COMPONENT 2

INTEGRATION OF NATURAL CAPITAL ACCOUNTING INTO LOCAL DEVELOPMENT PLANNING

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

NATURAL CAPITAL

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COMPONENT 2

INTEGRATION OF NATURAL CAPITAL ACCOUNTING INTO LOCAL DEVELOPMENT PLANNING AND OPERATIONS

OUTPUT 2.2.8

ASSESS THE WATER TARIFF RATES TO ENSURE THAT THE COSTS ASSOCIATED WITH THE MANAGEMENT AND PRODUCTION OF WATERSHEDS IS ADEQUATELY REFLECTED IN THE PRICE

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Acknowledgment

Assess water tariff rates to ensure that the costs associated with watershed management and water production are adequately reflected in pricing. Under Output 2.2.8, this assessment includes a review of water tariffs, irrigation water pricing, and wastewater treatment fees to develop a cost-reflective water pricing framework that captures the full economic costs of water resource management, supply, and wastewater treatment services.

Special thanks are given to, Provincial Office of Natural Resources and Environment Krabi, Wastewater Management Authority, Krabi Branch.

Finally, we would like to express our sincere appreciation to the Office of the National Water Resources for providing the opportunity to engage in constructive discussions and exchange information, perspectives, and expert insights on the challenges, considerations, and policy recommendations related to the development of water pricing mechanisms in Thailand.

Executive Summary

Charging for water is an important tool for improving the efficiency of water allocation and use, as it signals to users the true value and scarcity of water resources. It also creates incentives for cost savings, improved efficiency, cost recovery, and the financial sustainability of water management systems.

A review of water supply and wastewater treatment service charges, based on studies and actual fee collection in Krabi Province, revealed that current water prices are lower than the appropriate cost-recovery rate, while wastewater treatment service fees are also lower than the rates recommended by previous studies. These findings highlight the key issues surrounding water pricing and wastewater treatment service charges in Thailand. The main findings are summarized below:

Principles for determining water pricing: There are two main approaches to water pricing: (1) cost-plus pricing and (2) willingness-to-pay (WTP) assessment. Assessing users' willingness to pay is essential for improving the efficiency and sustainability of water resource management. Studies have shown that water prices determined using the cost-plus pricing approach are generally lower than those estimated using the WTP approach.

Variation in water prices: Water prices can vary because the unit cost of water depends on seasonal conditions, such as the rainy and drought seasons. Consequently, there is no single standard water price. In addition, water is currently provided free of charge in most areas, with charges applied only in officially designated irrigation zones.

Water pricing does not reflect the true opportunity cost: Because water users do not bear the full cost of raw water supplied through irrigation systems, water prices remain below their actual economic value. This underpricing encourages excessive and inefficient water use.

Regulatory limitations: Current Thai regulations do not allow water supply charges and wastewater treatment fees to be collected as a single combined charge. As a result, the agency responsible collect these fees separately, leading to fragmented and less efficient revenue collection.

Wastewater treatment fees are lower than recommended levels: The current wastewater treatment fee structure does not reflect full-cost pricing, limiting the capacity and coverage of wastewater treatment services. For example, wastewater treatment plants do not serve all areas, and some households and businesses are not connected to centralized wastewater collection and treatment systems. Consequently, untreated wastewater is discharged directly into public waterways and natural canals, eventually flowing into coastal and marine environments.

Water rates that have been studied and are currently being applied in Krabi Province

Issue	Suggested Tariff	Actual Tariff
Principles for determining water pricing. 2 Guidelines 1) Pricing based on cost. and 2) the assessment of water users' willingness to pay (WTP).	The estimated water price is based on... WTP It is worth more than the estimated price based on cost.	Pricing based on cost.
Water prices can vary. Cost of water per unit. The difference depends on how close or far it is from a water source. And seasonal variations (rainy / dry season).	-	Water bill 10.20-29.00 baht / cubic meter Differentiated by type of water user, such as households and small/large-scale enterprises.
The water pricing structure does not reflect the full cost pricing. This makes the water price lower than it should be. Raw water fee / Irrigation water fee Collect fees only from large water users.	1.49 Baht / cubic meter (TDRI 2018)	0.50 Baht / cubic meter Raw water/irrigation fees are collected exclusively from large-scale water users1
Current Thai regulations do not yet allow for the integration of water tariffs and wastewater treatment fees into a single billing system.	11.50-16.20 Baht / cubic meter (TDRI 2018) 14.00-18.00 Baht / cubic meter (WTP-TDRI 1995)	Currently not collected
The actual collected wastewater treatment fees are lower than those estimated in the studies.	11.50-13.75 Baht / cubic meter (Calculated based on investment costs and the operation and maintenance (O&M) costs of machinery and equipment.)	3.50-5.00 Baht / cubic meter The wastewater treatment cost depends on the type of treatment system and the source of the wastewater.

Recommendations on concepts for setting appropriate water tariffs to reflect the true cost of managing, conserving, and restoring water resources in the area are as follows:

1 Reviewing and expanding the base for collecting irrigation fees from water users to ensure they are appropriate and inclusive of all areas and all user groups. The revenue generated will be used to increase primary water volume, improve irrigation systems, and develop water sources outside the irrigation network. This includes the formal declaration of irrigation zones to enable broader fee collection across all areas.
2 Integrating tap water tariffs with wastewater treatment fees to cover the entire process—from supply, production, and usage to the treatment of effluent—to ensure the pricing is "Cost Reflective."
3 Amending regulations to enable waterworks authorities to manage water supplies effectively under different seasonal conditions (rainy and dry seasons).

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The water tariff rates review

Water is a limited yet crucial resource that drives the economy, supports consumption, and sustains agriculture, tourism, industrial production, and ecosystem health. In 2024, the region faced significant challenges, including droughts, high water demand during the dry season, and water quality issues in urban areas and tourist destinations. These challenges are exacerbated by the rapid growth of the service and tourism sectors, as well as urban expansion, which have collectively increased water demand in Krabi Province.

Therefore, it is essential to develop strategies to improve the efficiency of water resource management to ensure stability and sustainability. Water pricing is one such tool, as it promotes efficient water allocation and encourages its use in activities that generate economic value. Accordingly, this study reviews water pricing, tap water tariffs, and irrigation fees, and examines the principles for determining wastewater treatment charges. This section also presents the current water tariffs and wastewater treatment fees collected in Krabi Province, with details as follows:

1. Conceptual framework for determining water pricing

The conceptual framework for determining water pricing consists of four key aspects:

1) Economic Signaling Price is a critical tool for signaling the true value and scarcity of water resources to users. Many users consume water without fully appreciating its value, which leads to excessive and inefficient use. Consequently, setting appropriate prices helps incentivize the responsible and efficient use of resources.

2) Promoting Efficiency and Incentives Water conservation initiatives aim to encourage users to minimize waste and reduce unnecessary loss. Pricing strategies incentivize farmers to adopt more efficient agricultural practices—such as transitioning to low-water-demand crops—which can yield higher economic returns compared to water-intensive crops.

3) Cost Recovery and Financial Sustainability Revenue collection is essential for covering operation and maintenance (O&M) costs and offsetting investments in irrigation infrastructure, thereby ensuring system stability and continuous service. Although the government has developed extensive water storage and distribution infrastructure nationwide, a lack of commensurate pricing has led consumers to perceive water as an inexhaustible public commodity, resulting in inefficient consumption.

4) Service Accountability and Relationship Building Payment of water tariffs establish a formal relationship between service providers and users. When users pay for water services, they are empowered to demand higher quality and more reliable service from the government. Furthermore, transparent financial management at the local level fosters a sense of user ownership and encourages greater public participation in water management.

International Water Pricing Models

Examples of water pricing frameworks globally demonstrate that many governments utilize water tariffs as a primary mechanism to incentivize responsible consumption and promote resource efficiency. Sustainable water management must prioritize demand-side strategies over production-focused ones by encouraging users to

optimize their consumption through cost-reflective pricing. This approach ensures that tariffs comprehensively cover all associated expenses, including raw water sourcing, transportation, operational management, and the downstream costs of wastewater treatment.

A notable example is the water tariff structure in Melbourne, Australia. The water bill is broken down to reflect the true cost of service, comprising (*Figure 1)* :

- **Water Supply Services (38%):** Fees paid to the regional authority that manages the primary water resources.
- **Wastewater Services (22%):** Costs dedicated to developing and maintaining wastewater piping, drainage systems, and treatment facilities.
- **Organizational Operating Costs (14%):** General administrative and management expenses.
- **Infrastructure Investment (22%):** Funding new systems and facility upgrades.
- **Environmental/Sustainability Levy (4%):** Fees specifically earmarked to support eco-friendly and sustainable water management practices.

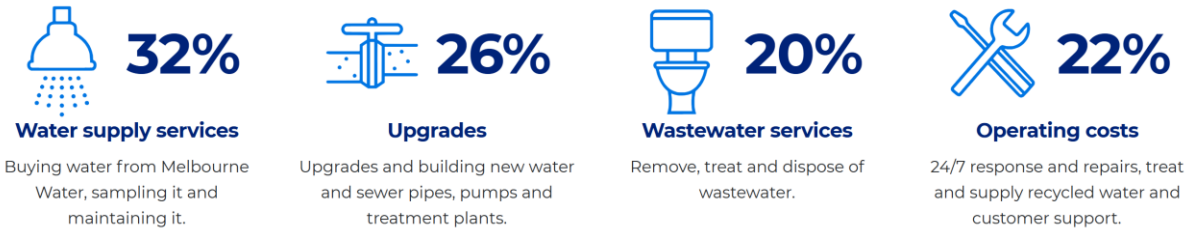
Implementing such pricing models not only supports financial sustainability but also fosters innovation by encouraging the adoption of water-saving technologies. Furthermore, by accounting for the full lifecycle of water use, these systems help mitigate external environmental impacts and enhance overall efficiency in water resource management.

Furthermore, implementing water charges can facilitate innovation and the adoption of new water management technologies. These advancements contribute to water conservation, infrastructure development, and other related factors, all of which directly benefit water resource management. Additionally, such measures help mitigate external impacts and minimize negative environmental effects

Figure 1 Example of the tap water cost structure in Australia

2018 Australian Tap Water Cost Structure

2025 Australian Tap Water Cost Structure



Source: South East Water Corporation (2018) and South East Water Corporation (2025)

In Singapore, water management is overseen by the Public Utilities Board (PUB). The water pricing structure consists of three main components designed to reflect true costs and promote conservation:

1. **Water Tariff:** Calculated based on actual consumption.
2. **Water Conservation Tax (WCT):** Implemented to raise awareness regarding water scarcity.
3. **Waterborne Fee:** An additional charge to cover the costs of wastewater collection, treatment, and drainage system maintenance.

The pricing structure employs a progressive rate system—where higher usage results in higher unit costs—to encourage conservation. Pricing is categorized by user type: household, business, and industry. Singapore reviews and adjusts its water pricing structure every four years to keep pace with rising production costs and

infrastructure investments. Collected revenue is reinvested into water treatment processes, reservoir maintenance, and water recycling initiatives, including desalination and the expansion of nationwide water pipeline and wastewater treatment systems.

Water pricing principles—covering raw water, tap water, and irrigation—serve as a tool for sustainable and efficient resource management. Beneficiaries of water resources should share the cost based on actual consumption to reduce the burden on public budgets. There are two primary approaches to determining these prices:

1. Cost-Plus Pricing

Cost-plus pricing is a method of calculating water tariffs by adding a suitable profit margin to the actual production costs. This approach ensures that water utilities remain financially sustainable and capable of ongoing infrastructure investment.

Determining Water Tariffs Establishing appropriate rates for tap water and irrigation is essential, as the revenue generated can be reinvested to improve service efficiency. The costs associated with water supply and allocation are comprehensive, encompassing:

- **Capital Investments:** Costs for infrastructure construction, such as water sources, pipelines, and metering systems.
- **Operational Costs:** Expenses related to water procurement, system maintenance, and service area expansion.
- **Administrative Costs:** Personnel and overhead expenses.
- **Opportunity Costs:** The value of the next best alternative use of water resources.

Pricing principles based on the cost concept are categorized as follows:

- **Marginal Cost Pricing:** Focused on profit maximization and planning for future capacity expansions to meet demand.
- **Market-Based Pricing:** Adjusting rates based on service volume.
- **Average Cost Pricing:** Including total investment and operational management expenses.

Water pricing should ideally reflect the "full cost" of supply, including production, opportunity, and externality costs.

2. Willingness-to-Pay (WTP)

Determining appropriate water, tap water, and irrigation tariffs requires applying the principles of the users' ability and willingness to pay (WTP). By identifying the maximum amount users are willing to contribute, this concept fosters public participation in monitoring and conserving water resources. It serves as a crucial mechanism for promoting efficient water use and maximizing societal benefits. Furthermore, this approach

ensures that water resource allocation—across both production and consumption sectors—positively impacts commodity pricing, income distribution, resource quantity, and environmental quality.

The collection of irrigation fees promotes economic efficiency in water resource utilization within a framework of equity and income distribution. Irrigation tariffs should be determined based on both the cost of resource acquisition and the incremental benefits derived from its use. This necessitates calculating the social costs associated with water production and supply, incorporating all resource utilization expenses in alignment with the "full-cost pricing" principle. Consequently, pricing must cover infrastructure investment, operation, and maintenance (O&M) costs, while reflecting the economic value generated. Additionally, policymakers should consider establishing a market for water usage rights, supported by clear guidelines and legislation, to ensure that market mechanisms function effectively.

Principles for collecting irrigation fees are rooted in both economic and social objectives:

1. **Beneficiary Pays Principle:** Fees are collected from farmers based on actual water consumption to sustain the irrigation management fund.
2. **Appropriateness and Fairness:** Rate setting must balance supply-side costs with demand-side capacity (the farmers' ability and willingness to pay) to ensure long-term sustainability.
3. **Efficiency Improvement:** Tariffs encourage farmers to recognize the true value of water, reduce wasteful consumption, and cultivate a sense of resource ownership in partnership with the government.

Implementing irrigation fees to improve the economic efficiency of water allocation can significantly reduce the fiscal burden on the government. Revenue generated from these fees can be used to maintain existing infrastructure, allowing the government to reallocate public funds toward further developing the nation’s irrigation systems. There are three primary approaches to setting irrigation tariffs, each designed to ensure farmers recognize the true cost of water supply:

- **Procurement-Based Pricing:** This model covers both fixed costs—such as the construction of dams, reservoirs, and distribution infrastructure, as well as data management for water allocation—and variable costs, including operational management, maintenance, and personnel salaries.
- **Incremental Benefit-Based Pricing:** This approach sets tariffs based on the added economic value generated by the water resources used.
- **Water Usage Rights-Based Pricing:** This model is based on granting formal water usage rights to users and establishing a secondary market for trading these rights.

There are two primary approaches to collecting irrigation fees:

1. **Fixed Fee:** Calculated based on the cultivated area and crop type (typically expressed as units per *rai* per year). This is often implemented during periods of water shortage or throughout the dry season.

2. **Volumetric Fee:** Based on the actual volume of water delivered to the cultivated plots (expressed as baht per cubic meter).

Several factors influence the structure of irrigation fees, including the scale of the irrigation project, the technical maturity of the water delivery system, and the condition of infrastructure during the growing season. Additionally, the ability to accurately measure water flow, crop-specific water requirements, and the market value of agricultural produce are critical considerations. Broader water management measures—such as promoting on-plot conservation, implementing water diversion systems, optimizing distribution, and strategic canal planning—also play a significant role in determining appropriate fee levels.

Groundwater Pricing Setting appropriate prices for groundwater involves factoring in scarcity and conservation costs to maximize societal welfare while ensuring the long-term sustainability of the resource. For example, in 2007, a groundwater conservation fee of 8.5 baht per cubic meter was implemented. This fee was designed to cover administrative costs while reflecting both the usage of the water and its inherent scarcity.

2. Water Tariffs, Tap Water Charges, and Irrigation Fees

2.1 Review of Water Pricing

A review of water pricing studies in Thailand, covering both tap water and irrigation, indicates that tariffs are generally determined using the average incremental cost principle to ensure sustainable resource management. Furthermore, pricing models frequently incorporate the Willingness-to-Pay (WTP) principle of water users.

Tap Water Pricing

Studies on cost-reflective pricing demonstrate that the marginal benefit of water use should ideally equal the marginal cost of supply. True costs include production expenses (e.g., fuel, machinery, and labor), opportunity costs, and external social costs associated with water production and usage. The Provincial Waterworks Authority (PWA) has applied the average marginal cost principle to determine efficient resource allocation and reflect opportunity costs. Research indicates that the current PWA water rate—including government subsidies—is 25.72 baht per cubic meter. Without subsidies, the price based on the average marginal cost principle is 18.58 baht per cubic meter. When compared to the current tariff of 19.13 baht per cubic meter, the actual rate is higher than the price that reflects the opportunity cost of the resource. Consequently, the current subsidized pricing does not optimize resource allocation or social welfare. Therefore, it is recommended that the PWA conduct a comprehensive review of water pricing to account for future demand and operational efficiency, reducing reliance on subsidies while ensuring tariffs reflect actual costs to users (Chongdee & Chaiwichitchart, 2024).

Research on water pricing in Phuket, which surveyed the willingness to pay for improved service and quality, found that users were willing to pay an additional 6.26–8.5 baht per cubic meter. This willingness-to-pay (WTP) figure is lower than the full production cost, estimated at 14–18 baht per cubic meter. However, when

purchasing water from private suppliers, consumers have demonstrated a WTP of 16–75 baht per cubic meter for higher-quality water (TDRI, 1995).

A study on sustainable management in Chanthaburi Province investigated the WTP for watershed forest conservation, given the link between forest health and water availability. It found that households using tap water were willing to pay an additional 104.61–111.52 baht per month to support conservation efforts that safeguard their water supply. Factors influencing this WTP included household income, the Beneficiary Pays Principle, and the baseline water tariff (Taweepatimakorn & Silprachawong, 2018). Similarly, a TDRI study (2018) found that farmers were willing to pay between 0.068 and 0.15 baht per cubic meter, provided the water supply was clean and consistent, and that the collected fees were managed by water user groups for irrigation canal maintenance.

Irrigation Water Pricing Framework

Setting appropriate tariffs for irrigation and agricultural water must account for the operational and maintenance (O&M) costs of the supply and delivery infrastructure. Irrigation fees serve as a critical instrument for the efficient management of water resources. There are three primary principles for determining these fees: pricing based on supply costs, pricing based on the incremental benefits of water use, and pricing based on the establishment of a water usage rights market.

While irrigation systems have been developed to mitigate water shortages during the dry season, the current situation is intensifying due to resource scarcity, inefficient reservoir management, and a lack of awareness regarding the true value of water. Furthermore, the absence of a standardized water fee collection system remains a significant challenge. For instance, the cost of water supply for the Kam River Basin Development and Maintenance Project ranges from 9.17 to 18.08 baht per cubic meter.

Research conducted by the Thailand Development Research Institute (TDRI) in 2018 indicates that farmers are generally willing to pay for irrigation, if water user groups collect the fees and reinvest them directly into canal maintenance—a process analogous to home utility repairs. Through such participatory management, farmers have expressed a willingness to pay at least 70 baht per rai for a consistent, high-quality water supply, and in some contexts, up to 175 baht per cubic meter for irrigation (Homdee & Deachakumpu, 2018) (Table 1).

Furthermore, research by the Thailand Development Research Institute (TDRI) in 2018 indicates that current raw water pricing does not reflect the actual cost of developing irrigation infrastructure, nor does it align with the users' willingness to pay (WTP). Findings suggest that water users are willing to pay between 12 to 15 baht per cubic meter for tap water, provided it is of potable quality and ensures a continuous, reliable flow.

Most studies regarding irrigation water costs utilize surveys to gauge farmers' WTP, contingent upon the delivery of adequate water quality, consistent supply, reliable delivery times, and proper system maintenance. These studies show that the average WTP for irrigation water varies by region, ranging from 3 to 40 baht per *rai* per growing season.

Regarding irrigation water intended for household consumption, surveys indicate that users are willing to pay between 11.5 to 16.2 baht per cubic meter for treated tap water. When converted to the cost of raw irrigation water, this equates to approximately 1.10 baht per cubic meter, which remains lower than the actual irrigation water production cost of 1.25 baht per cubic meter (TDRI, 2018) (Table 1).

A study on the Maharat Irrigation and Maintenance Project utilized data from 1992–2001 to assess farmers' willingness to pay (WTP) for irrigation water using valuation methods under hypothetical scenarios. Specifically, the Contingent Valuation Method (CVM) was employed to survey the maximum amount farmers would be willing to pay, assuming sufficient water availability (Narumon Phiwphong, 2004). The findings demonstrated that irrigation costs varied significantly depending on the type of crop cultivated (see Table 1). At an average rate of 0.191 baht per cubic meter, the calculated costs were 244.48 baht per rai for main-crop rice, 363.66 baht per rai for off-season rice, and 150.50 baht per rai for sweet potato cultivation.

Table 1 Summarizes the review of water pricing studies for both tap and irrigation water

Study	Methods of study	Study results
Tab Water		
Supat Charasuksawat , 2004 The Economic Pricing of Water by the Provincial Waterworks Authority: A Case Study of the Kabin Buri Waterworks Authority	Water pricing is determined using the average incremental cost principle, which serves as the base rate. This methodology aims to improve operational efficiency and supports a comprehensive study of the conditions surrounding the production, distribution, and infrastructure upgrades of the Kabin Buri water supply system.	- The current water tariff is 21.12 baht per cubic meter, inclusive of government subsidies, which results in an average consumer price of 11.79 baht per cubic meter. - When government transfer funds are excluded from investment costs, a water tariff of 9.74 baht per cubic meter is considered an efficient price.
TDRI (2018) Developing irrigation projects and managing water resources to maximize economic benefits.	The economic value of water is calculated using the Computable General Equilibrium (CGE) model.	- Shadow Price of Raw Water: The shadow price for raw water across all sources ranges from 1.24 to 1.68 baht per cubic meter. - Agricultural Water Price: The valuation for water in the agricultural sector ranges from 0.10 to 1.50 baht per cubic meter.

Study	Methods of study	Study results
		- Tap Water Price: The price for tap water is 14.73 baht per cubic meter, reflecting the costs associated with water quality improvement.
	Assessment of Water Users' Willingness to Pay (WTP)	Water users across the industrial, power generation, and service sectors have demonstrated a willingness to pay (WTP) 1.25–1.50 baht per cubic meter for general water supply, and 11.50–16.23 baht per cubic meter for potable water. This willingness to pay is contingent upon consistent supply, expanded service coverage, effective wastewater treatment, and improvements in water quality.
Athirat Thaweepathimakorn and Udomsak Silprachawong (2018)	This study explores water users' willingness to pay (WTP) for tap water services to ensure the sustainability of water resources through the conservation and restoration of watershed forests in Chanthaburi Province. The research examines the critical relationship between forest integrity and water availability, specifically focusing on how forest degradation diminishes water supplies for consumption.	Households using tap water services are willing to pay an additional 104.61–111.52 baht per month to support the conservation and restoration of watershed forests, recognizing the direct impact of these forests on their daily water supply. Furthermore, this willingness to pay is positively correlated with user satisfaction regarding the service received.
Irrigation Water Pricing		
Tipaporn Homdee and Kotchakorn Te Chakamphu (2016)	The valuation of irrigation water rates for the Royal Initiative Kam River Basin Development and Irrigation Project in Nakhon Phanom	Irrigation Water Valuation: Cost-of-Supply Analysis

Study	Methods of study	Study results
Irrigation water valuation: Royal Initiative Project for the Kam River Basin Development and Maintenance, Nakhon Phanom Province.	Province is based on the average cost method. This assessment reflects the cost of supply for farmers and includes both current average cost valuation and average cost valuation projected over the project's 50-year lifespan.	The valuation of irrigation water, based on the cost of supply, is categorized as follows: Total Supply Cost Valuation: Accounting for both the cost of water supply and the farmers' willingness to pay, the valuation ranges from 12.70 to 18.08 baht per cubic meter. Infrastructure and Management Cost Valuation: Based on the costs of constructing the water delivery system and ongoing project management, the estimated cost ranges from 9.17 to 12.96 baht per cubic meter. Project Management Cost Valuation: Based solely on operational project management expenses, the estimated cost ranges from 1.36 to 1.57 baht per cubic meter.
Tipaporn Homdee and Kotchakorn Te Chakamphu (2016) Assessing farmers' willingness to pay for irrigation management. (Evaluation of Farmers' Willingness to Pay for Irrigation Management)	This study assessed the willingness to pay (WTP) among farmers utilizing irrigation water from the Kam River Basin Development and Maintenance Project in That Phanom District, Nakhon Phanom Province. Utilizing the Contingent Valuation Method (CVM) with a sample size of 414, the research evaluated farmers' willingness to contribute toward flood prevention initiatives and water storage solutions for the dry season.	Approximately 54.11% of the 224 farmers surveyed expressed a willingness to pay (WTP) for irrigation management and water access. The average WTP was 0.188 baht per cubic meter, with contributions intended for the irrigation management fund. Factors significantly influencing this willingness to pay included the type of agricultural production (rice cultivation versus orchard farming), total agricultural land area, net

Study	Methods of study	Study results
		income after production costs, and the farmer's education level.
TDRI (2018)	Assessment of Farmers' Willingness to Pay (WTP) for Irrigation Water.	Farmers have expressed a willingness to pay for irrigation water at a rate of 0.10–0.15 baht per cubic meter, which remains lower than the actual production cost of 1.25 baht per cubic meter. This willingness to pay is contingent upon several conditions: the provision of clean and consistent water, the installation of water meters, the clear definition of basic water entitlements, and the stipulation that collected fees be managed by water user groups for the maintenance of irrigation canals.
Waraporn Panyawadee and colleagues, 2541 (1998). A study of willingness to pay for irrigation water in the Mae Taeng irrigation project area, Chiang Mai Province.	This study investigated farmers' willingness to pay (WTP) for irrigation water using the Contingent Valuation Method (CVM). The independent variables examined included landholding size, age, gender, distance from the farmland to the irrigation canal, perceived water adequacy, and the effectiveness of water user groups in collecting irrigation fees.	Farmers have expressed a willingness to pay (WTP) 61 baht per rai for irrigation water.
Chucheep Pipatsitthi, Supachart Sukharom, Kobkiat Phongphutthi, Wirat Khao-upatham, and Taweewong Thianseri, (2001) A study on water bill collection management.	Assessment of Farmers' Willingness to Pay (WTP) for Irrigation Water.	Farmers who utilize irrigation water are willing to contribute to the operation and maintenance (O&M) costs of the supply and distribution infrastructure.

Study	Methods of study	Study results
Narumon Phiwphong, 2004 Setting appropriate irrigation water rates: Maharat Irrigation and Maintenance Project.	This study investigated farmers' willingness to pay (WTP) for irrigation water using the Contingent Valuation Method (CVM). By surveying 55 farmers, the research assessed both their willingness and ability to pay, while accounting for socio-economic data and agricultural production returns	Farmers within the Maharat Irrigation Project area have expressed a willingness to pay irrigation fees of 40.11 baht per rai. Regarding the pricing structure, the irrigation water cost—calculated at the average cost rate—is 0.191 baht per cubic meter, while the rate based on the incremental cost is 0.092 baht per cubic meter. Notably, the required irrigation fees vary according to the specific crop cultivated.

Source: Data compiled by the research team

Groundwater pricing is determined by using a cost-based approach, comprising three primary components: **Fixed Costs:** Investment expenses, materials, equipment, and infrastructure access (e.g., pipelines and well drilling). **Variable Costs:** Expenses related to water extraction, maintenance of production units, and water quality treatment. And **Shadow Costs:** Non-market expenses, including the opportunity cost of resource scarcity (groundwater conservation costs), wastewater treatment, and environmental restoration.

2.2 Water Fee Collection in Krabi Province.

Water usage in Thailand is governed by the Royal Irrigation Act (1942) and its 1975 amendment, alongside the Water Resources Act (2018) and its associated Ministerial Regulations. Under these laws, water usage is classified into three categories:

1. **Type 1:** Use of public water resources for subsistence, household consumption, small-scale agriculture, livestock farming, or home-based industries.
2. **Type 2:** Use of public water resources for industrial purposes, tourism, power generation, water supply, and other commercial activities.
3. **Type 3:** Use of public water resources for large-scale operations that consume significant water volumes, potentially cause cross-basin impacts, or cover extensive geographic areas.

Certain activities are exempt from water usage fees, including water production for public consumption by non-state enterprises (with a capacity not exceeding 30 cubic meters per hour), water for educational institutions, and water for hospitals.

Water Tariff Structure While the law allows for a maximum fee of 5 baht per *rai* per year for non-agricultural users, current policy does not levy charges on agricultural or public users. For other users, fees are set at 0.50 baht per cubic meter within irrigation areas and 0.373 baht per cubic meter outside of them. These rates are significantly lower than the actual cost of supply, as they do not always account for infrastructure construction costs. According to the Thailand Development Research Institute, current water charges remain approximately 1.25 baht per cubic meter below the full cost of irrigation water (TDRI, 2018).

As of 2025, the water tariff structure in Krabi Province, administered by the three branches of the Provincial Waterworks Authority (PWA), is based on a progressive rate determined by consumption volume. The tariff is categorized into three user groups:

- **Category 1 (Residential):** Water rates range from 10.20 to 21.20 baht per cubic meter.
- **Category 2 (Government Agencies and Small/Medium Businesses):** This includes hospitals, schools, and government buildings, with rates ranging from 16.00 to 21.90 baht per cubic meter.
- **Category 3 (Large Businesses and Industry):** This includes industrial plants, banks, and large commercial establishments, with rates ranging from 18.00 to 29.00 baht per cubic meter.

Additionally, an irrigation and agricultural water fee of 0.50 baht per cubic meter is levied, which remains below the actual cost of irrigation water supply. Currently, no water charges are imposed on household or agricultural usage for industrial entities; however, groundwater extraction is charged at a rate of 3.50 baht per cubic meter (see Table 2)

Table 2 **Water Tariff Rates of the Provincial Waterworks Authority (Krabi Branch)**.

Water Usage Volume (cubic meters per month)	Type 1 Residential users	Type 2 Government agencies and small/medium-sized businesses users	Type 3 Industrial and Large-Scale Commercial: Includes industrial plants, office buildings, and large business establishments.
0-10	10.20	16.00	18.00
11-20	16.00	19.00	21.00
21-30	19.00	20.00	24.00
31-50	21.20	21.50	27.00
51-80		21.60	29.00
81-100		21.65	29.25

101-300		21.70	29.50
301-1,000		21.75	29.75
1,001-2,000		21.80	29.50
2,001-3,000		21.85	29.25
>3,000		21.90	29.00

Notes:

1. **Type 1 Water Users:** If monthly consumption exceeds 50 cubic meters, water usage starting from the 51st cubic meter will be charged at the current Type 2 rate.
2. **Type 2 Water Users:** If monthly consumption exceeds 80 cubic meters, water usage starting from the 81st cubic meter will be charged at the current Type 3 rate.

Source: Provincial Waterworks Authority, Krabi Branch (2025).

Under the Groundwater Act, fees for groundwater usage and conservation in areas outside of groundwater crisis zones are divided into usage fees and conservation charges. These are classified into three categories:

1. **Domestic use.**
2. **Businesses or industrial plants:** Includes both those that utilize agricultural products and those that do not, as specified by the Minister.
3. **Agriculture:** Includes crop cultivation and livestock farming, further categorized by daily consumption thresholds (above or below 50 cubic meters per day).

Current collection rates are as follows:

- **In areas with access to piped water:** 3.50 baht per cubic meter.
- **For businesses and industrial plants in areas without piped water:** 1.05–2.625 baht per cubic meter.
- **For livestock farming:** 1.05 baht per cubic meter (applied only to the excess volume for users exceeding 50 cubic meters per day).

Other groundwater users are exempt from these charges.

3. Wastewater treatment fee

3.1 Wastewater Treatment Fees: A Review of Determination Mechanisms

Wastewater treatment fees

Appropriate wastewater treatment rates must reflect the total actual costs incurred by the management system for each type of water user, in accordance with the Polluter Pays Principle (PPP). This approach emphasizes the importance of public participation and ensures that Local Administrative Organizations (LAOs) have sufficient revenue to operate treatment systems efficiently and sustainably.

The Pollution Control Department (PCD) serves as the primary standard-setter, providing guidance for determining wastewater treatment rates. The PCD has prepared a manual titled *Guidelines for Determining Community Wastewater Treatment Service Rates* to provide LAOs with a framework for adapting and managing systems within their respective jurisdictions (Pollution Control Department, 2020; Wastewater Management Authority, 2020).

Furthermore, studies regarding willingness to pay (WTP) have indicated that users are willing to contribute 2.08 baht per cubic meter (approximately 79 baht per month), which remains significantly lower than the actual treatment cost of 7 baht per cubic meter (TDRI, 1995). To raise public awareness and facilitate the gradual implementation of these fees, government policy initially stipulated that cost determination should be limited to operational, maintenance, and fund-reimbursement expenses. Consequently, any proposed rate must be approved by the public, considering both their willingness and ability to pay (Pollution Control Department, 2020).

The total cost of a wastewater treatment system comprises six categories: land acquisition, construction, system operations, routine maintenance, equipment replacement, and management costs—including the reimbursement of funds sourced from national budgets, local revenue, or environmental funds. Table 3 outlines the necessary data sets required to determine appropriate and equitable wastewater treatment rates for each area.

Table 3 Data Requirements for Determining Wastewater Treatment Rates

Data Categories	Data Source or Owner
Wastewater treatment service area	Engineering Division or Public Health and Environment Division (Local Administrative Organization)
- Water sources and consumption - Water supply service area and groundwater well data	Water Supply Division (Local Administrative Organization) / Provincial Waterworks Authority Groundwater Division, Department of Mineral Resources
- Current population size - Population Growth Projection	Civil Registration Office, Office of the Permanent Secretary (Local Administrative Organization)
Household and Establishment Data: Classified by building type, size, and location. Examples include residential households, commercial and service establishments, industrial plants, and educational institutions.	Tax maps and taxpayer registration, Treasury Division or Education Division (Local Administrative Organization) / Provincial Industry Office
Wastewater management profile by building type.	Field survey (Local Administrative Organization)
Financial and fiscal status (historical and projected)	Treasury Division (Local Administrative Organization)
Budgetary funding sources	Treasury Division (Local Administrative Organization)
Current wastewater inflow and projected growth rates (over the system's lifespan)	Engineering or Public Health and Environment Division (Local Administrative Organization)
Current and projected operating and maintenance (O&M) costs throughout the project's lifespan.	Engineering or Public Health and Environment Division (Local Administrative Organization)
Public willingness and ability to pay for wastewater treatment	Field survey (Local Administrative Organization).

Source: Pollution Control Department (2020)

Water users are generally classified into two main categories: **Residential**, which encompasses properties used exclusively for dwelling purposes without any commercial activity; and **Business**, which includes commercial, industrial, and government facilities, as well as office buildings. Notably, this classification remains inclusive of mixed-use properties where occupants reside on the premises alongside commercial operations. It is important to note that these definitions may vary based on the specific water service provider, such as local administrative organizations, the Metropolitan Waterworks Authority (MWA), or the Provincial Waterworks Authority (PWA).

Regarding wastewater volume, data is typically either measured directly via inflow meters at the treatment plant or estimated as 80% of total water consumption. According to the Department of Pollution Control (2024), there are three established methodologies for determining wastewater treatment costs.

1. **Flat-Rate System:** This approach is suitable for areas with limited access to water consumption data—for example, where Local Administrative Organizations (LAOs) lack their own water supply systems or face challenges retrieving usage data from the Provincial Waterworks Authority (PWA) or the Metropolitan Waterworks Authority (MWA). A practical example is the Kosum Phisai Subdistrict Municipality in Maha Sarakham Province, which charges a flat fee of 10 baht per month for residential households and 20 baht per month for commercial establishments.
2. **Usage-Based Billing System:** This system is appropriate for areas where water meters are installed for every user, enabling the LAO to monitor consumption accurately. Fees are calculated based on actual water usage and vary by user category. Pattaya City, Chonburi Province, utilizes this system with the following tiered structure:
    - **Group 1 (Residential, religious, or charitable):** 6.5 baht per cubic meter.
    - **Group 2 (Small businesses, hospitals, schools, government, and international organizations):** 7.0 baht per cubic meter.
    - **Group 3 (Industrial plants, banks, offices, and large commercial establishments):** 7.5 baht per cubic meter.
3. **Hybrid Billing Model**: This model combines flat-rate and usage-based systems. It is best suited for LAOs that have sufficient consumption data for specific user groups, but where business-to-residential ratios make a full usage-based system impractical. Typically, residential users are charged a flat fee, while business users are billed based on metered water consumption.

Since the Pollution Control Department (PCD) provides only foundational guidelines and criteria for wastewater treatment costs, the adoption of these standards through municipal ordinances remains at the discretion of each Local Administrative Organization (LAO). This has resulted in significant diversity in how wastewater treatment fees are determined across different jurisdictions, influenced by the following factors:

1. **Variability in User Classification:** The classification of water users into Groups 1, 2, and 3 often varies by locality. Definitions and criteria used by different LAOs may differ significantly from the model utilized by Pattaya City, Chonburi Province.
2. **Pollutant Loading:** Wastewater treatment costs are dependent on pollutant levels—specifically Biochemical Oxygen Demand (BOD) loading—which vary based on local pollution sources. Because LAOs exercise discretion in classifying users, similar entities may be subject to entirely different fee

structures depending on their location. For instance, the Kut Chik Subdistrict Municipality in Nakhon Ratchasima Province charges 10 baht/household/month for residential buildings and 2 baht/cubic meter for hotels, whereas the Karon Subdistrict Municipality in Phuket Province charges 75 baht/household/month for residential buildings and a flat rate of 84 baht/room/month for hotels.

3. **Progressive Fee Structures:** Some LAOs have implemented progressive fee systems, starting with a minimum service fee in the initial year and gradually increasing to a predetermined maximum rate over time.

Furthermore, the PCD has established recommended fee ranges based on the specific type of wastewater treatment system employed. Recommended ranges for the business sector are generally wider and feature higher minimum and maximum caps compared to the residential sector. For example, for Stabilization Pond (SP) systems, the recommended fee range for the business sector is 2.50–7.00 baht/cubic meter, compared to 2.00–4.00 baht/cubic meter for the residential sector. These rates are notably lower than those associated with Activated Sludge (AS) systems (Table 4) (Wastewater Management Authority, 2020; Pollution Control Department, 2024).

Table 4 Recommended Wastewater Treatment Service Fee Ranges of Pollution Control Department

Types of wastewater treatment systems	Proposed Service Rate Intervals (Baht/cubic meter)	
	business sector	residential sector
Stabilization Pond (SP) System	2.50-7.00	2.00-4.00
Aerated Lagoon (AL) System	3.00-9.00	2.50-6.00
Activated Sludge (AS) System	4.00-11.50	3.00-8.00

Source : Wastewater Management Authority (2020)

When evaluating the financial cost-effectiveness of wastewater treatment, systems are classified into three categories based on scale:

- **Group 1:** Small-scale wastewater treatment systems.
- **Group 2:** Medium-scale systems (modeled on the construction of the Om Noi Municipality system, Samut Sakhon Province).
- **Group 3:** Large-scale systems (capacity exceeding 10,000 cubic meters per day).

Total expenditures are categorized into three primary components: the cost of the wastewater collection system, the construction cost of the treatment system itself, and the operation and maintenance (O&M) costs for machinery and equipment. The financial evaluation is conducted across three scenarios:

- **Case 1:** Full-cost accounting, covering all construction, operational, and maintenance expenses.
- **Case 2:** Partial-cost accounting, considering only operational and maintenance expenses for machinery and equipment.
- **Case 3:** Targeted-cost accounting, considering the construction costs of the treatment system alongside operational and maintenance expenses.

Table 5 presents the minimum wastewater treatment service fees required to ensure the financial viability of the project. Financial viability is evaluated based on four key indicators (Wastewater Management Authority, 2020): Net Present Value (NPV): Greater than 0, Benefit-Cost Ratio (B/C Ratio): Greater than 1. Financial Internal Rate of Return (FIRR): Greater than 6.325%, and Payback Period: Not exceeding 15 years."

Table 5 Establishing Cost-Effective Wastewater Treatment fee

Categories	**scenarios**				
	Case 1		**Case 2**	**Case 3**	
	Wastewater Treatment fee (Baht/cubic meter)	**Payback period (years)**	**Wastewater Treatment fee (Baht/cubic meter)**	**Wastewater Treatment fee (Baht/cubic meter)**	**Payback period (years)**
Group 1	14.25	8 years 11 months	5.00	13.75	8 years
Group 2	15.00	12.00	5.00	8.25/10.25/11.50*	10 years and 4 months
Group 3	15.00	12.00	5.00	8.25/10.25/11.50*	10 years and 4 months

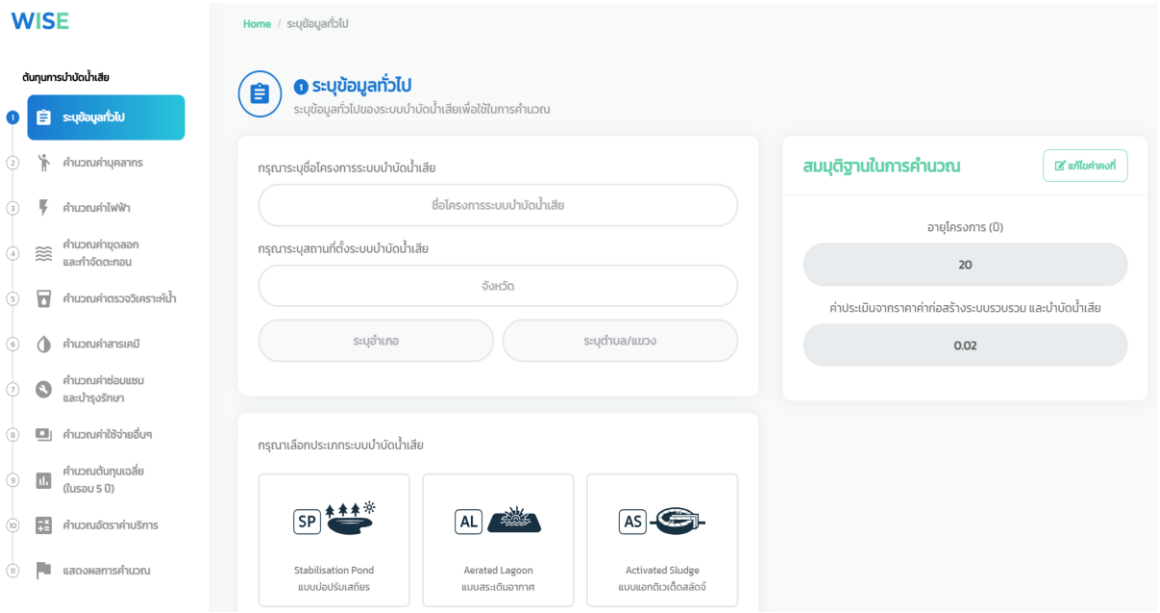
Note: * Service fees will be collected in three distinct phases: Phase 1, Phase 2, and Phase 3

Source: Wastewater Management Authority (2020)

In addition to the guidelines provided by the Pollution Control Department (PCD), Local Administrative Organizations (LAOs) can utilize the 'WISE' (Wastewater Treatment Infrastructure Service Fee Estimation) web application to calculate treatment costs and determine appropriate service fees. As outlined on the PCD website (Figure 2), calculated service fees should exceed the actual operational costs of wastewater treatment (Pollution Control Department, 2024).

However, a disparity often exists between willingness-to-pay (WTP) and actual costs. A study on public WTP for wastewater services indicated that users were willing to pay 2.08 baht per cubic meter—approximately 79 baht per month—whereas the actual cost of treatment is 7 baht per cubic meter (TDRI, 1995)

Figure 2 **The following interface displays the WISE calculator program.**



Source: Pollution Control Department (2024)

3.2 Overview of Wastewater Treatment Fee Structures in Krabi Province.

Currently, the centralized wastewater treatment systems in Krabi Province—serving Krabi Municipality and the Ao Nang Subdistrict Administrative Organization—collect fees through the Krabi Provincial Wastewater Management Organization (WMO).

As of 2025, the fee structure is categorized by pollution source into three types: Type 1 (households), Type 2 (small businesses), and Type 3 (large businesses). The Krabi Municipality wastewater system has been operated by the WMO since 2003. Table 6 outlines the WMO's fee structure and collection plan from 2016 to 2028, with rates ranging from 3 to 5 baht per cubic meter of water usage

Regarding fee application:

- **Type 1 Users:** Although the collection plan included them starting in 2022, these users are currently exempt from wastewater treatment fees under the existing plan.
- **Type 2 & 3 Users:** Fees are collected if these establishments operate their own small-scale wastewater treatment systems and discharge treated effluent. In these instances, fees are charged as a fixed monthly rate that adjusts annually.

While volumetric fees are calculated based on metered water consumption using a progressive rate, all three user types are subject to a standard, one-time pipe connection permit fee of 100 baht (Muang Krabi Municipality, n.d.).

Table 6 Wastewater Treatment Fee Rates for the Centralized Wastewater Treatment System (Wastewater Management Authority)

Year	Type 1 Users		Type 2 Users		Type 3 Users	
	Wastewater Rate (Baht/month)	Wastewater Fee (Baht/month)	Wastewater Rate (Baht/month)	Wastewater Fee (Baht/month)	Wastewater Rate (Baht/month)	Wastewater Fee (Baht/month)
2016	-	-	125	3.5	300	4.0
2560	-	-	125	3.5	300	4.0
2561	-	-	125	3.5	300	4.0
2562	-	-	125	3.5	300	4.0
2563	-	-	125	3.5	300	4.0
2564	-	-	125	3.5	300	4.0
2565	-	3.0	125	4.0	300	4.5
2566	-	3.0	125	4.0	300	4.5
2567	-	3.5	125	4.5	300	5.0
2568	-	3.5	125	4.5	300	5.0
2569	-	3.5	125	4.5	300	5.0

Year	Type 1 Users		Type 2 Users		Type 3 Users	
	Wastewater Rate (Baht/month)	Wastewater Fee (Baht/month)	Wastewater Rate (Baht/month)	Wastewater Fee (Baht/month)	Wastewater Rate (Baht/month)	Wastewater Fee (Baht/month)
2570	-	3.5	125	4.5	300	5.0
2571	-	3.5	125	4.5	300	5.0

Note:

1. Collection of wastewater treatment fees for Type 1 pollution sources commenced on March 1, 2012.
2. Collection of wastewater treatment fees for Type 2 and Type 3 pollution sources commenced on March 1, 2009.
3. Wastewater treatment fees are billed and collected on a monthly basis.
4. For pollution sources (Types 1–3) utilizing water from non-municipal sources, fees are calculated based on the designated category of the pollution source.

Source: Wastewater Management Authority, Krabi Branch (2025)

4. Water Pricing Policy: Challenges and Recommendations

The collection of wastewater treatment fees is a critical component of effective water resource management. Establishing monetary value for water services serves as a vital tool to heighten public awareness, promote conservation, mitigate water scarcity, and enhance overall water-use efficiency. Furthermore, revenue generated from these fees can be reinvested into the development and maintenance of infrastructure to better serve public needs. However, despite these benefits, significant challenges persist in achieving sustainable water management, as detailed below.

4.1 Key Challenges in Water tariff and Wastewater Treatment Fee Determination

Determining appropriate wastewater treatment fees also presents significant challenges, including:

Principles of Water tariff Determination

Water pricing principles serve as an essential tool for sustainable and efficient water resource management. There are two primary concepts for determining water prices:

1. **Cost-Plus Pricing:** This method calculates prices by aggregating the actual costs of water production, procurement, and distribution, then adding an appropriate profit margin. This ensures the organization's financial sustainability and ability to fund future investments. Ideally, this pricing should

reflect the full cost of water, encompassing capital expenditure (construction and infrastructure), operational and maintenance (O&M) expenses, opportunity costs, and environmental externalities.

2. **Willingness-to-Pay (WTP) and Ability-to-Pay:** This concept fosters public participation in water conservation and promotes economic efficiency. It serves as a mechanism to maximize societal benefits, ensuring that water allocation across sectors appropriately accounts for impacts on commodity prices, income levels, and environmental quality.

Currently, most water charges are based on the **cost-plus pricing** model. Consequently, water prices often fall below the valuation derived from WTP studies—a discrepancy most evident in the domestic sector. For instance, research indicates that during periods of extreme water scarcity (the dry season), consumers are willing to pay between 100 and 250 baht per cubic meter (Table 7), whereas standard tariffs remain significantly lower."

Table 7 Comparison of Suggested Water Tariff and Actual Water Tariff

Suggested Water Tariff		Actual Water Tariff	
Tariff Category	**Tariff (Baht/cubic meter)**	**Storage Characteristics**	**Tariff (Baht/cubic meter)**
Raw Water / Irrigation Fee	1.49 (TDRI 2018)	Raw Water / Irrigation Fee Collected only from large-scale water users..	0.50
Household Water Bill (Cost-Plus Pricing)	9.17-12.96 (Tipaporn Homdee and Kochakorn Te Chakamphu, 2016)	Varies by user type: Type 1 (Households), Type 2 (Small businesses, hospitals, schools, gov.), Type 3 (Industrial, banks, large businesses).	10.20-21.20 16.00-21.90 18.00-29.00
Water Bill (Willingness to Pay - WTP) **High-quality, safe tap water with consistent pressure and flow.**	12.00-15.00 (TDRI 2018) 104.6-111.52 baht per month per household (Athirat Taweepatimakorn and Udomsak Silprachawong, 2018).	Water bill (WTP)	-

Suggested Water Tariff		Actual Water Tariff	
Tariff Category	**Tariff (Baht/cubic meter)**	**Storage Characteristics**	**Tariff (Baht/cubic meter)**
Village Water Bill	-	Village Water Bill Categorized into two consumption ranges: 1–20 m^3 and >21+ m^3	6.00-8.00
Water supply and wastewater treatment costs (full cost price)	11.50-16.20 (TDRI 2018) 14.00-18.00 (WTP-TDRI 1995)	Covers total water supply and wastewater treatment costs.	No storage required.
Private Sector Consumption.	16.00-75.00 (WTP-TDRI 1995)	Market-based rate for water during dry season shortages.	100-250
Groundwater Fee	-	Applied to large-scale users and the industrial sector in areas with existing piped supply.	3.50

Source: Compiled by the research team

Water service pricing is subject to variation.

Establishing a water trading market involves defining usage structures for various sectors, including households, agriculture, and industry. In this fragmented market, several factors contribute to water price variations:

- **Pricing Methodologies:** Water prices are determined by integrating the 'cost-plus' pricing concept—which accounts for actual production, distribution, opportunity, and externality costs—with the 'willingness-to-pay' (WTP) of water users.
- **Seasonal Pricing:** Prices are adjusted based on seasonal availability to signal water scarcity, particularly during the dry season. This economic tool encourages behavioral changes, such as water conservation, and promotes sustainable resource allocation. Furthermore, it reflects the higher costs associated with water management technologies—such as the 3R principles (Reduce, Reuse, Recycle)—required during periods of scarcity. Implementing seasonal price differentials ensures that users are incentivized to conserve water when it is most critical.

- **Logistical and Topographical Factors:** The distance between the raw water source and the treatment plant significantly impacts pricing. Higher costs are incurred when raw water must be transported over long distances. Consequently, regional differences in topography and water source proximity lead to inherent variations in water pricing across different areas."

Water Pricing That Fails to Reflect Full Cost Pricing

The rising trend in water consumption across the agricultural, domestic, industrial, and service sectors is primarily driven by urban population growth, economic expansion, and increased tourism. A significant underlying issue is that water users are often shielded from the full costs of raw water procurement, resulting in artificially low prices that do not reflect the true cost of tap water production (Nipon Puapongsakorn, 2018). This discrepancy discourages efficiency and contributes to wasteful consumption.

According to the principles of fair water pricing, all sectors should bear the costs of developing irrigation infrastructure, wastewater treatment, and maintaining river and canal ecosystems. Research by the Thailand Development Research Institute (TDRI) indicates that the average development cost for irrigation systems in large and medium-sized reservoirs is 1.49 baht per cubic meter. However, the Royal Irrigation Department (RID) charges major water users—such as water utilities, industrial estates, factories, and resorts—only 0.50 baht per cubic meter, which is approximately one-third of the actual cost (Table 7).

Determining 'true' pricing requires the inclusion of production expenses (fuel, machinery, and labor) alongside opportunity costs (user costs) and environmental externalities (the costs to society of managing the wastewater generated during production and consumption). When tap water prices fail to reflect these true costs, authorities lack the necessary revenue to maintain infrastructure, improve service levels, and ensure water quality.

Regulatory frameworks do not currently support a combined billing system for water supply and wastewater treatment services

In Thailand, water supply services are provided by two primary agencies: the Metropolitan Waterworks Authority (MWA) and the Provincial Waterworks Authority (PWA). While these agencies establish their own water tariff structures, the responsibility for wastewater treatment fees lies with Local Administrative Organizations (LAOs) or dedicated wastewater management organizations. These treatment fees are assessed based on the volume of water consumed—whether from tap, groundwater, or other sources—utilizing data provided by the waterworks authorities.

Currently, the consolidation of water usage fees and wastewater treatment fees remain unfeasible, as they are governed by distinct regulatory frameworks. Furthermore, many LAOs lack standardized guidelines for drafting legislation to determine wastewater treatment fees that accurately reflect local contexts and operational realities.

Current wastewater treatment fees fail to recover the full cost of service

Currently, wastewater treatment fees range from 3.5 to 5.0 baht per cubic meter, depending on user classification. While these rates are designed to minimize the financial burden on the public, they remain significantly below the 11.50–13.75 baht per cubic meter suggested by Pollution Control Department (PCD) studies to cover full investment and operational costs. This persistent underpricing—failing to account for 'full-cost pricing'—results in chronic funding shortages. Consequently, many facilities lack the resources to maintain or upgrade systems, leading to the discharge of untreated effluent into natural waterways, seas, and coastlines. This degradation poses a severe threat to coastal ecosystems, the tourism industry, and the local economy.

Several factors prevent fees from reflecting true costs, including government subsidies intended to maintain social acceptance and minimize the cost of living. Furthermore, current assessment methods are flawed: they rely on water consumption metrics that do not accurately represent the volume of wastewater discharged. Additionally, incomplete coverage of collection networks prevents economies of scale, while a lack of public awareness persists regarding the 'Polluter Pays Principle' (PPP), with many viewing wastewater treatments as a free state-provided service rather than a shared responsibility.

To establish sustainable fee structures, local administrative organizations (LAOs) should transition toward load-based collection—particularly for commercial and industrial users—and expand service networks to increase the payer base. Many countries successfully integrate wastewater fees into water utility bills, ensuring that charges are proportional to consumption and incentivizing resource conservation.

In Thailand, managing these systems remains a challenge for LAOs due to limited personnel, budget constraints, and difficulties in fee enforcement (Pollution Control Department, 2019). While the National Environmental Quality Promotion and Preservation Act B.E. 2535 (1992) provide the legal basis for fee collection, the country lacks specific, unified legislation for wastewater management. This regulatory gap results in inconsistent fee structures across localities, with many LAOs relying solely on non-binding guidelines. Furthermore, even where the Wastewater Management Organization (WMO) has been engaged to support operations, systemic challenges remain in areas lacking local preparedness.

In Krabi Province, for example, the collection system—governed by contracts between LAOs and the WMO—suffers from limited-service coverage and insufficient connectivity, as many establishments have not integrated their pipes into the centralized system. This results in the discharge of untreated wastewater into natural canals, such as Khlong Chak and Khlong Ying Suea (Figure 3). During peak tourism seasons, the high volume of wastewater from hospitality and commercial activities severely degrades water quality, threatening seagrass beds, coral reefs, and marine life, including endangered species such as dugongs. To ensure the long-term sustainability of Krabi’s economy, it is imperative to manage waste within the marine carrying capacity and preserve the province's natural capital.

Figure 3 Locations of pollution sources (a) and water sources in Khlong Chak, Ao Nang, Krabi Province (b) (November 2019)

(a) This map illustrates the waterway and the locations of pollution sources in the Ao Nang canal area, Krabi Province.

(b) Water source in the Ao Nang canal area, Krabi Province.

Source: Krabi Provincial Office of Natural Resources and Environmental Policy and Planning (n.d.)

4.2 Policy Recommendations

Recommendations on concepts for setting appropriate water tariffs to reflect the true cost, encompassing economic, social, and environmental costs, including the scarcity value of water resources and the impacts of ecosystem degradation—in the management, conservation, and restoration of water resources in the area, are as follows:

1 **Reviewing and expanding the base for collecting irrigation fees** from water users to be appropriate and inclusive of all areas and all types of users. This revenue will be used to increase primary water volume, improve irrigation systems, and develop water sources outside the irrigation system to enhance efficiency. This includes supporting the Royal Irrigation Department in declaring irrigation zones to enable broader collection of water fees across all areas.

2 **Integrating tap water tariffs with wastewater treatment fees** to cover the entire process—from supply, production, operation and maintenance, usage, to wastewater treatment—to reflect the "Full Cost Pricing." Inclusive water pricing will allow collected revenue to be used for more efficient utility management, as well as for improving water quality and wastewater treatment. Furthermore, because water management and water quality are inseparable, environmental and wastewater treatment costs should be factored into water pricing to ensure sustainability.

Defining the true water tariff rate involves covering four components: 1) **Economic costs**, including infrastructure investment, operational costs, the cost of developing new water sources, maintenance, and water pipeline network expansion; 2) **Environmental costs**, which cover wastewater or effluent treatment based on the "Polluter Pays Principle"; 3) **Ecosystem costs**, accounting for ecosystem degradation resulting from water sourcing and usage; and 4) **Water conservation taxes**, to raise awareness of the "scarcity" of water resources and incentivize water conservation.

3 **Amending regulations** to enable relevant water supply management agencies, namely the Metropolitan Waterworks Authority, the Provincial Waterworks Authority, the Wastewater Management Authority, and local administrative organizations—to manage water effectively under different seasonal situations (rainy vs. dry seasons)

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