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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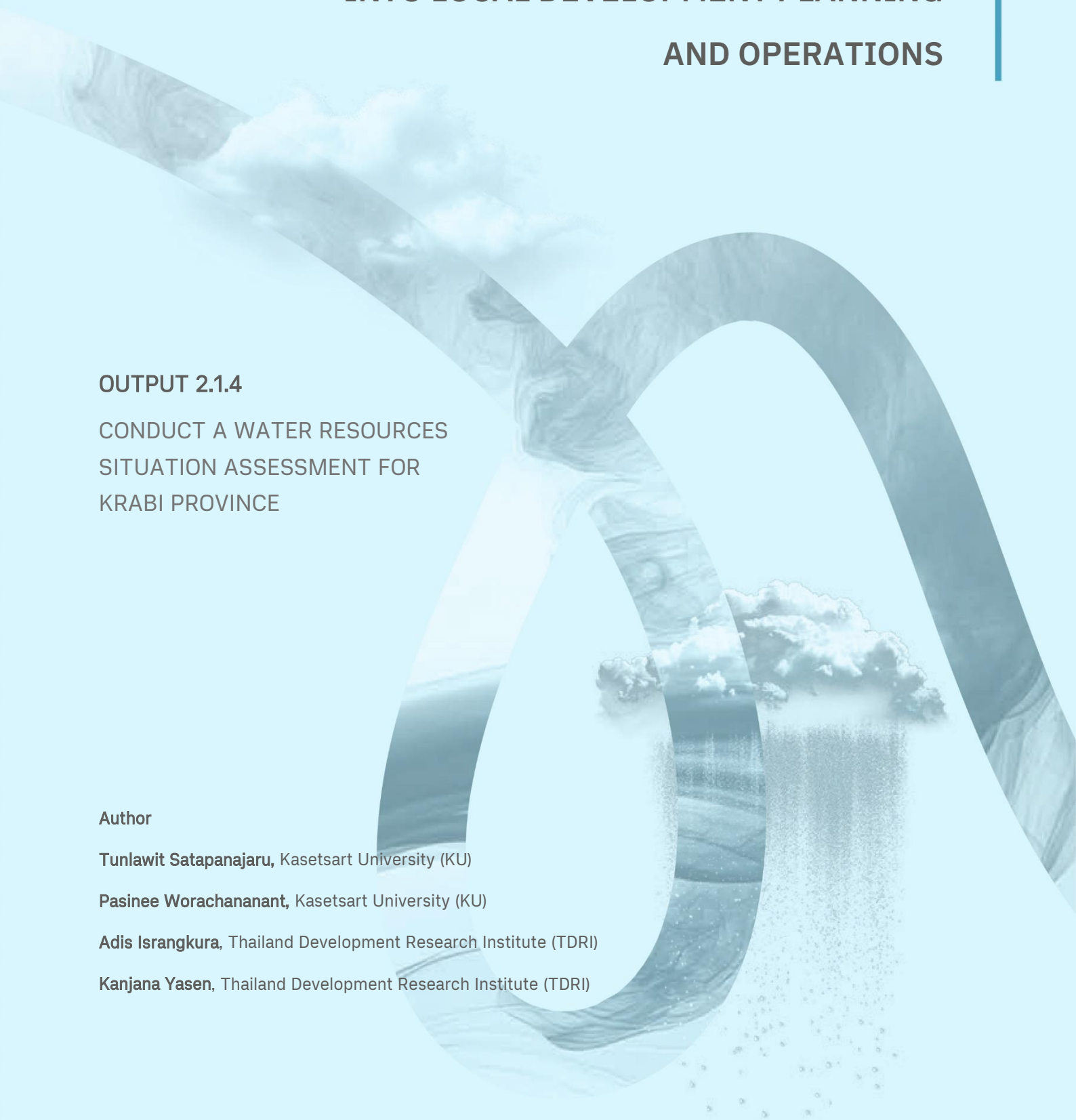

OUTPUT 2.1.4

CONDUCT A WATER RESOURCES SITUATION ASSESSMENT FOR KRABI PROVINCE

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Acknowledgement

This Conduct a water resources situation assessment for Krabi province was conducted based on data and reports obtained from relevant government agencies, including the Department of Water Resources, the Pollution Control Department, the Provincial Waterworks Authority, the Royal Irrigation Department, the Krabi Provincial Natural Resources and Environment Office, and other related organizations. The authors would like to thank these organizations for providing the information and data used in this study.

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Contents

Figures

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Executive Summary

This report indicates water resource situation assessment for Krabi province. The assessment was divided into 3 topics as follows:

Water Resources and Demand: Krabi province is located within the Western Southern watershed. At present, the quantity of water is still enough for water consumption in Krabi province. The total water demand for the province is 9,738 million cubic meters. However, during the high season of tourism from December to February, water consumption increases significantly.

Water Quality: Surface water data generally show a “good” water quality status. For coastal waters, recent measurements indicate that 83% of the monitored areas are classified as “good” quality, while 17% are in “fair” condition.

Wastewater Challenges: A major environmental challenge is wastewater management. The amount of wastewater generated in Krabi Province in 2022 was 132,015 cubic meters/day. However, the volume of treated wastewater is only 6,888.45 cubic meters per day, accounting for just 5.22% of the total generated wastewater

1. Overview of the Western Southern Watershed in Krabi Province, Thailand

According to the division of the main river basins of Thailand by the National Hydrological Committee, Krabi province is in the area of Western Southern watershed. This watershed is a total basin area of 18,841.20 sq. km., covering 7 provinces including: Ranong, Phang Nga, Phuket, Krabi, Nakhon Si Thammarat, Trang and Satun. It also covers some area of Chumphon province, Surat Thani, Phatthalung and Songkhla. The watershed lies between 6º 26' latitude North to a latitude of 10º 49' North and between a latitude of 98º 12' East and a latitude of 100º 14' East. In Krabi province, it covers 3,032.77 square kilometers or 64.34 percent of the provincial area and 16.10 percent of the area in Western Southern watershed (Figure 1).

The area Ko Yao District, Khao Phanom, Khlong Thom, Plai Phraya, Muang, Krabi, Nuea Khlong, Lam Thap, Ao Luek and Koh Lanta of Krabi are covered in Western Southern watershed. Water catchment area at Krabi province shows in Table 1 and Figure 2.

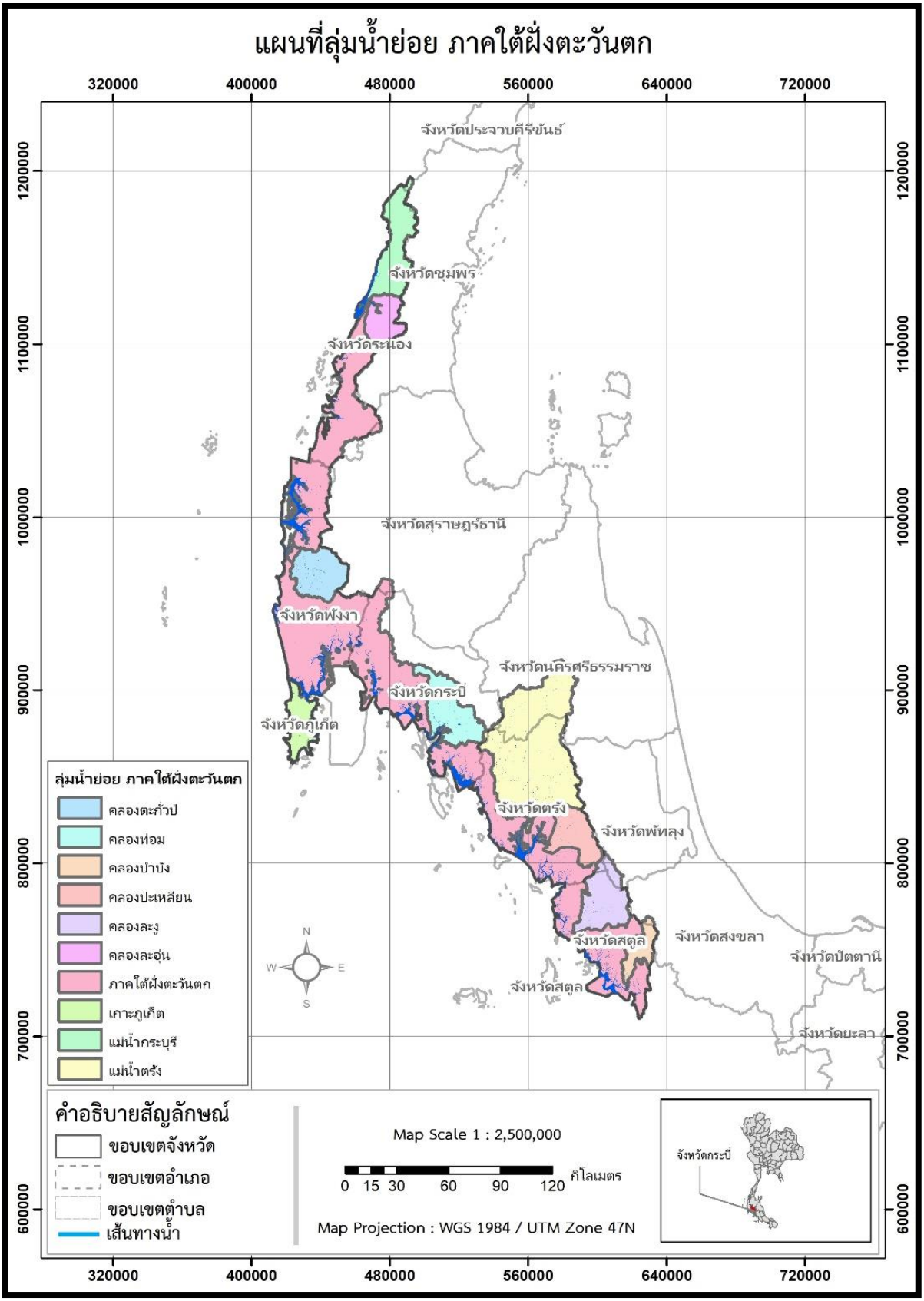
Table 1 Water Catchment area at Krabi province

Major watershed	Sub-watershed	Catchment area (km^2)
Western Southern watershed	Western Southern watershed-2	1,455
Western Southern watershed	Khlong Thom	940
Western Southern watershed	Western Southern watershed-3	525
Western Southern watershed	Trang River	41
Western Southern watershed	North Tapi River	24
Western Southern watershed	Klong Sin Pun	663
Western Southern watershed	Klong I-pun	1,021
Western Southern watershed	Klong Sok	14
Total		**4,683**

Source: Krabi Provincial Office (2025)

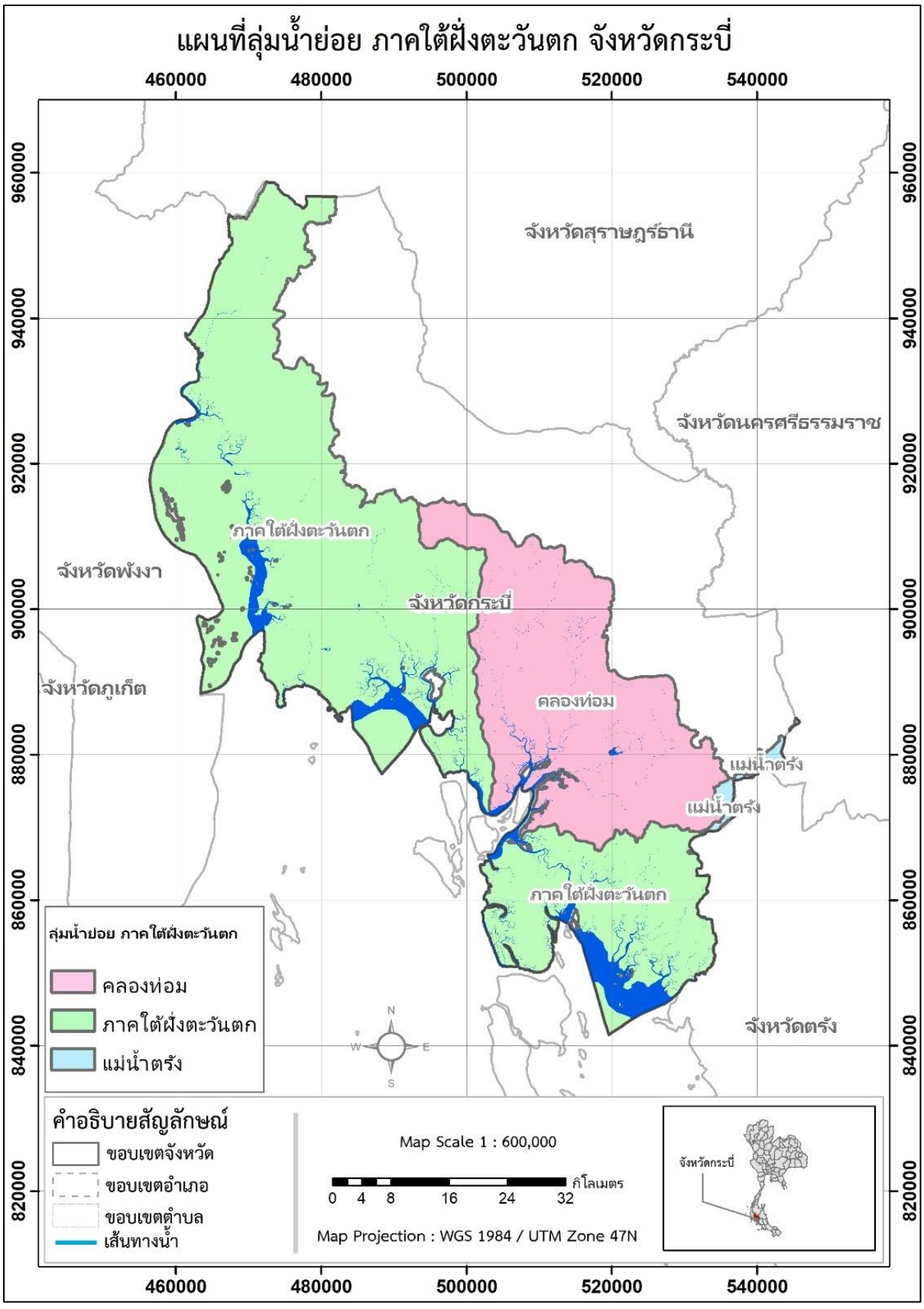
The information from Krabi Provincial Natural Resources and Environment Office (2022) indicated that water resources in Krabi Province were river, canal, ponds, swamps, small reservoirs, ponds/ponds/creeks, and medium-sized reservoirs, around 354 places. Water situation regarding water shortage and drought in Krabi Province was found that the area about 90% is a low level of drought problem. However, some areas in particular Coastal areas are not at risk of drought as shown in the Figure 3. For flood situation, most areas of Krabi province is low risk of flooding.

Figure 1 **Western Southern watershed, Thailand**



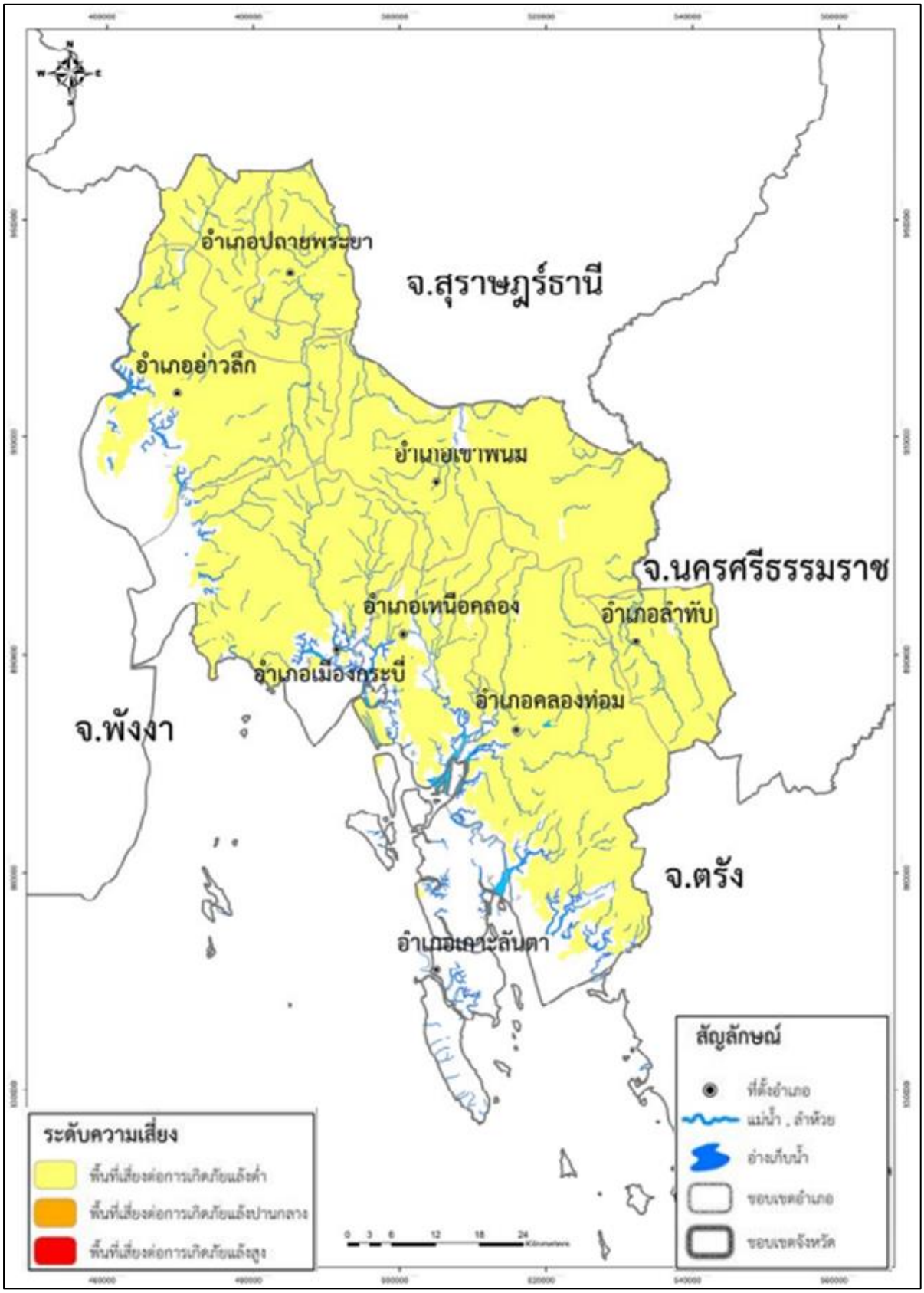
Source: Created by the authors using spatial data obtained from GISTDA (2022a).

Figure 2 **Sub watershed at Krabi province, Thailand**



Source: Created by the authors using spatial data obtained from GISTDA (2022b).

Figure 3 **Risk level of water shortage at Krabi province: yellow is low risk area, orange is moderate risk area and red is high risk area**



Source: Royal Irrigation Department (2018)

2. Water consumption

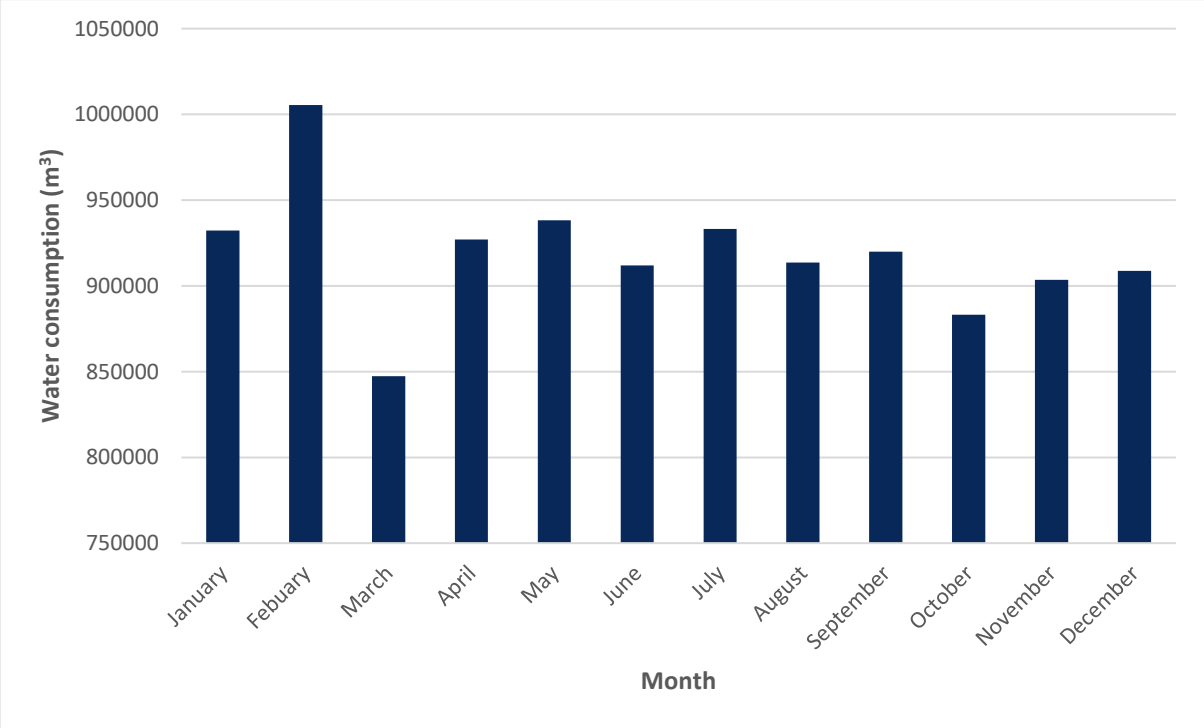
The water consumption in 2022 was between 840,000 cubic meter and 1,020,000 cubic meter per month. On the other hand, the water demand of Krabi province was around 3,000 million cubic meter per year as shown in Table 2. At present, the quantity of water including natural water and irrigation water is still enough for water consumption in Krabi province. The minimum water quantity required to sustain natural ecosystems should be around 678.34 million cubic meters. Water consumption in each month in 2020 shown in Figure 4. During high season of tourism (December-February), water consumption was increased significantly

Table 2 Water demand of Krabi province

Water use	Million cubic meters
For consumers	25.70
For travelling	1.06
For industry	13.48
For agriculture	2421.60
For ecological balance	617.56
Total	**3,079.40**

Source: Royal Irrigation Department (2018)

Figure 4 Water use and water consumption in 2002



Source: Data from Provincial Waterworks Authority (2022)

3. Water quality

Water Quality Index (WQI)

For water quality, water quality index of surface water sources (Water Quality Index, WQI) was calculated. WQI is a composite measure of water quality, calculated based on several key parameters, such as DO, BOD, pH, nitrates, and turbidity. WQI simplifies complex data into a single score to indicate the overall health of a water body. Higher WQI values indicate better water quality, making it easier to assess and communicate water quality conditions.

WQI has been used for identifying water quality. It is an assessment of the overall water quality situation of surface water sources. It was calculated from 4 parameters,

(1) Dissolved Oxygen (DO)

Dissolved oxygen refers to the amount of oxygen available in water, essential for aquatic life to survive. It's a critical measure of water quality because low DO levels indicate pollution, such as organic waste or excess nutrients that consume oxygen as they decompose. Ideal DO levels vary based on the water body but are usually around 5-8 mg/L for a healthy aquatic environment.

(2) Biochemical Oxygen Demand (BOD)

BOD measures the amount of oxygen required by microorganisms to decompose organic matter in water over a specific time period, usually 5 days. High BOD levels suggest high levels of organic pollution, which can deplete oxygen and harm aquatic organisms. BOD is an important indicator of organic waste pollution and water treatment efficiency.

(3) Coliform Bacteria (Total Coliform Bacteria: TCB) and Fecal Coliform Bacteria (FCB)

Coliform bacteria, especially fecal coliforms, are indicators of microbial contamination in water, often from human or animal waste. Total coliforms (TCB) can be found in soil, water, and vegetation, while fecal coliforms (FCB), such as *Escherichia coli*, are more specific to warm-blooded animals. Detecting coliform bacteria, especially fecal types, indicates potential contamination with pathogens harmful to human health.

(4) Ammonia (Total Ammonia: NH_3)

Total ammonia includes both ionized (NH_4^+) and un-ionized (NH_3) forms of ammonia. High ammonia levels in water can be toxic to fish and aquatic life. It is often a result of organic waste breakdown or agricultural runoff. Monitoring ammonia helps assess pollution levels and water safety for aquatic organisms.

Modified Water Quality Index (MWQI)

MWQI is an adapted version of the WQI, adjusted to suit specific water quality standards or local needs. This modification can involve adding additional parameters or changing the weighting of parameters to reflect local environmental or regulatory concerns more accurately. MWQI provides a more tailored water quality assessment relevant to particular ecosystems or water uses has a score between 0-100 by water quality criteria;

“very good” has a score of 91-100, “good” has a score of 71-90, “fair” has a score of 61-70, "deteriorated" with scores of 31-60, and "very deteriorated" There is a score of 0-30. In addition, Marine Water Quality Index (MWQI) was calculated from 8 parameters including dissolved oxygen (DO), bacteria total coliform group (TCB), phosphate-phosphorus (PO_4-P), nitrate nitrogen (NO_3-N), water temperature, suspended solids (TSS), pH, total ammonia (Total NH_3) However, if the amount of pesticides and animals and toxic substances including Cd, Total Cr, Cr^{6+}, Pb, Cu, CN- and PCBs exceed seawater quality standards. The seawater quality index will be “very deteriorated”.

4. Sources of Pollution in Krabi Province

The primary sources of pollution in Krabi Province are linked to various activities, particularly from the tourism industry, agriculture, and industrial development. Tourism generates a substantial amount of waste; for instance, the 2025 State of Environment (SOE) report indicates that plastic waste remains a dominant coastal pollutant, with Krabi being among the provinces where tourism significantly drives waste generation. This includes untreated wastewater, which is often released into water bodies without proper treatment, impacting both surface and marine water quality. National assessments by the Pollution Control Department (2024) confirm that such discharges contribute to the degradation of coastal water quality in key tourist zones. Agricultural practices contribute to pollution through pesticide and fertilizer runoff, which contaminates soil and water resources. This is reflected in the SOE 2025 finding that chemical contamination in agricultural soils remains a critical health and environmental concern. Industrial activities, though less prominent, also release pollutants that can degrade water and air quality.

Additionally, municipal waste from local communities adds to the pollution load, as waste treatment facilities currently process only about 70-80% of the total waste generated, leaving a significant portion improperly managed (Office of Natural Resources and Environmental Policy and Planning, 2025).

5. Analysis of Surface and Coastal Water Quality

Water quality monitoring in Krabi reveals varying levels of water quality in different areas. The Water Quality Index (WQI) for surface water is derived from parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), and coliform bacteria counts, providing a measure of organic pollution and bacterial contamination. The data generally show a “good” water quality status in surface waters, with some improvement trends in recent years.

For coastal waters, the Marine Water Quality Index (MWQI) includes factors like DO, total coliforms, and nutrients such as phosphate and nitrate. Recent measurements indicate that 83% of the monitored coastal areas are classified as "good" quality, while 17% are in “fair” condition. However, high coliform levels suggest contamination from untreated sewage, likely originating from tourism and domestic activities. Theories in environmental science suggest that nutrient loads from human activity can lead to eutrophication, which depletes oxygen and harms marine ecosystems. Proactive monitoring and improved waste management are critical in sustaining water quality amidst Krabi's rapid tourism and population growth.

6. Sea and coastal water quality situation

On June 9, 2022, the Department of Marine and Coastal Resources (DMCR), through the Lower Andaman Sea Marine and Coastal Research Center, monitored the marine and coastal environment and collected samples of phytoplankton and benthic organisms during the southwest monsoon season along the lower Andaman Sea coast in Krabi Province.

The basic water quality measurements recorded water temperatures ranging from 29.3–30.8°C, salinity between 29–32 ppt, pH levels from 7.56–8.12, and dissolved oxygen levels between 5.03–6.96 mg/L. Initial findings indicate that the overall water quality meets the standards for seawater quality types 1, 2, and 4, which are designated for the conservation of natural resources, coral reef conservation, and recreational activities.

The weather during the operation was clear, the sea was calm with no waves, and no instances of seawater discoloration were observed at any monitoring stations.

7. The Wastewater Situation in Krabi Province

Krabi is a major tourist destination in Thailand, resulting in numerous sources of pollution in the area, such as hotels, businesses, shops, and restaurants. However, the community wastewater treatment system does not cover and accommodate all wastewater in the area. As a result, a significant amount of wastewater from businesses and households is discharged into public water bodies and the sea without proper treatment. The amount of wastewater generated in Krabi Province in 2022 was 132,015 cubic meters/day. It is estimated that the volume of treated wastewater is 6,888.45 cubic meters per day, accounting for only 5.22% of the total generated wastewater as shown in Table 3 (Office of Environmental and Pollution Control 15, 2023).

Table 3 Community wastewater treatment system in Krabi province

Area	Wastewater capacity (m^3/day)	Average wastewater entering the system (m^3/day)	BOD Average wastewater entering the system (m^3/day)	BOD Average effluent (m^3/day)	Wastewater treatment service area			Type of wastewater treatment system
					Local administrative organization area (sq.km.)	Collection system covers an area (sq.km.)	Percentages	
Krabi Municipality	12,000	5,888.45	12.6	0.56	19	9.7	51.05	Aerated Lagoon
Ao Nang Subdistrict Administrative Organization, Phi Phi Island	400	200	-	-	10.25	2	19.51	Activated Sludge
Ao Nang Subdistrict Administrative Organization (Khlong Chak)	1,200	800	-	-	37.44	1.5	4	By electrical method
Summary	**13,600**	**6,888.45**						

Source: Data from Office of Environmental and Pollution Control 15 (2023)

8. Assessment of Pollution Sources and Environmental Impacts

Available information indicates that tourism-related activities and municipal wastewater are important sources of pollution in Krabi Province. As one of Thailand's major tourist destinations, Krabi accommodates many hotels, resorts, restaurants, commercial establishments, and recreational facilities that generate considerable amounts of solid waste and wastewater. The wastewater situation in 2022 shows that approximately 132,015 m^3/day of wastewater was generated, while only 6,888.45 m^3/day (5.22%) was treated through existing wastewater treatment systems. This suggests that a significant proportion of domestic and tourism-related wastewater may be discharged into natural water bodies without adequate treatment, which may contribute to microbial contamination and organic pollution.

The influence of tourism and domestic wastewater is reflected in coastal water quality monitoring results, which indicate elevated coliform bacteria levels at some monitoring locations. Although the overall Marine Water Quality Index (MWQI) remains within the "good" to "fair" categories, elevated coliform concentrations suggest possible contamination from untreated sewage and domestic wastewater discharges. This may have implications for recreational water quality and public health in areas with intensive tourism activities.

Agricultural activities also contribute to environmental pollution in the province. The use of fertilizers and pesticides may result in nutrient enrichment and chemical contamination through surface runoff, particularly during the monsoon season. However, available water quality data do not indicate widespread deterioration of surface water quality associated with agricultural activities. Impacts from agricultural runoff therefore appear to be localized and dependent on land use conditions and seasonal variation.

Industrial activities contribute to pollution to a lesser extent compared with tourism and agricultural activities, reflecting the province's economic structure, which is mainly based on tourism and agriculture rather than heavy industry. Nevertheless, localized impacts from industrial wastewater and waste disposal practices may occur in certain areas and require continued monitoring.

Municipal solid waste is also an environmental issue in Krabi Province. Environmental assessments indicate that approximately 70–80% of generated waste is managed through formal waste management systems, while the remaining portion may be subject to improper disposal. In addition, plastic waste has been identified as one of the dominant pollutants in coastal areas. This suggests that waste management practices may contribute to environmental conditions in coastal environments.

Overall, available information indicates that tourism-related wastewater and municipal wastewater are important contributors to pollution in Krabi Province. This is reflected in the high volume of wastewater generated, limited wastewater treatment coverage, and elevated coliform bacteria levels reported in some coastal monitoring locations. Although surface and coastal water quality generally remains within the good to fair categories, continued improvements in wastewater treatment systems, waste management practices, and environmental monitoring are needed to maintain environmental conditions and support sustainable tourism development in the province.

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