

### **COST AND BENEFIT ANALYSIS FROM USING AUTOMATIC METERING READING FOR GROUNDWATER REVENUE MANAGEMENT : CASE STUDY FROM THAILAND GROUNDWATER CRISIS AREA**

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According to The Groundwater Act, B.E. 2520 and its amendments, licensed groundwater users (hereafter licensees) are required to pay groundwater usage and groundwater preservation fees at the rates set forth in the Ministerial Regulations. Groundwater laws require licensees to keep a record of their groundwater usage and submit it to the local groundwater staff for the specific groundwater area. However, some licensee reports contradict the actual usage recorded by the water meters, and some users have failed to submit their groundwater usage reports and have refused to pay the groundwater usage fees.

Even though there is a default fee and punishment for late payments, there is still a significant revenue loss due to law enforcement due to a lack of government personnel and a low penalty rate. Furthermore, uneconomical groundwater use in excess of the permitted amount may cause damage and the risk of land subsidence, as well as a drop in groundwater levels, resulting in future water shortages. Aside from that, payments are made on a quarterly basis due to the metering groundwater usage collection and bill operating process with a limited number of government officers. Revenue collection efficiency, managerial efficacy, and cost effectiveness are all essential considerations.

At the moment, a number of countries, both developed countries such as the United States and developing countries such as Indonesia, India, and Bangladesh are hiring private agents to collect certain types of public revenue, for instance tax revenue and revenue from water consumption fees/groundwater usage fees. Additionally, the automatic metering reading (AMR) installation is an alternative for increasing the efficiency and efficacy of revenue collection from groundwater usage fees. The benefits of AMR, such as automated leak detection, water measurement and verification, water theft prevention, and so on, will provide efficiency/effectiveness/sustainability, and will be economically cost-effective.

Aside from that, the acquired groundwater usage data is available in real time. It can assist in reducing the volume of lost and wasted water by notifying both the utility and the licensee of water leaks and unusual use patterns. The collected data can be made available to licensees via mobile applications, and billing systems will allow licensees to access specific information about their groundwater use, generating equity in billing.

This study attempts to examine the cost and value of shifting the collecting process of groundwater revenue and groundwater preservation fees from a manual system to an automatic metered reading system utilizing marginal cost and marginal benefit. The methodology is based on a benefit-cost analysis that takes into account the time value of money. There are two types of AMR benefits: tangible benefits and intangible benefits. For tangible benefits, we classified AMR benefits as follows: (i) switching to AMR allows the possibility of shifting payment frequency from quarterly to monthly basis, creating reinvesting opportunity from revenue or interest on interest, and (ii) the AMR system and the IOT system helping to reduce the workload of the Department of Groundwater Resources staff. (iii) the marginal benefit derived from an efficient collection process. For intangible benefits, we evaluate (i) reducing the Department of Groundwater Resources personnel budget, and (ii) providing economic value by reducing the chance of an accidental rate arising attributable to licensee monitoring travel. AMR installation expenses can be broken down into four categories: (i) network security devices (Firewalls), (ii) core network devices (Core Switches), (iii) server computers for system development, and (iv) backup devices for ready maintenance backup programs.

The data in this study are gathered from groundwater crisis areas in seven provinces: Bangkok, Samut Prakan Province, Nonthaburi Province, Pathum Thani Province, Samut Sakhon Province, Nakhon Pathom Province, and Phra Nakhon Si Ayutthaya Province. Surveys and questionnaires would be collected from stakeholders and connected sectors, which are sample groups/representatives in the

commercial and industrial sectors, agricultural sector, and household sector, as well as related government organizations.

Due to the large number of groundwater licensees, the groundwater crisis area of four provinces, namely Pathum Thani, Samut Sakhon, Nakhon Pathom, and Phra Nakhon Si Ayutthaya, is chosen from billing of groundwater charge and preservation costs of at least one million baht every quarter. For the remaining groundwater crisis areas in three provinces: Bangkok, Samut Prakan, and Nonthaburi, the majority of licensees bill less than one million baht per quarter; thus, the selection criteria for these three provinces are the number of groundwater wells with the highest groundwater usage and groundwater conservation costs.

The following are the specific results: (1) Changing to an AMR meter can provide additional benefits in terms of time-savings for current personnel, as administrative work related to revenue collection from groundwater usage fees and groundwater preservation fees can be reduced by 70 percent. In this study, based on 2 personnel per province, using the rate of 26,397.46 baht per person per month to calculate, 70 percent will equate to an opportunity cost of 18,000 baht per person per month. (2) It will help reduce the accident rate from personnel having to travel to perform examinations of groundwater usage by licensees. This study utilizes the Traffic Accident on National Highways in 2019 reported by the Bureau of Highway Safety, Department of Highways, and the Ministry of Transport.

The report revealed that, in 2019, one instance of accident is valued at 3.25592 million baht. In 2019, the accident rate was equal to 149.46 accidents per 100,000 population. This study calculates the benefits from reducing accidents equal to 98,652.57 baht per person per month. In the case that the assumption of the marginal benefits in revenue collection through the AMR meter system fails to increase by 2 percent as assumed, the implementation of the project could still be carried out as long as the increase in collection efficiency is at or above 1.613 percent, which is the project's breakeven point.

However, because the AMR system is complicated and customizable, transitioning from manual to AMR systems is not a one-size-fits-all proposition. We propose that, in order for the AMR installation project to be implemented properly, a pilot project be carried out, and licensees to join the project be selected based on the following criteria: 1. Choose licensees from four groundwater crisis provinces: Pathum Thani Province, Samut Sakhon Province, Nakhon Pathom Province, and Phra Nakhon Si Ayutthaya Province, with a minimum of 1 million baht per quarter in groundwater usage and groundwater preservation fees. 2. For the groundwater crisis areas in Bangkok, Samut Prakan Province, and Nonthaburi Province, a criterion should be utilized to pick 10 to 15 wells among the enterprises with the highest groundwater usage fees and groundwater preservation fees to participate in the AMR meter installation project.

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