.pdf

3.2 Overview of the Current Waste Management in Koh Tao

Koh Tao, a picturesque mid-sized island in the Gulf of Thailand, spans 18.5 square kilometers and is home to approximately 2,500 residents (as per The Bureau of Registration Administration). Renowned for its stunning coral reefs, this island attracts tourists from across the globe. However, the surge in visitors has led to a significant increase in waste, threatening the island's fragile ecosystem.

In response to this urgent issue, the local municipality has implemented several sustainable waste management initiatives. They actively encourage both residents and tourists to reduce waste generation and practice proper waste segregation. Biodegradable waste is repurposed as animal feed or compost, significantly reducing the overall waste burden.

Recyclable materials are collected and transported to the mainland via cargo ships, where they are processed and reused. Hazardous waste is meticulously managed and sent to the provincial waste management organization for safe disposal.

Local businesses are integral to these efforts, adopting eco-friendly packaging and minimizing the use of single-use plastics. Some enterprising individuals have even started transforming collected plastic bottle caps into valuable products, raising environmental awareness among visitors.

General waste on the island is collected by municipal waste collection trucks and transported to designated landfill sites on Koh Tao. The collaborative efforts of the community, local businesses, and tourists are essential in preserving Koh Tao's natural beauty and ensuring a sustainable future for this idyllic island.

3.2.1 Waste Infrastructure, Waste Flow, and Management in Koh Tao

To provide a comprehensive overview of waste infrastructure in Surat Thani Province, we have reviewed all disposal sites listed in the Pollution Control Department database. These findings are summarized and visualized in the following (Figure 7).

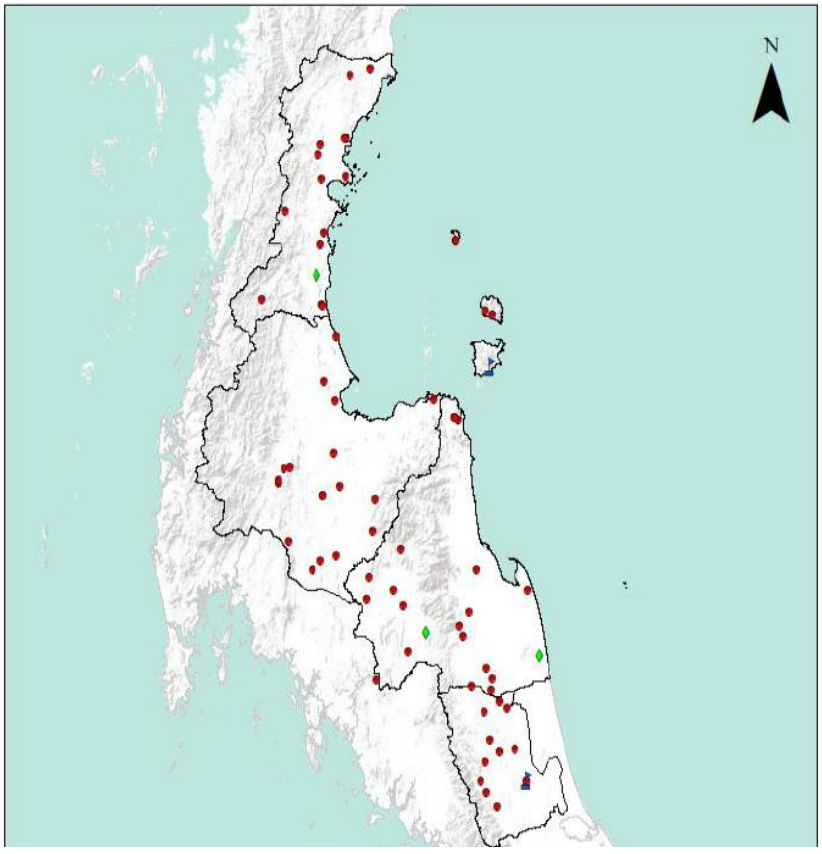

Figure 7 Waste Infrastructure in Trang Province

According to information from the Pollution Control Department, Surat Thani Province hosts a total of 40 waste disposal sites. These facilities are categorized as follows: one transfer station, two incinerators without air treatment systems, 20 open dumps, and 17 inactive landfills. The distribution and types of these sites are detailed in the accompanying table.

The transfer station serves as an intermediate point where waste is temporarily held before being transported to larger disposal facilities or treatment plants. This system helps in managing waste efficiently by consolidating smaller loads into larger ones for more economical transport.

The two incinerators, although lacking air treatment systems, are used for burning waste. However, the absence of air treatment poses environmental concerns due to the potential release of pollutants into the atmosphere. These facilities highlight a critical area for improvement in the province's waste management strategy.

Open dumps are the most prevalent type of disposal site in the province, with 20 in total. These sites typically involve unregulated deposits of waste, leading to significant environmental and health hazards, including soil and water contamination and the attraction of vermin.

The 17 inactive landfills, which are currently not in operation, present both challenges and opportunities. While they no longer actively receive waste, these sites need to be monitored and managed to prevent environmental degradation. Some of these landfills may be candidates for rehabilitation or conversion into managed facilities to better serve the province’s waste disposal needs.

In summary, Surat Thani Province's current waste disposal infrastructure reflects a mix of active and inactive sites with varying degrees of environmental impact. The information underscores the need for improved waste management practices and the development of more sustainable and environmentally friendly disposal solutions.

Table 3 Disposal Site in Surat Thani

No.	Disposal Site	Size (Rai)	Disposal System	Waste Input (Tons/Day)
1.	SRT Power Green Co., Ltd. (Tham Rong Kang SAO)	160	Open Dump	279
2.	Tham Sathorn SAO	8		
3.	Bang Ma Ruea SAO	112		
4.	Tham Chang Subdistrict Municipality	4	Open Dump	4
5.	Pak Chalui SAO	1		
6.	Khian Sa Subdistrict Municipality	1	Open Dump	1.5
7.	Khian Tha SAO	7	Open Dump	5
8.	Khao Lok SAO	3	Open Dump	1.5
9.	Phru Phi Subdistrict Municipality	2		
10.	Phoem Phun Sap SAO	2	Open Dump	4
11.	Bang Sawan Subdistrict Municipality	7	Open Dump	6
12.	Yan Din Daeng Subdistrict Municipality	31	Open Dump	22
13.	Song Phrak SAO	12	Open Dump	3
14.	Chai Buri SAO	2	Open Dump	2
15.	Tham Chana SAO	30		
16.	San Li SAO	5		
17.	Samo Thong SAO	1		
18.	Phum Riang Subdistrict Municipality	2		
19.	Private Wiang Subdistrict Municipality	1	Open Dump	24
20.	Thung SAO	1		
21.	Takuk Nuea SAO	3		

No.	Disposal Site	Size (Rai)	Disposal System	Waste Input (Tons/Day)
22.	Tha Yon Subdistrict Municipality	3		
23.	Yan Yao SAO	6	Open Dump	0.5
24.	Ton Yuan SAO	14	Open Dump	8.5
25.	Ban Chiao Lan Subdistrict Municipality	3	Open Dump	4
26.	Ban Ta Khun Subdistrict Municipality	5	Open Dump	4
27.	Khao Wong SAO	5	Open Dump	1.2
28.	Phanom Subdistrict Municipality	5		
29.	Khlong Sok SAO	3		
30.	Ton Sak Municipality	28	Open Dump	12
31.	Chaloen SAO	9		
32.	Koh Phangan Subdistrict Municipality	5	Incinerator without air treatment system	15
33.	Ban Tai Subdistrict Municipality	7	Incinerator without air treatment system	15
34.	Koh Tao Subdistrict Municipality	3	Open Dump	20
35.	Lucky Clean Energy Co., Ltd.	149	Open Dump	220
36.	Tha Na Subdistrict Municipality	4	Open Dump	10
37.	Ban Thamniap SAO	3		
38.	Kanchanadit Subdistrict Municipality	5		
39.	Solid Waste Transfer Station, Koh Samui Municipality	32	Transfer Station	140
40.	Surat Thani Municipality			

*SAO is Subdistrict Administrative Organization

To Scope down the focus area the Ministry of interior has grouped the disposal site into the cluster to improve the consolidation of disposal site in each province to enable the effective development of waste management systems. For this cluster of Trang Province as shown in table 3.

Table 4 Landfill Cluster in Surat Thani

Cluster	Responsible LAO	Waste Volume	
		New Waste (Ton/Day)	Accumulated Waste (Ton)
Cluster 1	Tha Rong Chang SAO	675.40	0.00
Cluster 2	Ban Song Subdistrict Municipality	377.60	0.00
Cluster 3	Kanchanadit Subdistrict Municipality	12.00	0.00
Cluster 4	Don Sak Town Municipality	16.00	0.00
Cluster 5	Koh Phangan Subdistrict Municipality	46.00	0.00
Cluster 6	Koh Tao Subdistrict Municipality	20.00	0.00

The focus area of concern is Koh Tao District, which hosts a single disposal site, the Koh Tao Subdistrict Municipality Disposal Site. This site is situated in Koh Tao Subdistrict, within the Koh Phangan District of Surat Thani Province. The disposal site operates as an open dump, receiving approximately 20 tons of municipal waste daily. Spanning an area of 3 rai (about 4,800 square meters), the current landfill capacity is inadequate to handle the anticipated future waste volumes.

To address this issue, the municipality plans to lease an additional 11,200 square meters of land and invest in a new incinerator to enhance waste management capabilities. However, the island's rocky terrain presents significant challenges for landfill expansion, making it difficult to accommodate more waste through traditional means.

Currently, Koh Tao is grappling with a substantial waste problem, with 42,000 tons of accumulated waste on the island. This situation underscores the urgent need for improved waste management strategies and infrastructure to ensure the island can sustainably manage its waste and preserve its natural beauty.

In summary, Koh Tao's waste management challenges are significant, with limited landfill space and a rapidly growing waste volume. The municipality's proactive plans to lease additional land and acquire a new incinerator are crucial steps towards addressing these issues, but the island's unique geographical constraints will require innovative and sustainable solutions.

Figure 8 Landfill in Koh Tao

4. Qualitative research on Knowledge of plastic waste management and attitudes towards segregation

To effectively assess consumption and management practices, particularly the handling and disposal of plastic waste in Trang City and Koh Tao, PITH conducted a series of expert interviews and surveys with key stakeholders. These stakeholders included representatives from the local municipal administration, community leaders, and members of the informal sector, such as junk shop owners, within the targeted areas. The sampling size for these interviews was detailed in the table below. By engaging with a diverse group of stakeholders, PITH aimed to gain a comprehensive understanding of the current plastic waste management landscape and identify actionable strategies to enhance sustainability efforts in both Trang City and Koh Tao

This study employs a survey research methodology, with the following objectives:

1. To explore experiences, perceptions, and opinions regarding waste management and plastic reduction among communities in the municipalities of Koh Tao and Trang City.
2. To examine behaviors and attitudes towards waste management and plastic reduction within these communities.
3. To identify problems and provide recommendations for improving waste management and reducing plastic use in these communities.

Research Framework
The research framework is structured into three components:

1. Household Waste Management and Plastic Reduction
    - Collect personal information and waste generation data.
    - Assess awareness and opinions on waste separation and community waste management.
    - Identify problems and propose recommendations for waste management and plastic reduction.
2. Community Operations
    - Analyze the status of waste management operations, including waste collection, transportation, campaigns, and related activities.
    - Evaluate mechanisms and community measures for waste separation, collection, disposal, transportation, and recycling.
3. Organizational/Agency Operations in the Area
    - Examine policies, mechanisms, measures, and processes for waste management and plastic reduction, including recycling and reuse.
    - Assess baseline factors, readiness, and constraints in waste management operations and related activities.

Sampling Size
Sampling methods include Proportional Stratified Sampling and Quota Sampling to ensure representation across different groups which have the sample size for both destinations as following table

Table 5 Interview and Survey Sample Size for Koh Tao and Trang

Sites	Sampling size			
	Local Municipalities Administration	Communities Leader	Informal Sector (Junk Shop)	Household (Survey)
Trang City	2	3	5	250
Koh Tao	1	3	1	150

Research Tools and Data Collection

1. Research Instruments: Research tools were designed based on preliminary data collected from documents and interviews. Key tools include:
2. Questionnaires for Residents:
    - General information: Gender, age, occupation, marital status, etc.
    - Experiences and opinions on waste management and plastic reduction, including awareness of policies and practices.
    - Recommendations for improving waste management and plastic reduction practices.
3. Questionnaires for Community Leaders:
    - Similar to resident questionnaires but tailored for leadership perspectives on community operations and challenges.
4. Interviews with Government Officials:
    - Covering policies, practices, limitations, and recommendations for waste management and plastic reduction.
5. Interviews with Junk Shop Operators:
    - Exploring awareness of regulations, waste volume, and perspectives on participation in waste management.

Data Collection

Data collection involves a combination of structured interviews and questionnaires. A pre-test was conducted with 20 participants to refine the instruments. Final data collection included face-to-face interviews, with participants selected through simple random sampling.

Data Analysis

Quantitative data from questionnaires were analyzed using descriptive statistics, including percentages and means, through SPSS software. Qualitative data were summarized and presented as reports for each area and population group.

This methodology provides a comprehensive approach to understanding the dynamics of waste management and plastic reduction in Koh Tao and Trang City, offering actionable insights to address existing challenges effectively.

4.1 Findings in Koh Tao Municipality from Qualitative Research

4.1.1 Current Situation

- Koh Tao's waste production has significantly increased due to the growth in tourism, businesses, and the presence of foreign workers.
- Official population: Approximately 5,000 residents, with an additional 8,000 migrant workers (primarily from Myanmar) and 2,000 foreign residents, making the effective population 15,000–20,000 people per month due to tourism.
- Tourist segments:
    1. Short-term stays (2–3 days): 60%
    2. Medium-term stay (5 days): 20%
    3. Long-term stays (2–3 weeks or more): 20%
    - A smaller group stays 30–60+ days, primarily for diving courses.
- Campaigns: Koh Tao has successfully implemented initiatives to eliminate plastic bags and foam packaging, targeting both Thai and foreign residents. Agreements with businesses ensure the use of aluminum cans instead of glass bottles.
- Challenges: Despite progress, the increase in single-use plastics from food delivery services has offset some of these efforts.
- Marine Debris: On average, 1–3 tons of marine debris accumulate during the monsoon season, requiring extensive volunteer cleanup efforts, primarily organized by diving groups and international tourists.

4.1.2 Waste Volume

- Waste production averages 1 kg per person per day, or 20 tons daily, for an estimated 20,000 people.
- Since 2018: Approximately 5,674 tons of waste have accumulated at landfill sites on the island.
- Composition:
    - Wet waste: 2 tons/day.
    - Plastic waste: Peaks at 20 tons/day during festivals and averages 13–15 tons/day during regular periods.

4.1.3 Waste Management in Koh Tao

Key points regarding waste management in Koh Tao are summarized as follows:

- **Waste Collection**
  Waste is collected once per day. Wet waste is collected at 11:00 PM, followed by other types of waste at 1:00 AM. Certain types of waste, such as foam boxes, weeds, wooden crates, cardboard boxes, and electronic devices, are excluded from collection. The collected waste is transported to a sorting site, where it is separated. Plastic waste is melted (currently under evaluation with conservation groups to determine appropriate processing methods before being sent back to Koh Samui or other locations). Sorted recyclable materials, such as glass bottles (approximately 5%), are sold to junk shops, which then transport them to the mainland for resale.

- **Municipal Waste Management**
  All uncollected waste becomes the responsibility of the municipality. However, the municipality only collects waste that is placed in black garbage bags. Waste outside of bags or bins is not collected, resulting in "orphan waste" in the area. The municipality occasionally sends trucks to collect this orphan waste following complaints (as reported by community leaders), but the issue remains unresolved, leaving some waste to be transported to landfill pits that are still under construction (two pits have been dug but are not yet operational).

Given the nature of the island, suitable waste management solutions face significant challenges. For example:

1. Landfilling requires specially constructed pits with systems to prevent groundwater contamination, such as lining the pits with plastic and conducting seepage studies.
2. Incineration is complex and requires expertise.

Currently, the municipality has started outsourcing waste sorting and recycling to private companies. For example, a company named "MITRY" is involved, though the exact processes and their effectiveness (e.g., detailed vs. rough sorting and the impact on waste reduction) remain under evaluation. The goal is to recycle 50% of the waste received by the municipality.

In terms of wet waste, the municipality has struggled to manage it effectively due to a lack of budget, which has only recently been allocated after eight years. Policies like replacing black bags with color-coded bags for waste separation have been introduced, but residents often sell sorted waste themselves, providing little economic benefit to the municipal system. Future initiatives include preparing to crush glass for mixing with cement for construction (not yet implemented) and investing in composting processes for wet waste. These plans will require significant investment and clear processes, which may not be feasible without external support due to fundamental resource constraints.

- **Waste Sorting:** Currently, waste with resale value is sorted into two main groups:
  1. Households and Large Businesses: These typically sort waste and sell it themselves.
  2. Small Businesses: These often do not sort waste, leaving it to municipal workers.

The municipality outsources waste collection and sorting, employing workers to collect waste daily, though in some areas, such as parts of Sairee Beach, collection occurs every two weeks due to limited access for collection trucks. This delay leads to waste accumulation in the community, becoming a significant issue. Sorted waste is melted for recycling. For example, the municipality has signed a memorandum of understanding (MOU) with an unnamed company to manage sorting. During data collection, migrant workers were observed sorting waste; however, details about the recycling and sale processes were unclear.
Some participants in focus groups noted that although the municipality outsources waste sorting, whether workers follow the agreed procedures depends on management. This lack of consistent management has led to public skepticism. Many residents question the importance of sorting waste, saying, "Why sort waste when it all gets mixed together anyway?"

- **Public and Private Sector Collaboration:** Full cooperation between the government and private sectors is essential. Each community has unique contexts and limitations, so holding workshops to identify solutions and address existing constraints is recommended to foster long-term collaboration. Examples include:
  1. Waste Purchase or Separation: Determining how to implement these processes in both academic and practical contexts to achieve effective outcomes.
  2. Budget Allocation: Managing a budget of 2,400 THB for a population of 600,000 people annually.
  3. Source-Level Waste Separation: Whether through donation or sale, managing the collection by municipalities remains an issue due to limited space (most land is privately owned, and the municipality lacks adequate space, forcing storage in hilly areas, leading to further problems).
  4. Legal Limitations: Rules stating "waste must be disposed of where it is generated" prevent waste from being transported outside the area. Solutions to address this restriction are necessary.
  5. Identifying Suitable Models: Collaborative discussions are needed to explore options like buying waste, transporting it off the island for disposal, or other alternatives.

- **Legal and Regulatory Challenges**

From interviews with community leaders, government officials, and entrepreneurs:

Municipal limitations stem from regulations that waste, once deemed municipal property, cannot be sold or transported out of the area. Even when transportation is permitted, Koh Tao's Island status presents challenges in terms of volume, methods, and costs. Consequently, operational delays occur due to coordination and budgetary constraints requiring approval from various stakeholders.

- **Waste Collection Fees**
  - Increased Fees: Business operators and community leaders in Mae Haad community support increasing waste collection fees to 500–1,000 THB, which businesses are willing to pay to enhance waste management efficiency.
  - 100% Waste Removal: Operators propose measures to ensure that waste brought onto the island is entirely removed (e.g., "what comes in must go out").

- Declarations and Agreements: For example, using recyclable cardboard boxes or eco-friendly packaging should be a shared commitment.

- **Campaigns and Community Engagement**

The following points summarize the campaigns:

- Campaigns to eliminate plastic and foam packaging have been implemented for both Thai and foreign residents, with agreements between businesses to replace glass bottles with cans. However, the rise in single-use plastics from food delivery services remains a challenge.
- Numerous campaigns are already active on the island, with significant participation from business groups. However, not all collected materials are recycled and must eventually be transported off the island. Marine debris, averaging 1 ton (and up to 3 tons during the monsoon season), requires management as it cannot always be reused.
- Volunteers, such as divers and international tourists, regularly participate in conservation activities like beach cleanups and underwater waste collection. However, a large amount of debris remains unmanaged.
- The municipality has promoted waste separation for over 20 years, achieving successful projects like "No Plastic, No Bottle Beer," which reduced glass bottle waste by 95%. Challenges persist in fostering awareness and compliance among new arrivals to the island.

- **Establishing Collaborative Agreements**
  - Shared Agreements: Waste management on the island faces greater limitations than on the mainland, but Koh Tao's residents exhibit higher awareness and cooperation. Collaborative agreements, such as "Reduce-Reuse-Recycle," have been implemented. For example:
    - Second-hand shops (operated by Thai owners but staffed by Burmese workers) are active, though no clear recycling facilities exist on the island.
    - Agreements have been made to reduce beer bottle imports, cutting waste from 6 tons to less than 1 ton.
    - Increased plastic waste from takeaway businesses has prompted campaigns to replace foam boxes with paper packaging, despite higher costs. Most businesses comply, except for fresh product packaging, which remains essential.
    - Initiatives like reusing shipping boxes have been established with wholesale suppliers, reducing costs and promoting sustainability.

4.1.4 Migrant Populations

Interviews revealed the following:

- Koh Tao’s official registered population is 5,000, but there are 8,000 migrant workers (mainly Burmese) and 2,000 foreign residents. Including short-term tourists, the effective population impacting waste production is 15,000–20,000 people per month.
- Tourist Groups:
  1. Short stays (2–3 days): 60%.
  2. Medium stays (5 days): 20%.
  3. Long stays (2–3 weeks): 20%, with some staying 30–60+ days for diving courses.
- Migrant workers often do not separate waste. The municipality works with community leaders to encourage waste separation and disposal, with varying levels of cooperation. Approximately 20% still do not separate waste before disposal.

4.1.5 Public Expectations of Municipal Operations

Community feedback suggests that municipal operations are perceived as insufficiently proactive, negatively affecting public attitudes and waste separation behavior. Specific issues include:

- The municipality collects only properly bagged waste, leaving unbagged or orphaned waste unattended.
- Public spaces are not consistently managed for waste collection, leading to long-term waste accumulation. Proposals include transporting waste off the island for disposal on the mainland with support from central agencies.

4.1.6 Summary of Interviews with the Burmese Community in Koh Tao

General Demographic Information
The general demographic details of the Burmese community, categorized by area, are summarized as follows:

Table 6 The general demographic details of the Burmese community

Variable	Area		
	Moo 1 (Sairee Beach)	**Moo 2 (Mae Haad)**	**Moo 3 (Chalok Ban Kao)**
Gender/Age	- Majority male (5 male, 1 female) with an average age of 39.3 years (range: 31–54 years).	- Majority male (4 male, 1 female) with an average age of 36.4 years (range: 20–46 years).	- Majority female (4 female, 3 male) with an average age of 35 years (range: 25–48 years).
Income/Source of Income	- Monthly income: 12,000–15,000 THB (300–500 THB/day). - All employed by establishments/resorts.	- Monthly income: 12,000–15,000 THB (300–500 THB/day). - Employed at resorts, restaurants, repair shops, and as general laborers.	- Monthly income: 10,000–15,000 THB (300–500 THB/day). - A mix of unemployed and employed individuals. - Most work in restaurants (4 people), housekeeping (2 people), repair shops, and resorts.
Housing/Years of Residence	- Most have lived on Koh Tao for 15–39 years. - Housing includes employer-provided accommodation or rentals (families tend to rent separately).	- Most have lived on Koh Tao for 10–20 years (fewer years than Sairee). - Live in rented houses in Mae Haad, forming a large Burmese community (~30 households, nearly 100 people).	- Only 2 individuals have lived long-term (10 and 25 years). - Live in rented houses in Solok, forming a large Burmese community (~100–150 people).

Waste Generation by the Burmese Community
Waste generation behaviors and details for each area are summarized as follows:

1. Moo 1 (Sairee Beach):
- Daily Living and Waste Creation:
  - Workers living with employers do not cook but receive meals, creating waste mainly from weekly market shopping or convenience stores.
  - Average waste: 1 bag/day per household (0.5–1 kg) depending on household size.
  - Individuals drinking bottled water (living alone): up to 2 bottles/day per person or 6 bottles/day per household.
- Recycling and Waste Management:
  - Foam boxes: 2–3/day for takeout.
  - Beer cans (primarily males): 2–3 cans/day, stored for resale or donation.
  - Plastic bottles: Collected weekly, with recyclable materials sorted into 10 bags of 5 kg each.
- Online Shopping: Weekly purchases result in 2–3 cardboard boxes per week.

2. Moo 2 (Mae Haad):
    - Daily Living and Waste Creation:
        - Cooking meals daily generates 2–3 plastic bags/day, sometimes 4–5 bags/day during peak shopping.
        - Individuals drinking bottled water (living alone): 1 bottle/day per person.
        - Foam boxes: 2/day for occasional takeout.
        - Small communities produce 2–3 trash bags (5 kg each) weekly, collected by the municipality.
    - Recycling and Waste Management:
        - Restaurants separate waste, with 1 small bag containing 10–20 plastic items.
        - Recyclables, including cans and plastics, are sold weekly, generating approximately 2,000 THB.
3. Moo 3 (Chalok Ban Kao):
    - Daily Living and Waste Creation:
        - Each household produces 1–2 trash bags/day, primarily wet waste (1 kg per bag).
        - Weekly plastic bottle collection generates 2 kg per bag every 3 days.
        - Online shopping contributes to daily cardboard and plastic waste.
    - Recycling and Waste Management:
        - Beer cans: 2–3/day, collected in large 5-kg bags every two weeks.
        - Community waste collection involves two trips/day by private pickup trucks (5 bags per trip) and municipal trucks with a capacity of 1.5 tons.

Waste Separation Behavior of the Burmese Community

The details of waste separation behavior in the Burmese community, categorized by area, are summarized in the following table:

Table 7 Waste Separation Behavior of the Burmese Community by Area

Area	Waste Separation Behavior
Moo 1 (Sairee Beach)	- Majority separate waste such as plastic bottles and wet waste, following resort practices where staff are trained to do so.
	- Sell recyclable waste, while non-recyclables are tied in bags and left at municipal collection points.
	- On average, recyclable waste like plastic bottles and cans is collected in bags weighing 3 kg/day for sale, generating 600 THB/day for workers.
	- Aware of municipal waste collection policies and monthly fees (300–500 THB) paid by employers or community leaders.
	- Hazardous waste is separated and given to the municipality, although sometimes mixed with general waste for municipal sorting.
	- Waste generated by establishments: 1 container of wet waste (10 kg) daily.
	- Observations indicate that 80% separate waste while 20% do not, primarily due to lack of awareness. Increased education, social media campaigns, and leadership can address this.
Moo 2 (Mae Haad)	- Households typically separate waste like plastic bottles, beer cans, and glass bottles for sale. On average, 1 large bag (5 kg) of recyclable materials is collected every 3 days.
	- Establishments in the Save Koh Tao group have systematic waste separation practices and keep detailed records for environmental certification.
	- Evaluations of waste separation vary greatly: some estimate 70% separate waste, others claim 20% do while 80% do not.
	- Many participate in community cleanups on main roads but neglect waste sorting at home.
Moo 3 (Solok Ban Kao)	- Households typically separate waste at their doorsteps, sorting items like plastic bottles, glass, and food waste, then using plastic bags for multiple uses.
	- Recyclable materials, such as plastic bottles and beer cans, are sold to local buyers.
	- General waste is collected in 1–2 bags/day and placed at municipal collection points, where trucks pick up waste daily at 6 AM.
	- Observations indicate that 50% of households separate waste while the remaining 50% do not.
	- Residents involved in the Save Koh Tao group estimate that 80% of the community responds well to guidance and education.

Summary of Waste Generation and Separation Behaviors

- **Community Practices**:
  - Moo 1 (Sairee Beach) has more systematic waste management, with greater awareness and practice of separation, supported by local leaders and employers.
  - Moo 2 (Mae Haad) shows mixed behaviors, with evaluations ranging from 20%–70% participation in waste separation.
  - Moo 3 (Solok Ban Kao) exhibits higher waste accumulation due to dense living conditions, with 50% of households separating waste consistently.
  - Motivations for Waste Separation:
  - Economic incentives drive recycling efforts, with proceeds often shared among workers or community members.
  - Establishments with environmental policies foster better waste practices among employees.
- **Challenges**:
  - Lack of awareness, scattered housing, and dense living conditions hinder systematic waste management.
  - Non-recyclable and unsorted waste often lead to reliance on municipal or informal waste collectors.
- **Community Involvement**:
  - The Save Koh Tao group plays a crucial role in community engagement and education, organizing regular cleanups and promoting environmentally friendly practices.

4.2 Finding of Trang Municipality from Qualitative Research

4.2.1 Current Situation

- Trang Municipality implements the "Clean Trang City" policy, where public waste bins are minimal except in key locations.
- Waste is collected and managed under the “Separate and Dispose” policy, categorized into general waste, recyclable waste, hazardous waste, and organic waste, all transported to the Tung Chang disposal site and outsourced for treatment.

4.2.2 Community Waste Volume

- Waste Composition: Organic waste constitutes 50% of total waste. The municipality processes it into fertilizer and EM (effective microorganisms), achieving 100% disposal efficiency.
- General, Plastic, and Hazardous Waste: Recyclables are separated at 100% efficiency by municipal staff and waste pickers at disposal sites.
- Waste Generation: The average amount of waste generated per person is 1 kg/day. With a population of 55,000, this results in approximately 50,500 kg/day, of which 50% is organic waste, effectively managed into compost or EM.

4.2.3 Waste Management Practices

- No Public Bins Policy: Minimal public bins, emphasizing household waste separation.
- Collection and Disposal: Waste is collected twice daily. Large items like furniture are collected upon notification through the municipal "Ma Kep Ta" app.
- Disposal Methods: Waste is disposed of through landfilling, with some outsourced for conversion into fuel to minimize accumulation.
- Public Engagement: Communities are educated and involved in separation through workshops, focusing on four types: general waste, recyclables, hazardous waste, and organic waste.
- Recycling Support: Initiatives like community recycling markets and partnerships with recyclers are encouraged.

4.2.4 Waste Collection and Transportation

- General Waste: Collected daily by 15 teams, averaging 52.5-63 tons/day.
- Large Waste: Includes furniture, collected by dump trucks averaging 12-14 tons/day.
- Organic Waste: Collected by small trucks, averaging 300-500 kg/day.
- Recyclables and Hazardous Waste: Collected as per notifications, often integrated with apps and community programs.

4.2.5 Reduction and Recycling Initiatives

- Community Engagement: WWF and local stakeholders support campaigns like waste banks, workshops for school children, and equipment for waste compression.
- Household Separation Challenges: Lack of bins results in mixed waste at the source, increasing municipal burden.
- Recyclable Management: Informal waste pickers (approximately 300) help separate and sell recyclables. Issues include littering during sorting and low compensation for recyclables.
- Organic Waste Use: Converted into EM and compost, used in municipal landscaping.

4.2.6 Problems and Limitations

- Source-Level Issues: Insufficient community involvement in waste separation due to misconceptions and lack of awareness.
- Midstream Issues: Inadequate equipment and capacity to handle waste, with about 50% of daily waste left unmanaged.
- Downstream Challenges: Accumulated waste at disposal sites and limited budget for comprehensive management.

4.2.7 Policies and Regulations

- Cost Disparity: Actual waste management cost is 50 THB, while residents are charged only 10 THB, leading to a lack of awareness about the actual costs.
- Regulation Enforcement: Incentives and community involvement are seen as more effective than strict legal enforcement.

4.2.8 Advocacy for the 3R Approach

- Reduce and Reuse practices are limited, while recycling has better implementation, particularly through partnerships with informal sectors.

4.2.9 Assessment of Municipal Waste Management

- Municipal performance is rated at a "B" level. Effective disposal and community collaboration are notable, but there is room for improvement in addressing accumulated waste and enhancing public awareness.

4.2.10 Best Practices

- The "Generous Waste Project" by Health Volunteers (Aor Sor Mor):
    - Active in waste separation for over 10 years, covering 16 out of 27 communities.
    - Collaboration with recyclers and promotion of clean streets and separated waste streams.
    - Community-led initiatives for selling recyclables to benefit elderly and disabled residents.

5. Quantitative Research of Behavior and Attitudes Towards Waste Management

The data was collected through individual interviews (Face-to-Face) and focus group discussions. A simple random sampling method ensured coverage across various areas—north, south, east, and west—and systematic random sampling was applied at the household level. Accidental sampling was used within each household, targeting respondents available at the time of the survey.

A total of 414 respondents participated in the study, divided as follows:

- Residents who had lived in the Koh Tao or Trang municipality areas for at least one year
- Government officials and community leaders, including village heads and representatives
- Local entrepreneurs, including shop owners and restaurant operators

5.1 General Information About Respondents

1. By Location/Population Group:
    - 414 respondents consisted of:
        - Residents: 337 (81%).
        - Entrepreneurs: 58 (14%).
        - Community leaders/government officials: 19 (5%).
    - Respondents were distributed across:
        - Koh Tao Municipality: 151 (36%).
        - Trang Municipality: 263 (64%).

Table 8 Distribution by Location and Population Group

Location	Residents (%)	Leaders/Officials (%)	Entrepreneurs (%)	Total (%)
Koh Tao	73.51	3.31	23.18	36.47
Trang	85.93	5.32	8.75	63.53

2. By Community:
    - Distribution of 414 respondents:
        - Highest proportion: Tabtiang Subdistrict (15.7%).
        - Lowest proportion: Nong Yuan Community (1.9%).

Table 9 Distribution by Community and Population Group

Community	Residents (%)	Leaders/Officials (%)	Entrepreneurs (%)	Total (%)
Haad Sai Ree	12.2	10.5	15.5	12.6
Mae Haad	10.4	0.0	29.3	12.6
Old Town	10.4	15.8	15.5	11.4
Bang Rak	6.8	10.5	12.1	7.7
Trok Pla	12.5	15.8	15.5	13.0
Suan Chan	14.5	15.8	3.4	13.0
Commercial 3	13.4	5.3	6.9	12.1
Nong Yuan	2.4	0.0	0.0	1.9
Tabtiang	17.5	26.3	1.7	15.7

3. Demographics of Respondents

    Gender:
    - Female respondents dominated (74.2%), with higher representation among residents (83.6%).
    - Males were more prevalent among entrepreneurs (19.2%) and officials (7.7%).

    Age:
    - Average age: 45.9 years (range: 18-84 years).
    - Koh Tao: 40 years average.
    - Trang: 49.2 years average.

    Education:
    - The majority (38.4%) held a bachelor's degree.

- Higher education levels were observed in Trang Municipality.

Occupation:

- Predominantly self-employed/business owners (48.8%).
- The highest proportion of entrepreneurs was found in Koh Tao.

5.2 Household Waste Generation and Quantities

5.2.1 Household Waste Generation by Type

The study (Table 4.1.2-1) indicates that plastic waste is the most commonly generated type (82.4%), followed by organic waste (74.2%), and other types of waste being the least generated (3.6%). When analyzed by location:

- Koh Tao produces the most plastic waste (86.1%).
- Trang Municipality generates the most organic waste (80.6%).

Regarding specific types of plastic waste:

- Plastic bottles are the most generated (79.2%), followed by plastic bags (74.6%), and the least generated are other plastic items like jugs (0.5%).

By location:

- Koh Tao generates the most plastic bottles (92.1%) and plastic bags (75.5%).
- Trang Municipality generates the most plastic bags (74.1%) and plastic bottles (71.9%).

Table 10 Number and Percentage of Sample Group by Waste Type

Variable	Koh Tao (N=151)	Trang (N=263)	Total (N=414)
Organic waste	95 (62.9%)	212 (80.6%)	307 (74.2%)
Plastic waste	130 (86.1%)	211 (80.2%)	341 (82.4%)
Plastic bags	114 (75.5%)	195 (74.1%)	309 (74.6%)
Foam containers	17 (11.3%)	57 (21.7%)	74 (17.9%)
UHT/milk cartons	39 (25.8%)	94 (35.7%)	133 (32.1%)
Plastic bottles	139 (92.1%)	189 (71.9%)	328 (79.2%)
Plastic cups	42 (27.8%)	103 (39.2%)	145 (35.0%)
Metal/rubber scraps	13 (8.6%)	16 (6.1%)	29 (7.0%)
Other plastics (e.g., jugs)	1 (0.7%)	1 (0.4%)	2 (0.5%)
Other waste (e.g., sticks, paper, cans)	3 (2.0%)	12 (4.6%)	15 (3.6%)

5.2.2 Waste Generation in Koh Tao by Community

- Plastic waste is the most generated type across Koh Tao communities:
  - Chalok Ban Kao: 89.4%
  - Mae Haad: 88.5%
  - Sairee Beach: 80.8%
- Organic waste ranks second:
  - Chalok Ban Kao: 66%
  - Mae Haad: 65.4%
  - Sairee Beach: 57.7%
- Other waste is the least generated:
  - Chalok Ban Kao: 4.3%
  - Mae Haad: 1.9%

Plastic bottles are the most produced across all communities:

- Sairee Beach: 96.2%
- Mae Haad: 94.2%
- Chalok Ban Kao: 85.1%

Plastic bags are the second most generated:

- Chalok Ban Kao: 76.6%
- Sairee Beach and Mae Haad: 75% each.

Table 11 Number and Percentage by Waste Type in Koh Tao Municipality

Variable	Sairee Beach (N=52)	Mae Haad (N=52)	Chalok Ban Kao (N=47)
Organic waste	30 (57.7%)	34 (65.4%)	31 (66.0%)
Plastic waste	42 (80.8%)	46 (88.5%)	42 (89.4%)
Plastic bags	39 (75.0%)	39 (75.0%)	36 (76.6%)
Foam containers	4 (7.7%)	8 (15.4%)	5 (10.6%)
UHT/milk cartons	17 (32.7%)	15 (28.8%)	7 (14.9%)
Plastic bottles	50 (96.2%)	49 (94.2%)	40 (85.1%)
Plastic cups	17 (32.7%)	12 (23.1%)	13 (27.7%)
Metal/rubber scraps	2 (3.8%)	6 (11.5%)	5 (10.6%)
Other plastics (e.g., jugs)	0 (0.0%)	0 (0.0%)	1 (2.1%)
Other waste	0 (0.0%)	1 (1.9%)	2 (4.3%)

5.2.3 Waste Generation in Trang Municipality by Community

- Organic waste is most generated in four communities:
    - Nong Yuan: 100%
    - Suan Chan and Commercial District 3: 94.4% each
    - Bang Rak: 71.9%
- Plastic waste is most generated in:
    - Nong Yuan: 100%
    - Trok Pla: 72.2%

Plastic bags are the most generated in:

- Nong Yuan: 100%
- Commercial District 3 and Suan Chan: 81.5% each.

Plastic bottles are most generated in:

- Trok Pla: 85.2%
- Thap Thiang: 70.8%.

Table 12 Number and Percentage by Waste Type in Trang Municipality

Variable	Bang Rak (N=32)	Trok Pla (N=54)	Commercial District 3 (N=54)	Suan Chan (N=54)	Nong Yuan (N=8)	Thap Thiang (N=65)
Organic waste	23 (71.9%)	28 (51.9%)	51 (94.4%)	47 (94.4%)	8 (100.0%)	55 (84.6%)
Plastic waste	20 (62.5%)	39 (72.2%)	47 (87.0%)	49 (87.0%)	8 (100.0%)	48 (73.8%)
Plastic bags	20 (62.5%)	35 (64.8%)	44 (81.5%)	48 (81.5%)	8 (100.0%)	40 (61.5%)
Foam containers	5 (15.6%)	5 (9.3%)	24 (44.4%)	14 (44.4%)	0 (0.0%)	9 (13.6%)
UHT/milk cartons	6 (18.8%)	24 (44.4%)	21 (38.9%)	17 (38.9%)	4 (50.0%)	22 (33.8%)
Plastic bottles	15 (46.9%)	46 (85.2%)	31 (57.4%)	43 (57.4%)	7 (87.5%)	46 (70.8%)
Plastic cups	12 (37.5%)	14 (25.9%)	27 (50.0%)	25 (50.0%)	4 (50.0%)	21 (32.3%)
Metal/rubber scraps	0 (0.0%)	3 (5.6%)	1 (1.9 %)	3 (1.9%)	0 (0.0%)	5 (7.7%)

6. Analysis of waste generation in households

6.1 Waste Generation and Waste Flow Diagram in Trang City

The data on average waste generation per household in Trang City, categorized by income level and day type, measured in kilograms per person per day. High-income households generate 1.41 kg per person on weekdays and 1.44 kg on weekends, averaging 1.42 kg per day over the week. Middle-income households produce 1.16 kg per person on weekdays and 1.19 kg on weekends, with a weekly average of 1.17 kg per day. Low-income households generate the least waste, with 1.07 kg per person on weekdays and 1.13 kg on weekends, averaging 1.09 kg per day weekly. Overall, across all income levels, the average waste generation is 1.14 kg per person on weekdays, 1.19 kg on weekends, and 1.15 kg per day for the entire week. This data indicates that waste generation is generally higher on weekends, and higher-income households tend to produce more waste compared to middle- and low-income households. These findings are based on a waste composition analysis conducted by PITH in Trang City, considering income ranges and working days. The weekly average of 1.15 kg per person per day will be used as the basis for calculating data in the waste flow diagram for Trang City.

Table 13 Average Waste Generation of Household in Trang City

Income Range	Average Waste Generation of Household on Weekday (Kg. per capita per day)	Average Waste Generation of Household on Weekend (Kg. per capita per day)	Average Waste Generation of Household on Week (Kg. per capita per day)
High Income	1.41	1.44	1.42
Middle Income	1.16	1.19	1.17
Low Income	1.07	1.13	1.09
Average	1.14	1.19	1.15

Furthermore, PITH conducted a detailed waste composition analysis in Trang City to examine the specific fractions of different types of waste generated by households. This analysis was crucial for understanding the breakdown of waste streams such as organic waste, plastics, paper, and other materials. These results are summarized in the following table, providing a comprehensive picture of the waste composition across different economic segments of Trang City.

Table 14 Waste Composition Analysis in Trang City

Waste composition: Household (All level of average of week)								
Waste Sampling Type		High income		Middle income		Low income		All level
		%by group	Composition percentage (%)	%by group	Composition percentage (%)	%by group	Composition percentage (%)	
Plastics	PET Bottle	21.31%	11.71%	17.18%	12.76%	11.97%	4.70%	9.75%
	PE Bottle		2.34%		0.58%		1.44%	1.46%
	PP Bottle		0.00%		0.37%		0.00%	0.09%
	PS Bottle		0.00%		0.00%		0.00%	0.00%
	PP Tube/Cups/Tray		1.63%		1.68%		0.96%	1.53%
	PET Cup/Tray		0.10%		0.04%		0.08%	0.10%
	PS Cups/Tray		0.04%		0.04%		0.03%	0.04%
	Mixed Plastics		0.34%		0.14%		0.16%	0.31%
	PE Film		3.26%		1.06%		4.10%	2.65%
	PS Film		0.00%		0.00%		0.00%	0.00%
	PP Film		0.85%		0.40%		0.15%	0.49%
	Multi-layer Film		1.06%		0.11%		0.34%	0.49%
Metal		6.32%	6.32%	3.16%	3.16%	1.82%	1.82%	4.00%
Glass		14.49%	14.49%	8.40%	8.40%	4.86%	4.86%	9.86%
Paper & Board		6.54%	6.54%	6.69%	6.69%	2.36%	2.36%	5.40%
Other		2.29%	2.29%	2.61%	2.61%	0.70%	0.70%	2.28%
Organics		49.06%	49.06%	61.97%	61.97%	78.30%	78.30%	61.54%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

From the waste generation data in Trang City, the waste composition diagram was plotted as follows.

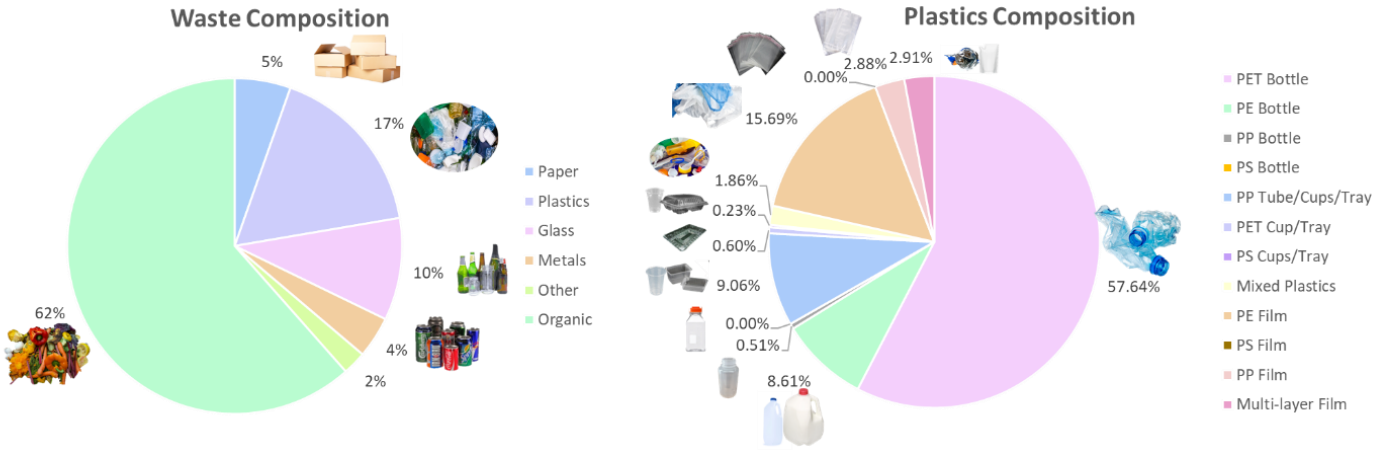

Figure 9 Waste Composition in Trang City

6.2 Waste Generation and Waste Flow Diagram in Koh Tao

The data on average waste generation per household in Koh Tao, categorized by income level and day type, is measured in kilograms per person per day. High-income households generate 1.33 kg per person on weekdays and 1.38 kg on weekends, averaging 1.35 kg per day over the week. Middle-income households produce 1.17 kg per person on weekdays and 1.24 kg on weekends, with a weekly average of 1.19 kg per day. Low-income households generate the least waste, with 1.03 kg per person on weekdays and 1.11 kg on weekends, averaging 1.05 kg per day weekly. Overall, across all income levels, the average waste generation is 1.12 kg per person on weekdays, 1.19 kg on weekends, and 1.14 kg per day for the entire week. This data indicates that waste generation is generally higher on weekends, and higher-income households tend to produce more waste compared to middle- and low-income households. These findings are based on a waste composition analysis conducted in Koh Tao, considering income ranges and working days. The weekly average of 1.14 kg per person per day will be used as the basis for calculating data in the waste flow diagram for Koh Tao.

Table 15 Waste Generation assumptions in Koh Tao

Income Range	Average Waste Generation of Household on Weekday (Kg. per capita per day)	Average Waste Generation of Household on Weekend (Kg. per capita per day)	Average Waste Generation of Household on Week (Kg. per capita per day)
High Income	1.33	1.38	1.35
Middle Income	1.17	1.24	1.19
Low Income	1.03	1.11	1.05
Average	1.12	1.19	1.14

Furthermore, PITH conducted a detailed waste composition analysis in Koh Tao to examine the specific fractions of different types of waste generated by households. This analysis was crucial for understanding the breakdown of waste streams such as organic waste, plastics, paper, and other materials. The results of this analysis are summarized in the following table, providing a comprehensive picture of the waste composition across different economic segments of Koh Tao.

Table 16 Waste Composition Analysis in Koh Tao

Waste composition: Household (All level of average of week)								
Waste Sampling Type		High income		Middle income		Low income		All level
		%by group	Composition percentage (%)	%by group	Composition percentage (%)	%by group	Composition percentage (%)	
Plastics	PET Bottle	21.87%	11.64%	18.82%	7.90%	18.35%	6.99%	10.48%
	PE Bottle		2.98%		1.24%		2.16%	2.19%
	PP Bottle		0.00%		0.22%		0.05%	0.11%
	PS Bottle		0.00%		0.00%		0.00%	0.00%
	PP Tube/Cups/Tray		1.65%		2.00%		0.97%	1.54%
	PET Cup/Tray		0.10%		0.16%		0.04%	0.25%
	PS Cups/Tray		0.04%		0.00%		0.00%	0.02%
	Mixed Plastics		0.35%		0.16%		0.21%	0.44%
	PE Film		3.09%		6.92%		7.16%	3.59%
	PS Film		0.00%		0.00%		0.00%	0.00%
	PP Film		0.87%		0.11%		0.23%	0.48%
	Multi-layer Film		1.15%		0.11%		0.53%	0.75%
Metal		7.52%	7.52%	4.81%	4.81%	5.69%	5.69%	5.75%
Glass		10.11%	10.11%	3.35%	3.35%	3.67%	3.67%	7.14%
Paper & Board		7.88%	7.88%	1.89%	1.89%	2.87%	2.87%	5.83%
Other		2.34%	2.34%	0.00%	0.00%	0.00%	0.00%	1.96%
Organics		50.27%	50.27%	71.12%	71.12%	69.43%	69.43%	59.48%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

From the waste generation data in Koh Tao, the waste composition diagram was plotted as follows.

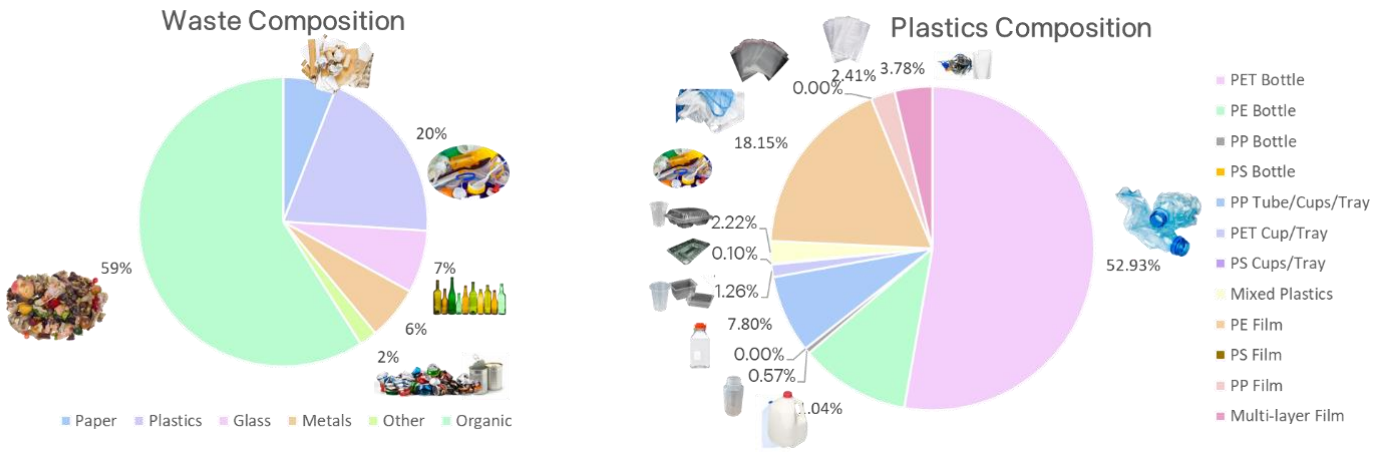

Figure 10 Waste Composition in Koh Tao

6.3 Overview and Key findings from 1st Stakeholder Workshop

From the feedback gathered during the 1st stakeholder workshop, we identified valuable comments that can be utilized to develop actionable recommendations. These comments, categorized by key focus areas, are as follows:

Topics	Trang City	Koh Tao
Attitude and Behavior	In Trang, the community is actively engaged in waste separation, sorting their trash into categories such as plastic waste, organic waste, glass bottles, metal waste, and food waste. However, there is a significant issue with "formal collection," as the lack of sufficient garbage bins—especially those dedicated to specific waste types—leads to confusion. People often discard mixed waste, and this mixed disposal undermines efforts to separate waste properly. Even when households and businesses separate their waste into different bags, these bags are often collected as mixed waste, which diminishes the effectiveness of their waste management efforts. This inconsistency in waste collection has led to varying attitudes and levels of participation, with many residents feeling that clearer guidelines and infrastructure improvements are needed to enhance community awareness and commitment to waste separation.	Households in Koh Tao demonstrate a willingness to participate in waste sorting initiatives; however, there are some limitations due to the challenging terrain, which makes access to certain households difficult. This has led to self-managed waste disposal in some areas, resulting in a lack of control and an increase in waste being sent to landfills. Despite the desire to engage in proper waste management, these geographical challenges prevent a fully efficient system from being implemented.
Waste Volume	In Trang, garbage collection occurs twice daily—once in the morning and again in the evening—using municipal garbage trucks. Additionally, there is a special service for collecting large items such as mattresses, wooden crates, and hazardous waste, though this service must be scheduled through the municipal app, "Ma Kep Ta." This app allows residents to request special waste collections and septic tank services online. Despite these systems, certain areas remain dirty due to unbagged waste being left uncollected. This creates an ongoing	While there has been significant public involvement in waste management efforts on Koh Tao, the island still faces the issue of accumulated waste. Due to the high volume of waste generated daily, especially with a steady influx of tourists, the waste collection infrastructure is often overwhelmed. This contributes to areas where waste accumulates, creating environmental concerns for both residents and the island's natural surroundings.

Topics	Trang City	Koh Tao
	challenge for maintaining cleanliness and addressing waste overflow in parts of the city.	
Infrastructure	Trang's municipal infrastructure for waste management has notable gaps, particularly in terms of cleaning equipment and designated waste storage areas. The lack of adequate facilities to store and manage the large volumes of waste—especially waste that originates from outside the municipality—presents a major challenge. Additionally, the workforce dedicated to waste management and street cleaning is insufficient to meet the city's needs. This shortage of manpower results in delays in waste collection and street cleaning, exacerbating the city's waste management problems and affecting overall cleanliness.	Koh Tao waste generation daily from the permanent resident are a significant number compare to the size of landfill. However, the challenge is compounded by the influx of tourists, which drastically increases the overall waste volume. Managing waste for both residents and tourists places a significant strain on the local budget, as there are limited resources available to handle such a large population of waste generators. Additionally, the waste management infrastructure is not equipped to efficiently manage the waste generated during peak tourist seasons, leading to budgetary and logistical constraints in ensuring proper waste disposal.

7. Developed Recommendation and Waste Flow Diagram from WWF

Based on the research data provided by PITH, WWF has identified several data gaps that require further exploration to strengthen the foundation for effective decision-making. To address these gaps and ensure comprehensive outcomes for the second stakeholder workshop in Trang City and Koh Tao, WWF intends to provide guidance on key findings, recommendations, and a detailed waste flow diagram. This will help establish a robust data framework for informed discussions. The details are outlined as follows:

7.1 Koh Tao Waste Flow Diagram and Recommendation

7.1.1 Waste Flow Diagram

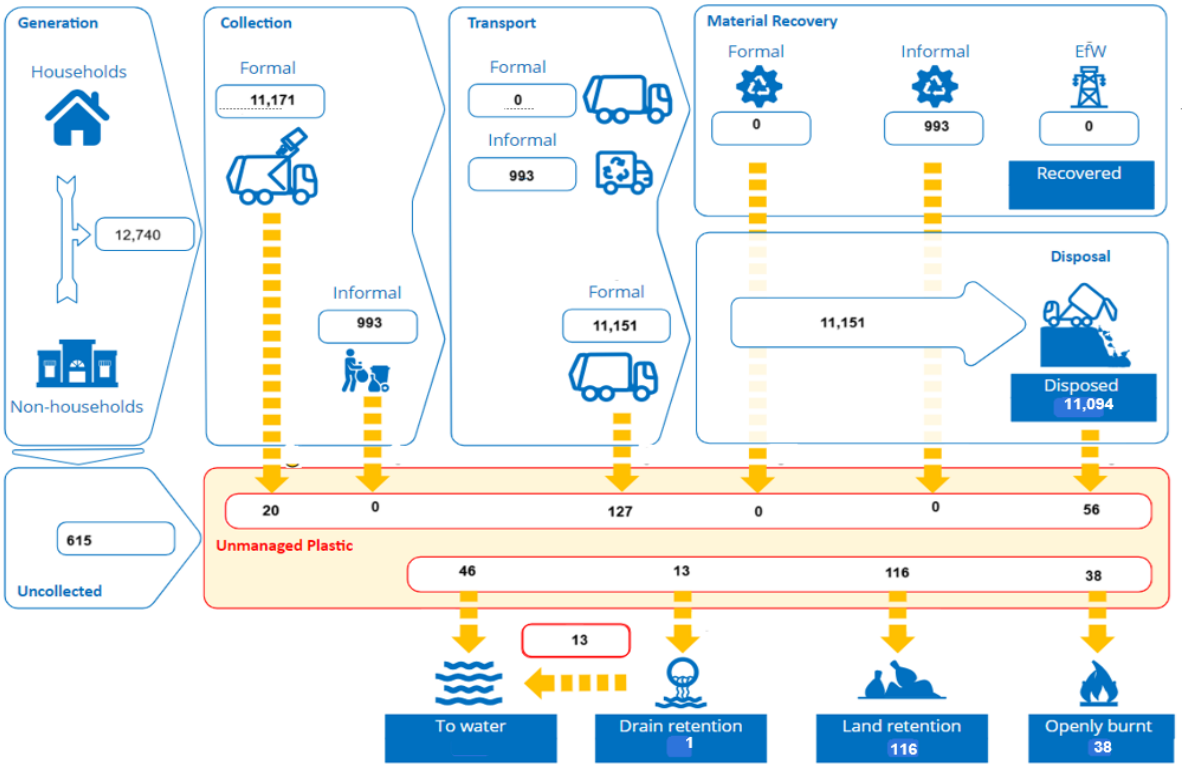

Figure 11 Koh Tao Waste Flow Diagram developed by WWF

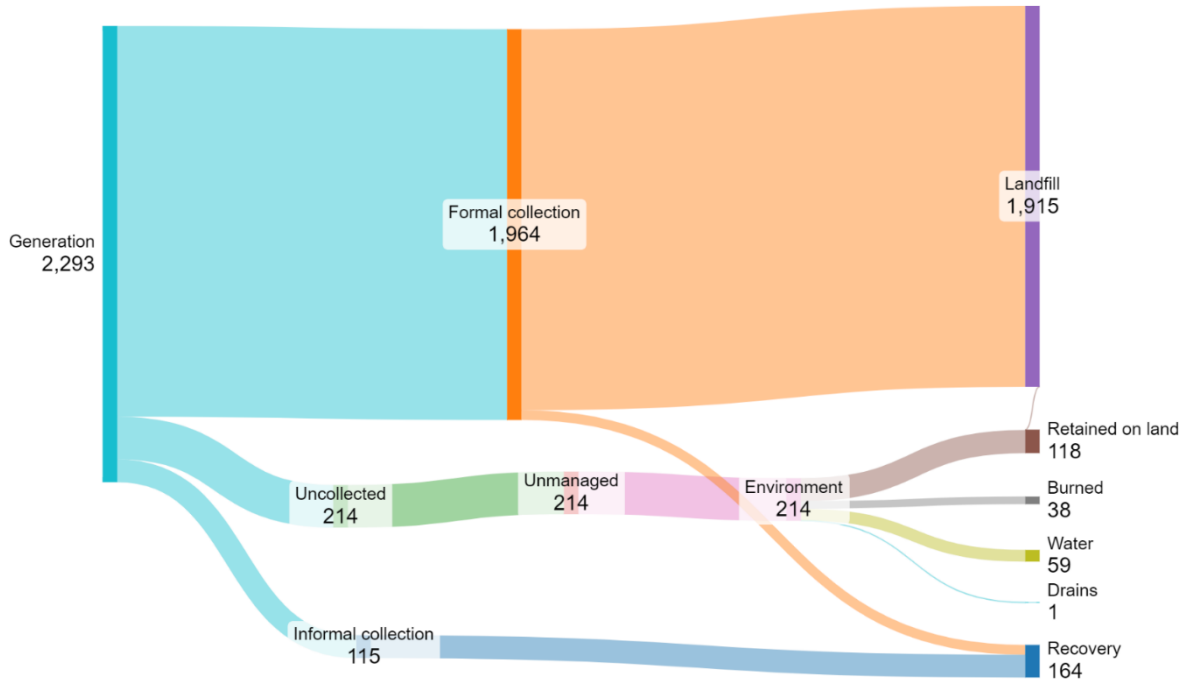

Figure 12 Koh Tao Plastics Waste Flow developed by WWF

7.1.2 Key findings from the analysis developed by WWF:

Waste Generation

- *High Share of Organic Waste: Municipal waste is characterized by a significant proportion of organic waste across nearly all sectors (households and businesses).*
- *Single-Use Plastic (SUP) Packaging:*
    - *SUP constitutes a substantial portion of municipal solid waste.*
    - *PET Bottles and PE Film: These dominate SUP waste by volume and mass flow in both household and commercial/institutional segments.*
    - *Plastic Bags: Shopping bags form a significant share of waste; plans for substitution are underway.*
    - *Food Packaging: SUP waste from food/grocery delivery services and take-away items, including large plastic cups, contributes heavily to waste generation.*
    - *Goods Packaging: Plastic packaging for store-sold goods, especially foodstuffs and outer packaging, represents a major waste stream.*
    - *Styrofoam Containers: While not a significant mass-flow, they present ecological challenges. Although take-back arrangements exist with Surat Thani province, they are underutilized.*
- *Household Packaging from Online Orders: The increasing volume of packaging, primarily cartons and bubble wrap, is notable.*
- *Polystyrene Leakage: Damaged bean bags in beach bars release polystyrene, which, while not a large mass-flow, poses ecological concerns.*
- *Progressive Tourism Businesses: A few leading businesses are already implementing effective plastic waste avoidance and reuse practices. However, water shortages constrain the use of reusable containers and packaging.*

Waste Collection

- *Segregation Gaps: Although mandated by national law, separate waste collection capacity is lacking. Proper segregation, especially of wet and dry waste at the household level, is crucial for improving recovery rates.*
- *Underserved Areas: Some areas lack adequate municipal waste collection, leading to informal dumping and environmental leakage, which also poses health risks.*
- *Burning of Waste: In areas without collection services, burning waste is a common practice, especially for items like furniture and polystyrene, creating health and safety hazards.*

Waste Recovery & Disposal

- *Recyclable Waste Recovery:*
  - *Valuable materials like aluminum cans and PET bottles are effectively recovered from households and businesses. However, there is potential to improve the recovery of low-value recyclables such as LDPE, HDPE, and PP.*
  - *Partnerships, such as those with Midori and OGGA for PET bottle recovery, show promise.*
- *Landfill Challenges:*
  - *The current unsanitary landfill is exposed to weather, creating risks to public health and the environment, including odor issues and leakage.*
  - *Public access to the landfill complicates municipal tracking of deposited waste quantities.*
- *Tourism-Driven Waste Challenges:*
  - *Koh Tao's high municipal solid waste generation per capita, driven by tourism, strains its waste management system.*
  - *Topographical constraints and high shipping costs limit recycling and disposal capacity. National laws prohibiting mixed waste export to the mainland exacerbate the challenge.*
  - *Effective segregation and resource recovery are critical.*

Waste Leakage

- *Littering:*
  - *Streets and beaches are frequently littered. While business owners clean areas near their premises, public spaces such as roadsides and canals remain problematic.*
  - *A portion of beach litter originates from the sea.*
- *Landfill Leakage: Minimal leakage during collection and transport, but significant leakage occurs from the landfill.*

Other Aspects

- *Insufficient Funding:*
  - *Waste management fees collected from households and businesses do not cover the full cost of municipal solid waste management.*
  - *The 20 THB fee collected from travelers at the pier, along with other municipal revenues, could be earmarked to support waste management initiatives.*
- *Prioritizing Waste Avoidance:*
  - *Waste avoidance should take precedence, per the waste hierarchy. However, replacing SUP packaging with reusable alternatives will require addressing Koh Tao's water shortages, especially during the dry season.*

This analysis highlights critical gaps and opportunities in waste management, paving the way for targeted strategies to address these challenges effectively.

7.1.3 Recommendations developed by WWF

Table 17 Koh Tao Recommendations developed by WWF

Strategies	Measures	Impact	Effort/ input	Comment
1. Introducing/ improving waste segregation at source	Roll out separation of organic waste across the entire municipality, incl. distribution of segregation bins first to businesses, then rolling out to households	+++	+++	Need to be combined
	Enable consistent separate collection of organic waste, incl from households, by municipality (MSWM)	+++	+++	
	Establish collection points for hazardous waste	+++	++	Three collection points planned already
	Conduct awareness-raising among tourists and residents	++	+	800,000 THB available under a special budget
2. Increasing collection rates	Establish collection points in hard-to-reach neighbourhoods (on small or steep roads)	+++	++	Residents may lack incentive to bring their waste. Cleanliness around collection points can be a challenge, by past experience.
	Adequate vehicles serving hard-to-reach neighbourhoods	++	++	
	Raise awareness of residents, run a behaviour change campaign	++	+	
	Set up segregation bins in public spaces and on beaches	+++	+++	Has been trialled and given up again due to challenges
	Establish regular street cleaning, pot. focusing on main roads and litter hotspots	++	+	
	Conduct awareness-raising among tourists (and residents) about littering	++	+	
3. Reducing waste disposal on the landfill by increasing recovery/ recycling rates	Establish/ strengthen a community or school waste bank, linking it up with recyclers/MRFs to recover esp. low-value fractions (LDPE, HDPE)	++	++	The existing agreement between school and OGGA is hard to fulfill. Supports enforcement of Thai waste management law.
	Increase establish local recycling of HDPE and LDPE (e.g. PlastTao)	++	++	

Strategies	Measures	Impact	Effort/ input	Comment
	Establish partnership with professional MRFs and recyclers	++	++	
	Capacity building for junk shops and public to sort and separate parts of recycle materials to obtain higher prices	++	+	
	Send milk boxes from school milk programme to recycling facility in Surat Thani (15,000 boxes/ month)	++	++	Sound feasibility in view of water shortages
4. Reducing, and improving monitoring of, littering & leakage	Set up segregation bins in public spaces and on beaches (see 2.)	+++	+++	see “2. Increasing collection rates”
	Ensure that the landfill meets minimum requirements of a sanitary disposal facility	+++	+++	
	Conduct awareness-raising among tourists (and residents) about littering	++	+	
	(Drone-based) Monitoring of littering in settlements and on beaches - half-yearly at first, annually in the long run	+	++	To ascertain the effectiveness of other measures. If done manually, can be combined with clean-up events
5. Reducing the use of single-use plastic items in municipality’s procurement and in businesses	Replace thin plastic bags (retail stores, food delivery and take-away services)	+++	++	Continue the ongoing initiative, expand to food delivery
	Reduce SUP water bottles through refill stations	++	++	Continue the ongoing initiative, establish more publicly available stations
	Enforce ban on plastic straws	++	+	Ensures compliance with national law. Support businesses with sourcing alternatives.
	Encourage businesses and households to avoid SUP packaging (e.g. by offering shampoo/detergents refill stations from commercial brands)	++	+	Pioneers are already being given visibility in the *Spotlight Koh Tao* event.

7.1.4 Highlight and Outcome from the 2nd Stakeholder workshop in Koh Tao

Highlights:

- The workshop presented Koh Tao's significant waste management challenges, emphasizing the need for waste segregation and recovery.
- Key stakeholders identified single-use plastic (SUP) reduction as a priority, highlighting major contributors such as food delivery packaging and tourist-related SUPs.
- A Plastic Smart City Action Plan (PSC AP) was discussed, focusing on prevention, collection, and recycling measures tailored to the island's unique challenges.

Outcomes:

- Stakeholders committed to enhancing waste segregation at the source and increasing recovery rates for recyclable materials like PET bottles and LDPE plastics.
- Plans were initiated to upgrade the existing landfill to meet sanitary standards and reduce environmental leakage.
- A consensus was reached on the need for stricter enforcement of SUP policies and the introduction of reusable packaging initiatives, despite challenges like water shortages during high tourist seasons.
- Schools pledged to expand community-based education on waste management and implement "waste-back-to-school" programs.
- WWF provided guidance for aligning local actions with Thailand's national plastic waste roadmap.

7.2 Trang City Waste Flow Diagram and Recommendation

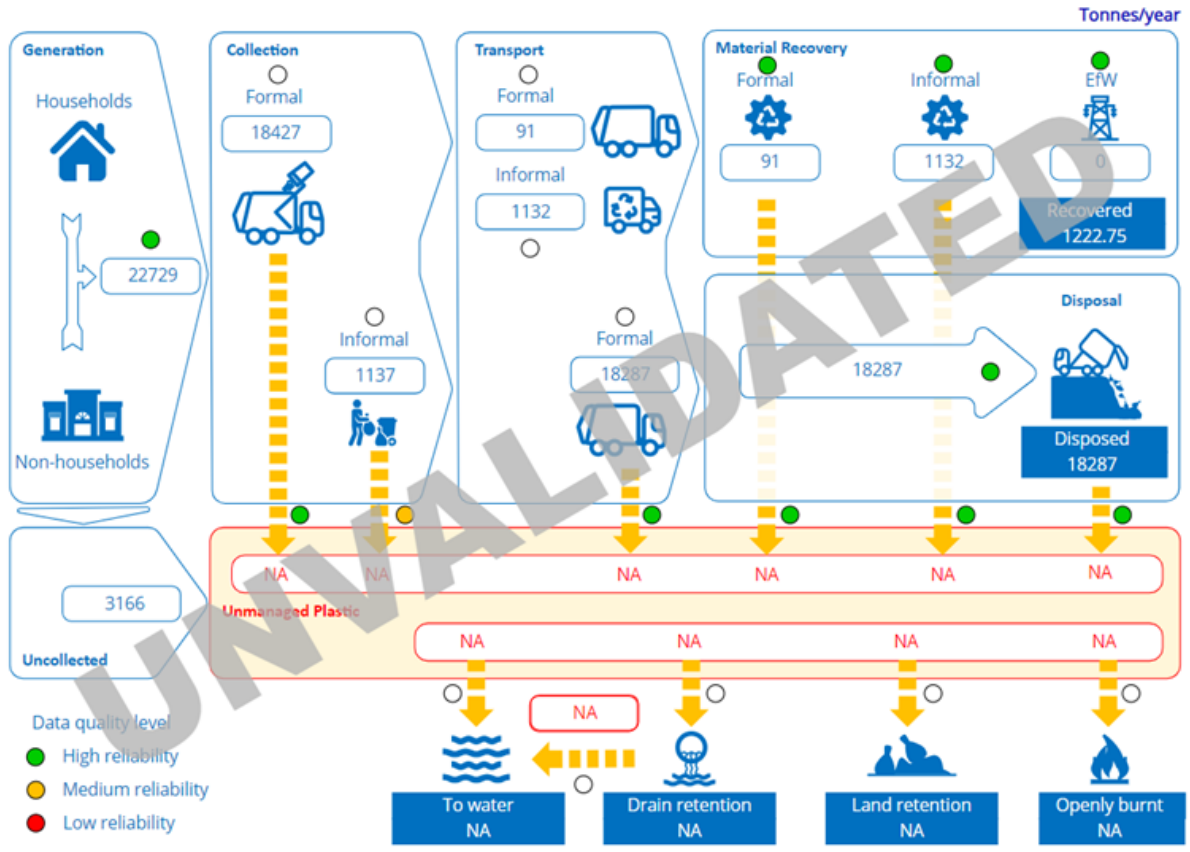

Figure 13 Trang City Waste Flow Diagram developed by WWF

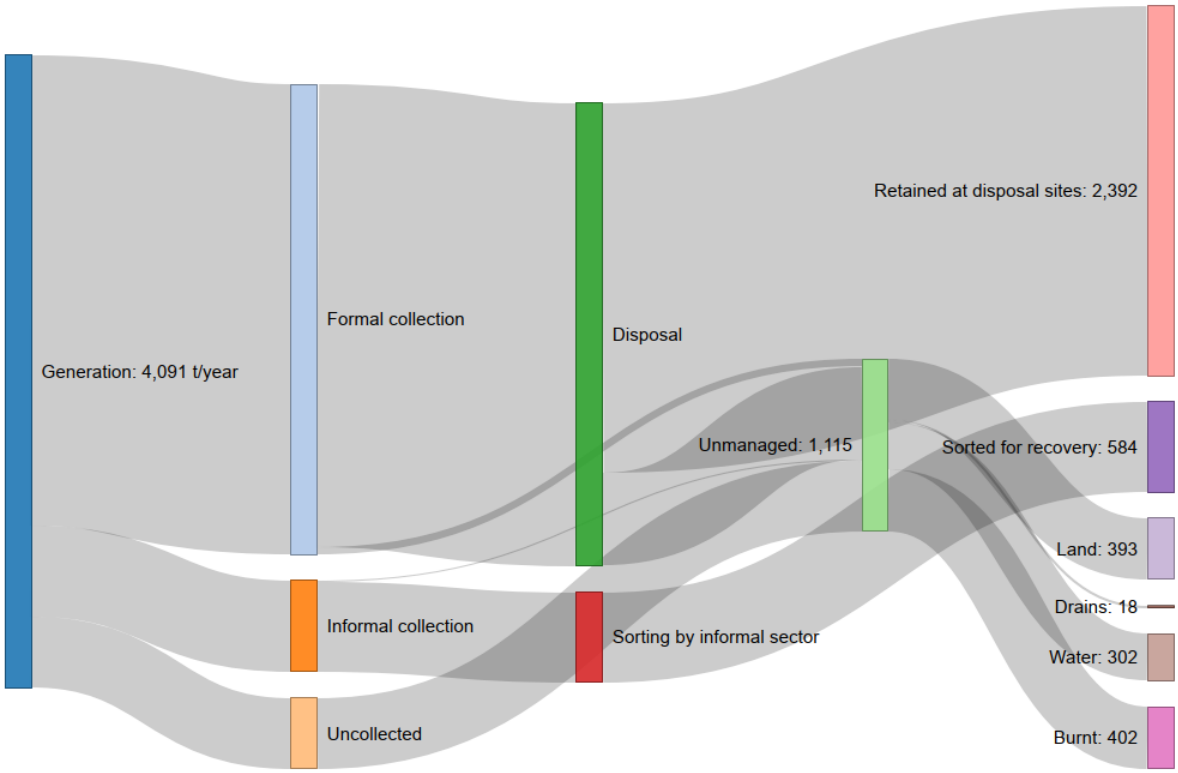

Figure 14 Trang City Plastics Flow Diagram developed by WWF

7.1.2 Key findings from the analysis developed by WWF

Waste Generation

- High Organic Waste Share: Municipal waste consists predominantly of organic waste across most segments, including households and businesses. This underscores the need to prioritize waste segregation and establish a municipal composting facility. Such measures would enable the recovery of other recyclable waste fractions and alleviate the pressure on landfill staff with limited processing capacity.
- Significant Contribution of Single-Use Plastics (SUPs):
    - PET bottles and PE film are the largest contributors to SUP waste in both household and commercial/institutional segments.
    - SUPs from goods sold in stores and indoor/outdoor markets constitute another substantial stream of plastic waste, including plastic bags and outer packaging.

Waste Collection and Leakage

- Municipal Coverage: Waste collection reaches all neighborhoods within the municipal boundaries.
- Challenges with Waste Segregation:
    - While waste segregation is mandated by national law, capacity for separate waste collection remains limited. Effective separation of wet and dry waste at the household level is critical to ensuring high recovery rates.
    - Waste segregation bins are being distributed gradually, but household participation in waste segregation remains inconsistent. Some communities have initiated separate collections of wet and dry waste.
- Leakage During Collection:
    - Open bins and informal waste collectors extracting valuables from waste left outside for collection contribute to leakage.
- Litter Control:
    - Despite the absence of public bins, street littering is minimal, with streets being cleaned monthly by municipal sweepers.

    - Market Waste Leakage: Outdoor markets face significant leakage due to improper waste management and wind exposure. This requires quantification.

Waste Recovery and Disposal

- Valuable Waste Recovery:
    - Recovery of high-value recyclable materials (aluminum cans, steel, PET bottles, glass, paper) is functioning relatively well. However, there is significant potential to improve recovery of low-value recyclable materials such as LDPE, HDPE, and PP.
- Landfill Operations:
    - While the landfill meets the criteria for a “controlled facility” (per SDG indicator 11.6.1), limited staff capacity often prevents timely processing (e.g., compacting and covering) of all incoming waste.
    - The landfill is fenced, but damaged areas in the fencing have led to waste leakage beyond the premises. Notably, the eastern boundary near a rivulet/creek/canal (specific name to be confirmed) shows waste spilling down the embankment, posing a risk of contamination in the Trang River.

Other Aspects

- Financial Burden:
    - Solid waste management imposes a significant financial strain on the municipality, with costs exceeding collection fees by a factor of four (5 THB spent for every 1 THB collected). Addressing financial sustainability will require exploring additional funding sources and improving the efficiency of municipal solid waste management (MSWM) systems.

7.1.3 Recommendations developed by WWF

Table 18 Trang City Recommendations developed by WWF

Strategies	Measures	Impact	Cost/ effort	Comment
1. Rolling out waste segregation at source	Ensuring separate waste collection by the municipality	+++	+++	
	Rolling out segregation bins to all communities (over the course of X years)	+++	+++	
	Conduct awareness-raising among residents, institutions and businesses	++	+	
2. Increase collection rates	Install bins in public spaces allowing for waste segregation, esp. in parks and along river paths			
3. Reducing SUP waste	Avoid plastic packaging in the municipality's procurement	++	++	
	Raise awareness of plastic pollution and alternatives to SUP packaging in collaboration with business associations	++	+	
4. Reducing waste disposal by increasing recovery/ recycling rates	Establish community waste banks, linking them up with recyclers/ MRF recovering low-value plastic waste fractions	++	++	
	(*Address municipality's interest in recycling bricks*)			
5. Reducing leakage from drains and open waterbodies				

Strategies	Measures	Impact	Cost/ effort	Comment
6. Ensure financial sustainability of the municipal solid waste management system (MSWM)	Establish current financing gap, financing needs and funding plan			

7.2.4 Highlight and Outcome from the 2nd Stakeholder workshop in Trang City

Highlights:

- The workshop revealed that Trang generates 1.15 kg of waste per capita daily, with plastics making up 18% of the total. However, only 5% of waste is recovered due to infrastructural and financial limitations.
- Presentations outlined future scenarios for improving municipal solid waste management, emphasizing source segregation, recovery, and SUP reduction.
- Stakeholders discussed integrating community-level efforts with municipal policies for greater efficiency.

Outcomes:

- Commitments included expanding waste segregation at the source, installing segregated bins in public spaces, and promoting community education campaigns.
- The proposed actions included collaborating with recyclers for low-value plastics and establishing community waste banks.
- Stakeholders agreed on innovative funding mechanisms, such as municipal partnerships and community waste fees, to cover the financial gaps in waste management.
- The municipality plans to enhance its waste collection coverage and address leakage issues from the landfill.
- The PSC Action Plan will be integrated into municipal operations, with specific metrics for monitoring progress toward reducing plastic waste leakage.

ANNEX – Copy of Survey