COMPONENT 2

INTEGRATION OF NATURAL CAPITAL ACCOUNTS INTO LOCAL DEVELOPMENT PLANNING AND OPERATIONS

THE INTEGRATION OF NATURAL CAPITAL ACCOUNTING IN PUBLIC AND PRIVATE SECTOR POLICY AND DECISION-MAKING FOR SUSTAINABLE LANDSCAPES

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COMPONENT 2

INTEGRATION OF NATURAL CAPITAL ACCOUNTS INTO LOCAL DEVELOPMENT PLANNING AND OPERATIONS

OUTPUT 2.1.2

CONDUCT A TOURISM SITUATION ASSESSMENT FOR KRABI PROVINCE

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Acknowledgement

The report “Output 2.1.2 Conduct a Tourism Situation Assessment for Krabi Province” was prepared under the technical guidance and academic leadership of Assoc. Prof. Dr. Tunlawit Satapanajaru, an expert in environmental technology and environmental management, and Asst. Prof. Dr. Pasinee Worachananant, an expert in environmental science and marine environmental management, both from Kasetsart University (KU).

We would like to express our sincere appreciation to both experts for their comprehensive analysis and valuable contributions to this assessment of the tourism situation in Krabi Province. Their expertise was instrumental in examining key aspects of the tourism system, including tourism footprint and economic impacts, environmental challenges, waste management issues, and tourism–waste linkages.

This study is primarily based on the synthesis of secondary data and information from relevant agencies and published reports. The authors would like to acknowledge all relevant agencies and organizations for their valuable data, reports, and information, which formed the foundation of this study and enabled a comprehensive and evidence-based assessment of the tourism situation in Krabi Province.

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Executive Summary

This report indicates tourism situation assessment for Krabi province. The assessment divided into 5 topics as follows:

Tourism Footprint and Economic Impact: Krabi Province is a premier tourist destination renowned for its islands, beaches, and coral reefs, generating significant economic value and maintaining a high GDP per capita. While visitor numbers and revenue dropped significantly during the COVID-19 pandemic, the sector began a strong recovery in 2022 and 2023.

Environmental Challenges: Infrastructure development necessary to support tourism—such as airport expansion and hotel construction—poses risks to the local ecosystem, including deforestation, soil erosion, and habitat destruction.

Waste Management Crisis: Solid waste is a critical and growing concern; Krabi generated an average of 537.37 tons per day in 2023, of which over 30% was improperly disposed of. Currently, only 1 of the 20 active waste disposal sites in the province operates correctly according to academic principles.

Tourism and Waste Linkages: Fluctuations in waste generation are directly tied to tourism levels. Waste volumes dropped during pandemic travel restrictions but surged when hotels, restaurants, and tourism services reopened. High-traffic marine destinations like Ao Nang and Phi Phi Island struggle with the logistical and financial burdens of transporting waste to mainland facilities.

Marine Residue: Ecosystems are further burdened by marine waste carried by ocean currents, particularly during the monsoon season, underscoring the urgent need for sustainable tourism capacities.

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1. Introduction

1.1 Tourism in Krabi: Economic Impact, Environmental Challenges, and Pathways to Sustainable Growth

Krabi is famous for its scenic views, beaches, and islands. Its coral reef vistas are also one of the world's most beautiful, which makes the city a great spot for diving. The attractions include hot springs, a wildlife sanctuary, sea caves, flourishing coral reefs, exotic marine life, limestone cliffs that draw rock climbing enthusiasts from around the world, and national parks that include the Island paradises of Koh Phi Phi and Koh Lanta. From the information of Tourism Authority of Thailand suggests highlight places to visit are 75-Million-Year-Old Shell Cemetery, Hat Maya, Mu Koh Lanta National Park, Ko Po Da Nok (Ko Dam Khwan), and Choa Le Village (To Ba Leaw Community)

The information of tourist visiting at Krabi province during 2018-2022 is shown in Table 1 and the revenue of visiting (Million Baht) is shown in Table 2.

Table 1 Tourism information of Krabi

	2018	2019	2020	2021	2022	2023
Occupancy rate (%)	69.16	68.54	18.26	6.11	24.91	68.66
Number of guest arrivals	4,186,576	4,186,069	1,090,127	297,712	1,159,933	1,807,123
Visitor	6,766,858	6,759,836	1,578,186	407,133	1,820,724	3,803,375
Thai	2,530,535	2,447,230	955,565	381,567	1,357.526	2,102,059
Foreigner	4,236,323	4,312,606	622,621	25,566	463,198	1,701,316

Source: Data from Ministry of Tourism and Sports (2023)

Table 2 The revenue of visiting (Million Baht)

	2018	2019	2020	2021	2022	2023
Revenue	115,176.70	112,055.50	28,825.77	4,527.28	21,763.31	52,500.69
Thai	39,773.26	38,380.97	13,562.54	4,277.98	14,508.97	22,213.91
Foreigner	75,403.44	73,674.53	15,263.23	249.3	7,254.34	30,286.78

Source: Data from Ministry of Tourism and Sports (2023)

For transportation, Krabi international receives daily flights from Bangkok and some flights from Singapore. Moreover, the visitor can land on Phuket international airport. Phuket to Krabi by road takes just 3 hours roads. For travelling by car, Bangkok is approximately 800km away and buses take about 14 hours traveling either by day or overnight. From Krabi you can also travel by ferry to Phuket, Phi Phi and Koh Lanta although many services only run in the high season from November to May. Besides these, public transportation such as, local songtaew buses, tuk tuk, and taxi is available. Number of ports, routes, boats, and passengers to Krabi during 2017-2021 is shown in Table 3.

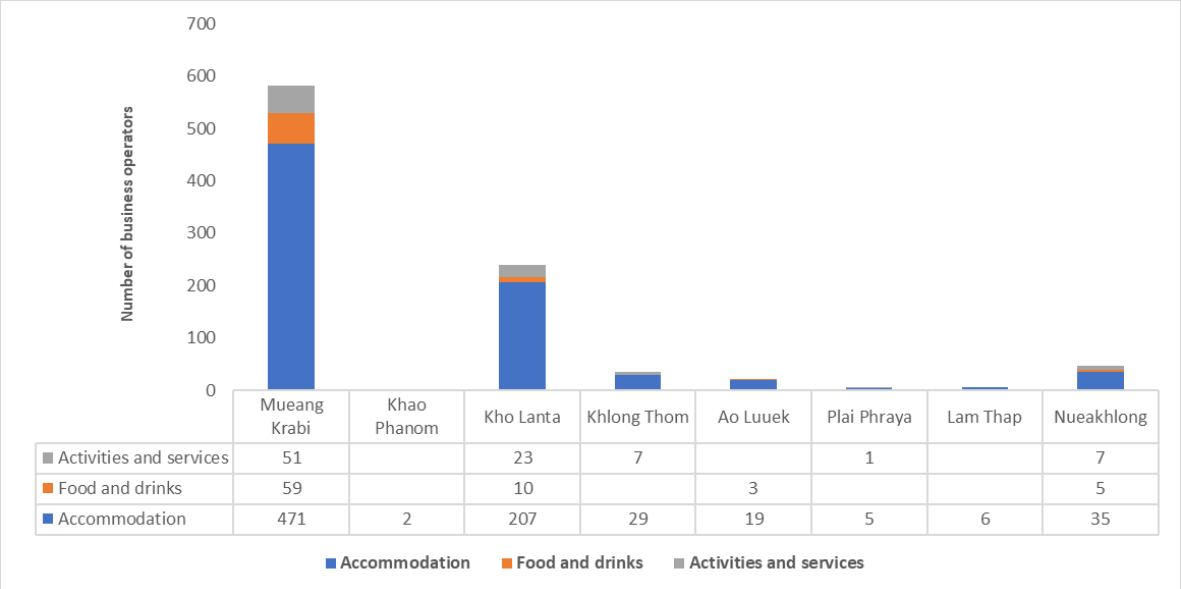
Table 3 Number of ports, routes, boats, and passengers

	2017	2018	2019	2020	2021	2022	2023
Ports	6	17	20	7	10	20	19
Cruise (Cruise/year)	106,568	292,050	300,966	18,278	11,760	169,911	204,179
Passenger (people/year)	5,099,730	4,566,234	6,026,686	630,150	210,330	2,995,303	4,226,913

Source: Data from Department of Marine and Coastal Resource (2024)

For the information, the number of visitors to Krabi were decreased during Coronavirus disease (COVID-19) pandemic, However, it is trending to increase in 2022 and 2023. For the tourism footprint of Krabi province can be divided into accommodation, food and drink and activities and services of visitor. The tourism footprint is shown in Figure 1. The information shows that Amphoe Mueang is high in accommodation and food and drinks, whereas Amphoe Ao Luek is high in activities and services. Ao Luek Tai is a city in Krabi Province, Thailand. It has many popular attractions, including Than Bok Khorani National Park, Krabi Elephant Sanctuary, Krabi Canoe, making it well worth a visit.

Figure 1 Tourism footprint of Krabi province 2023



Source: Calculated by Kasetsart university under the data of the National Statistical Office. (2020)

2. Assessment of the Tourism Situation in Krabi

Krabi has been declared a tourist province since 1985 with 52 tourist attractions. They can be divided into:

1) Islands/sandy beaches, 7 islands.
2) Caves/mountains, 4 caves.
3) Forest and water fall, 13 places.
4) Historical paintings, 9 places.
5) Eco-tourism/cultural/community way of life, 5 places.

In the year 2019 at Krabi Province, there are 2.53 million Thai tourists, 4.23 million foreigners, totaling 6.76 million people, with an income of 115,176.70 million baht. However, in 2020-2022, the number of tourists has continuously decreased due to the Covid situation. 19 In 2022, the number of tourists, both Thais, was 0.38 million, foreigners were 0.02 million, totaling 0.4 million, with an income of only 4,527.28 million baht. However, the number of tourists has begun to increase since 2023 onwards.

Krabi Province has GDP per capita worth 168,552 baht per year in 2021, which is the fifth highest in the southern region and is ranked 19th in the country. The tourism industry is one important industry that results in Krabi province having a high product value per capita.

In conclusion, Krabi have fruitful services in both the direct and indirect contributions of ecosystems to human well-being and have an impact on our survival and quality of life especially tourism.

The residuals generated as a result of tourism consumption (either by the visitors themselves or by the enterprises supplying goods and services to visitors)

3. Impact of Tourism on Krabi Province

The tourism affects on the ecological system (United Nations Environment Programme [UNEP], 2001) of Krabi province as the following:

Construction activities and infrastructure development, the development of tourism facilities such as accommodation, water supplies, restaurants and recreation facilities can involve sand mining, beach and sand dune erosion, soil erosion and extensive paving. In addition, road and airport construction can lead to land degradation and loss of wildlife habitats and deterioration of scenery. The data from Department of Airports, the Karbi International Airport had been developed since 2020-2022 for tourism (UNEP, 2001).

Deforestation and intensified or unsustainable use of land, construction of resort and hotel accommodation and facilities frequently requires clearing forested land. In addition, coastal wetlands are often drained and filled due to lack of more suitable sites for construction of tourism facilities and infrastructure. These activities can cause severe disturbance and erosion of the local ecosystem, even destruction in the long term (UNEP, 2001).

Development of marinas and breakwaters can cause changes in currents and coastlines. Furthermore, the extraction of building materials such as sand affects coral reefs, mangroves, and hinterland forests, leading to erosion and destruction of habitats. In the Philippines and the Maldives, dynamiting and mining of coral for resort building materials has damaged fragile coral reefs and depleted the fisheries that sustain local people and attract tourists (UNEP, 2001).

Overbuilding and extensive paving of shorelines can result in destruction of habitats and disruption of land-sea connections (such as sea-turtle nesting spots). Coral reefs are especially fragile marine ecosystems and are suffering worldwide from reef-based tourism developments. Evidence suggests a variety of impacts to coral result from shoreline development, increased sediments in the water, trampling by tourists and divers, ship groundings, pollution from sewage, overfishing, and fishing with poisons and explosives that destroy coral habitat.

The major environmental concern about impact of tourism on ecosystem at Krabi province is the solid waste. In areas with high concentrations of tourist activities and appealing natural attractions, waste disposal is a serious problem and improper disposal can be a major despoiler of the natural environment - rivers, scenic areas, and roadsides (UNEP, 2001). The solid waste situation at Krabi province then will be discussed.

3.1 Linkages Between Tourism and Waste Generation

Tourism activities are strongly linked to solid waste generation in coastal destinations such as Krabi Province. Tourist consumption patterns—including accommodation services, food and beverage consumption, transportation, and recreational activities—generate large quantities of municipal solid waste. Hotels, restaurants, tour operators, and recreational facilities contribute significantly to the overall waste stream in major tourist areas (Krabi Provincial Natural Resources and Environment Office, 2022).

Studies have shown that tourist destinations often experience a rapid increase in waste generation during peak tourism seasons due to higher visitor numbers and intensified service activities (UNEP, 2001; Pollution Control Department, 2023). In Krabi Province, the increase in tourist arrivals after the relaxation of COVID-19 restrictions in 2022 corresponded with a significant rise in solid waste generation, particularly in high-tourism areas such as Ao Nang, Railay Beach, and the Phi Phi Islands (Krabi Provincial Natural Resources and Environment Office, 2022).

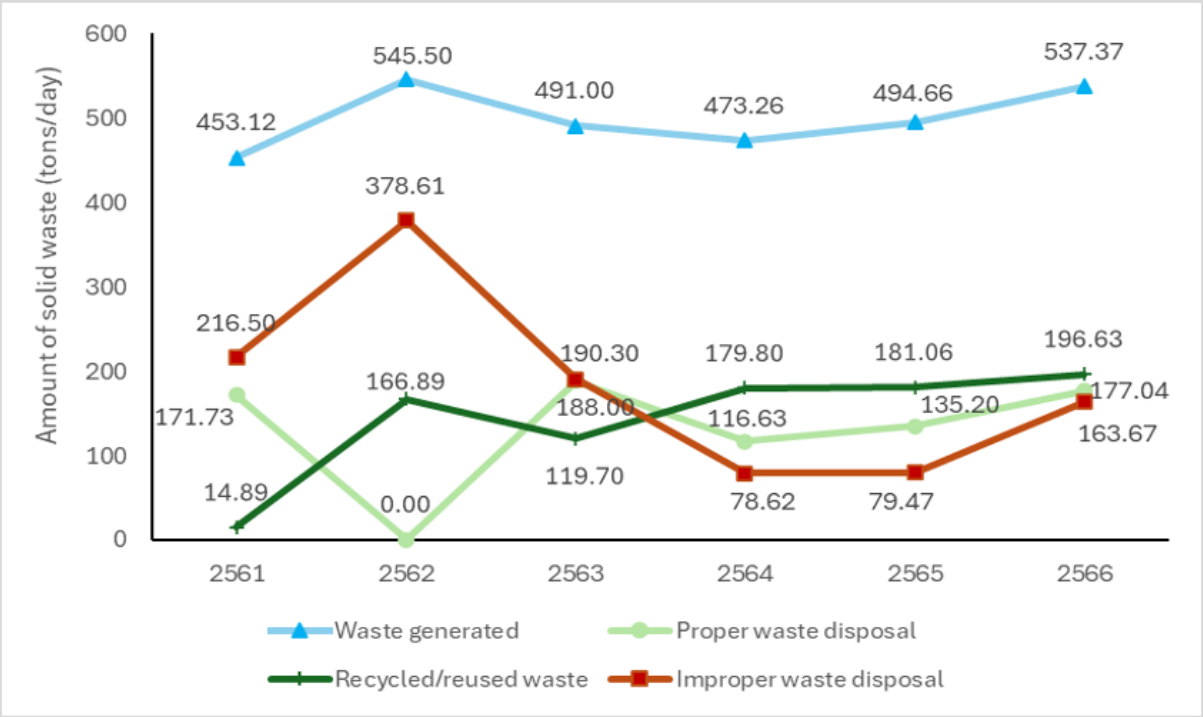
Tourism-related waste typically consists of food waste, plastic packaging, single-use plastics, beverage containers, and other disposable materials generated from tourism services. Without effective waste management systems, these wastes can accumulate in coastal environments and contribute to marine debris and ecosystem degradation.

Therefore, understanding the linkage between tourism activities and waste generation is essential for sustainable tourism planning. Integrating tourism management with improved waste management strategies—such as waste reduction, recycling initiatives, and circular economy approaches—can help mitigate environmental impacts and support long-term sustainability of Krabi's tourism sector (Pollution Control Department, 2024).

3.2 The Solid Waste Situation at Krabi Province

In 2023, Krabi Province generated 196,139 tons of solid waste, an average of 537.37 tons per day. This was an increase from 2022, which generated an average of 494.66 tons per day. Moreover, 196.63 tons of solid waste per day were recycled or reused, accounting for 36.59 percent, and 177.04 tons of solid waste per day were disposed of properly according to academic principles, representing 32.95 percent. However, 163.67 tons of solid waste per day, accounting for 30.46 percent, were disposed of improperly according to academic principles. The amount of residual waste was approximately 64,092 tons, an increase from 2021 is shown in Figure 2 (Pollution Control Department, 2024; Krabi Provincial Natural Resources and Environment Office, 2022).

Figure 2 The amount of waste generated, recycled, proper disposed and improper disposed in Krabi Province, 2018-2023



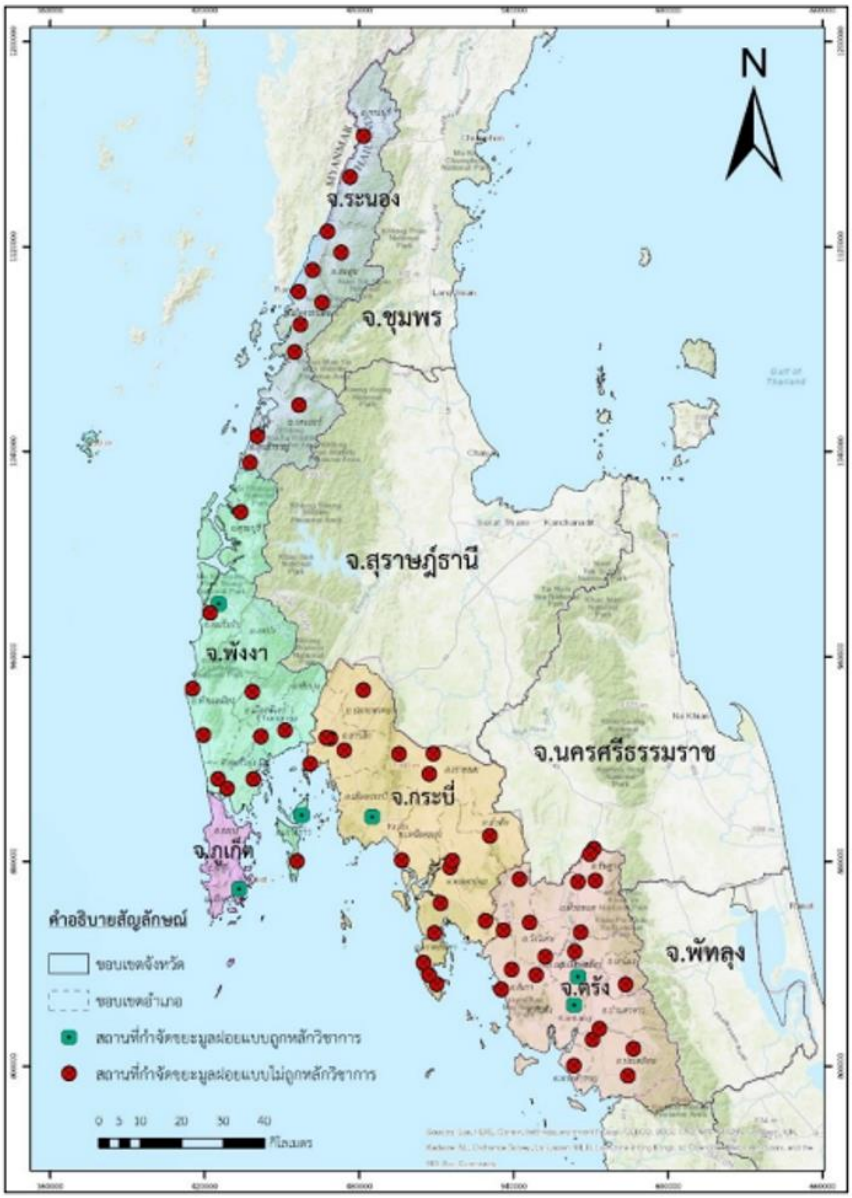
Source: Pollution Control Department (2024)

Krabi Municipality generated the highest amount of waste at 14,872.68 tons, followed by Ao Nang Subdistrict Administrative Organization with 11,137.56 tons and Krabi Noi Subdistrict Municipality with 4,310 tons, respectively (Krabi Municipality, 2023). The waste volume in Krabi Province showed a decreasing trend during 2020-2021, influenced by the reduced number of tourists due to the COVID-19 pandemic restrictions, which limited international travel. However, waste levels increased in 2022 following the relaxation of these measures, leading to a rise in tourism in Krabi. This resurgence also saw the reopening of businesses such as hotels, restaurants, and travel agencies, increasing resource usage and waste generation (Krabi Municipality, 2023; Pollution Control Department, 2024). This trend is driven by consumption patterns that prioritize convenience, such as the use of single-use packaging and food delivery services. National statistics reflect this challenge, with Thai citizens generating an average of 1.17 kg of waste per person per day in 2024, up from 1.15 kg in 2023.

Notably, waste generation in urban areas is found to be 1.5 times higher than in rural areas (Pollution Control Department, 2025).

Solid waste disposal in Krabi Province has a total of 20 waste disposal sites in operation. Out of these, 19 sites are operating improperly, while only 1 site (the Krabi Municipal Waste Disposal Site), is operating properly according to academic principles (Pollution Control Department, 2024). Figure 3 shows the location of the community waste disposal site in Krabi Province. This site has collaborated with a private company to construct a waste-to-energy power plant with a total capacity of 6 megawatts. The plant began selling electricity in December 2020 and can dispose of up to 500 tons of waste per day. In 2022, approximately 56,400.32 tons of waste were sent for disposal, marking a 17.46% increase from 2021, when 46,552.60 tons were sent for disposal. (Pollution Control Department, 2024)

Figure 3 Location of community waste disposal sites



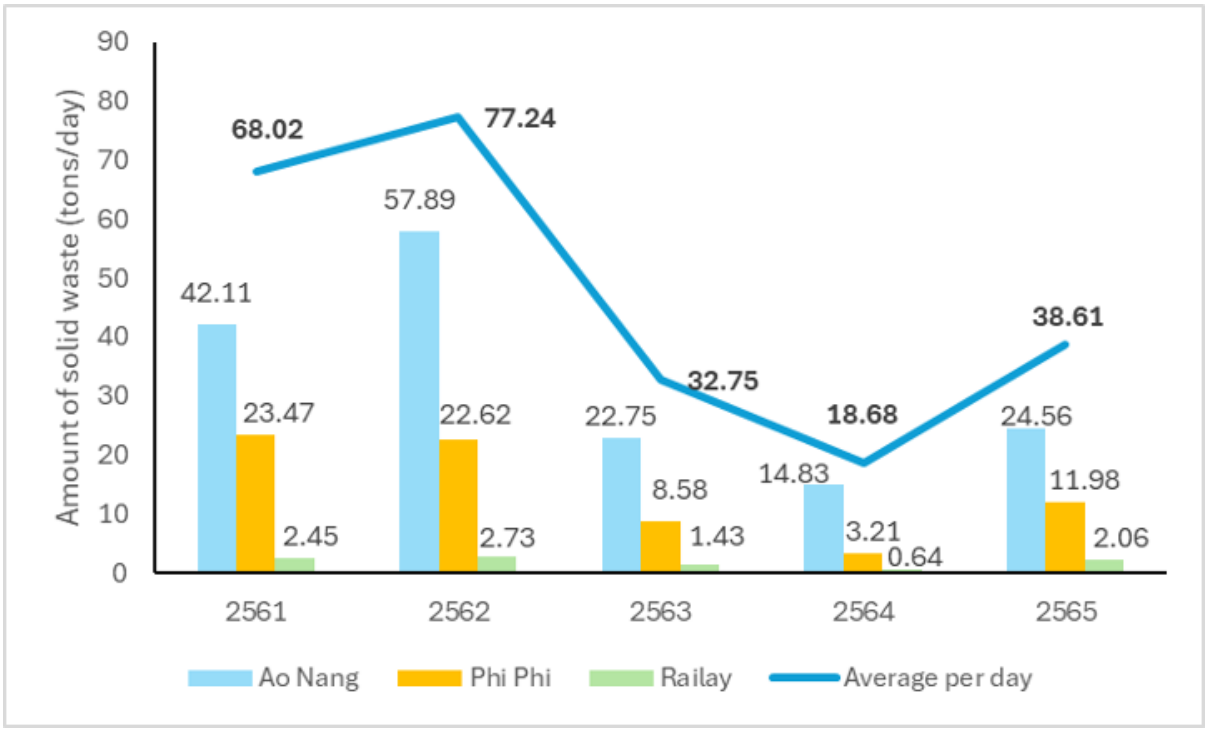
Source: Pollution Control Department (2024)

3.3 Solid Waste Situation in Important Marine and Coastal Tourist Areas

Area of Ao Nang Subdistrict Administrative Organization (Ao Nang, Railay Beach and Phi Phi Island)

Ao Nang Subdistrict Administrative Organization has famous marine and coastal tourist attractions, including Ao Nang, Railay Beach and Phi Phi Island. In 2022, the amount of solid waste generated was 14,091 tons, an average of 38.61 tons per day, representing 51.61 percent increase from 2021, when the amount of solid waste generated was 6,819 tons, an average of 18.68 tons per day. Most of the waste originated from the Ao Nang area, followed by the Phi Phi Islands and Railay Beach. Between 2018-2019, waste volumes showed an increasing trend, but this trend reversed during 2020-2021 due to the COVID-19 pandemic The pandemic led to the implementation of travel restrictions and the cancellation of group activities, including various tourism-related events, to prevent the spread of the virus. Consequently, the number of tourists during those years significantly decreased, leading to a reduction in waste generation. However, as COVID-19 restrictions were relaxed, tourism activities resumed, and the number of tourists began to rise, resulting in an increase in waste generation in 2022 (Figure 4) (Ao Nang Subdistrict Administrative Organization, 2023).

Figure 4 The amount of solid waste generated in Ao Nang, Phi Phi Island and Railay Beach from 2018-2022



Source: Ao Nang Subdistrict Administrative Organization (2023)

Solid waste management in the areas of Ao Nang, Railay Beach, and Phi Phi Island is the responsibility of Ao Nang Subdistrict Administrative Organization, which collects waste from households and businesses every day. In Ao Nang and Railay Beach, waste is collected and transported by vehicles and personnel of Ao Nang Subdistrict Administrative Organization, while in Phi Phi Island, waste is collected and transported by boat through a private contractor. In the fiscal year 2022, the contract fee for waste collection and transport from Phi Phi Island was approximately 11.44 million baht. All collected waste is sent to the Krabi Municipality's community waste-to-

energy power plant for disposal, with a waste disposal service fee of 400 baht per ton. In the fiscal year 2022, the total cost for waste disposal services was approximately 8.86 million baht. However, only about 2 million baht was collected in waste collection and transportation fees. Households are charged a rate of 35 baht per month, while hotels/accommodations are charged based on the number of rooms, and restaurants are charged according to the size of their premises. On Phi Phi Islands, waste collection and transportation fees are higher than on the mainland. For special events held in public areas, an additional daily fee for waste collection and transportation is charged (Ao Nang Subdistrict Administrative Organization, 2023).

Koh Lanta District

Koh Lanta District, with its key marine and coastal tourist destination of Koh Lanta, is particularly popular with foreign tourists. Before the COVID-19 pandemic, Koh Lanta District generated more than 50 tons of solid waste per day. A study conducted in March 2022, before the reopening to international tourists, found that the district was generating approximately 43 tons of solid waste per day. Another survey conducted in November 2022, after the reopening to international tourists, showed that the solid waste generation had increased to about 48 tons per day. In a study on the composition of waste in Koh Lanta District, it was found that organic waste made up the largest proportion (food waste and garden waste), followed by various types of plastic (Office of Natural Resources and Environmental Policy and Planning [ONEP], 2023).

Koh Lanta District has 6 local administrative organizations responsible for solid waste management: Saladan Subdistrict Municipality, Koh Lanta Yai Subdistrict Administrative Organization, Koh Lanta Yai Subdistrict Municipality, Koh Lanta Noi Subdistrict Administrative Organization, Koh Klang Subdistrict Administrative Organization, and Khlong Yang Subdistrict Administrative Organization. From the data collection, it was found that almost all local administrative organizations provide solid waste collection and transportation services for households and businesses within their jurisdiction. The waste collection and transportation fees for households range from 30-60 baht per month, except for Koh Lanta Noi Subdistrict Administrative Organization, which does not provide solid waste collection services but schedules times to buy recyclable waste from the community (ONEP, 2023).

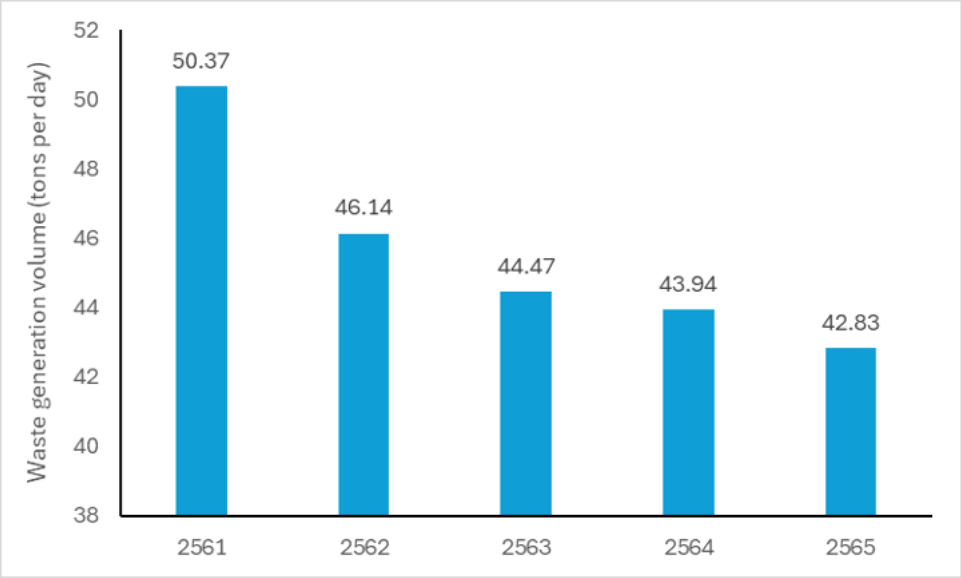
The waste disposal methods used by these local administrative organizations, which involve simply piling up waste, do not follow academic principles. However, the waste disposal sites of Saladan Subdistrict Municipality, Koh Klang Subdistrict Administrative Organization, and Khlong Yang Subdistrict Administrative Organization still have sufficient capacity to handle waste for some time. In contrast, the waste disposal sites of Koh Lanta Yai Subdistrict Administrative Organization and Koh Lanta Yai Subdistrict Municipality are nearing capacity (ONEP, 2023).

Transporting waste from Koh Lanta District to the community waste-to-energy power plant in Krabi Municipality incurs relatively high costs due to the island's geography and the long distance involved. Additionally, establishing a new waste disposal site in Koh Lanta District that meets scientific standards is challenging because the island has limited space and requires a high investment budget, which poses a financial constraint for small local administrative organizations (ONEP, 2023).

Krabi Municipality

Krabi Municipality generated 15,631.26 tons of solid waste in 2022, averaging 42.83 tons per day, which represents a 2.53% decrease from 2021, when the solid waste volume was 16,037.74 tons, averaging 43.94 tons per day. From 2018-2022, the amount of solid waste in Krabi Municipality tended to decrease. However, during the COVID-19 pandemic, there was an increase in plastic waste due to the rise in food delivery services following requests for the public to limit travel or work from home. In contrast, after the easing of COVID-19 restrictions, there was an increase in organic waste as businesses started to reopen, and the government relaxed measures to welcome foreign tourists and implemented measures to stimulate domestic tourism (Figure 5) (Krabi Municipality, 2023).

Figure 5 Amount of Solid Waste Generated by Krabi Municipality in 2018-2022



Source: Krabi Municipality (2023)

For solid waste management in Krabi Municipality, all waste is collected and transported to the Krabi Municipality's waste-to-energy power plan for disposal. Waste is collected daily at scheduled times. The collection fee for households is set at 20 baht per month, while for hotels and accommodations, the fee is 10 baht per room per month. However, information from key stakeholders interviewed indicates that some waste is left uncollected due to disposal outside the municipality's designated times. In some areas, waste collection vehicles cannot access certain locations due to narrow roads, and large waste items are often placed around the waste bins. Most of this uncollected waste is generated by households rather than hotels, restaurants, and tourists (Krabi Municipality, 2023).

3.3 Marine and Coastal Ecosystem Waste Residue

In 2022, the volume of waste residue in the marine and coastal ecosystems in Krabi Province totaled 14,966.38 tons, equivalent to 176,978 pieces of waste (Office of Marine and Coastal Resources 10, 2023). Additionally, the Mu Ko Lanta National Park organized a beach cleanup event on Rok Island, specifically at Thalu Beach and

Makham Beach, where 2,707 kilograms of waste were collected. Moreover, 20 kilograms of underwater waste were collected around Ha Island. In total, 2,727 kilograms of marine waste were gathered from these activities (Thailand Environment Institute Foundation, 2023).

A portion of the waste residue found along the coastline is carried by waves, monsoon winds, and currents from both nearby and distant sources. It is often observed that more waste accumulates during the off-peak tourist season (Low Season) compared to the peak tourist season (High Season). This is due to the monsoon season when heavy rain and strong waves make coastal areas unsuitable for tourism. However, the sea waves and winds during this period play a crucial role in transporting waste from other sources, leading to its accumulation along the coast. (ONEP, 2023)

In conclusion, the ecosystem in Krabi province still has sufficient capacity to support tourists. However, the critical situation of some resources, such as sea grass and coral reefs, has led to restrictions on the number of tourists in those areas to recover these natural resources.

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