COMPONENT 1

POLICIES AND MARKET INCENTIVES IN SUPPORT OF NATURAL CAPITAL

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

NATURAL CAPITAL

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POLICIES AND MARKET INCENTIVES IN SUPPORT OF NATURAL CAPITAL

OUTPUT 1.2.6

OPPORTUNISTICALLY INTEGRATE EMERGING NC INFORMATION INTO THE NATIONAL WATER RESOURCES SATELLITE ACCOUNT (WRSA)

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Executive summary

Thailand's development of national water resource accounts has progressed through several distinct periods. In the initial phase, water accounting during 2005–2007 focused on synthesizing an overall picture through a three-tier water balance analysis— Water Managers, Water Providers, and Water Users—presented on a seasonal basis (wet and dry seasons). However, this period faced limitations in data availability and completeness, requiring estimation methods for certain data due to the absence of systematic recording, such as water volumes for medium and small-scale water sources, water reuse volumes, and wastewater volumes, among others. Nevertheless, an economic valuation was conducted for water resource storage, provision, and use across surface water, groundwater, and piped water supply. The study found that although Thailand possesses adequate water resources overall, the high seasonal variability in rainfall represents a major challenge for adaptation to changing conditions. Recommendations for application at the area level, such as river basins and sub-districts, to determine the status of available water volume, water use volume, water use efficiency, and shortages—which would need to be linked with economic accounting to support sustainable water resource management planning. Accordingly, the study proposed several recommendations for water accounting: mapping water sources, locations, and capacities to reveal the physical potential for water distribution across areas, thereby supporting water management decision-making and risk/crisis management planning; conducting economic efficiency analyses for water use across areas or between countries, and using these to assess the value of investment in water source development; supporting local authorities in surveying water source data and preparing household accounts to obtain accurate information for comprehensive and cost-effective assistance planning; and using data from water accounts as a foundation for provincial development plans, so that water management aligns with economic and social growth in each area.

The subsequent water accounting study in 2016 employed a holistic analytical approach covering both the demand side and the supply side. This involved analyzing the water balance among net inflow, depleted water, and outflow, as well as analyzing crop water use and evaporation from soil and water surfaces, by applying hydrological processes in conjunction with satellite data to obtain an overview of river basins across all sectors, including forested areas and areas outside irrigation zones. The study also incorporated spatial and temporal management for 25 major river basins, and selected representative years—low-water, medium-water, and high-water years—between 2001 and 2013 to compare water conditions under different scenarios. However, this round of water accounting was limited to physical study and did not include economic valuation.

Regarding the challenges of water resource management in Thailand, the study found that water demand continues to rise due to urban and economic expansion, while rainfall and climatic conditions exhibit high variability, leading to conflicts over water use among different sectors, particularly during low-water years. Data limitations were also identified, including insufficient distribution of rainfall gauge stations to cover all areas—particularly mountainous regions—and outdated land-use data. Nevertheless, the government sector should support responsible agencies in using water accounts as a decision-making tool for river basin development planning and feasibility studies, in order to gain a systematic understanding of overall impacts; in constructing medium- and small-scale water storage facilities to capture usable runoff; in linking water networks between river basins; and in pursuing integrated management involving collaboration between public and private agencies, with the aim of achieving sustainable water resource management.

In addition, the government sector prepared a practical guidance manual for developing the System of Environmental-Economic Accounting and water accounts for Thailand in 2021, to serve as a framework and guideline for national water accounting in line with the SEEA standard. This involved studying the conceptual framework, consulting with experts and policy agencies to identify required indicators, designing and adjusting the scope to fit the Thai context—such as choosing to prepare accounts separately by season (wet/dry)—and compiling and analyzing data from multiple agencies. However, Thailand still lacks a central agency that comprehensively compiles nationwide water resource data, such as data on self-abstraction, village/municipal water supply data, data on desalinated freshwater production by private operators, groundwater data for wells drilled without permits, and data on wastewater volumes self-treated at establishments, among others. This also includes support for linking such data with national accounts.

Nevertheless, although Thailand has undertaken water accounting efforts, these have lacked continuity, and there remains no clear physical water account assessment. Therefore, development should proceed toward linking water accounts with economic value, in order to reveal the true overall cost of water resources, by connecting the Input-Output (I-O) Table with water accounting under the SEEA framework, to integrate environmental data with the economic system—enabling policymakers to gain a clearer macro-level view of the water situation overall.

The results of Krabi Province's water accounting during the period of 2015–2024, the formulation of Krabi Province's water account continues to face data constraints. This is particularly evident in the lack of data concerning water inflows from other territories, as well as comprehensive data on wastewater and reused water, given that current records only capture wastewater entering centralized treatment systems. Consequently, systematic collection and compilation of relevant data will be necessitated in the future.

Recommendations for the development of water accounts include: 1) Using water account data to support policy decision-making 2) Applying economic measures to water management 3) Linking with national income accounts: The long-term goal is to develop water accounts that can be linked to Thailand's GDP figures, to measure sustainable economic growth while accounting for the degradation of natural resources and 4) Developing a more comprehensive database system: Agencies should be encouraged to record water user data according to TSIC codes, to enable linkage with national accounts and calculation of water use efficiency by sector. Integration of wastewater data is also needed to determine the actual volume of wastewater entering treatment systems, which would benefit future expansion of treatment system capacity. Additional data collection tools should be developed for data outside formal registration which will require additional surveys.

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Water Resources Satellite Account (WRSA)

1. Framework of System of Environmental-Economic Accounting for Water

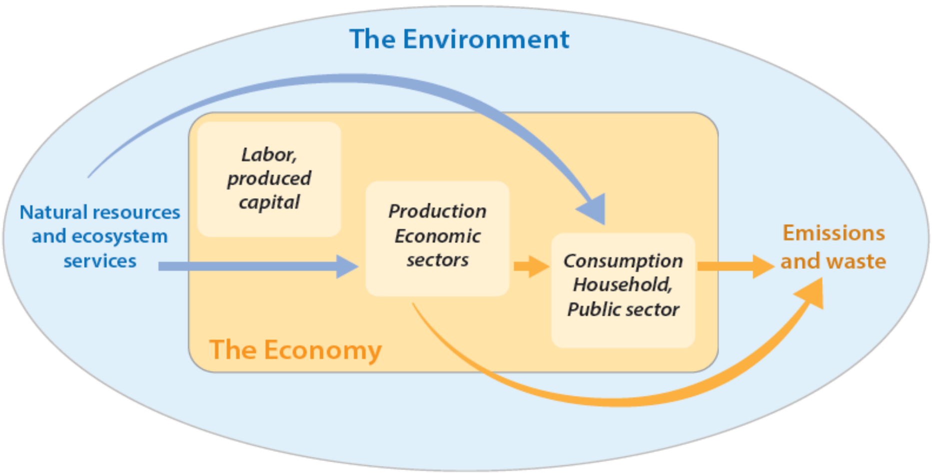
There are several water accounting frameworks. The focus on the SEEA is because it has been adopted over time via United Nations (UN) processes as an international statistical standard. The SEEA has several components, including the: SEEA Central Framework (UN et al., 2014), SEEA Ecosystem Accounting (UN et al., 2021), SEEA Water (UN, 2012a)

System of National Accounts (SNA) and SEEA

Water accounting is part of the "Environmental-Economic Accounting" group under SEEA, which is linked to SNA (EC et al., 2009). The SNA system has been used for creating global macroeconomic statistics for over 50 years and is the origin of the most well-known accounting indicator: Gross Domestic Product (GDP) (Coyle, 2015).

Generally, SEEA demonstrates the interaction between the economy and the environment. Figure 1 shows the use of natural resources and ecosystem services by economic sectors, as well as the release of pollutants and waste. The definition of "economy" follows the SNA guidelines.

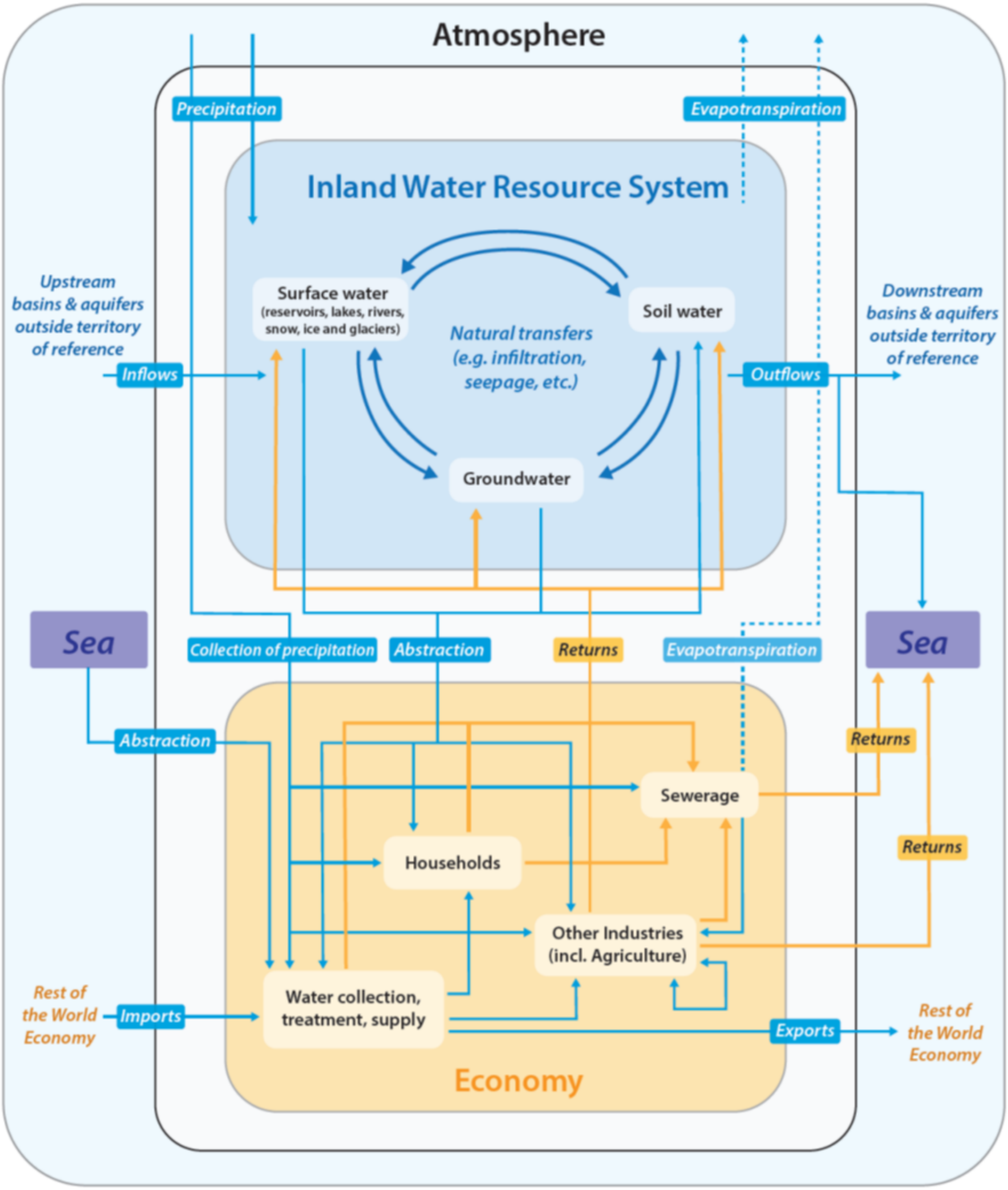
Figure 1 Environmental and Economic Context for Accounting



Source: World Bank (2021) refer to Michael J. Vardon, Thi Ha Lien Le, Ricardo Martinez-Lagunes, Ogopotse Batlokwa Pule, Sjoerd Schenau, Steve May, and R. Quentin Grafton (2023).

The scope of water accounting is presented in Figure 2 showing the physical stocks and flows of water within the hydrological system, which is a part of the environment, and the economy, and the interactions between the two. Many of the flows, and particularly those within the economy and between the economy and the inland water resource system, have matching monetary flows (Michael J. Vardon, Thi Ha Lien Le, Ricardo Martinez-Lagunes, Ogopotse Batlokwa Pule, Sjoerd Schenau, Steve May, and R. Quentin Grafton, 2023).

Figure 2 The scope of water accounting



Source: UN (SEEA Water) (2012)) refer to Michael J. Vardon, Thi Ha Lien Le, Ricardo Martinez-Lagunes, Ogopotse Batlokwa Pule, Sjoerd Schenau, Steve May, and R. Quentin Grafton (2023).

The SEEA Water provides information on (Michael J. Vardon, Thi Ha Lien Le, Ricardo Martinez-Lagunes, Ogopotse Batlokwa Pule, Sjoerd Schenau, Steve May, and R. Quentin Grafton, 2023).

- Stocks and flows of water resources within the environment.
- Pressures on the environment from the economy, including the volume of water extraction and wastewater returned to the environment.
- The supply and use of water and in production process and by households.
- The reuse of water within the economy.
- The costs of collection, purification, distribution and treatment of water and financing of these costs (e.g. charges to the users of water supply and sanitation services).
- Payment of permits for access to extract water from the environment or for the discharge of wastewater to the environment.
- The hydraulic stock in place, as well as investments in hydraulic infrastructure.
- Water quality and water pollution.
- The economic valuation of water resources.

Water accounting is a tool developed to improve water management by integrating environmental and economic data. Managing water comprehensively across environmental, economic, and social dimensions is the core of Integrated Water Resources Management (IWRM), a widely accepted water management approach. From water accounting collections across various countries, water accounts support: 1) Creation of descriptive indicators and statistics for monitoring and evaluation; 2) Comprehensive statistics for policy analysis

Water accounting can create indicators to assess water supply and usage, evaluate wastewater generation, and identify industrial sector sources creating pressure on water resources.

These analyses and indicators can be directly calculated from water accounts without extensive technical expertise. Additionally, water accounting supports international indicator development, such as Sustainable Development Goals (SDGs) Goal 6 on Water and Sanitation, including key indicators like: 6.1.1: Percentage of drinking water from clean sources; 6.3.1: Proportion of household and industrial wastewater safely treated; 6.4.1: Changes in water use efficiency over time; and 6.4.2: Water stress level (proportion of freshwater usage to total freshwater). Water accounting can also support more complex policy analysis using economic models, such as forecasting future water demands and assessing impacts of water price reforms.

SEEA Water Accounts is a framework that helps collect and integrate data necessary for water management, referencing the SEEA Central Framework, which was approved by the United Nations Statistical Commission (UNSC) as an international standard. Over 44 countries have already implemented this framework.

Water accounts aim to assess water usage in economic activities, evaluate household consumption, analyze ecosystem services, and provide a framework linking water resources with other natural resources. Key characteristics are to describe the natural water cycle and water flow within the economic system, quantify water resources in numerical terms, and measure in both physical and monetary terms. Water resources in land and economic systems can be defined by countries, administrative regions, watersheds

Water exchange can occur through 1) water imports and exports (between economic systems), 2) Natural inflows from upstream and outflows to downstream territories, and 3) Exchanges between seas and atmospheric layers (considered outside land water resources). For hydrological measurement purposes, these exchanges should be maintained within the water accounting framework to ensure comprehensive analysis.

In economic systems, water usage can be divided into two cases: first case is water extraction are withdrawing water from the environment for production and consumption activities. Examples include using rainwater, water absorption by crops in rainfed agricultural areas, and hydroelectric power generation. Second case is water usage without extraction are using water for recreational and transportation purposes. Examples include fishing and other uses dependent on water's physical presence. It often relies on water quality and may negatively impact water sources, but not directly considered in water accounting since water is not physically extracted. Water return to environment: Water can be returned directly to inland water sources or flow into the sea. Typically, water return negatively affects environmental water quality. Returned water usually has lower quality compared to its original state. Despite quality reduction, water return increases water quantity. Returned water can potentially be reused for other purposes.

This description emphasizes the complex interactions between economic systems and natural water resources, highlighting the importance of understanding water extraction, usage, and return processes.

Water Resource Account Components

Physical Asset Accounts for Water

Physical water asset accounts record stock data for freshwater and brackish water in artificial reservoirs, lakes, rivers and streams, groundwater, and soil water. At the beginning and end of the accounting period, these accounts record compose of:

- Water extraction volumes
- Water consumption
- Precipitation amounts
- Water inflows and outflows between countries
- Water flows into the sea

The purposes of this physical water asset accounts are to assess available water to meet economic system needs and evaluate long-term water demand sustainability. Measurements are physically quantified, typically measured in million cubic meters, and classified by water resource type

Physical Supply and Use Tables for Water (PSUT)

PSUT shows water supply and use, reflecting water circulation from environment to economic system and back. Five main components:

1. Water extraction from environment is the records water volume from sources, categorized by extracting industries, and sources include reservoirs, rivers, lakes, groundwater, soil water, precipitation.

2. Water distribution and use can be separated to two parts: water used by economic units directly and water distributed to other economic units. Usage recorded in three sections:

- Intermediate industrial consumption
- Household final consumption
- Water exports

3. Wastewater and Recycling: Tracks wastewater circulation between economic units. Wastewater can be 1) directly released to environment, 2) discharged into drainage systems and 3) transferred for reuse.

4. Water Return to Environment includes water released 1) directly by industries/households, after treatment and water losses.

5. Water Evaporation, Transpiration, and Product Incorporation included water evaporation, water transpiration, and water in products.

Measured in million cubic meters, aiming to balance water flow into and out of economic systems. Industry categories follow ISIC classification:

- Subsection 01-03: Agriculture, Forestry, and Fishing
- Subsection 05-33 and 41: Mining and Quarrying, Manufacturing, and Construction, respectively
- Subsection 35: Electricity, Gas, Steam, and Air Conditioning
- Subsection 36: Water Supply, Water Production, and Water Distribution
- Subsection 37: Wastewater Management
- Subsection 38, 39, and 45-99: Other Industries
- Emphasis on ISIC subsections 35, 36, and 37 due to direct water supply and use relevance.

Monetary Valuation of Water Resources

Conceptual Framework

Although these accounts provide valuable information for policy analysis and decision-making, they are currently considered experimental because no internationally accepted best practice exists that is comparable to the standard System of National Accounts (SNA).

A key challenge in valuing water resources is that observed market prices often do not reflect their true economic value. This discrepancy arises from factors such as government price regulation, natural monopolies, and the absence of well-defined property rights.

Valuation Methodologies

Valuation methods vary according to the type of water use.

Water as an Intermediate Input (Agriculture and Manufacturing)

- **Residual Value Method:** Estimates the value of water as the residual difference between the total value of output and the opportunity costs of all non-water inputs.
- **Change in Net Income (CNI):** Measures the change in net income resulting from a change in water use and is commonly applied to compare alternative water allocation scenarios.
- **Production Function Approach:** Uses statistical regression techniques to estimate the relationship between water inputs and production outputs, such as industrial output or agricultural crop yields.
- **Mathematical Programming:** Applies optimization techniques, including Linear Programming and Computable General Equilibrium (CGE) models, to estimate the shadow price of water under specified constraints.

Water as a Final Consumer Good

- **Demand Function Approach:** Estimates water value based on observed market behavior, such as household or utility water consumption data.
- **Contingent Valuation Method (CVM):** A stated preference method that uses surveys to estimate consumers' willingness to pay for water or improvements in water services under hypothetical scenarios.

Environmental Services (Waste Assimilation)

- **Cost of Averting Damage:** Estimates value based on expenditures incurred to prevent or mitigate environmental damage, such as the installation of water filtration systems.
- **Benefits from Damage Averted:** Estimates value based on the economic benefits of avoiding damages, including reduced healthcare costs, lower equipment corrosion, and improved environmental quality resulting from better water management.

Precautions and Key Considerations

Several factors should be considered when conducting monetary valuation of water resources:

- **Site-Specific Nature:** The economic value of water varies considerably across locations, seasons, and hydrological conditions. Consequently, local valuation estimates cannot be directly extrapolated to the national level without appropriate adjustments.
- **Double Counting:** The economic value of water may already be implicitly incorporated into industry value added, land values, or other assets reported in the SNA. Care must be taken to ensure that explicit water valuations are not added to these aggregates without appropriate adjustments.

- **Consistency with the SNA:** Certain valuation methods, such as the Contingent Valuation Method, estimate consumer surplus rather than exchange values. Since the SNA is based on observed market transaction values, these estimates are generally not directly compatible with SNA monetary accounts.
- **Sensitivity to Assumptions:** Valuation results are highly sensitive to assumptions regarding capital costs, discount rates, interest rates, production technologies, and the prices of other production inputs.

Prevention of Double Counting in Water Accounting

Double counting is a potential issue across several components of water accounts. The SEEA-Water framework provides specific accounting procedures to minimize this risk in four principal areas.

<u>Physical Supply and Use Accounts</u>

To prevent double counting during water distribution, water supply is recorded net of distribution losses. In addition, water abstracted for public distribution is recorded as a use by the water supply industry (ISIC 36) and is distinguished from water abstracted for own use by other industries. This distinction enables the movement of water through the economy to be accurately traced without duplication.

<u>Water Asset Accounts</u>

Natural interactions frequently occur between different water resources, particularly between surface water and groundwater (e.g., river water infiltrating an aquifer). To avoid counting the same water volume more than once, the SEEA-Water framework records these exchanges using a matrix of flows between water resources, which explicitly identifies natural transfers among water assets.

<u>Water Emission Accounts</u>

To avoid double counting pollutants that pass through wastewater treatment systems, the accounts distinguish between **gross emissions**, measured at the point where pollutants are discharged by an economic activity, and **net emissions**, representing the pollutants that ultimately enter the environment after treatment. Emissions associated with the sewerage industry (ISIC 37) are attributed back to the industries or households that originally generated the wastewater.

<u>Monetary Valuation</u>

As discussed previously, the economic value of water is often embedded within the value of other assets. For example, the value of groundwater may already be reflected in the market value of the overlying land, while the value of irrigation water is typically captured in a farm's operating surplus. Consequently, separate monetary estimates of water resources should be presented as explicit analytical information and should not be directly added to SNA aggregates without careful consideration to avoid double counting.

2. Water Resources Satellite Account in Thailand

Thailand has developed the Thailand Water Resources Satellite Account at the national level, consisting of three volumes: two volumes comprising the water accounts, and a handbook of practical guidelines for compiling Thailand's water accounts in accordance with SEEA principles. The details are as follows.

Thailand Water Account Year 2012

Thailand first compiled the Thailand Water Account in 2012, undertaken by the Faculty of Engineering, Chulalongkorn University. The study was conducted under the conceptual framework of the System of Environmental-Economic Accounting for Water (SEEAW) of the United Nations (UN), with the principal objective of integrating environmental data with economic data, since conventional indicators such as GDP do not account for the cost of natural resource degradation arising from national development. The study's findings present estimates of the supply and use of water resources (in physical units, such as cubic meters) at the national level, using data for the years 2005-2007, assessed by source and use (Sucharit Koontanakulvong, Piyatida Hoisangwan, and Winai Chaowivat, 2012).

The results of the 2012 water account compilation comprise account components covering the entire water cycle, from water resources, water managers, and water service providers to water users. The estimation of supply and use was conducted through water balance analysis, dividing the level of supply (Supply) into three tiers, together with the regulatory body, in order to present a clear picture of water distribution and to examine water losses within the system (Water Loss), under a balance analysis covering the 25 major river basins, as follows:

- **Level 1 (Water Supply 1 - Water Managers):** water managers by function, covering water volumes from large, medium, and small reservoirs, with the principal agencies being the Royal Irrigation Department (RID) and the Electricity Generating Authority of Thailand (EGAT).
- **Level 2 (Water Supply 2 - Water Providers):** entities allocating water to various user groups, covering the volume of water allocated to water service agencies such as the Metropolitan Waterworks Authority (MWA), the Provincial Waterworks Authority (PWA), and various irrigation projects.
- **Level 3 (Water Supply 3 - Water Users):** water users across various activities, such as households, industry, agriculture, and ecosystem maintenance.

For the assessment of water use, this comprises three main components: households, calculated from population multiplied by the per-capita water use rate; agriculture, calculated from cultivated area, cropping calendar, and crop water requirements, less the volume of effective rainfall; and industry, calculated from factory horsepower multiplied by the water use rate according to industry type.

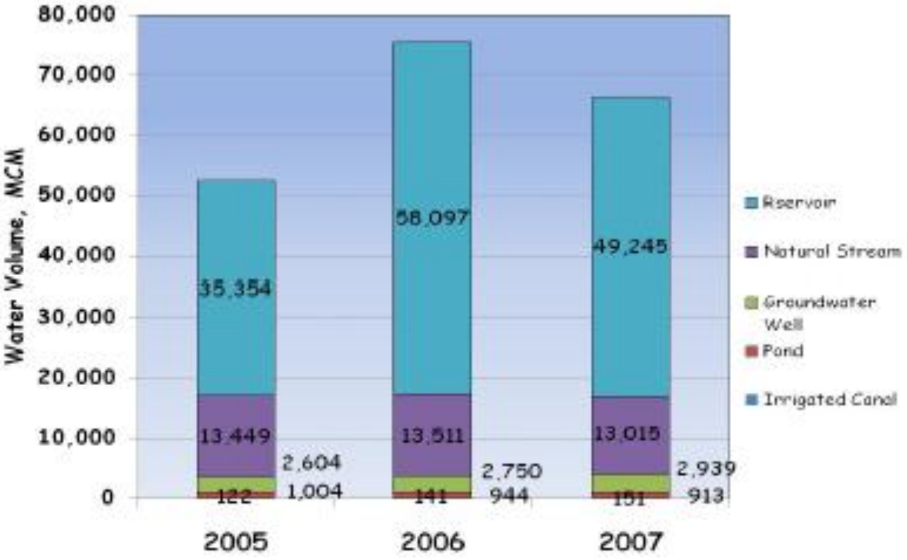
The estimation of national water supply and use for 2005-2007 used 2005 as a low-water-year baseline, 2006 as a high-water year, and 2007 as a normal-water year. The assessment of water supply and use found that Thailand's water demand has continued to trend upward, with the principal volume of water derived from reservoirs. The country continues to face challenges from seasonal rainfall variability, which differs substantially between the wet and dry seasons. Most water user groups belong to the agricultural sector, and the volume of water retained for ecosystem maintenance varies according to water conditions in each year. The volume of water stored in reservoirs, which serve as the principal water source during the dry season, reflects the condition of water scarcity at the start of the dry season each year. Thailand is facing major challenges in adapting to changing conditions (Table 1 and Figures 3 - 4). The volume of water passing through wastewater treatment systems remains very small.

Table 1 Summary of water supply and use in the year 2005-2007

List	Water Resources	2005	2006	2007
Water Supply 1	Natural stream	13,448.50	13,510.99	13,014.52
	Reservoir	35,475.96	59,239.19	49,395.75
	Ground water well	2,633.53	2,750.29	2,938.84
	Pond	1,004.15	944.14	912.71
Water Supply 2	Natural stream	12,063.11	12,132.48	11,682.55
	Water loss from stream	1,385.49	1,378.51	1,331.97
	Reservoir	28,741.39	51,076.98	42,276.42
	Water loss from reservoir	6,612.36	7,020.39	5,958.09
	Irrigated canal	91.39	108.97	117.02
	Water loss from irrigated canal	27.52	31.05	34.22
	Ground water well	2,571.56	2,713.53	2,899.35
	Water loss from ground water well	32.07	36.75	39.49
	Pond	907.65	907.52	874.94
	Water loss from pond	96.51	36.62	37.77
Water Supply 3	Natural stream	10,781.23	10,867.56	10,473.88
	Water loss from stream	1,281.88	1,264.93	1,208.56
	Reservoir	24,171.53	44,101.25	35,357.14
	Water loss from reservoir	5,570.06	6,975.73	5,919.28
	Irrigated canal	91.39	106.70	114.64
	Water loss from irrigated canal	-	2.27	2.38
	Ground water well	2,570.30	2,709.24	2,894.33
	Water loss from ground water well	1.26	4.29	5.01
	Pond	831.14	870.90	837.18
	Water loss from pond	36.51	36.62	37.77
	Water reuse	142.00	150.00	150.00
	Return flow to stream	4,123.00	5,810.00	5,609.00
Water Use	Natural stream	10,781.23	10,867.56	10,473.98
	Reservoir	24,171.53	44,101.25	35,357.14
	Irrigated canal	91.39	106.70	114.64
	Ground water well	2,570.30	2,709.24	2,894.33
	Pond	831.14	870.90	837.18

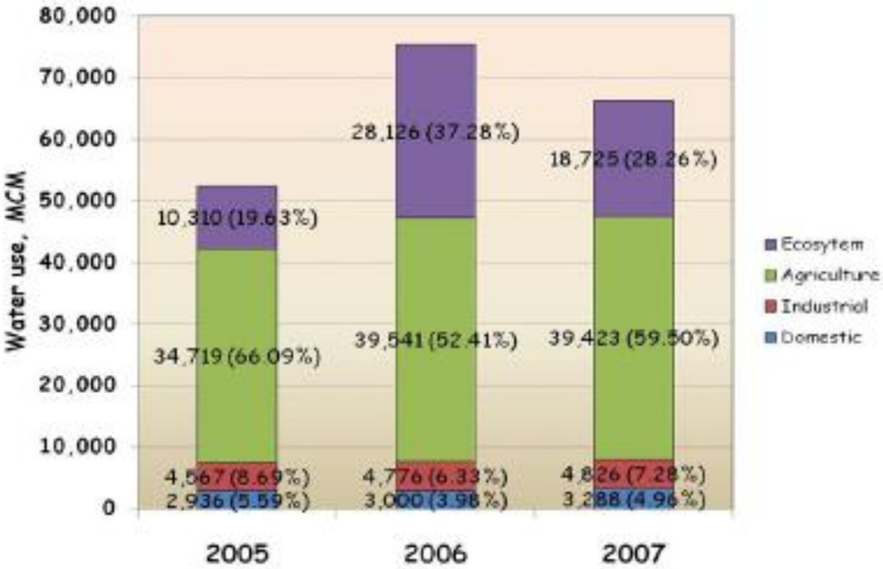
Source: Sucharit Koontanakulvong, Piyatida Hoisangwan, and Winai Chaowivat (2012)

Figure 3 The water supply from each water resource



Source: Sucharit Koontanakulvong, Piyatida Hoisangwan, and Winai Chaowivat (2012)

Figure 4 The water used in each activity



Source: Sucharit Koontanakulvong, Piyatida Hoisangwan, and Winai Chaowivat (2012)

The valuation of water resources, both in terms of supply and use as an ecosystem factor, does not carry a market price in the way that water traded within the economic system does for industrial and household units. Therefore, for the valuation of water resources to approximate their true value, this study estimated the value of the supply and use of surface water (stream flow), groundwater, and tap water. The valuation results for 2005 show that the supply of water resources (on the supply side) was valued at 115,110 million baht, of which the value of total water losses amounted to 23,305 million baht. Water used to maintain ecosystems and the environment, amounting to 10,310 million cubic meters, was valued at 20,620 million baht. On the demand side, water use across production activities, households, and the public sector had a combined value of 159,824 million baht (Chula Unisearch, Chulalongkorn University, 2010).

The challenges and limitations of the study include: 1) data availability, since certain data remain limited — for example, the absence of some data required the use of estimation methods for water volumes, such as data on water releases from medium and small reservoirs, and the assessment scope did not cover certain small river basins, among other gaps — together with the approach for translating physical data into economic valuation (Economic Value). The use of water accounts helps decision-makers identify which production sectors consume large volumes of water and whether such use is economically worthwhile. Applying economic measures to improve groundwater management plans is important, given the rising trend of groundwater use in the agricultural sector; the scope of the groundwater study did not include several small river basins. The calculation of industrial water use is complex, since water sources include both self-extracted (drilled) water and tap water. In addition, further challenges arise from climatic conditions, such as high seasonal rainfall variability and heavy reliance on water in the agricultural sector, which present challenges in adapting to changing conditions.

Thailand Water Account Year 2016

The study of sustainable water security across all 25 river basins aims to address the imbalance between water supply (Supply) and water demand (Demand), which has been increasing due to climate change and economic activity. The conceptual framework comprises the following:

- **Holistic analysis:** a study covering both the demand side (consumption, agriculture, industry, tourism, and ecosystems) and the supply side (rainfall, stream flow, and storage).
- **The Water Accounting Plus (WA+) methodology:** an internationally recognized tool developed by UNESCO-IHE, which combines hydrological processes with satellite data analysis to provide an overview of the river basin across all sectors, including forested areas and areas outside irrigation zones.
- **Spatial and temporal management:** monthly water accounts compiled for the 25 major river basins and 254 sub-basins, divided into 5 basin groups according to geographic characteristics and the natural flow of water (North-Central, Northeast, East, West, and South).

The data used in the study include:

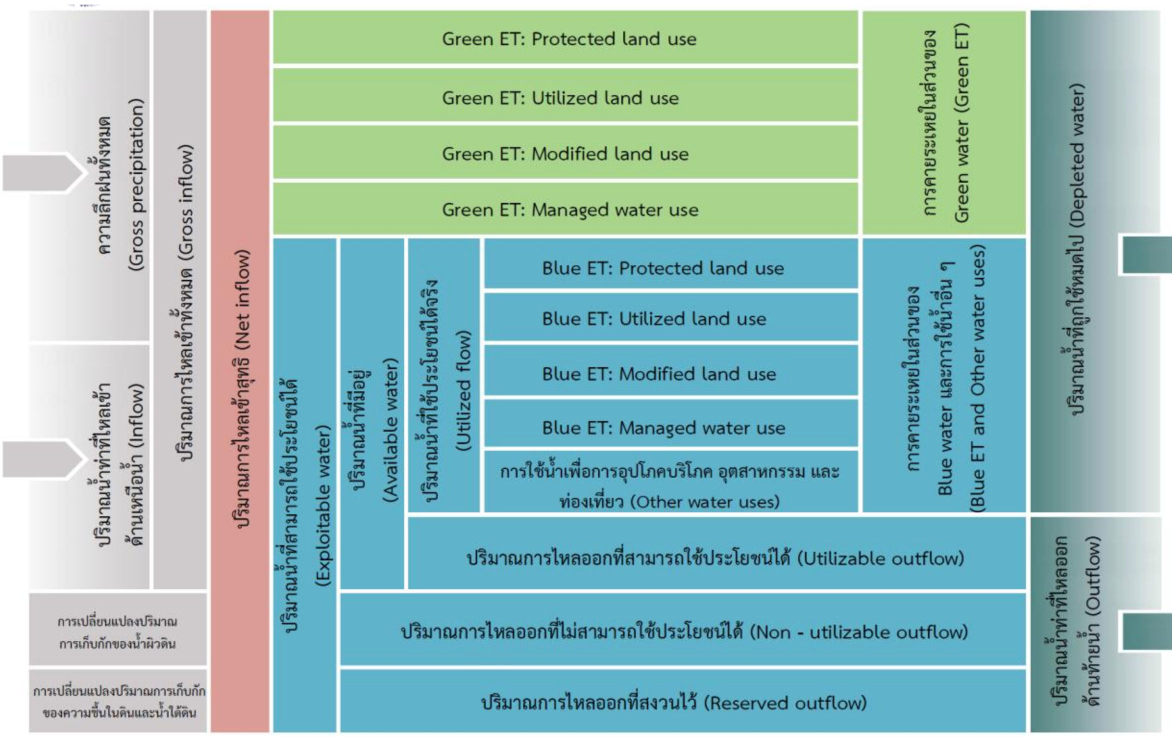
Meteorological and hydrological data: compiled from 124 weather stations and more than 2,071 rain-gauge stations nationwide.

- **Remote sensing data:** satellite data used to estimate evapotranspiration (ET Products) from 6 international data sources, and CHIRPS rainfall data calibrated against field data.
- **Socioeconomic data:** population data, consumption water demand, and industrial factory data.
- **Related resource data:** groundwater sources, land use data, water resource development projects, and irrigated areas.

The water accounts were compiled by selecting representative years — a low-water year, a medium-water year, and a high-water year — between 2001 and 2013, to compare water conditions under each scenario, comprising two types of components:

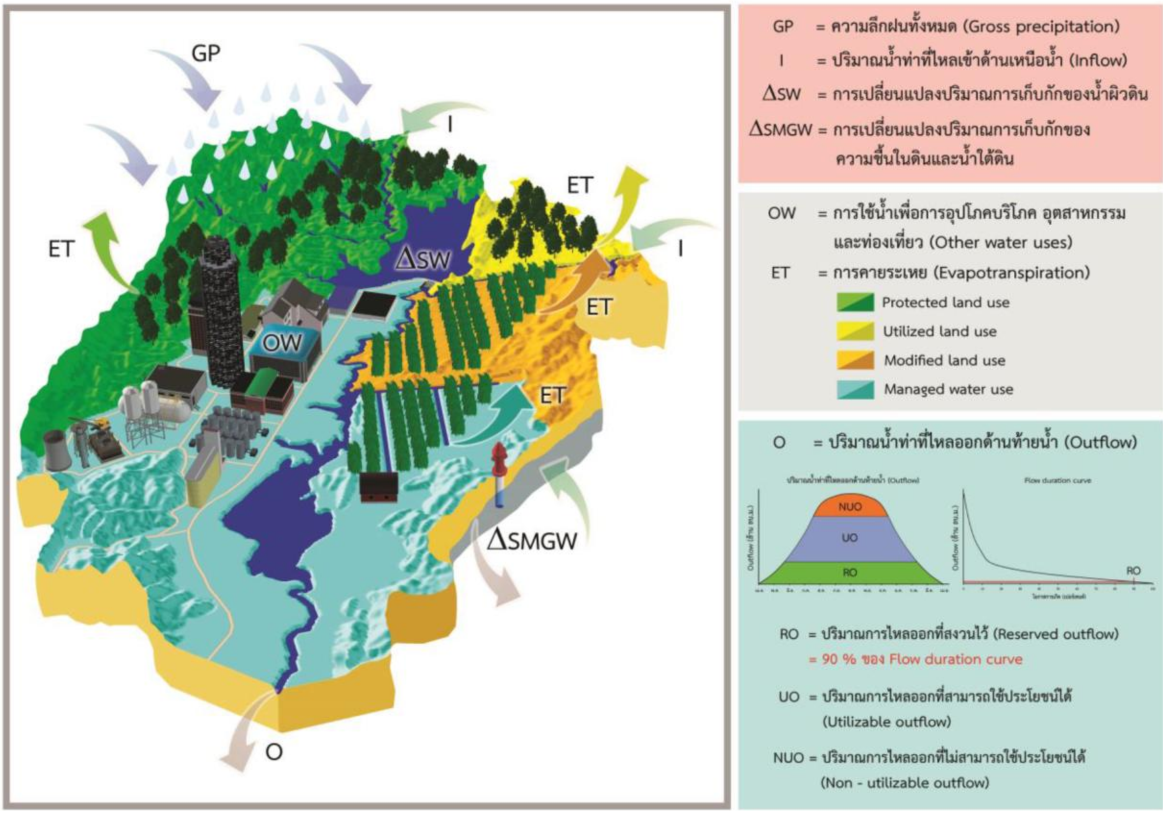
- **Resource base sheet:** analyzes the water balance among net inflow, depleted water, and outflow (Figures 5-6).
- **Evapotranspiration sheet:** analyzes crop water use and evaporation from soil and water, covering vegetation interception, plant transpiration, and soil and water evaporation, classified by land use type in order to assess the benefits derived from water used in evapotranspiration (Figures 7-8).

Figure 5 Schematic of Resource base sheet



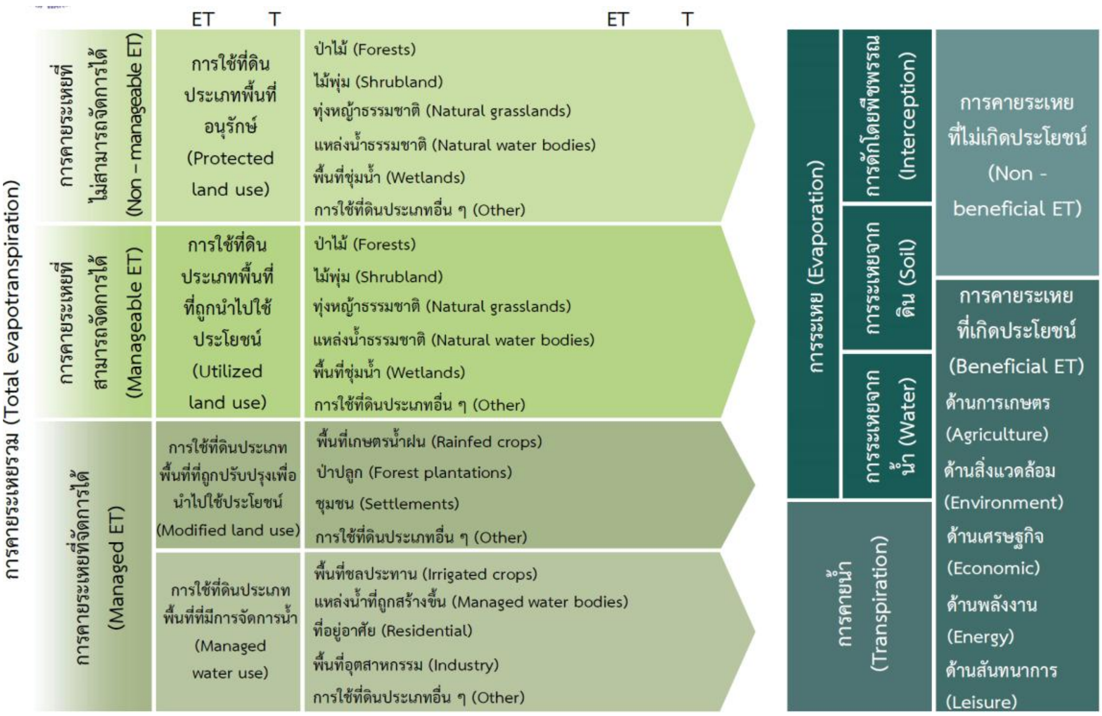
Source: Department of Water Resources (2016)

Figure 6 Components of Resource base sheet



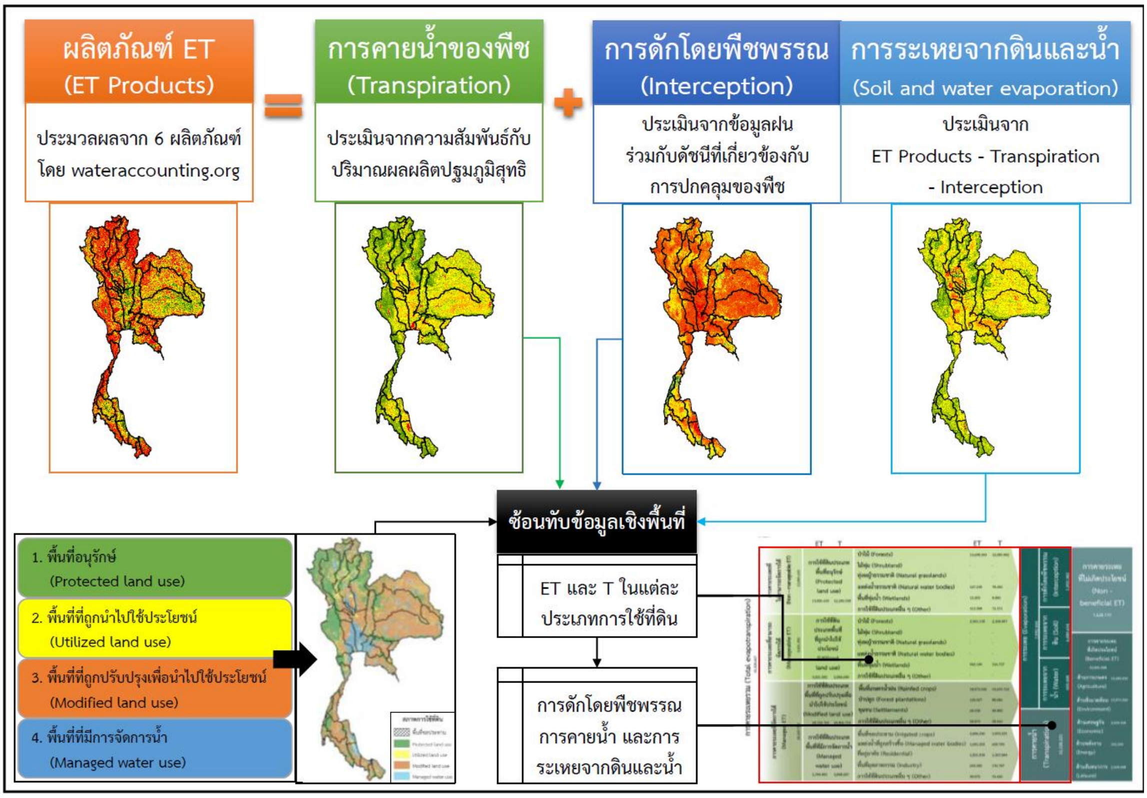
Source: Department of Water Resources (2016)

Figure 7 Schematic of Evapotranspiration sheet



Source: Department of Water Resources (2016)

Figure 8 Procedure for Estimating Vegetation Interception, Plant Transpiration, and Soil and Water Evaporation



Source: Department of Water Resources (2016)

In addition, scenario analysis was conducted to build water resource security, for use as a decision-making tool for future development, divided into two main groups: the national overview and area-specific projects, with details as follows. The national overview group includes: securing water sources to maintain ecosystem balance downstream; securing water sources for consumption, industry, and tourism; conservation and restoration of degraded upstream forest areas; increasing irrigation efficiency by 10% in every season, which helps save water; and expanding irrigated areas by 8.88 million (rai). The area-specific project group includes: the project to increase water volume in the Mae Kuang Udomtara Dam (Chiang Mai) to maintain ecosystems and support the expansion of Chiang Mai city and agricultural areas; the project to increase the water supply of the Bhumibol Dam to convey water to agricultural areas in the lower Ping River basin and the greater Chao Phraya basin, covering more than 850,000 rai; the Khong-Chi-Mun water management project to convey water to agricultural areas in the Northeast (Phase 1), diverting water for storage in the Lam Pao and Ubol Ratana dams; the water diversion project in the Eastern river basins to strengthen the Eastern Economic Corridor (EEC); and the raw-water pipeline project to Phuket and Koh Samui.

The results of the study of Thailand's water situation, derived from the water accounts under low-, medium-, and high-water conditions, are detailed as follows:

1. National Water Balance: it was found that net inflow — Thailand has an average net water inflow of approximately 702,717 million cubic meters per year, with the principal water source being rainfall (Gross Precipitation). Depleted water represents actual water use in all forms (including evapotranspiration from forests and agriculture), averaging approximately 482,308 million cubic meters per year (accounting for 68.6% of net inflow). Total outflow — the volume of water flowing out of the country — averages approximately 220,409 million cubic meters per year. It was found that utilizable outflow accounts for approximately 82.75%, reflecting that Thailand still lacks efficient water storage systems to capture and utilize this portion of water.

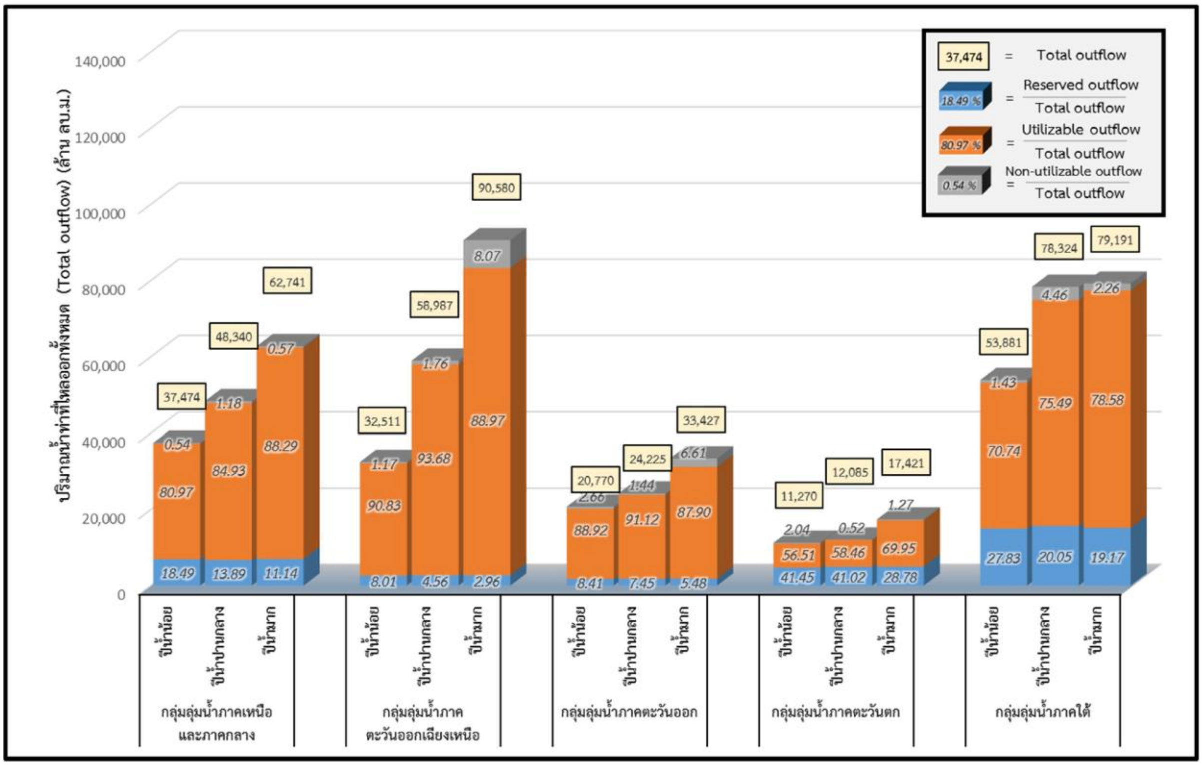
2. Water situation by river basin group: it was found that the Northern and Central river basin group has the largest share of net inflow in the country (32.84%) and is the region with the smallest share of water discharged out of the country compared with other groups. The Northeastern river basin group faces low net inflow per unit area, particularly the Chi River basin, where most of the water is nearly entirely consumed by evapotranspiration and household consumption. The Western river basin group serves as the country's "upstream forest," with a share of water use in forested areas as high as 58.44%. The Southern river basin group has the highest net inflow per unit area (2.15 million cubic meters per square kilometer) and a long rainy season but still faces risks of water scarcity in tourism economic areas such as Phuket and Samui due to a lack of water storage facilities.

Approaches to building future water security (Scenario Analysis) include increasing irrigation efficiency by 10%, the only measure that genuinely saves water, capable of saving an average of up to 7,748 million cubic meters per year. Thailand will need to secure additional water sources totaling approximately 6,340-8,140 million cubic meters per year to implement the entire development plan (ecosystem maintenance, consumption, and forest restoration). Therefore, the following actions should be undertaken:

- Increasing water storage sources to build security in a sustainable manner.
- Managing risks arising from water use for consumption, industry, and tourism, in order to reduce impacts on quality of life and the economy.
- River-basin-level management: "water accounts" and "efficiency indices" should be used as decision-making tools before initiating development projects, in order to assess impacts on downstream areas and ensure fairness in water allocation.

Key analytical findings show that Thailand has an average utilizable outflow as high as 82.75% of total outflow, with the Northeastern river basin group having the largest share of utilizable outflow (Figure 9), owing to a lack of water storage facilities, particularly large-scale storage. This reflects that constructing additional storage facilities would help build greater security. Regarding evapotranspiration, this is divided into Green ET (rainfall stored in soil) and Blue ET (water from water sources/irrigation). It was found that forested areas play a significant role in maintaining hydrological balance, particularly in the Northern and Central regions. Regarding the efficiency index, it was assessed that downstream areas have high total net inflow, since they receive water from upstream areas

Figure 9 Total Outflow of Each River Basin for Dry, Normal, and Wet Hydrological Years



Source: Department of Water Resources (2016)

Practical Guide for Thailand Water Account according to SEEA Principles Year 2021

The Practical Guide for compiling Thailand's water accounts according to SEEA (System of Environmental-Economic Accounting) principles presents content on several issues concerning the conceptual framework, the components of water accounts, applications, limitations, and recommendations for compiling national-level water accounts.

Conceptual Framework for Compiling Water Accounts and Their Components

Water accounts constitute a framework for integrating environmental and economic data, in order to describe the natural water cycle and its circulation within the economic system. This comprises two main parts:

- Physical Asset Accounts: cover water volumes from various sources, namely surface water, groundwater, and soil water, taking into account changes over the course of the year, such as increases from rainfall or decreases from water withdrawal for use.
- Physical Supply and Use Tables (PSUT): present the supply and use of water in order to track water circulation across three components — the extraction of water from nature into the economy, the allocation of water, the use of water within the economic system according to type of user, and the flow back to the environment.
- Consideration of water volume in spatial and temporal terms:

- Spatial dimension: water resources are distributed differently across areas; accounts can be compiled at the national, provincial, or river-basin level, the latter being the most appropriate unit for holistic management (IWRM).
- Temporal dimension: water volume data depends on the season, while economic data is referenced according to the calendar year or fiscal year. Compiling water accounts therefore requires finding a balance so that both sets of data can be linked.

Thailand's Compilation of Water Accounts

Thailand has compiled and published SEEA accounts on water resources to serve ad-hoc purposes in the past. At present, there is still no regular and consistent data collection and publication, and no agency is yet officially responsible for this as a core mission. However, the National Statistical Office has developed practical guideline handbooks and prototype accounts, such as Thailand's water account, to serve as an operational framework for various agencies to adapt and apply, emphasizing the integration of environmental data with Thailand's Standard Industrial Classification (TSIC) codes in order to systematically link with economic data. Coordination has also begun with various agencies and ministries through a working group comprising relevant experts, with the principal agencies including: the Royal Irrigation Department; the Electricity Generating Authority of Thailand (data on water in large and medium reservoirs); the Thai Meteorological Department (rainfall data); the Metropolitan Waterworks Authority and the Provincial Waterworks Authority (water distribution data); the Department of Groundwater Resources; and the Industrial Estate Authority of Thailand.

The process of compiling Thailand's water accounts is divided into five main steps according to the SEEA-CF standard, namely: studying the conceptual framework, definitions, and classification according to United Nations international standards; determining requirements through discussion with experts and policy agencies to identify the desired indicators, such as water security; designing the working framework to adjust the scope to fit the Thai context, such as choosing to compile accounts by seasonal cycle (wet season/dry season) rather than by calendar year; integrating data from multiple agencies and using calculation models for components that are not directly measured, such as plant water use, among others; and verifying accuracy, to confirm the correctness of definitions and calculation methods.

The analysis of water account data is divided by economic sector, including: [agricultural water use], calculated from rainfed and irrigated agricultural areas, using rainfall volume and irrigation efficiency; [self-extraction of water], compiling data on the registration of private groundwater wells; [industrial sector], grouped according to Thailand's Standard Industrial Classification (TSIC) to link with national accounts, particularly the accommodation (hotel) category, which is linked to tourism.

Status of Water Resource Data

The study's findings and the status of water resource data show that Thailand's principal water sources are rainfall and surface water, such as reservoirs, the volumes of which vary by season (wet-dry), with water use declining during the dry season. The largest water demand comes from the agricultural sector, which mostly relies on soil water from rainfall, followed by the electricity-generation industry, which merely withdraws water temporarily and returns it to natural water sources.

Resource data with a high level of readiness include stock data for large and medium reservoirs, basic hydrological data such as precipitation/rainfall data, and water production and distribution data from waterworks authorities — data that is continuously compiled, with standardized storage and disclosure. However, there remain limitations in data that is still missing (Data Gaps), including: soil water data, despite being the principal water source for agriculture, meaning that fertility or drought conditions cannot be accurately forecast; evaporation data from natural water sources (rivers, lakes) and evaporation from soil water; unregistered water data on direct withdrawal from natural water sources for own use, such as data on rainwater harvesting for household storage (jars/tanks) and seawater extraction by the private sector, reflecting freshwater scarcity in certain areas; as well as water distribution data from village and municipal waterworks. Regarding wastewater volume data, it was found that data exists on the volume of wastewater entering combined treatment systems, but this data remains fragmented and duplicated in some areas, while data is lacking on the volume of wastewater treated on-site at establishments, and the actual volume of water treated is unknown — data that is important for measuring overall water management efficiency. Furthermore, there is still no separate calculation of the volume of rainwater flowing into urban drainage systems (Urban Run-off) apart from the actual volume of wastewater entering treatment systems.

Regarding the application of water accounts, they can be used at the policy level to assess water security and water use efficiency, with clear sustainability indicators such as Water Stress and Water Productivity, applied to support reporting on SDG Goal 6 (water management and sanitation), as well as an approach to integrating databases linking water resources with land use, forestry, and energy, in order to examine the impacts of economic growth on natural resources.

Challenges and Recommendations

Thailand's water data collection remains fragmented, lacking a central agency that comprehensively compiles national-level water resource data, since water resource data is scattered across multiple agencies with differing definitions and units of measurement — for example, village/local waterworks data and private-sector data. Furthermore, waterworks user data is not grouped according to Standard Industrial Classification (TSIC) codes, requiring the use of proportional estimation to link with national accounts. In addition, the water account compilation cycle, covering April-September and October-March in order to align with the economy, does not yet match the actual planning needs for seasonal water management. This also includes the lack of several categories of water data, namely: self-abstraction data, such as the withdrawal of water directly from rivers, canals, or swamps for own use (e.g., agricultural pumping), since there is no market transaction; village/municipal waterworks data; data on private-sector freshwater production from seawater; groundwater data for unlicensed drilling; and data on the volume of wastewater treated on-site at establishments.

Recommendations include: 1) developing a database system for the direct supply and use of water from natural sources, and recording water user data according to Thailand's Standard Industrial Classification (TSIC) codes, in order to enable analysis alongside economic data and to precisely calculate the water use efficiency of each sector; 2) developing a wastewater database to cover the collection of data on the volume of wastewater treated on-site at establishments and the volume of rainwater in drainage systems (Urban Run-off), in order to determine the actual volume of wastewater entering treatment systems, which would benefit the future expansion of treatment system capacity; 3) surveying unregistered data for water that is not traded in the market, such as the direct withdrawal of water from rivers and canals for own use, or household rainwater harvesting, wastewater volume data, and soil water data, through additional surveys; 3) developing a standardized platform for data collection, particularly area-level data, in order to establish a complete national-level database; and 4) expanding the compilation of water accounts to the area level, such as regions and river basins, in order to more accurately reflect actual local water-scarcity issues than can be captured at the national level; 5) linking water accounts to serve as a basis for compiling other resource accounts, such as land accounts, forest accounts, and so on.

3. Water Accounting for Krabi Province

This study developed a water account for Krabi Province as a pilot application at the subnational level in accordance with the SEEA framework. Detailed estimation methods are presented in the Appendix. In this water accounting process, two primary components are developed: Physical Asset Accounts for Water and Physical Supply and Use Tables for Water (PSUT) in 2024, with the following details:

Physical Asset Accounts for Water

These are accounts displaying stock data for freshwater and brackish water located in artificial reservoirs, lakes, rivers and streams, including water stored in groundwater and soil water. The study considers seasonal variations (dry season: November-April and rainy season: May-October). The water asset accounts record included water extraction volumes, water consumption, precipitation amounts, water inflows and outflows between regions, and water flows into the sea The primary purpose is to evaluate water availability for economic system needs and assess long-term water supply sustainability and demand alignment.

Physical Supply and Use Tables for Water (PSUT)

PSUT illustrates water supply and use, reflecting the comprehensive water circulation from environment to economic system and back. It comprises five main components:

- Water extraction from environment is to record water volume drawn from sources and sources include reservoirs, rivers, lakes, groundwater, and soil water.
- Water distribution and use that divided into two primary sections: water used directly by economic units and water distributed to other units, categorized as: intermediate industrial consumption, household final consumption, and water exports.
- Wastewater and Recycling is to track wastewater circulation between economic units. Wastewater can be directly released to environment, discharged into drainage systems, and transferred for reuse.

- Water Return to Environment included recording water released by industries or households, direct release without treatment, water released after treatment, and water losses.
- Water Evaporation included recording water evaporation, water transpiration, and water incorporated into products.

Industry categories are classified according to ISIC standards:

- Subsections 01-03: Agriculture, Forestry, and Fishing
- Subsections 05-33 and 41: Mining, Manufacturing, and Construction
- Subsection 35: Electricity, Gas, Steam, and Air Conditioning
- Subsection 36: Water Supply, Production, and Distribution
- Subsection 37: Wastewater Management
- Subsections 38, 39, and 45-99: Other Industries
- The analysis emphasizes subsections 35, 36, and 37 due to their direct relevance to water supply and use

Water accounting in province level Based on the preparation of input data, including water resource volume, water accounts can be prepared for both the dry season and rainy season in Year 2024 as shown in Tables 2

Table 2 Physical water asset account for Krabi Province in provincial level (Unit: Million cubic meters)

a) Dry Season

Dry season	Type of water resources						Total
	Surface water			Groundwater	Others	Soil water	
	Reservoirs	Ponds	River and Canals				
Water Resources Stock at the Beginning	43.25	7.84	0.00	0.00	0.00	0.00	51.09
Stock Increases							
Return flow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Precipitation	3.15	4.01	2,365.00	2,365.00	0.00	0.00	4,737.16
Inflow from Other Territories	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inflow from Other Inland Water Resources	18.44	3.73	2,100.00	236.29	0.00	0.00	2,358.46
Discovery of Water in Aquifers	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Stock Increases	21.59	7.74	4,465.00	2,601.29	0.00	0.00	7,095.62
Stock Decreases							
Water Extraction	0.78	7.69	9.85	12.77	3,255.08	0.00	3,286.17
Evaporation and Transpiration	3.10	3.70	0.00	0.00	0.00	0.00	6.80
Outflow to Other Territories	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outflow to the Sea	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outflow to Other Inland Water Resources	2.81	0.00	3.22	0.42	0.00	0.00	6.45
Total Stock Decreases	6.69	11.39	13.07	13.19	3,255.08	0.00	3,299.42
Water Resources Stock at the End	25.18	3.76	0.00	0.00	0.00	0.00	28.94

b) Wet Season

Wet season	Type of water resources						Total
	Surface water			Groundwater	Others	Soil water	
	Reservoirs	Ponds	River and Canals				
Water Resources Stock at the	22.69	3.37	0.00	0.00	0.00	0.00	26.06
Stock Increases							
Return flow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Precipitation	6.56	7.77	6,738.00	6,738.00	0.00	0.00	13,490.32
Inflow from Other Territories	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inflow from Other Inland Water	38.77	14.25	3,029.00	674.02	0.00	0.00	3,756.04
Discovery of Water in Aquifers	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Stock Increases	45.33	22.02	9,767.00	7,412.02	0.00	0.00	17,246.37
Stock Decreases							
Water Extraction	0.81	8.94	9.31	12.53	2193.57	0.00	2225.17
Evaporation and Transpiration	2.45	2.82	0.00	0.00	0.00	0.00	5.27
Outflow to Other Territories	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outflow to the Sea	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outflow to Other Inland Water	4.05	0.00	2.72	0.42	0.00	0.00	7.18
Total Stock Decreases	7.30	11.77	12.03	12.95	2193.57	0.00	2237.62
Water Resources Stock at the End	36.55	5.73	0.00	0.00	0.00	0.00	42.28

Based on the preparation of input data, including water allocation volumes from relevant agencies and self-sourced water volumes, water accounts can be prepared for both the dry season and rainy season as shown in Tables 3

Table 1 Physical water supply and use table in Krabi Province in provincial level (Unit: Million cubic meters)

a) Dry season

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Water Sources Drawn												
Surface Water												
Irrigation Water Use in Irrigation Zones	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.78
Water Use from Reservoirs Outside Irrigation Zones	7.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.69
Pumping Water for Water Supply (PWA)	0.00	0.00	0.00	0.00	0.00	0.00	9.85	0.00	0.00	0.00	0.00	9.85
Total	7.69	0.00	0.00	0.00	0.00	0.00	10.64	0.00	0.00	0.00	0.00	18.32
Groundwater												
Pumping from Private Wells in Water Supply Zones	0.00	0.00	0.00	0.00	3.06	1.93	0.00	0.00	0.00	0.00	0.00	4.99
Pumping from Public Wells in Water Supply Zones	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.52	0.00	1.52
Pumping from Public Shallow Wells in Water Supply Zones	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
Pumping from Private Wells Outside Water Supply Zones	0.00	0.00	0.00	0.00	1.31	0.79	0.00	0.00	0.00	0.00	0.00	2.10

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Pumping from Public Wells Outside Irrigation Zones	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	1.16
Pumping from Public Shallow Wells Outside Irrigation Zones	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.81
Pumping Water for Village Water Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.09	0.00	0.00	0.00	4.38	2.72	2.17	0.00	0.00	2.41	0.00	12.77
Water from Other Sources												
Water Use in Irrigation Zones from Other Surface Water Sources	47.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.06
Water Use in Water Supply Zones from Other Surface Water Sources	0.00	0.14	0.09	0.12	0.01	0.12	0.00	0.00	0.73	0.00	0.00	1.21
Water Use Outside Irrigation Zones from Other Surface Water Sources	3204.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3204.22
Water Use Outside Water Supply Zones from Other Surface Water Sources	0.00	0.04	0.13	0.00	1.07	0.86	0.00	0.00	0.49	0.00	0.00	2.58
Total	3251.29	0.18	0.22	0.12	1.08	0.98	0.00	0.00	1.22	0.00	0.00	3255.08
Water Distribution												

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Provincial Waterworks Authority	0.00	0.01	0.03	0.00	3.33	2.07	0.00	0.00	0.15	4.24	0.00	9.83
Royal Irrigation Department	14.05	0.03	0.07	0.00	0.00	0.00	0.00	0.00	0.64	0.78	0.00	15.58
Village Water Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.09	0.00	2.09
Total	14.05	0.03	0.10	0.00	3.33	2.07	0.00	0.00	0.79	7.12	0.00	27.49
Self Extraction												
Total Surface Water	7.69	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	7.88
Total Groundwater	1.09	0.00	0.00	0.00	4.38	1.93	0.09	0.00	0.00	2.41	0.00	9.90
Total Water from Other Sources	3251.29	0.18	0.22	0.12	1.08	0.98	0.00	0.00	1.22	0.00	0.00	3255.08
Total from All Sources	3260.07	0.18	0.22	0.12	5.46	2.91	0.28	0.00	1.22	2.41	0.00	3272.86
Wastewater and Recycled Water												
Wastewater												
Wastewater Received from Other Units	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	1.20
Self Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recycled Water												
Reused Water Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Self Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	1.20

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Water Recirculation, Water Returning to Environment												
To Inland Water Resources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.44	50.44
To Other Water Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5236.57	5236.57
Total Recirculation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5287.01	5287.01
Evaporation of Drawn Water, Transpiration, and Water Incorporated in Products												
Evaporation of Drawn Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.80	6.80
Transpiration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Incorporated in Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Usage	6534.18	0.40	0.54	0.24	14.25	8.67	13.09	1.20	3.23	11.93	5287.01	11874.73

b) Rainy season

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Water Sources Drawn												
Surface Water												
Irrigation Water Use in Irrigation Zones	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.81
Water Use from Reservoirs Outside Irrigation Zones	8.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.94
Pumping Water for Water Supply (PWA)	0.00	0.00	0.00	0.00	0.00	0.00	9.31	0.00	0.00	0.00	0.00	9.31
Total	8.94	0.00	0.00	0.00	0.00	0.00	10.12	0.00	0.00	0.00	0.00	19.06
Groundwater												
Pumping from Private Wells in Water Supply Zones	0.00	0.00	0.00	0.00	3.14	1.85	0.00	0.00	0.00	0.00	0.00	4.99
Pumping from Public Wells in Water Supply Zones	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.52	0.00	1.52
Pumping from Public Shallow Wells in Water Supply Zones	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
Pumping from Private Wells Outside Water Supply Zones	0.00	0.00	0.00	0.00	1.36	0.76	0.00	0.00	0.00	0.00	0.00	2.11
Pumping from Public Wells Outside Irrigation Zones	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	1.16
Pumping from Public Shallow Wells Outside Irrigation Zones	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.56

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Pumping Water for Village Water Supply	0.00	0.00	0.00	0.00	0.00	0.00	2.17	0.00	0.00	0.00	0.00	2.17
Total	0.84	0.00	0.00	0.00	4.50	2.61	2.17	0.00	0.00	2.41	0.00	12.53
Water from Other Sources												
Water Use in Irrigation Zones from Other Surface Water Sources	20.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.45
Water Use in Water Supply Zones from Other Surface Water Sources	0.00	0.14	0.09	0.12	0.01	0.12	0.00	0.00	0.74	0.00	0.00	1.22
Water Use Outside Irrigation Zones from Other Surface Water Sources	2169.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2169.34
Water Use Outside Water Supply Zones from Other Surface Water Sources	0.00	0.04	0.13	0.00	1.10	0.82	0.00	0.00	0.49	0.00	0.00	2.57
Total	2189.78	0.18	0.22	0.12	1.11	0.94	0.00	0.00	1.23	0.00	0.00	2193.57
Water Distribution												
Provincial Waterworks Authority	0.00	0.01	0.03	0.00	3.07	1.80	0.00	0.00	0.14	4.08	0.00	9.11
Royal Irrigation Department	20.23	0.03	0.07	0.00	0.00	0.00	0.00	0.00	0.64	0.81	0.00	21.78
Village Water Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.09	0.00	2.09
Total	20.23	0.03	0.10	0.00	3.07	1.80	0.00	0.00	0.77	6.98	0.00	32.98
Self Extraction												
Total Surface Water	8.94	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	9.19

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Total Groundwater	0.84	0.00	0.00	0.00	4.50	1.85	0.09	0.00	0.00	2.41	0.00	9.69
Total Water from Other Sources	2189.78	0.18	0.22	0.12	1.11	0.94	0.00	0.00	1.23	0.00	0.00	2193.57
Total from All Sources	2199.57	0.18	0.22	0.12	5.61	2.79	0.33	0.00	1.23	2.41	0.00	2212.45
Wastewater and Recycled Water												
Wastewater												
Wastewater Received from Other Units	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00	0.00	0.00	1.16
Self Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recycled Water												
Reused Water Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Self Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00	0.00	0.00	1.16
Water Recirculation, Water Returning to Environment												
To Inland Water Resources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.95	59.95
To Other Water Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3539.93	3539.93
Total Recirculation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3599.87	3599.87
Evaporation of Drawn Water, Transpiration, and Water Incorporated in Products												
Evaporation of Drawn Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.27	5.27

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Transpiration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Incorporated in Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Usage	4419.37	0.39	0.54	0.24	14.28	8.14	12.63	1.16	3.23	11.79	3599.87	8071.64

The Monetary value of water account

The conversion of Physical Supply and Use Tables (PSUT) into monetary water accounts for the year 2024 was conducted to determine the economic value of water resources, thereby supporting the formulation of water management policies and strategic plans. The values presented in the tables represent preliminary estimates developed by the research team. Detailed valuations for water assets and water supply and use for both the dry and rainy seasons are provided in Tables 4 and 5.

The valuation of water resources encompasses water asset accounts and water supply and use tables, with values derived from specific tariff rates or unit costs for each water category. For instance, the raw water tariff is calculated at a recommended utilization fee of 1.49 baht per cubic meter.

Within the supply and use framework, water consumption is valued across seven sectors: services, accommodation, households, wastewater management, other industries, agriculture, and environmental recirculation. Consumption volumes are multiplied by sector-specific prices—based on established tariff schedules and regulatory fee structures—to derive their respective monetary values:

- Households: Valued at 16.6 baht per cubic meter, reflecting the average tariff for Type 1 users by the Krabi Provincial Waterworks Authority.
- Service Sector: Assigned a rate of 20.8 baht per cubic meter, corresponding to the average tariff for Type 2 users.
- Accommodation and Other Industries: Valued at 26.84 baht per cubic meter, consistent with the average tariff for Type 3 users.
- Wastewater Management: Priced at 15 baht per cubic meter, in line with the 20-Year Community Wastewater Management Plan (2018–2037).
- Agriculture and Environmental Recirculation: Valued at 0.5 baht per cubic meter, in accordance with the irrigation fee schedule established by the 2021 Ministerial Regulation issued by the Royal Irrigation Department

Table 4 Monetary values water asset account for Krabi Province (Unit: Million Baht)

a) Dry Season

Dry season	Type of water resources						Total
	Surface water			Groundwater	Others	Soil water	
	Reservoirs	Ponds	River and Canals				
Water Resources Stock at the Beginning	64.44	11.68	-	-	-	-	76.12
Stock Increases							
Return flow	-	-	-	-	-	-	-
Precipitation	4.69	5.97	3,523.85	3,523.85	-	-	7,058.37
Inflow from Other Territories	-	-	-	-	-	-	-
Inflow from Other Inland Water Resources	27.48	5.56	3,129.00	352.07	-	-	3,514.11
Discovery of Water in Aquifers	-	-	-	-	-	-	-
Total Stock Increases	32.17	11.53	6,652.85	3,875.92	-	-	10,572.47
Stock Decreases	-	-	-	-	-	-	-
Water Extraction	1.16	11.46	14.68	19.03	4,850.07	-	4,896.39
Evaporation and Transpiration	4.62	5.51	-	-	-	-	10.13
Outflow to Other Territories	-	-	-	-	-	-	-
Outflow to the Sea	-	-	-	-	-	-	-
Outflow to Other Inland Water Resources	4.19	-	4.80	0.63	-	-	9.61
Total Stock Decreases	9.97	16.97	19.47	19.65	4,850.07	-	4,916.14
Water Resources Stock at the End	37.52	5.60	-	-	-	-	43.12

b) Wet Season

Wet season	Type of water resources						Total
	Surface water			Groundwater	Others	Soil water	
	Reservoirs	Ponds	River and Canals				
Water Resources Stock at the	33.81	5.02	-	-	-	-	38.83
Stock Increases	-	-	-	-	-	-	-
Return flow	-	-	-	-	-	-	-
Precipitation	9.77	11.58	10,039.62	10,039.62	-	-	20,100.58
Inflow from Other Territories	-	-	-	-	-	-	-
Inflow from Other Inland Water	57.77	21.23	4,513.21	1,004.29	-	-	5,596.50
Discovery of Water in Aquifers	-	-	-	-	-	-	-
Total Stock Increases	67.54	32.81	14,552.83	11,043.91	-	-	25,697.09
Stock Decreases	-	-	-	-	-	-	-
Water Extraction	1.21	13.32	13.87	18.67	3,268.42	-	3,315.50
Evaporation and Transpiration	3.65	4.20	-	-	-	-	7.85
Outflow to Other Territories	-	-	-	-	-	-	-
Outflow to the Sea	-	-	-	-	-	-	-
Outflow to Other Inland Water	6.03	-	4.05	0.63	-	-	10.70
Total Stock Decreases	10.88	17.54	17.92	19.30	3,268.42	-	3,334.05
Water Resources Stock at the End	54.46	8.54	-	-	-	-	63.00

Table 2Monetary values water supply and use table in Krabi Province (Unit: Million Baht)

a) Dry season

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Water Sources Drawn	-	-	-	-	-	-	-	-	-	-	-	-
Surface Water	-	-	-	-	-	-	-	-	-	-	-	-
Irrigation Water Use in Irrigation Zones	-	-	-	-	-	-	1.16	-	-	-	-	1.16
Water Use from Reservoirs Outside Irrigation Zones	3.85	-	-	-	-	-	-	-	-	-	-	3.85
Pumping Water for Water Supply (PWA)	-	-	-	-	-	-	14.68	-	-	-	-	14.68
Total	3.85	-	-	-	-	-	15.85	-	-	-	-	19.70
Groundwater	-	-	-	-	-	-	-	-	-	-	-	-
Pumping from Private Wells in Water Supply Zones	-	-	-	-	63.65	51.80	-	-	-	-	-	115.45
Pumping from Public Wells in Water Supply Zones	-	-	-	-	-	-	-	-	-	25.23	-	25.23
Pumping from Public Shallow Wells in Water Supply Zones	-	-	-	-	-	-	-	-	-	0.33	-	0.33
Pumping from Private Wells Outside Water Supply Zones	-	-	-	-	27.25	21.20	-	-	-	-	-	48.45

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Pumping from Public Wells Outside Irrigation Zones	0.16	-	-	-	-	-	-	-	-	14.28	-	14.43
Pumping from Public Shallow Wells Outside Irrigation Zones	0.40	-	-	-	-	-	-	-	-	0.33	-	0.73
Pumping Water for Village Water Supply	-	-	-	-	-	-	-	-	-	-	-	-
Total	0.55	-	-	-	91.10	73.00	3.23	-	-	40.01	-	207.89
Water from Other Sources	-	-	-	-	-	-	-	-	-	-	-	-
Water Use in Irrigation Zones from Other Surface Water Sources	23.53	-	-	-	-	-	-	-	-	-	-	23.53
Water Use in Water Supply Zones from Other Surface Water Sources	-	0.07	2.42	3.22	0.21	3.22	-	-	19.59	-	-	28.73
Water Use Outside Irrigation Zones from Other Surface Water Sources	1,602.11	-	-	-	-	-	-	-	-	-	-	1,602.11
Water Use Outside Water Supply Zones from Other Surface Water Sources	-	0.02	3.49	-	22.26	23.08	-	-	13.15	-	-	62.00
Total	1,625.65	0.09	5.90	3.22	22.46	26.30	-	-	32.74	-	-	1,716.37
Water Distribution	-	-	-	-	-	-	-	-	-	-	-	-

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Provincial Waterworks Authority	-	0.01	0.81	-	69.26	55.56	-	-	4.03	70.38	-	200.04
Royal Irrigation Department	7.03	0.02	1.88	-	-	-	-	-	17.18	12.95	-	39.04
Village Water Supply	-	-	-	-	-	-	-	-	-	34.69	-	34.69
Total	7.03	0.02	2.68	-	69.26	55.56	-	-	21.20	118.19	-	273.94
Self Extraction	-	-	-	-	-	-	-	-	-	-	-	-
Total Surface Water	3.85	-	-	-	-	-	0.30	-	-	-	-	4.14
Total Groundwater	0.55	-	-	-	91.10	51.80	0.13	-	-	40.01	-	183.59
Total Water from Other Sources	1,625.65	0.09	5.90	3.22	22.46	26.30	-	-	32.74	-	-	1,716.37
Total from All Sources	1,630.04	0.09	5.90	3.22	113.57	78.10	0.42	-	32.74	40.01	-	1,904.09
Wastewater and Recycled Water	-	-	-	-	-	-	-	-	-	-	-	-
Wastewater	-	-	-	-	-	-	-	-	-	-	-	-
Wastewater Received from Other Units	-	-	-	-	-	-	-	18.00	-	-	-	18.00
Self Treatment	-	-	-	-	-	-	-	-	-	-	-	-
Recycled Water	-	-	-	-	-	-	-	-	-	-	-	-
Reused Water Distribution	-	-	-	-	-	-	-	-	-	-	-	-
Self Use	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	18.00	-	-	-	18.00

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Water Recirculation, Water Returning to Environment	-	-	-	-	-	-	-	-	-	-	-	-
To Inland Water Resources	-	-	-	-	-	-	-	-	-	-	75.16	75.16
To Other Water Sources	-	-	-	-	-	-	-	-	-	-	7,802.49	7,802.49
Total Recirculation	-	-	-	-	-	-	-	-	-	-	7,877.64	7,877.64
Evaporation of Drawn Water, Transpiration, and Water Incorporated in Products	-	-	-	-	-	-	-	-	-	-	-	-
Evaporation of Drawn Water	-	-	-	-	-	-	-	-	-	-	10.13	10.13
Transpiration	-	-	-	-	-	-	-	-	-	-	-	-
Water Incorporated in Products	-	-	-	-	-	-	-	-	-	-	-	-
Total Usage	3,267.09	0.20	14.49	6.44	296.40	232.70	19.50	18.00	86.69	198.04	7,877.64	12,017.21

b) Rainy season

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	House holds	Recirculation from Environment	Total
Water Sources Drawn	-	-	-	-	-	-	-	-	-	-	-	-
Surface Water	-	-	-	-	-	-	-	-	-	-	-	-
Irrigation Water Use in Irrigation Zones	-	-	-	-	-	-	1.21	-	-	-	-	1.21
Water Use from Reservoirs Outside Irrigation Zones	4.47	-	-	-	-	-	-	-	-	-	-	4.47
Pumping Water for Water Supply (PWA)	-	-	-	-	-	-	13.87	-	-	-	-	13.87
Total	4.47	-	-	-	-	-	15.08	-	-	-	-	19.55
Groundwater	-	-	-	-	-	-	-	-	-	-	-	-
Pumping from Private Wells in Water Supply Zones	-	-	-	-	65.31	49.65	-	-	-	-	-	114.97
Pumping from Public Wells in Water Supply Zones	-	-	-	-	-	-	-	-	-	25.23	-	25.23
Pumping from Public Shallow Wells in Water Supply Zones	-	-	-	-	-	-	-	-	-	0.33	-	0.33
Pumping from Private Wells Outside Water Supply Zones	-	-	-	-	28.29	20.40	-	-	-	-	-	48.69
Pumping from Public Wells Outside Irrigation Zones	0.16	-	-	-	-	-	-	-	-	14.28	-	14.43
Pumping from Public Shallow Wells Outside Irrigation Zones	0.27	-	-	-	-	-	-	-	-	0.33	-	0.60

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	House holds	Recirculation from Environment	Total
Pumping Water for Village Water Supply	-	-	-	-	-	-	3.23	-	-	-	-	3.23
Total	0.42	-	-	-	93.60	70.05	3.23	-	-	40.01	-	207.31
Water from Other Sources	-	-	-	-	-	-	-	-	-	-	-	-
Water Use in Irrigation Zones from Other Surface Water Sources	10.23	-	-	-	-	-	-	-	-	-	-	10.23
Water Use in Water Supply Zones from Other Surface Water Sources	-	0.07	2.42	3.22	0.21	3.22	-	-	19.86	-	-	29.00
Water Use Outside Irrigation Zones from Other Surface Water Sources	1,084.67	-	-	-	-	-	-	-	-	-	-	1,084.67
Water Use Outside Water Supply Zones from Other Surface Water Sources	-	0.02	3.49	-	22.88	22.01	-	-	13.15	-	-	61.55
Total	1,094.89	0.09	5.90	3.22	23.09	25.23	-	-	33.01	-	-	1,185.44
Water Distribution	-	-	-	-	-	-	-	-	-	-	-	-
Provincial Waterworks Authority	-	0.01	0.81	-	63.86	48.31	-	-	3.76	67.73	-	184.46
Royal Irrigation Department	10.12	0.02	1.88	-	-	-	-	-	17.18	13.45	-	42.63
Village Water Supply	-	-	-	-	-	-	-	-	-	34.69	-	34.69
Total	10.12	0.02	2.68	-	63.86	48.31	-	-	20.67	115.87	-	261.52
Self Extraction	-	-	-	-	-	-	-	-	-	-	-	-
Total Surface Water	4.47	-	-	-	-	-	0.37	-	-	-	-	4.84
Total Groundwater	0.42	-	-	-	93.60	49.65	0.13	-	-	40.01	-	183.81

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	Households	Recirculation from Environment	Total
Total Water from Other Sources	1,094.89	0.09	5.90	3.22	23.09	25.23	-	-	33.01	-	-	1,185.44
Total from All Sources	1,099.79	0.09	5.90	3.22	116.69	74.88	0.49	-	33.01	40.01	-	1,374.08
Wastewater and Recycled Water	-	-	-	-	-	-	-	-	-	-	-	-
Wastewater	-	-	-	-	-	-	-	-	-	-	-	-
Wastewater Received from Other Units	-	-	-	-	-	-	-	17.40	-	-	-	17.40
Self Treatment	-	-	-	-	-	-	-	-	-	-	-	-
Recycled Water	-	-	-	-	-	-	-	-	-	-	-	-
Reused Water Distribution	-	-	-	-	-	-	-	-	-	-	-	-
Self Use	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	17.40	-	-	-	17.40
Water Recirculation, Water Returning to Environment	-	-	-	-	-	-	-	-	-	-	-	-
To Inland Water Resources	-	-	-	-	-	-	-	-	-	-	89.33	89.33
To Other Water Sources	-	-	-	-	-	-	-	-	-	-	5,274.50	5,274.50
Total Recirculation	-	-	-	-	-	-	-	-	-	-	5,363.81	5,363.81
Evaporation of Drawn Water, Transpiration, and Water Incorporated in Products	-	-	-	-	-	-	-	-	-	-	-	-
Evaporation of Drawn Water	-	-	-	-	-	-	-	-	-	-	7.85	7.85
Transpiration	-	-	-	-	-	-	-	-	-	-	-	-

Water Usage	Agriculture	Agricultural Industries, Forestry, and Fisheries	Mining and Quarrying, Manufacturing, and Construction	Electricity, Gas, Steam, and Air Conditioning	Service Sector	Accommodation	Water Supply, Water Production, and Water Distribution	Wastewater Management	Other Industries	House holds	Recirculation from Environment	Total
Water Incorporated in Products	-	-	-	-	-	-	-	-	-	-	-	-
Total Usage	2,209.69	0.20	14.49	6.44	297.02	218.48	18.82	17.40	86.69	195.71	5,363.81	8,428.75

4. Synthesis of Findings and Recommendations

Thailand faces significant risks to its water security driven by systemic environmental and anthropogenic shifts. Foremost among these are localized water scarcities exacerbated by hydrological variability, alongside climate change impacts that exert long-term pressures on surface runoff and aquifer recharge rates. Concurrently, escalating water demand has intensified demand-supply imbalances across various catchments. These coupled challenges jeopardize livelihoods, ecological integrity, and ecosystem services, while the increasing frequency and intensity of hydro-meteorological hazards pose compounding risks nationwide.

Consequently, robust water resources management—calibrated to the nation's hydrological potential—is imperative to optimize allocative efficiency and ensure alignment with national water strategic frameworks. Within this context, establishing a national water accounting framework is critical. Such a system systematically quantifies water assets (resource potential) and water expenditures across distinct economic sectors, providing a standardized, empirical foundation for strategic planning, resource conservation, and sustainable utilization.

The System of Environmental-Economic Accounting for Water (SEEA-Water) provides a conceptual framework for organizing hydrological and economic information in a coherent and consistent manner. Developed as a satellite system of the 2008 System of National Accounts (SNA), it directly links environmental data to economic accounts through shared structures, definitions, and classifications. Its primary objective is to enable a rigorous analysis of the contribution of water resources to the economy, as well as the environmental impacts exerted by economic activities on the water cycle.

The components of the water accounts are categorized into the following core modules:

- **Physical Supply and Use Tables (PSUT):** These tables describe water flows in physical units within the economy, as well as exchanges between the environment and the economy. They systematically record water abstraction (withdrawal from the environment), distribution within the economic system, the reuse of wastewater, and return flows (discharges back into the environment).
- **Emission Accounts:** This component quantifies the anthropogenic pressures exerted on the environment by measuring the pollutants added to water resources. It records the mass of pollutants generated by economic activities and households that are either released directly into the environment or intercepted and removed by wastewater treatment processes.
- **Hybrid and Economic Accounts:** These accounts align the physical data from supply and use tables with the monetary supply and use tables of the SNA. By combining disparate measurement units (e.g., cubic meters and currency), they facilitate the derivation of water efficiency indicators, such as gross value added (GVA) per unit of water used. Furthermore, they isolate the economic costs associated with water abstraction, purification, distribution, and wastewater management, while identifying how these environmental services are financed.

- **Asset Accounts:** These accounts measure the stocks of water resource assets at the opening and closing of an accounting period. They record fluctuations in stocks driven by both natural processes (e.g., precipitation, evapotranspiration, and inflows) and human interventions (abstraction and return flows), effectively structuring a hydrological water balance within an accounting framework.
- **Water Quality Accounts:** This module characterizes water resources by their ecological or chemical status, tracking the stocks of different quality classes between the beginning and end of a period. Because attributing specific quality fluctuations to exact causal factors is inherently complex, these accounts generally describe net changes over the accounting period. This component is currently classified as experimental.
- **Valuation of Water Resources:** This category focuses on the economic valuation of water assets and ecosystem services, which often extend beyond the market transactions recorded in the standard SNA. It evaluates various environmental economic valuation techniques to establish the shadow price or economic value of water as an environmental good. Like quality accounts, this remains an experimental module due to the lack of an international consensus on a standardized.

Synthesis of Findings

Thailand's development of national water resource accounts has progressed through several distinct periods. In the initial phase, water accounting during 2005–2007 focused on synthesizing an overall picture through a three-tier water balance analysis— Water Managers (dams and reservoirs), Water Providers (irrigation and water supply authorities), Water Users (households, agriculture, and industry)—presented on a seasonal basis (wet and dry seasons). However, this period faced limitations in data availability and completeness, requiring estimation methods for certain data due to the absence of systematic recording, such as water volumes for medium- and small-scale water sources, groundwater volumes, water reuse volumes, and wastewater volumes, among others. Nevertheless, an economic valuation was conducted for water resource storage, provision, and use across surface water, groundwater, and piped water supply. The study found that although Thailand possesses adequate water resources overall, the high seasonal variability in rainfall represents a major challenge for adaptation to changing conditions. The study also offered recommendations for application at the area level, such as river basins and sub-districts, to determine the status of available water volume, water use volume, water use efficiency, and shortages—which would need to be linked with economic accounting to support sustainable water resource management planning. Accordingly, the study proposed several recommendations for water accounting: mapping water sources, locations, and capacities to reveal the physical potential for water distribution across areas, thereby supporting water management decision-making and risk/crisis management planning; conducting economic efficiency analyses for water use across areas or between countries, and using these to assess the value of investment in water source development; supporting local authorities in surveying water source data and preparing household accounts to obtain accurate information for comprehensive and cost-effective assistance planning; and using data from water accounts as a foundation for provincial development plans, so that water management aligns with economic and social growth in each area.

The subsequent water accounting study in 2016 employed a holistic analytical approach covering both the demand side (consumption, agriculture, industry, tourism, and ecosystems) and the supply side (rainfall, runoff, and storage). This involved analyzing the water balance among net inflow, depleted water, and outflow, as well as analyzing crop water use and evaporation from soil and water surfaces, by applying hydrological processes in conjunction with satellite data to obtain an overview of river basins across all sectors, including forested areas and areas outside irrigation zones. The study also incorporated spatial and temporal management for 25 major river basins, grouped into 5 basin clusters according to geographic characteristics and natural water flow (North-Central, Northeast, East, West, and South), and selected representative years—low-water, medium-water, and high-water years—between 2001 and 2013 (B.E. 2544–2556) to compare water conditions under different scenarios. However, this round of water accounting was limited to a physical study and did not include economic valuation.

Regarding the challenges of water resource management in Thailand, the study found that water demand continues to rise due to urban and economic expansion, while rainfall and climatic conditions exhibit high variability, leading to conflicts over water use among different sectors, particularly during low-water years. Data limitations were also identified, including insufficient distribution of rainfall gauge stations to cover all areas—particularly mountainous regions—and outdated land-use data. Nevertheless, the government sector should support responsible agencies in using water accounts as a decision-making tool for river basin development planning and feasibility studies, in order to gain a systematic understanding of overall impacts; in constructing medium- and small-scale water storage facilities to capture usable runoff; in linking water networks between river basins; and in pursuing integrated management involving collaboration between public and private agencies, with the aim of achieving sustainable water resource management.

In addition, the government sector prepared a practical guidance manual for developing the System of Environmental-Economic Accounting and water accounts for Thailand in 2021, to serve as a framework and guideline for national water accounting in line with the SEEA standard. This involved studying the conceptual framework, consulting with experts and policy agencies to identify required indicators, designing and adjusting the scope to fit the Thai context—such as choosing to prepare accounts separately by season (wet/dry)—and compiling and analyzing data from multiple agencies. However, Thailand still lacks a central agency that comprehensively compiles nationwide water resource data, such as data on self-abstraction, village/municipal water supply data, data on desalinated freshwater production by private operators, groundwater data for wells drilled without permits, and data on wastewater volumes self-treated at establishments, among others. This also includes support for linking such data with national accounts.

Nevertheless, although Thailand has undertaken water accounting efforts, these have lacked continuity, and there remains no clear physical water account assessment. Therefore, development should proceed toward linking water accounts with economic value, in order to reveal the true overall cost of water resources, by connecting the Input-Output (I-O) Table with water accounting under the SEEA framework, to integrate environmental data with the economic system—enabling policymakers to gain a clearer macro-level view of the water situation overall.

Recommendations

- Using water account data to support policy decision-making: Water accounts should be used as supporting information for decision-making, in order to identify which production sectors use large volumes of water and whether continued support for such sectors is worthwhile relative to the output generated.
- Applying economic measures to water management: Since water use tends to continue rising while raw water sources remain fixed, future water management planning must incorporate economic measures as part of its considerations.
- Linking with national income accounts: The long-term goal is to develop water accounts that can be linked to Thailand's GDP figures, in order to measure sustainable economic growth while accounting for the degradation of natural resources.
- Developing a more comprehensive database system: Agencies should be encouraged to record water user data according to TSIC codes, to enable linkage with national accounts and calculation of water use efficiency by sector. Integration of wastewater data is also needed to determine the actual volume of wastewater entering treatment systems, which would benefit future expansion of treatment system capacity. Additional data collection tools should be developed for data outside the formal registration system—such as household rainwater harvesting, soil moisture, and self-use agricultural water pumping—which will require additional surveys.

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Appendix 1: Water Resources Accounting for Krabi Province

1. Introduction

1.1 Background

Water resource management has become increasingly critical in the face of growing environmental challenges, climate change, and increasing demand across various sectors. The complex interactions between natural water systems and human economic activities necessitate comprehensive and integrated approaches to understanding water resources. Water accounting emerges as a crucial methodology to systematically track, analyze, and manage water resources, providing insights into water availability, usage patterns, and sustainability.

Water Accounting is a process of linking water resources and allocated water to water users, considering water account components from water sources, water procurement, water losses, user types, and agencies that provide water services. Data can be collected and analyzed from water service providers and other government agencies. Additionally, spatial water resources and demand can be analyzed using rainfall maps, temperature, and evaporation rates from satellite imagery to determine actual or near-actual water usage for each user type, water use efficiency, and water scarcity in the area.

The System of Environmental-Economic Accounting for Water (SEEAW) provides a conceptual framework for organizing hydrological and economic data in a coherent manner, describing interactions between the economy and environment while covering all natural resources and environmental aspects (CEC et al., 1993). It is a standard system for collecting economic statistics and obtaining national economic indicators such as Gross Domestic Product (GDP) or determining water value in production processes.

SEEAW is a valuable tool supporting Integrated Water Resources Management (IWRM) by preparing information systems to provide knowledge for decision-making processes. This includes efficient water resource allocation, improving water use efficiency, understanding water management impacts on users, maximizing investment value in infrastructure, linking water use capabilities, and providing standardized information consistent with various sources, accepted by stakeholders.

The objective of water accounting is to assist in evaluating water utilization across economic activities, household consumption, and ecosystem services. It serves as a framework for linking water resources with other natural resources, while also helping to explain the natural water cycle and the flow of water within the economic system. Furthermore, it acts as fundamental data for water source development and the evaluation of water resource policy implementation.

The system also facilitates using indicators, involving stakeholders in decision-making, studying climate change impacts on water usage, and assessing water resource potential Water accounting builds upon several foundational concepts and methodological frameworks:

1. System of National Accounts (SNA):

- Established global macroeconomic statistical framework
- Provides basis for economic indicators
- Serves as a foundation for environmental-economic accounting

2. System of Environmental-Economic Accounting (SEEA):

- Demonstrates interactions between economic systems and environmental resources
- Tracks resource extraction, ecosystem service utilization, and waste generation
- Offers a standardized approach to integrating environmental considerations into economic analysis

3. Integrated Water Resources Management (IWRM):

- Holistic approach to water management
- Considers environmental, economic, and social dimensions simultaneously
- Emphasizes comprehensive and sustainable water resource governance

1.2 Objectives

1. Quantify water resources, allocation, and demand across different sectors (agriculture, industry, domestic consumption, services)

2. Implement water accounting frameworks for tracking water flows and transformations within a district context

1.3 Scope of works

1. Collect and analyze climate and hydrological conditions from relevant agencies such as Thai Meteorological Department and Royal Irrigation Department.

2. Collect and assess water resources and water flow volumes from relevant agencies such as Royal Irrigation Department and Land Development Department.

3. Gather allocated water and self-extracted water volumes from relevant government agencies such as Royal Irrigation Department, Provincial Waterworks Authority, Krabi Provincial Office, and Department of Groundwater Resources.

4. Collect and analyze water demand for various activities such as domestic, industrial, agricultural, and service Sectors.

5. Develop water accounts for Krabi Province by district using the aforementioned relevant Data.

1.4 Expectations for Water Accounting

1. Provide Comprehensive Data Insights

- Detailed mapping of water resources
- Quantitative analysis of water flows
- Identification of water usage patterns across sectors

2. Support Policy Development

- Create evidence-based foundations for water management strategies
- Enable precise tracking of water allocation and consumption
- Support sustainable development goals

3. Enable Environmental and Economic Integration

- Demonstrate complex interactions between water resources and economic activities
- Facilitate understanding of water's role in broader ecological and economic systems

4. Enhance Decision-Making Capabilities

- Provide actionable insights for water resource management
- Support adaptive strategies in response to changing environmental conditions
- Enable proactive resource allocation and conservation efforts

2. Principles and Study Guidelines

In preparing this water account, the water accounting principles were implemented under the following guidelines: water resource volume assessment, water allocation by agencies, self - water procurement, water usage for various activities, and economic and environmental accounting. The details are as follows:

2.1 Water Resource Volume Assessment Guidelines

2.1.1 Water Storage

1. Medium-sized reservoir water storage volume was obtained by collecting water storage data from 6 important reservoirs of the Royal Irrigation Department: Bang Kam Prad Reservoir, Huai Sai Khao Reservoir, Huai Leuk Reservoir, Khlong Ya Reservoir, Khlong Haeng Reservoir, and Huai Nam Khiew Reservoir.

2. Pond water storage volume is estimated by multiplying the ground surface area by the pond depth, with the pond depth set at approximately 6 meters.

2.1.2 Inflow of water resources

1. Small reservoir water inflow volume was collected from medium-sized reservoir data from the Royal Irrigation Department.

2. Pond water inflow was estimated using the water supply coefficient of the reservoir's catchment area, with the assumption that a 500 cubic meter reservoir volume corresponds to a 1-rai (1,600 sq.m) catchment area

(based on the initial consideration manual for small water resource development by the Agricultural Land Reform Office, Ministry of Agriculture and Cooperatives)

3. River runoff is estimated by multiplying the reservoir's water supply coefficient with the district area.

2.2 Guidelines for Analyzing Water Allocation from Relevant Agencies

1. Provincial Waterworks Authority water supply volume was obtained by collecting data on water distribution for consumption, commercial, and industrial purposes from the Provincial Waterworks Authority.

2. Village water supply pumping volume (groundwater) was calculated by multiplying the number of households served by village water supply by the number of people per household, multiplied by the water usage rate per person (set at 50 liters per person per day).

3. Groundwater pumping volume for government wells for consumption was estimated by multiplying the authorized pumping volume by the number of pumping hours (8 hours) multiplied by the groundwater pumping coefficient (average approximately 0.60).

4. Groundwater pumping volume for private wells used for consumption, business, and agriculture was estimated by multiplying the authorized pumping volume by the number of pumping hours (8 hours) multiplied by the groundwater pumping coefficient (average approximately 0.60).

5. Irrigation project water allocation volume was estimated by dividing the project's agricultural water usage data by 1.3.

6. Water usage from storage ponds was estimated by dividing the effective water volume of storage ponds by 1.3.

2.3 Guidelines for Estimating Water Demand for Various Activities

The analysis of water demand for Krabi Province includes water requirements for consumption, industry, and agriculture, with the following study details:

2.3.1 Domestic Water Demand

The assessment of domestic water demand can be estimated using population data by sub-district and water usage rates, with the following evaluation details:

1. Collect relevant data, including: Population data by sub-district from the Department of Local Administration, categorized into population numbers within and outside municipal areas for the years 2015-2024. Water usage rates within and outside water service areas (Royal Irrigation Department, 2003, 2010) Water usage rates defined as: Within water service areas: 176 liters/person/day and outside water service areas: 50 liters/person/day.

2. Calculate current domestic water consumption by sub-district for the years 2015 - 2024 by multiplying the current population by the water usage rate, using the following equation:

WDpr = Ppr x WUdpr x 1000 x 365 (1)

Where :

WDpr = Current domestic water consumption (cubic meters per year)

Ppr = Number of people in the sub-district within and outside water service areas

WUdpr = Water usage rate per person (liters/person/year)

3. Summarize domestic water consumption within and outside water service areas by sub-district and district for the period 2015 - 2024.

2.3.2 Industrial Water Demand

The assessment of industrial water demand can be estimated from basic industrial plant information, including: number of horsepower per sub-district and district, production capacity, water usage rate per horsepower, water usage rate per production unit, number of working hours, water reduction capability, water use efficiency (Sustainability Water Institute, 2015) The evaluation details are as follows:

1. Collect relevant data: basic information of industrial plants authorized to operate from 2015 - 2024, classified into 107 industrial plant types, number of horsepower per plant

2. Calculate current industrial water demand (WIpr) for 2015-2024 by district and industrial plant type, using the following equation:

WIPpr = Wr x HP x Dw x %EFF (2)

Where :

WIPpr = Water consumption rate per horsepower per day (cubic meters per horsepower per day)

HP = Number of horsepower for industrial plants (cubic meters)

Dw = Number of working days (set at 261 days in this study)

%EFF = Water use efficiency for each industrial type, calculated as (1-%ECO)

%ECO = Water saving capability (in percentage)

3. Summarize industrial water demand by sub-district and district for the period 2015 - 2024. Here's the translation to English:

2.3.3 Agricultural Water Demand

The assessment of agricultural water demand by district can be estimated from data related to agricultural areas, including: economic crop cultivation areas in irrigation zones, irrigation project cultivation areas from 2015 - 2024, cropping calendar by region, climate data, crop water coefficient reference. Data was collected from irrigation areas : Royal Irrigation Department and rainfed areas: Office of Agricultural Economics for the period 2015 - 2024. Detailed assessment includes:

1. Collect annual economic crop cultivation data for irrigation and non-irrigation zones from 2015-2024, including: wet season rice, dry season rice, field crops, additional relevant information such as: cropping calendar, field infiltration, crop-specific water coefficients, crop reference evapotranspiration rate.

2. Summarize and create a database of economic crop cultivation areas in irrigation and non-irrigation zones by province from 2015 - 2024

3. Analyze crop reference evapotranspiration daily and weekly using Penman-Montieth equation

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

Where : ETo = Reference crop water consumption (mm/day)

Rn = Total solar radiation received by the crop (megajoules/m²/day)

G = Rate of heat energy transfer in soil (megajoules/m²/day)

T = Average air temperature (degrees Celsius)

Δ = Slope of the vapor pressure gradient curve (kilopascals/degrees Celsius)

γ = Psychrometric constant (kilopascals/degrees Celsius)

U2 = Wind speed at 2 meters above ground level (meters/second)

(es - ea) = Rate of transfer (vapor pressure deficit).

4. Analyze water requirements by considering: field infiltration, crop-specific water coefficients, and reference crop evapotranspiration

$$ET = K_c \times E_{tp}$$

$$W_{ir} = (ET + P - Re) / EFF_{ir}$$

Where :

Wir = Water requirement of crops after deducting effective rainfall, unit in millimeters

ET = Water used by crops, unit in millimeters

P = Infiltration volume in cultivation fields, unit in millimeters

Re = Effective rainfall, unit in millimeters

Kc = Crop-specific water coefficient

Etp = Reference crop evapotranspiration, unit in millimeters

EFFirr = Irrigation efficiency, for non-irrigation areas: set to 1.0, and rainfed areas: set to 0.65.

5. Calculate agricultural water demand in irrigation and non-irrigation zones: daily and weekly calculations, by crop type, province, and month.

6. Summarize monthly agricultural water demand for irrigation and non-irrigation zones by sub-district and district in the period 2015-2024.

2.3.4 Water Demand for Services

The assessment of water demand for services covers 4 user groups: educational institutions, business establishments, hotels and resorts, and hospitals. Detailed calculation methodology:

Assessment of educational institutions' water demand can be estimated from the number of students and teachers (schools and universities) during the period 2015-2024, using data from the National Statistical Office. Calculation details included water usage rate: 60 liters/person/day, working days: 200 days (Metcalf and Eddy, 2003). Specific steps:

1. Collect data on the number of students and teachers from 2015-2024 using National Statistical Office information

2. Calculate academic water demand (WDA) using the following equation:

$$WDA = NS \times Wrt \times 200/1{,}000$$

Where :

NS = Number of students and teachers (persons)

Wrt = Water usage rate per person (liters/person/day)

3. Summarize monthly water demand for educational services by sub-district and district.

Assessment of commercial enterprises' water demand can be estimated from the number of workers using Krabi Provincial Statistical Office data: water usage rate: 75 liters/person/day and working days : 246 days. Detailed evaluation steps:

1. Collect data on the number of workers from 2015-2024 using the Business and Service Census conducted by the National Statistical Office.

2. Calculate enterprise water demand (WDB) using the following equation:

$$WDB = NE \times Wrt \times 246/1{,}000$$

Where :

NE = Number of entrepreneurs and employees (persons)

Wrt = Water usage rate per person (liters/person/day)

3. Summarize monthly water demand for business establishments by sub-district and district.

Assessment of water demand for hotels and resorts were evaluated based on the number of tourists staying overnight and the number of overnight stays multiplied by water usage rate per person per day.

1. Collect data on the number of tourists staying overnight from 2015-2024 using information from the Ministry of Tourism and Sports

2. Calculate water demand for hotels and resorts (Accommodation water demand, WDH) using the following equation :

$$WDH = NH \times DH \times WH / 1{,}000$$

Where : NH is guest arrivals of accommodation (persons), DH is length of stay (days), WH is water usage rate per person (210 liters per person per day)

3. Summarize monthly water demand for hotels and resorts by sub-district and district.

Assessment of water demand for hospital services were evaluated based on the number of medical personnel and patients from 2015 - 2024, considering inpatients and outpatients multiplied by overnight stays and water usage rate per person per day. Detailed assessment steps:

1. Collect data on number of inpatient days and number of daily outpatients from hospital basic information under the Permanent Secretary of the Ministry of Public Health for the period 2015-2024.

2. Calculate hospital water demand (WDH) with two components:

Inpatient Water Demand: $WDHIN = NHIN \times Wrt / 1{,}000$

Where: NHIN is number of inpatient days and Wrt is water usage rate (60 liters/person/day)

Outpatient Water Demand: $WDHOUT = NHOUT \times Wrt / 1{,}000$

Where : NHOUT is number of daily outpatients and Wrt is water usage rate (5 liters/person/day)

3. Summarize monthly hospital water demand by sub-district and district.

3. Meteorology

The objective of studying hydrology and meteorology is to utilize the findings for analyzing agricultural water demand within and outside irrigation areas, as well as evaluating water budget. The details of the study are as follows:

3.1 Meteorological Conditions

Daily and monthly meteorological data from weather stations in Krabi Province were collected and analyzed based on Thai Meteorological Department records from 1995 to 2024. This data includes maximum temperature, minimum temperature, average temperature, relative humidity, wind speed, sunshine duration, evaporation rate, and evapotranspiration rate. When analyzing the monthly averages, maximums, and minimums, it was found that Krabi Province has an average maximum temperature of 32.47 - 32.57 °C, with a range of 30.91 - 34.79°C; the highest value occurs in April and the lowest in December. The average minimum temperature is 22.96 - 24.39°C, with a range of 12.77 - 25.10°C; the highest value occurs in May and the lowest in February. The overall average temperature is 27.76°C, with a range of 26.54 - 29.63°C; the highest value occurs in April and the lowest in December.

The average relative humidity is 82.88 - 83.08%, with a range of 75 - 86%; the highest value occurs in November and the lowest in February. The average wind speed is 11.71 – 13.57 knots, with a range of 10.93 – 17.38 knots; the highest value occurs in August and the lowest in April. The average sunshine duration is 5.88 – 5.98 hours, with a range of 4.53 - 8.09 hours; the highest value occurs in February and the lowest in October. The average evaporation rate is 1,442.49 - 1,450.34 mm/year, with a monthly range of 99 - 150 mm/month; the highest value occurs in March and the lowest in November. The average evapotranspiration rate is 1,559.92 - 1,583.13 mm/year, with a monthly range of 105 - 165 mm/month; the highest value occurs in March and the lowest in November. The distribution of meteorological conditions for the Krabi weather station is shown in Table 1 and 2, and the meteorological summary of Krabi Province is provided.

Table 3 Summary of Meteorological Conditions for Station 566201

Weather	Statistics	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Dry	Wet	Annual
Average Maximum Temperature	Max	ºC	34.35	35.03	35.86	36.65	35.46	33.45	33.57	33.16	32.57	32.49	32.21	33.06	34.53	33.45	33.99
	Min	ºC	30.60	31.95	32.74	32.12	31.61	31.43	31.11	29.93	30.28	29.73	30.24	29.20	31.14	30.68	30.91
	Average	ºC	32.05	33.34	34.24	34.35	33.20	32.44	32.15	31.86	31.61	31.44	31.18	30.99	32.69	32.12	32.41
Average Minimum Temperature	Max	ºC	25.65	25.43	26.63	26.47	26.11	26.43	25.96	26.25	25.60	25.40	25.20	24.94	25.72	25.96	25.84
	Min	ºC	21.56	22.25	23.12	23.79	23.96	23.90	23.69	23.38	23.49	23.46	23.25	22.14	22.68	23.65	23.17
	Average	ºC	23.68	23.77	24.36	24.92	25.10	24.91	24.74	24.72	24.48	24.28	24.11	23.66	24.08	24.71	24.39
Average Temperature	Max	ºC	29.61	30.04	30.63	31.02	30.56	29.70	29.76	29.06	28.86	28.65	28.39	28.69	29.73	29.43	29.58
	Min	ºC	26.64	27.37	28.23	28.37	28.38	28.03	28.01	27.13	27.45	27.25	26.78	25.85	27.21	27.71	27.46
	Average	ºC	27.87	28.55	29.30	29.63	29.15	28.67	28.45	28.29	28.05	27.86	27.64	27.32	28.39	28.41	28.40
Average Relative Humidity	Max	%	90	87	91	94	93	93	90	93	93	95	94	93	91.25	93.10	92.17
	Min	%	69	68	68	73	77	76	78	78	81	80	79	72	71.52	78.55	75.04
	Average	%	79	76	79	82	84	85	84	85	86	87	86	83	80.84	85.33	83.08
Average Solar Radiation	Max	Hour	8.73	9.36	8.95	8.79	7.10	6.54	6.18	6.04	5.82	6.31	6.23	7.01	8.18	6.33	7.25
	Min	Hour	3.80	5.32	4.86	5.59	4.17	4.29	3.90	4.03	3.73	3.26	3.31	3.95	4.47	3.90	4.18
	Average	Hour	6.99	8.09	7.75	7.41	6.07	5.30	5.12	5.27	4.82	4.73	4.91	5.34	6.75	5.22	5.98
Average Wind Speed	Max	Knot	17.77	18.02	18.73	17.43	21.03	24.77	23.03	26.13	24.77	24.32	14.92	16.39	17.21	24.01	20.61
	Min	Knot	6.74	6.29	7.71	6.83	8.58	8.53	9.61	11.35	7.50	7.39	4.53	5.84	6.32	8.83	7.58
	Average	Knot	12.14	12.13	11.68	11.38	14.40	15.80	16.27	17.38	16.49	13.49	10.54	11.17	11.51	15.64	13.57
Average Evapolation rate	Max	mm.	154	158	191	182	153	132	135	178	141	128	123	123	931.71	867.45	1799.16
	Min	mm.	100	103	111	108	112	99	105	97	100	90	83	87	592.84	604.11	1196.95
	Average	mm.	123	133	150	139	127	117	118	122	110	107	99	106	750.20	700.14	1450.34
Average Evapotranspiration rate	Max	mm.	197	196	202	177	163	156	151	155	140	140	127	162	1059.43	904.26	1963.69
	Min	mm.	101	115	112	119	109	98	111	100	100	90	89	92	627.48	607.74	1235.22
	Average	mm.	144	152	165	150	137	123	127	130	117	113	106	118	835.42	747.70	1583.12

Table 4 Summary of Meteorological Conditions for Station 566202, Krabi Province

Weather	Stat	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Dry	Wet	Annual
Average Maximum Temperature	Max	oC	34.72	36.01	37.22	38.10	36.01	34.44	33.83	33.10	32.36	33.27	32.73	33.49	35.38	33.84	34.61
	Min	oC	30.20	31.74	32.59	32.46	32.32	31.75	31.43	30.24	30.69	30.56	29.93	29.08	31.00	31.16	31.08
	Average	oC	32.01	33.43	34.70	34.79	33.47	32.61	32.24	31.99	31.79	31.61	31.24	30.91	32.85	32.29	32.57
Average Minimum Temperature	Max	oC	24.08	23.32	23.92	25.52	25.57	25.06	24.87	24.87	24.80	24.47	24.49	23.86	24.20	24.94	24.57
	Min	oC	17.91	17.97	20.33	21.09	22.10	21.49	20.98	20.51	19.95	19.39	19.81	19.52	19.44	20.74	20.09
	Average	oC	21.85	21.77	22.66	23.59	24.08	23.80	23.52	23.32	23.07	22.82	22.81	22.18	22.48	23.43	22.96
Average Temperature	Max	oC	29.15	29.66	30.57	31.81	30.79	29.65	28.78	28.79	28.22	28.76	28.61	28.67	29.75	29.16	29.45
	Min	oC	24.43	25.12	27.38	27.58	27.28	27.00	26.58	25.74	25.63	25.45	25.09	24.81	25.74	26.28	26.01
	Average	oC	26.93	27.60	28.68	29.19	28.78	28.21	27.88	27.65	27.43	27.22	27.02	26.54	27.66	27.86	27.76
Average Relative Humidity	Max	%	94	93	93	97	97	97	96	98	98	99	98	96	95.33	97.62	96.47
	Min	%	64	57	61	68	73	77	79	78	79	80	77	71	66.34	77.49	71.92
	Average	%	78	75	77	80	84	85	85	86	87	88	87	83	79.88	85.89	82.88
Average Solar Radiation	Max	Hour	8.82	9.35	8.99	8.59	7.07	6.67	5.81	5.99	5.40	6.14	6.39	7.03	8.20	6.18	7.19
	Min	Hour	3.62	5.25	4.96	5.32	3.98	3.86	3.57	3.29	3.26	3.00	3.05	3.73	4.32	3.49	3.91
	Average	Hour	7.13	8.10	7.70	7.25	5.81	5.01	4.89	5.07	4.57	4.53	4.96	5.54	6.78	4.98	5.88
Average Wind Speed	Max	Knot	18.77	22.50	14.10	15.30	16.23	16.77	20.97	18.94	18.37	20.26	16.33	20.74	17.96	18.59	18.27
	Min	Knot	6.35	6.64	5.84	5.50	5.23	6.42	5.48	5.55	5.47	5.19	5.33	6.71	6.06	5.56	5.81
	Average	Knot	12.28	12.30	11.19	10.93	10.99	11.40	12.07	12.44	11.92	11.07	11.29	12.61	11.77	11.65	11.71
Average Evapolation rate	Max	mm.	155	171	189	184	155	132	132	149	130	123	122	128	948.7	820.19	1768.89
	Min	mm.	99	105	113	91	98	93	106	97	96	87	84	83	574.2	576.82	1151.02
	Average	mm.	121	134	152	141	126	116	116	120	109	104	99	105	751.6	690.84	1442.49
Average Evapotranspiration rate	Max	mm.	202	235	227	194	176	147	151	158	134	131	135	161	1154.	897.03	2051.74
	Min	mm.	98	112	105	120	107	91	93	92	85	85	79	85	597.9	554.08	1152.01
	Average	mm.	144	153	169	154	134	119	121	123	111	109	105	119	844.1 5	715.77	1559.92

3.2 Rainfall Conditions

Rainfall data was collected from 21 rainfall stations within Krabi Province, managed by the Thai Meteorological Department, covering the period from 1995 to 2024. Based on the analysis of monthly average, maximum, and minimum rainfall data, it was found that Krabi Province has an average annual rainfall of 1,773.7 mm, with a range of 32.7 – 247.0 mm. The highest rainfall occurs in September, while the lowest is in February and a summary of rainfall conditions by district is provided in Table 3.

Table 5 Summary of Monthly Average Rainfall by Station in Krabi Province

Station	Monthly Average Rainfall, mm/month												Dry season	Wet Season	Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
BKHN	92.6	30.6	56.0	102.3	139.7	120.1	159.7	161.0	199.6	223.8	215.5	134.8	597.1	1003.9	1601.1
BMDG	82.9	25.9	32.0	88.5	148.2	159.0	168.9	184.3	176.4	237.8	177.5	131.3	514.8	1074.7	1589.5
BSBA	74.2	12.9	14.8	35.8	87.7	49.2	92.5	77.9	97.3	119.6	149.2	103.0	373.0	524.1	897.2
CBUR	82.4	37.4	44.2	132.1	186.6	113.1	159.6	163.3	191.0	197.0	179.3	106.7	544.3	1010.6	1554.9
CHNA	67.1	24.6	36.8	98.0	151.1	107.2	154.7	151.9	194.9	191.7	173.7	92.4	470.4	951.5	1421.9
HYOD	87.7	47.2	47.9	98.7	130.4	130.4	169.6	160.7	185.9	243.0	225.1	158.3	623.9	1020.0	1643.9
KHNI	57.3	27.5	25.0	105.9	166.6	136.3	148.0	131.1	145.1	189.3	148.6	106.9	446.0	916.5	1362.5
KMSI	43.6	20.0	31.2	96.2	163.6	196.5	235.1	290.2	286.4	204.1	172.8	91.0	421.4	1375.8	1797.2
KOSK	52.1	39.2	63.5	112.6	221.7	268.8	416.6	379.3	508.8	416.1	168.8	109.6	506.7	2211.3	2718.0
LMKD	55.3	32.9	38.8	107.7	154.1	142.8	176.5	209.8	218.8	180.5	202.4	94.0	485.7	1082.5	1568.2
NANG	70.4	35.5	72.8	120.7	232.6	191.5	252.9	288.8	320.8	265.4	190.8	84.9	523.7	1551.9	2075.6
NKO001	130.4	43.5	31.3	75.5	166.1	159.3	161.7	171.1	211.9	222.5	302.9	200.8	746.6	1092.5	1839.1
TKP002	61.2	47.1	69.1	120.8	266.0	258.4	308.9	322.1	375.3	321.9	164.1	79.8	486.2	1852.7	2338.9
TNG001	83.6	25.7	49.3	114.8	119.1	122.4	165.4	186.5	193.6	202.4	206.8	141.4	582.7	989.5	1572.2
TNG002	68.6	25.8	36.5	120.5	169.6	146.5	187.9	228.1	286.7	238.5	216.5	143.3	572.0	1257.3	1829.3
TPI005	53.8	20.8	51.1	85.6	157.1	110.3	157.9	121.4	137.3	177.9	158.9	84.5	396.8	861.9	1258.7
TTLG	69.7	44.9	77.3	127.6	280.1	208.8	260.1	291.1	308.8	248.6	168.5	82.2	500.4	1597.6	2098.0
VLGE09	71.9	41.2	50.6	115.6	169.2	123.9	205.7	143.6	194.2	203.3	172.3	107.8	520.2	1040.0	1560.1
552008	73.5	22.2	39.4	102.3	188.2	150.9	191.7	164.2	195.6	221.5	204.4	144.4	565.8	1112.0	1677.8
566005	89.6	39.6	88.9	165.6	242.2	290.6	312.8	342.8	398.5	277.4	188.4	99.3	584.0	1864.2	2448.3
567010	102.7	41.8	99.4	171.1	235.8	248.7	298.2	244.4	359.7	287.0	240.3	165.5	721.6	1673.7	2395.3
Average	74.8	32.7	50.3	109.4	179.8	163.6	208.8	210.2	247.0	231.9	191.8	117.2	532.5	1241.2	1773.7

4. Water Resource, Allocated Water, and Procured Water Volumes

This chapter consists of assessing water resource volumes, evaluating allocated water volumes, determining procured water volumes for each district, and providing input data for water accounting.

4.1 Water Resources

Data collected includes water storage in medium reservoirs, small water sources and river runoff volumes.

4.1.1 Medium Reservoirs

The study collected water storage data from six medium reservoirs in Krabi Province, including Bang Kam Prat, Huai Nam Khiew, Khlong Ya, Huai Leuk, Khlong Haeng, and Huai Sai Khao Reservoirs. The total water storage amounts to 33.68 million cubic meters. Table 4 presents the average monthly water storage for these medium-sized reservoirs in Krabi Province.

Table 6 Average Monthly Water Storage for Medium Reservoirs in Krabi Province

Reservoir	Storage, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
Bang Kam Prat	14.29	14.26	13.66	12.83	11.67	10.91	11.37	10.83	10.98	11.17	12.14	13.28	12.94	11.63	12.28
Huai Nam Khiew	4.93	4.83	4.58	4.19	3.80	3.57	3.61	3.59	3.76	4.04	4.41	4.82	4.32	4.04	4.18
Khlong Ya	3.22	3.04	2.96	2.74	2.44	2.31	2.59	2.58	2.71	2.89	3.13	3.13	2.78	2.84	2.81
Huai Leuk	2.27	2.15	2.03	1.80	1.58	1.43	1.54	1.49	1.59	1.73	1.88	2.21	1.88	1.74	1.81
Khlong Haeng	10.30	9.92	10.12	9.28	8.42	7.66	7.09	6.86	7.06	7.51	8.65	9.97	9.28	7.86	8.57
Huai Sai Khao	4.29	4.29	4.03	3.93	3.79	3.36	4.81	4.65	3.41	3.62	4.25	3.97	3.95	4.12	4.03
Total	39.29	38.49	37.37	34.77	31.70	29.24	31.01	30.01	29.50	30.95	34.47	37.37	35.14	32.22	33.68

4.1.2 Small Water Sources

Based on data from the National Water Resources Office database, Krabi Province has a total of 171 small water sources with a water storage capacity of 6 million cubic meters. The average monthly water storage for these small water sources is presented in Table 5.

Table 7 Average Monthly Water Storage for Small Water Sources in Krabi Province

Code	District	Water storage, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	2.07	1.93	1.82	1.67	1.53	1.47	1.54	1.62	1.83	2.08	2.16	2.10	1.75	1.89	1.82
8102	Khao Phanom	1.18	1.17	1.11	1.04	0.95	0.89	0.93	0.91	0.94	0.99	1.06	1.13	1.06	0.99	1.03
8103	Ko Lanta	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
8104	Khlong Thom	0.98	0.97	0.91	0.85	0.79	0.74	0.75	0.74	0.76	0.80	0.88	0.94	0.87	0.81	0.84
8105	Ao Luek	0.32	0.30	0.28	0.26	0.23	0.22	0.24	0.25	0.28	0.32	0.33	0.32	0.27	0.29	0.28
8106	Plai Phraya	0.43	0.41	0.39	0.36	0.32	0.30	0.33	0.32	0.34	0.37	0.40	0.42	0.37	0.36	0.36
8107	Lam Thap	0.89	0.90	0.86	0.81	0.73	0.68	0.71	0.68	0.69	0.70	0.76	0.83	0.81	0.73	0.77
8108	Nuea Khlong	1.03	1.00	0.95	0.87	0.79	0.74	0.76	0.77	0.82	0.89	0.96	1.02	0.90	0.87	0.88
Total		6.92	6.69	6.34	5.86	5.36	5.06	5.28	5.31	5.68	6.17	6.56	6.77	6.04	5.96	6.00

4.1.3 River Runoff

River runoff for each sub-district was analyzed by calculating the specific yield coefficient through multiplying reservoir inflow volume by district area. Krabi Province's total river runoff is 11,205 million cubic meters, with 4,578 million cubic meters during the dry season and 6,626 million cubic meters during the rainy season. Table 6 summarizes the monthly average river runoff by district.

Table 8 Monthly Average River Runoff by District

Code	District	River runoff, MCM/month												Dry,	Wet,	Total,
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	MCM	MCM	MCM
8101	Mueang Krabi	114	97	59	48	42	40	61	62	82	158	112	133	401	607	1008
8102	Khao Phanom	356	297	248	207	150	159	291	276	380	391	343	353	1415	2034	3449
8103	Ko Lanta	24	13	11	11	10	15	16	14	50	23	33	36	85	173	257
8104	Khlong Thom	194	160	136	133	91	106	154	140	254	211	210	226	820	1196	2016
8105	Ao Luek	147	119	79	69	57	58	97	86	109	179	134	167	530	772	1302
8106	Plai Phraya	140	113	81	77	58	64	111	90	109	146	117	159	533	732	1265
8107	Lam Thap	121	101	85	71	51	54	100	95	131	132	117	119	483	694	1177
8108	Nuea Khlong	73	66	51	51	34	36	53	49	70	90	73	83	312	419	730
Total		1170	965	750	666	494	533	884	813	1184	1329	1139	1277	4578	6626	11205

4.2 Water Allocation

4.2.1 Irrigation Water Volume from Medium Reservoirs

In preparing this water account, irrigation water volume from medium-sized reservoirs was collected from the Royal Irrigation Department's water allocation plan. Water allocation covers different sectors including consumption, industry, agriculture (for both dry and rainy seasons). The seasonal water allocation was distributed by multiplying the proportion of water demand for consumption, industry, and agriculture for each month. Water allocation for consumption, industry, and agriculture according to the Royal Irrigation Department's allocation plan is shown in Tables 7 to 9.

Table 9 Water Allocation for Consumption According to the Royal Irrigation Department's Allocation Plan

Code	District	Water Allocation for Consumption, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.08	0.08	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.51	0.53	1.05
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8103	Ko Lanta	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.06	0.11
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8105	Ao Luek	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.10
8106	Plai Phraya	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.06
8107	Lam Thap	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.23	0.24	0.48
8108	Nuea Khlong	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.04	0.04	0.26	0.26	0.52
Total		0.19	0.18	0.19	0.19	0.18	0.21	0.20	0.20	0.19	0.20	0.20	0.18	1.14	1.18	2.31

Table 10 Water Allocation for Industrial Purposes According to the Royal Irrigation Department's Allocation Plan

Code	District	Water Allocation for Industrial, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.23	0.23	0.46
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8103	Ko Lanta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8105	Ao Luek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8106	Plai Phraya	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8107	Lam Thap	0.03	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.20	0.20	0.40
8108	Nuea Khlong	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06	0.06	0.13
Total		0.07	0.08	0.09	0.08	0.08	0.09	0.09	0.08	0.08	0.08	0.09	0.07	0.49	0.49	0.99

Table 11 Water Allocation for Agricultural Purposes According to the Royal Irrigation Department's Allocation Plan

Code	District	Water Allocation for Agricultural, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.32	0.38	0.55	0.52	0.58	0.49	0.43	0.28	0.43	0.19	0.18	0.31	2.85	1.82	4.67
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8103	Ko Lanta	0.11	0.12	0.19	0.17	0.22	0.16	0.14	0.09	0.15	0.07	0.06	0.09	0.97	0.59	1.56
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8105	Ao Luek	0.27	0.34	0.48	0.44	0.40	0.40	0.42	0.28	0.43	0.18	0.18	0.30	2.34	1.79	4.12
8106	Plai Phraya	0.25	0.28	0.43	0.37	0.37	0.34	0.39	0.25	0.38	0.17	0.17	0.24	2.04	1.59	3.63
8107	Lam Thap	0.23	0.26	0.39	0.40	0.38	0.38	0.43	0.27	0.45	0.21	0.20	0.30	2.03	1.86	3.89
8108	Nuea Khlong	1.32	1.68	2.41	2.31	2.43	2.31	2.20	1.40	2.15	1.02	0.89	1.61	12.47	9.28	21.75
Total		2.49	3.05	4.46	4.20	4.39	4.09	4.02	2.57	3.98	1.84	1.67	2.85	22.69	16.93	39.61

4.2.2 Water Allocation from Small Water Sources

In preparing this water account, water allocation from small water sources was determined by: Using the proportion of water release to capacity of medium-sized reservoirs and multiplying by the capacity of small water sources and considering only water allocation for agricultural purposes. The seasonal water allocation was distributed by multiplying the proportion of agricultural water demand for each month. Water allocation from small water sources for agriculture is about 30.59 million cubic meters per year. The monthly water allocation from small water sources for agriculture is shown in Table 10

Table 12 Monthly Water Allocation from Small Water Sources for Agriculture

Code	District	Monthly Water Allocation from Small Water Sources for Agriculture, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.65	0.68	0.55	0.52	0.64	0.66	0.65	0.69	0.68	0.82	0.71	0.72	3.70	4.27	7.96
8102	Khao Phanom	0.41	0.40	0.37	0.34	0.33	0.34	0.41	0.49	0.48	0.51	0.42	0.40	2.18	2.71	4.88
8103	Ko Lanta	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.09
8104	Khlong Thom	0.41	0.41	0.40	0.42	0.39	0.40	0.42	0.43	0.42	0.45	0.37	0.39	2.43	2.48	4.91
8105	Ao Luek	0.10	0.10	0.08	0.08	0.10	0.10	0.10	0.11	0.10	0.13	0.11	0.11	0.57	0.65	1.22
8106	Plai Phraya	0.26	0.25	0.21	0.20	0.19	0.21	0.22	0.23	0.22	0.23	0.21	0.28	1.33	1.39	2.72
8107	Lam Thap	0.31	0.30	0.30	0.26	0.24	0.25	0.32	0.39	0.38	0.39	0.32	0.30	1.66	2.10	3.76
8108	Nuea Khlong	0.40	0.41	0.42	0.45	0.43	0.44	0.43	0.42	0.42	0.46	0.38	0.38	2.55	2.50	5.05
Total		2.55	2.57	2.34	2.27	2.32	2.40	2.55	2.77	2.70	2.99	2.54	2.59	14.45	16.15	30.59

4.2.3 Provincial Waterworks Authority Water Distribution

In preparing this water account, water distribution by the Provincial Waterworks Authority was considered, which represents water extracted from surface water sources. Water distribution was categorized into 4 main user groups included households, business services, hotels, and industrial sectors. Total water distribution is about 16.05 million cubic meters/year included households 7.06 million cubic meters/year, business services 5.88 million cubic meters/year, hotels 2.81 million cubic meters/year, and industrial sectors: 0.30 million cubic meters/year. Monthly water distribution for Provincial Waterworks Authority by user groups is shown in Tables 11 to 15

Table 13 Monthly Water Distribution by Provincial Waterworks Authority for Household Group

Code	District	Monthly Water Distribution for Household, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.29	0.28	0.29	0.30	0.30	0.31	0.30	0.30	0.29	0.30	0.29	0.28	1.76	1.75	3.52
8102	Khao Phanom	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.31	0.31	0.61
8103	Ko Lanta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8104	Khlong Thom	0.05	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.34	0.34	0.68
8105	Ao Luek	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.22	0.22	0.44
8106	Plai Phraya	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.27	0.27	0.54
8107	Lam Thap	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.12	0.12	0.25
8108	Nuea Khlong	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.08	0.08	0.51	0.51	1.03
Total		0.57	0.56	0.59	0.59	0.60	0.63	0.61	0.59	0.58	0.59	0.57	0.57	3.54	3.52	7.06

Table 14 Monthly Water Distribution by Provincial Waterworks Authority for Business Service Group

Code	District	Monthly Water Distribution for Business Service, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.32	0.31	0.34	0.34	0.36	0.36	0.35	0.35	0.36	0.36	0.35	0.33	2.03	2.11	4.14
8102	Khao Phanom	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.09	0.08	0.17
8103	Ko Lanta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8104	Khlong Thom	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.22	0.22	0.44
8105	Ao Luek	0.03	0.04	0.04	0.03	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.21	0.21	0.42
8106	Plai Phraya	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.10	0.10	0.19
8107	Lam Thap	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.08	0.08	0.16
8108	Nuea Khlong	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.18	0.17	0.35
Total		0.45	0.46	0.49	0.48	0.51	0.51	0.50	0.50	0.50	0.51	0.49	0.48	2.90	2.97	5.88

Table 15 Monthly Water Distribution by Provincial Waterworks Authority for Hotel Group

Code	District	Monthly Water Distribution for Hotel, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.20	0.25	0.25	0.26	0.25	0.25	0.22	0.20	0.18	0.19	0.18	0.20	1.47	1.18	2.65
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.04
8103	Ko Lanta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
8105	Ao Luek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.05
8106	Plai Phraya	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8107	Lam Thap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
8108	Nuea Khlong	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.04
Total		0.21	0.27	0.27	0.27	0.27	0.26	0.23	0.21	0.20	0.20	0.20	0.21	1.55	1.26	2.81

Table 16 Monthly Water Distribution by Provincial Waterworks Authority for Industrial Group

Code	District	Monthly Water Distribution for Industrial, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.10	0.09	0.19
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.05
8103	Ko Lanta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8105	Ao Luek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8106	Plai Phraya	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8107	Lam Thap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
8108	Nuea Khlong	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.05
Total		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.16	0.15	0.30

Table 17 Monthly Water Distribution by Provincial Waterworks Authority for all groups

Code	District	Monthly Water Distribution, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.83	0.86	0.9	0.92	0.93	0.94	0.89	0.87	0.84	0.87	0.84	0.82	5.36	5.13	10.5
8102	Khao Phanom	0.06	0.06	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.45	0.43	0.87
8103	Ko Lanta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8104	Khlong Thom	0.08	0.09	0.1	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.08	0.1	0.57	0.57	1.15
8105	Ao Luek	0.06	0.07	0.08	0.07	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.07	0.46	0.45	0.91
8106	Plai Phraya	0.06	0.06	0.07	0.06	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.37	0.37	0.73
8107	Lam Thap	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.2	0.2	0.43
8108	Nuea Khlong	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.11	0.12	0.11	0.11	0.73	0.72	1.47
Total		1.25	1.32	1.38	1.37	1.41	1.43	1.37	1.32	1.3	1.32	1.29	1.28	8.15	7.9	16.05

4.2.4 Village Water Supply Distribution

Data collection details were focused on sub-districts and number of households served and most village water supplies use groundwater for production of drinking water. Calculation method is to take number of people per household multiplied by number of households served multiplied by water usage rate (set at 50 liters/person/day). Total water distribution by village water supply is about 4.18 million cubic meters/year. Monthly water distribution by village water supply is shown in Table 16

Table 18 Monthly water distribution by village water supply

Code	District	Monthly water distribution by village water supply, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.27	0.27	0.53
8102	Khao Phanom	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.26	0.26	0.52
8103	Ko Lanta	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.23	0.23	0.46
8104	Khlong Thom	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.53	0.53	1.06
8105	Ao Luek	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.24	0.24	0.49
8106	Plai Phraya	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.13	0.27
8107	Lam Thap	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.10	0.10	0.20
8108	Nuea Khlong	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.33	0.33	0.66
Total		0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.09	2.09	4.18

4.3 Self-Water Procurement

4.3.1 Groundwater Pumping from Private Wells

Groundwater well data was collected from Department of Groundwater Resources. The purposes of groundwater wells are used for hotel services and other service sectors. Groundwater pumping is calculated from authorized groundwater volume multiplied by pumping hours per day (8 hours) multiplied by pumping coefficient (0.5). Total groundwater pumping is about 9.978 million cubic meters, included hotel services 3.035 million cubic meters and other services: 6.943 million cubic meters. Monthly groundwater pumping volumes from private wells for hotel services are shown in Table 17 and 18.

Table 19 Monthly groundwater pumping from private wells for hotel services

Code	District	Monthly groundwater pumping from private wells for hotel services, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.178	0.211	0.203	0.204	0.199	0.190	0.172	0.163	0.157	0.157	0.157	0.172	1.184	0.978	2.162
8102	Khao Phanom	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.007	0.007	0.014
8103	Ko Lanta	0.050	0.072	0.069	0.069	0.067	0.064	0.058	0.055	0.052	0.053	0.053	0.058	0.391	0.328	0.718
8104	Khlong Thom	0.004	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.027	0.027	0.054
8105	Ao Luek	0.002	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.015	0.012	0.027
8106	Plai Phraya	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.005
8107	Lam Thap	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
8108	Nuea Khlong	0.004	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.029	0.025	0.054
Total		0.240	0.296	0.286	0.286	0.279	0.267	0.243	0.230	0.221	0.222	0.221	0.243	1.655	1.379	3.035

Table 20 Monthly groundwater Pumping from Private Wells for Services

Code	District	Monthly groundwater Pumping from Private Wells for Services, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.321	0.295	0.302	0.302	0.307	0.315	0.333	0.342	0.349	0.348	0.349	0.333	1.841	2.054	3.894
8102	Khao Phanom	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.057	0.057	0.115
8103	Ko Lanta	0.087	0.087	0.090	0.090	0.092	0.095	0.101	0.104	0.106	0.106	0.106	0.101	0.540	0.625	1.165
8104	Khlong Thom	0.048	0.049	0.048	0.048	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.291	0.292	0.583
8105	Ao Luek	0.024	0.027	0.027	0.027	0.027	0.027	0.028	0.028	0.028	0.028	0.028	0.028	0.160	0.167	0.327
8106	Plai Phraya	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.134	0.135	0.268
8107	Lam Thap	0.012	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.080	0.081	0.161
8108	Nuea Khlong	0.036	0.035	0.035	0.035	0.035	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.213	0.217	0.430
	Total	0.559	0.538	0.548	0.548	0.555	0.567	0.591	0.605	0.613	0.613	0.613	0.592	3.316	3.627	6.943

4.3.2 Groundwater Pumping from Government Wells

Groundwater well data was collected from Department of Groundwater Resources. The purposes of groundwater wells are used for consumption and agricultural sectors. Groundwater pumping is calculated from pumped groundwater volume multiplied by pumping hours per day (8 hours) multiplied by pumping coefficient (0.5). Total groundwater pumping from government wells is about 5.357 million cubic meters, included consumption 4.745 million cubic meters and agriculture: 0.612 million cubic meters. Monthly groundwater pumping volumes from government wells for consumption and agriculture are shown in Tables 19 and 20.

Table 21 Monthly Groundwater Pumping from Government Wells for Consumption

Code	District	Monthly Groundwater Pumping from Government Wells for Consumption, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.301	0.301	0.602
8102	Khao Phanom	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.291	0.291	0.583
8103	Ko Lanta	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.066	0.066	0.132
8104	Khlong Thom	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.393	0.393	0.786
8105	Ao Luek	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.455	0.455	0.910
8106	Plai Phraya	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.152	0.152	0.304
8107	Lam Thap	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.453	0.453	0.907
8108	Nuea Khlong	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.261	0.261	0.521
	Total	0.395	0.395	0.395	0.395	0.395	0.395	0.395	0.395	0.395	0.395	0.395	0.395	2.373	2.373	4.745

Table 22 Monthly Groundwater Pumping from Government Wells for Agriculture

Code	District	Monthly Groundwater Pumping from Government Wells for Agriculture, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.041	0.041	0.081
8102	Khao Phanom	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.112	0.112	0.224
8103	Ko Lanta	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.009	0.009	0.019
8104	Khlong Thom	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.008	0.008	0.017
8105	Ao Luek	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.014	0.014	0.028
8106	Plai Phraya	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.035	0.035	0.071
8107	Lam Thap	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.077	0.077	0.153
8108	Nuea Khlong	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.010	0.010	0.020
	Total	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.306	0.306	0.612

4.3.3 Groundwater Pumping from Public Shallow Wells

Groundwater pumping from public shallow wells data was collected from Department of Community Development The purposes of groundwater wells are used for consumption and agricultural sectors. Groundwater pumping from public shallow wells are calculated from number of functional shallow wells multiplied by water usage rate for consumption or agriculture. Total shallow well water pumping is about 1.394 million cubic meters including consumption 0.068 million cubic meters and agriculture: 1.326 million cubic meters. Monthly groundwater pumping volumes from public shallow wells for consumption and agriculture are shown in Tables 21 and 22.

Table 23 Monthly Groundwater Pumping from Public Shallow Wells for Consumption

Code	District	Groundwater Pumping from Public Shallow Wells for Consumption, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.006	0.006	0.012
8102	Khao Phanom	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.005	0.010
8103	Ko Lanta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
8104	Khlong Thom	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.004	0.007
8105	Ao Luek	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.009	0.009	0.018
8106	Plai Phraya	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.006
8107	Lam Thap	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.004
8108	Nuea Khlong	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.006	0.006	0.011
	Total	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.034	0.034	0.068

Table 24 Monthly Groundwater Pumping from Public Shallow Wells for Agriculture

Code	District	Groundwater Pumping from Public Shallow Wells for Agriculture, MCM/month												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.022	0.022	0.022	0.022	0.022	0.022	0.015	0.015	0.015	0.015	0.015	0.015	0.134	0.091	0.225
8102	Khao Phanom	0.019	0.019	0.019	0.019	0.019	0.019	0.013	0.013	0.013	0.013	0.013	0.013	0.112	0.076	0.188
8103	Ko Lanta	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.013	0.009	0.023
8104	Khlong Thom	0.014	0.014	0.014	0.014	0.014	0.014	0.009	0.009	0.009	0.009	0.009	0.009	0.083	0.056	0.139
8105	Ao Luek	0.034	0.034	0.034	0.034	0.034	0.034	0.023	0.023	0.023	0.023	0.023	0.023	0.203	0.139	0.342
8106	Plai Phraya	0.011	0.011	0.011	0.011	0.011	0.011	0.008	0.008	0.008	0.008	0.008	0.008	0.067	0.046	0.113
8107	Lam Thap	0.008	0.008	0.008	0.008	0.008	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.047	0.032	0.079
8108	Nuea Khlong	0.022	0.022	0.022	0.022	0.022	0.022	0.015	0.015	0.015	0.015	0.015	0.015	0.129	0.088	0.218
	Total	0.131	0.131	0.131	0.131	0.131	0.131	0.090	0.090	0.090	0.090	0.090	0.090	0.788	0.537	1.326

5. Water Demand

This study analyzed water demand for various activities in Krabi Province, including consumption, industrial use, agricultural purposes, and service sectors. Analysis was conducted at the district level, with results to be used for sub-district water accounting.

5.1 Domestic Water Demand

Domestic water demand was analyzed by examining population in and outside water supply service areas, multiplied by the per capita daily water usage rate. The total water demand reached 2 million cubic meters/year, with 1.67 million cubic meters/year (83.5%) within water service areas and 0.33 million cubic meters/year (16.5%) outside these areas. From 2015-2024, water demand showed an increasing trend, with an average annual growth rate of 0.58%. In terms of district ranking for water consumption, Mueang Krabi recorded the highest demand, followed by Khlong Thom and Nuea Khlong. Detailed analysis of water consumption for municipal and non-municipal areas across Krabi Province is presented in Tables 23 to 25

Table 25 Analysis of water demand within water service areas by district in Krabi Province

Code	District	Water demand within water service areas, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	0.72	0.73	0.74	0.76	0.77	0.77	0.77	0.78	0.79	0.67
8102	Khao Phanom	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.23
8103	Ko Lanta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8104	Khlong Thom	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.31
8105	Ao Luek	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.07
8106	Plai Phraya	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.04
8107	Lam Thap	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.07
8108	Nuea Khlong	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.36	0.27
	Total	2.07	2.09	2.11	2.13	2.15	2.15	2.16	2.16	2.17	1.67

Table 26 Analysis of water demand outside water service areas by district in Krabi Province

Code	District	Water demand outside water service areas, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
8102	Khao Phanom	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
8103	Ko Lanta	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
8104	Khlong Thom	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
8105	Ao Luek	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.08
8106	Plai Phraya	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
8107	Lam Thap	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
8108	Nuea Khlong	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Total		0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.33

Table 27 Analysis of total water demand in and outside water service areas by district in Krabi Province

Code	District	Total water demand in and outside water service areas, MCM/day									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	0.74	0.75	0.76	0.77	0.78	0.79	0.79	0.79	0.80	0.69
8102	Khao Phanom	0.29	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.26
8103	Ko Lanta	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
8104	Khlong Thom	0.43	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.35
8105	Ao Luek	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.16
8106	Plai Phraya	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.08
8107	Lam Thap	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10
8108	Nuea Khlong	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.38	0.30
Total		2.31	2.33	2.35	2.37	2.39	2.40	2.40	2.41	2.42	2.00

5.2 Industrial Water Demand

Industrial water demand was calculated by multiplying the horsepower of each factory by its industrial type and the corresponding water usage rate per horsepower per day. The industrial factories were categorized into four subsections:

- Subsection 01-03: Agriculture, Forestry, and Fishing
- Subsection 05-33 and 41: Mining, Manufacturing, and Construction
- Subsection 35: Electricity, Gas, Steam, and Air Conditioning
- Subsection 38 , 39 , and 45 – 99 : Other Industries

In 2023, the total industrial water demand reached 4,950,882 cubic meters per year. The district ranking for industrial water demand, from highest to lowest, was Mueang Krabi, Khao Phanom, and Plai Phraya. A detailed analysis of industrial water demand by district in Krabi Province is presented in Table 26.

Table 28 Analysis of Industrial Water Demand in Krabi Province by District.

a) Subsection 01 - 03: Agriculture, Forestry, and Fishing

Code	District	Industrial Water Demand, MCM/year								
		2015	2016	2017	2018	2019	2020	2021	2022	2023
8101	Mueang Krabi	0	0	6,232	6,232	6,232	6,232	6,232	6,232	6,232
8102	Khao Phanom	0	0	0	0	0	0	0	0	0
8103	Ko Lanta	0	0	0	0	0	0	0	0	0
8104	Khlong Thom	0	0	0	0	0	0	0	0	0
8105	Ao Luek	0	0	0	0	0	0	0	0	0
8106	Plai Phraya	55,508	55,508	55,508	55,508	55,508	55,508	55,508	372,065	372,065
8107	Lam Thap	0	0	0	0	9,023	9,023	9,023	9,023	9,023
8108	Nuea Khlong	0	0	36,004	36,004	36,004	36,004	36,004	36,004	36,004
Total		55,508	55,508	97,745	97,745	106,768	106,768	106,768	423,324	423,324

b) Subsection 05 - 33 and 41: Mining and Quarrying, Manufacturing, and Construction

Code	District	Industrial Water Demand, MCM/year								
		2015	2016	2017	2018	2019	2020	2021	2022	2023
8101	Mueang Krabi	91,389	91,389	91,389	91,389	91,389	91,389	91,389	91,389	91,389
8102	Khao Phanom	32,283	32,283	100,816	100,816	100,816	100,816	100,816	100,816	100,816
8103	Ko Lanta	0	0	0	0	0	0	0	0	0
8104	Khlong Thom	15,621	15,621	15,621	15,621	15,621	26,845	26,845	26,845	26,845
8105	Ao Luek	711	19,258	88,897	88,897	123,982	135,206	209,591	258,571	258,571
8106	Plai Phraya	9,022	15,611	15,611	15,611	56,584	132,481	132,481	132,481	132,481
8107	Lam Thap	0	6,046	6,046	6,046	6,046	6,046	48,686	48,686	48,686
8108	Nuea Khlong	11,789	56,444	56,444	56,967	56,967	56,967	56,967	59,547	59,547
Total		160,815	236,652	374,824	375,347	451,405	549,750	666,775	718,335	718,335

c) Subsection 35 : Electricity , Gas, Steam , and Air Conditioning

Code	District	Industrial Water Demand, MCM/year								
		2015	2016	2017	2018	2019	2020	2021	2022	2023
8101	Mueang Krabi	0	320	320	320	320	320	320	320	320
8102	Khao Phanom	525	525	525	525	525	2,731	2,731	2,731	2,731
8103	Ko Lanta	0	0	0	0	0	0	0	0	0
8104	Khlong Thom	0	485	485	485	485	794	794	794	794
8105	Ao Luek	1,284	1,468	1,468	1,468	1,468	2,592	2,592	2,592	2,592
8106	Plai Phraya	314	314	110,923	110,923	110,923	221,532	221,532	221,532	221,532
8107	Lam Thap	349	349	349	349	349	349	349	349	349
8108	Nuea Khlong	304	304	304	304	304	304	304	304	304
Total		2,775	3,766	114,375	114,375	114,375	228,621	228,621	228,621	228,621

d) Subsection 38 , 39 , and 45 - 99 : Other Industries

Code	District	Industrial Water Demand, MCM/year								
		2015	2016	2017	2018	2019	2020	2021	2022	2023
8101	Mueang Krabi	594,756	643,526	650,358	653,254	668,839	1,156,971	1,157,787	1,160,743	1,160,743
8102	Khao Phanom	130,424	130,424	159,289	185,165	783,261	785,281	785,281	785,281	785,281
8103	Ko Lanta	1,044	1,044	1,044	1,044	1,044	1,531	1,531	1,531	1,531
8104	Khlong Thom	214,257	214,470	214,470	214,470	216,864	273,610	273,610	273,610	273,610
8105	Ao Luek	444,999	445,116	445,116	447,678	453,012	458,208	461,165	461,165	461,165
8106	Plai Phraya	95,876	144,087	146,756	147,414	147,414	148,961	150,164	150,244	150,244
8107	Lam Thap	585,764	587,096	587,096	602,429	602,439	602,439	602,439	602,439	602,439
8108	Nuea Khlong	126,106	141,957	142,123	142,662	142,662	144,238	144,238	144,238	145,590
Total		2,193,226	2,307,720	2,346,252	2,394,116	3,015,534	3,571,238	3,576,214	3,579,251	3,580,602

e) Total Subsections

Code	District	Industrial Water Demand, MCM/year								
		2015	2016	2017	2018	2019	2020	2021	2022	2023
8101	Mueang Krabi	686,145	735,235	748,299	751,195	766,780	1,254,912	1,255,728	1,258,684	1,258,684
8102	Khao Phanom	163,232	163,232	260,630	286,506	884,602	888,828	888,828	888,828	888,828
8103	Ko Lanta	1,044	1,044	1,044	1,044	1,044	1,531	1,531	1,531	1,531
8104	Khlong Thom	229,878	230,576	230,576	230,576	232,970	301,249	301,249	301,249	301,249
8105	Ao Luek	446,994	465,842	535,481	538,043	578,462	596,006	673,348	722,328	722,328
8106	Plai Phraya	160,720	215,520	328,798	329,456	370,429	558,482	559,685	876,322	876,322
8107	Lam Thap	586,113	593,491	593,491	608,824	617,857	617,857	660,497	660,497	660,497
8108	Nuea Khlong	138,199	198,705	234,875	235,937	235,937	237,513	237,513	240,093	241,445
Total		2,412,324	2,603,646	2,933,196	2,981,583	3,688,082	4,456,377	4,578,378	4,949,531	4,950,882

5.3 Agricultural Water Demand

Agricultural Water Demand was calculated from cultivation areas in and outside irrigation zones multiplied by crop water requirements. Considerations include cropping calendar, crop growth coefficient (Kc), reference crop evapotranspiration (ETo), and effective rainfall. Crop data was collected from the Office of Agricultural Economics and land use maps from the Department of Land Development used for area adjustments.

Irrigated agricultural water demand in 2024 is about 101.79 million cubic meters per year. The average irrigated agricultural water demand (2015 - 2024) is approximately 106.31 million cubic meters per year, comprising 71.66 million cubic meters during the dry season and 34.65 million cubic meters during the rainy season. The district ranking for the irrigation zone, from highest to lowest, is Nuea Khlong, Mueang Krabi, and Ao Luek. Annual and monthly analyses by district are presented in Tables 27 and 30

Rainfed agricultural water demand in 2024 is about 5,390.96 million cubic meters per year. The average rainfed agricultural water demand (2015 - 2024) is approximately 5,207.1 million cubic meters per year, with 3,395.1 million cubic meters during the dry season and 1,812.0 million cubic meters during the rainy season. The district ranking for the rainfed zone, from highest to lowest, is Ao Luek, Khlong Thom, and Khao Phanom. Annual and monthly analyses by district are detailed in Tables 28 and 31

Total agricultural water demand for both irrigated and rainfed areas in 2024 is about 5,492.74 million cubic meters per year. The average agricultural water demand (2015 - 2024) is approximately 5,313 million cubic meters per year, with 3,467 million cubic meters during the dry season and 1,847 million cubic meters during the rainy season. The overall district ranking, from highest to lowest, is Ao Luek, Khlong Thom, and Khao Phanom. Annual and monthly analyses by district are presented in Tables 29 and 32

Table 29 Annual agricultural water demand in Irrigation zones of Krabi Province by district

Code	District	Agricultural water demand, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	7.82	9.75	8.79	8.27	44.63	11.32	10.36	7.81	10.77	12.29
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8103	Ko Lanta	1.88	2.53	3.33	3.45	5.78	4.35	3.68	2.82	3.61	4.30
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8105	Ao Luek	6.23	7.49	7.38	7.03	46.29	10.07	9.50	7.27	11.11	10.91
8106	Plai Phraya	5.58	7.20	7.78	7.09	24.53	8.46	7.50	6.16	8.40	9.12
8107	Lam Thap	5.68	8.24	7.44	7.70	22.07	9.42	8.50	6.96	8.44	10.60
8108	Nuea Khlong	34.86	43.63	48.03	44.71	182.44	51.03	41.80	36.81	47.59	54.57
Total		62.05	78.84	82.75	78.25	325.73	94.65	81.34	67.82	89.92	101.79

Table 30 Annual Agricultural Water Demand in Non-Irrigation Zones of Krabi Province by District

Code	District	Agricultural water demand, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	430.65	533.88	490.51	464.78	1,958.96	607.25	535.29	417.38	580.88	654.10
8102	Khao Phanom	604.35	832.31	725.74	689.82	1,746.23	861.10	776.71	618.72	792.22	981.27
8103	Ko Lanta	77.22	105.09	130.64	138.92	251.79	176.83	152.17	114.70	145.60	172.27
8104	Khlong Thom	637.35	883.26	839.81	839.59	1,683.24	994.34	855.68	687.81	855.19	1,025.92
8105	Ao Luek	553.08	675.78	675.68	637.09	3,312.40	880.80	809.12	627.41	942.97	940.88
8106	Plai Phraya	409.52	522.53	547.84	501.63	1,875.74	616.59	556.02	453.59	617.96	675.33
8107	Lam Thap	241.43	348.71	318.83	328.42	970.79	398.72	357.47	290.81	355.82	448.37
8108	Nuea Khlong	317.10	406.02	430.07	415.91	1,428.95	470.44	390.29	331.52	427.38	492.82
Total		3,270.69	4,307.58	4,159.13	4,016.15	13,228.09	5,006.06	4,432.76	3,541.94	4,718.02	5,390.96

Table 31 Annual Total Agricultural Water Demand in Irrigation and Non-Irrigation Zones of Krabi Province by District

Code	District	Agricultural water demand, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	438.47	543.63	499.30	473.04	2,003.59	618.57	545.65	425.19	591.65	666.39
8102	Khao Phanom	604.35	832.31	725.74	689.82	1,746.23	861.10	776.71	618.72	792.22	981.27
8103	Ko Lanta	79.10	107.63	133.97	142.36	257.57	181.18	155.86	117.52	149.21	176.57
8104	Khlong Thom	637.35	883.26	839.81	839.59	1,683.24	994.34	855.68	687.81	855.19	1,025.92
8105	Ao Luek	559.31	683.27	683.06	644.11	3,358.68	890.87	818.62	634.68	954.08	951.79
8106	Plai Phraya	415.10	529.73	555.61	508.72	1,900.27	625.05	563.51	459.75	626.36	684.45
8107	Lam Thap	247.10	356.94	326.27	336.13	992.85	408.14	365.97	297.77	364.27	458.97
8108	Nuea Khlong	351.96	449.65	478.11	460.63	1,611.39	521.48	432.09	368.33	474.97	547.39
Total		3,332.74	4,386.42	4,241.88	4,094.39	13,553.82	5,100.72	4,514.10	3,609.76	4,807.94	5,492.74

Table 32 Monthly Agricultural Water Demand in Irrigated Zones of Krabi Province by District

Code	District	Agricultural Water Demand, MCM/year												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	0.56	0.75	1.19	1.61	2.56	2.84	0.86	0.66	0.57	0.51	0.47	0.60	9.51	3.67	13.18
8102	Khao Phanom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8103	Ko Lanta	0.19	0.24	0.43	0.52	0.62	0.34	0.28	0.21	0.21	0.19	0.16	0.17	2.34	1.23	3.57
8104	Khlong Thom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8105	Ao Luek	0.49	0.67	0.99	1.39	2.36	2.88	0.84	0.66	0.54	0.49	0.45	0.57	8.78	3.55	12.33
8106	Plai Phraya	0.44	0.53	0.82	1.14	2.33	0.68	0.75	0.61	0.50	0.47	0.44	0.48	5.93	3.25	9.18
8107	Lam Thap	0.41	0.52	0.83	1.23	1.26	1.57	0.83	0.66	0.57	0.54	0.49	0.58	5.83	3.67	9.50
8108	Nuea Khlong	2.28	3.23	5.10	7.07	10.00	11.59	4.41	3.42	3.10	2.68	2.54	3.14	39.27	19.27	58.55
Total		4.37	5.94	9.36	12.96	19.12	19.90	7.98	6.21	5.49	4.87	4.56	5.54	71.66	34.65	106.31

Table 33 Monthly Agricultural Water Demand in Non-Irrigation Zones of Krabi Province by District

Code	District	Agricultural Water Demand, MCM/year												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	29.0	39.9	66.1	88.1	118.8	129.7	47.5	35.8	30.6	26.8	23.8	31.3	471.7	195.7	667.4
8102	Khao Phanom	41.7	52.5	82.5	113.6	157.5	83.8	73.4	60.6	53.0	49.5	42.7	52.1	531.6	331.2	862.8
8103	Ko Lanta	7.5	9.5	17.3	21.5	26.2	13.9	11.9	9.0	8.6	7.6	6.2	7.2	95.9	50.6	146.5
8104	Khlong Thom	44.5	56.9	94.4	131.6	128.0	112.0	83.9	64.0	57.7	51.9	47.6	57.7	567.6	362.7	930.2
8105	Ao Luek	43.5	57.5	87.4	119.9	237.2	152.2	73.1	57.3	47.6	42.3	39.7	47.9	697.6	307.9	1,005.5
8106	Plai Phraya	31.0	38.0	59.4	82.7	177.8	50.3	54.7	44.4	37.0	34.3	32.5	35.7	439.1	238.6	677.7
8107	Lam Thap	17.6	22.2	36.0	52.3	53.0	73.2	34.5	27.2	23.9	22.4	20.0	23.5	254.3	151.6	405.9
8108	Nuea Khlong	21.2	29.0	47.2	65.1	100.3	74.6	40.0	30.9	28.0	24.3	22.7	27.8	337.4	173.7	511.1
Total		236.0	305.5	490.4	674.8	998.8	689.6	419.0	329.2	286.4	259.3	235.3	283.1	3,395.1	1,812.0	5,207.1

Table 34 Monthly Agricultural Water Demand in Irrigation and Non-Irrigation Zones of Krabi Province by District

Code	District	Agricultural Water Demand, MCM/year												Dry, MCM	Wet, MCM	Total, MCM
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
8101	Mueang Krabi	29.6	40.7	67.3	89.7	121.4	132.5	48.3	36.5	31.1	27.3	24.3	31.9	481.2	199.4	680.5
8102	Khao Phanom	41.7	52.5	82.5	113.6	157.5	83.8	73.4	60.6	53.0	49.5	42.7	52.1	531.6	331.2	862.8
8103	Ko Lanta	7.7	9.7	17.7	22.0	26.9	14.2	12.2	9.2	8.9	7.8	6.4	7.4	98.2	51.8	150.1
8104	Khlong Thom	44.5	56.9	94.4	131.6	128.0	112.0	83.9	64.0	57.7	51.9	47.6	57.7	567.6	362.7	930.2
8105	Ao Luek	44.0	58.2	88.4	121.3	239.5	155.1	73.9	58.0	48.1	42.8	40.2	48.5	706.4	311.5	1017.8
8106	Plai Phraya	31.4	38.5	60.2	83.8	180.1	50.9	55.4	45.0	37.5	34.8	33.0	36.1	445.0	241.9	686.9
8107	Lam Thap	18.0	22.7	36.8	53.6	54.2	74.8	35.4	27.9	24.5	23.0	20.5	24.1	260.1	155.3	415.4
8108	Nuea Khlong	23.5	32.3	52.3	72.2	110.3	86.1	44.4	34.3	31.1	27.0	25.2	31.0	376.6	193.0	569.6
Total		240	311	500	688	1,018	710	427	335	292	264	240	289	3,467	1,847	5,313

5.4 Service Sector Water Demand

In analyzing water demand for service sectors, four user groups were identified:

Schools water demand was calculated by multiplying the number of teachers and students by school days and water usage rate per person. Total school water demand is 0.340 million cubic meters/year. Mueang Krabi district has the highest demand, followed by Khlong Thom and Nuea Khlong districts. There is a water demand decline rate of 0.95% due to decreasing student numbers over the past 10 years. Detailed analysis by district is shown in Table 33

Business enterprise water demand was calculated by multiplying the number of workers by water usage rate per person. Total business establishment water demand is 2.946 million cubic meters/year. Mueang Krabi district has the highest demand, followed by Ko Lanta and Nuea Khlong districts. There is a water demand increase rate of 1.05%. Detailed analysis by district is shown in Table 34

Hotels and Resorts water demand was calculated by multiplying the number of guests by overnight stays and water usage rate per person. Total hotel and resort water demand is 2.649 million cubic meters/year. Mueang Krabi district has the highest demand, followed by Ko Lanta and Khlong Thom districts. There is a water demand increase rate of 12.38%. Detailed analysis by district is shown in Table 35

Hospitals water demand was calculated by multiplying inpatients and outpatients by overnight stays and water usage rate per person. Total hospital water demand is 0.079 million cubic meters/year. Mueang Krabi district has the highest demand, followed by Khlong Thom and Nuea Khlong districts. There is a water demand decline rate of 1.31%. Detailed analysis by district is shown in Table 36

In 2024, Krabi Province has a total service sector water demand of 6.01 million cubic meters/year. Mueang Krabi district has the highest demand, followed by Ko Lanta and Khlong Thom districts, with an overall water demand increase rate of 1.74%. Detailed analysis by district is shown in Table 37

Table 35 School water demand

Code	District	School water demand, MCM/year									
		2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
8101	Mueang Krabi	0.083	0.083	0.084	0.085	0.084	0.084	0.083	0.084	0.083	0.082
8102	Khao Phanom	0.051	0.051	0.052	0.052	0.051	0.051	0.050	0.050	0.049	0.041
8103	Ko Lanta	0.033	0.034	0.034	0.034	0.034	0.033	0.032	0.032	0.030	0.029
8104	Khlong Thom	0.067	0.065	0.067	0.067	0.065	0.065	0.066	0.065	0.064	0.062
8105	Ao Luek	0.046	0.043	0.044	0.043	0.043	0.044	0.044	0.043	0.041	0.040
8106	Plai Phraya	0.027	0.026	0.025	0.024	0.024	0.024	0.024	0.023	0.023	0.022
8107	Lam Thap	0.021	0.021	0.022	0.022	0.023	0.023	0.023	0.023	0.022	0.021
8108	Nuea Khlong	0.044	0.044	0.044	0.045	0.046	0.046	0.045	0.045	0.044	0.043
Total		0.371	0.367	0.371	0.372	0.370	0.370	0.366	0.364	0.356	0.340

Table 36 Business enterprises water demand

Code	District	Business enterprises water demand, MCM/year									
		2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
8101	Mueang Krabi	1.963	1.879	2.083	1.954	1.966	1.951	1.936	2.096	2.181	2.130
8102	Khao Phanom	0.051	0.049	0.054	0.051	0.051	0.050	0.050	0.054	0.056	0.055
8103	Ko Lanta	0.409	0.391	0.434	0.407	0.410	0.406	0.403	0.437	0.454	0.444
8104	Khlong Thom	0.047	0.045	0.050	0.047	0.047	0.047	0.046	0.050	0.052	0.051
8105	Ao Luek	0.085	0.082	0.091	0.085	0.086	0.085	0.084	0.091	0.095	0.093
8106	Plai Phraya	0.033	0.032	0.035	0.033	0.034	0.033	0.033	0.036	0.037	0.036
8107	Lam Thap	0.021	0.020	0.022	0.021	0.021	0.021	0.021	0.022	0.023	0.023
8108	Nuea Khlong	0.105	0.101	0.112	0.105	0.105	0.105	0.104	0.112	0.117	0.114
Total		2.715	2.599	2.881	2.702	2.719	2.698	2.677	2.900	3.017	2.946

Table 37 Hotels and resorts water demand

Code	District	Hotels and Resorts Water Demand, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	1.917	1.929	2.130	2.327	2.263	1.064	0.460	0.843	1.871	2.032
8102	Khao Phanom	0.020	0.016	0.016	0.022	0.018	0.015	0.019	0.021	0.024	0.024
8103	Ko Lanta	0.489	0.488	0.524	0.518	0.499	0.214	0.054	0.138	0.384	0.424
8104	Khlong Thom	0.077	0.061	0.062	0.092	0.079	0.061	0.073	0.086	0.098	0.099
8105	Ao Luek	0.020	0.019	0.020	0.021	0.020	0.010	0.005	0.008	0.017	0.018
8106	Plai Phraya	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8107	Lam Thap	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8108	Nuea Khlong	0.057	0.055	0.058	0.060	0.056	0.027	0.014	0.023	0.048	0.052
Total		2.580	2.569	2.811	3.042	2.936	1.392	0.626	1.123	2.443	2.649

Table 38 Hospital water demand

Code	District	Hospital water demand, MCM/year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8101	Mueang Krabi	0.082	0.054	0.053	0.054	0.047	0.065	0.083	0.062	0.069	0.057
8102	Khao Phanom	0.003	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.003	0.003
8103	Ko Lanta	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001
8104	Khlong Thom	0.012	0.008	0.008	0.008	0.007	0.010	0.013	0.010	0.010	0.009
8105	Ao Luek	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
8106	Plai Phraya	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8107	Lam Thap	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8108	Nuea Khlong	0.008	0.006	0.006	0.006	0.005	0.007	0.009	0.007	0.007	0.006
Total		0.109	0.073	0.073	0.074	0.065	0.087	0.111	0.086	0.093	0.079

Table 39 Total Service Sector Water Demand

Code	District	**Hospital water demand, MCM/year**									
		2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
8101	Mueang Krabi	4.04	3.94	4.35	4.42	4.36	3.16	2.56	3.09	4.20	4.30
8102	Khao Phanom	0.12	0.12	0.12	0.13	0.12	0.12	0.12	0.13	0.13	0.12
8103	Ko Lanta	0.93	0.91	0.99	0.96	0.94	0.65	0.49	0.61	0.87	0.90
8104	Khlong Thom	0.20	0.18	0.19	0.21	0.20	0.18	0.20	0.21	0.22	0.22
8105	Ao Luek	0.15	0.15	0.16	0.15	0.15	0.14	0.13	0.14	0.15	0.15
8106	Plai Phraya	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
8107	Lam Thap	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05
8108	Nuea Khlong	0.22	0.20	0.22	0.22	0.21	0.18	0.17	0.19	0.22	0.21
Total		5.78	5.61	6.14	6.19	6.09	4.55	3.78	4.47	5.91	6.01

5.5 Overall Water Demand Summary for Krabi Province

Based on the calculations of water demand for various activities, the summary for 2024 is as follows: Total Water Demand is about 5,325.96 million cubic meters/year included consumption (Domestic Use) 2.00 million cubic meters/year (0.04%), industrial use 4.95 million cubic meters/year (0.09%), agricultural use 5,313.00 million cubic meters/year (99.76%), and service sector 6.01 million cubic meters/year (0.11%). The data clearly shows that agricultural use dominates water demand in Krabi Province, accounting for nearly 99.76% of the total water consumption, while other sectors contribute minimally to the overall water usage.

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