Cover page

Title: **Setting Provision on Water Tariff for Disasters Preparedness**

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Setting Provision on Water Tariff for Disasters Preparedness

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ABSTRACT

The Water Price Calculation Formula and Detailed Items are determined according to Article 59 of the “Water Law”. It set the water price to make the Water Utility to operate smoothly under normal conditions. However, earthquakes, typhoons, extreme weather and other disasters will always damage the water supply system and require a large amount expenditure of restoring. It will make water utilities into a financial problem if there is no support from the Government.

This presentation takes the adjustment of water price by the Taipei Water Department (TWD) as an example. It shows the Water Price Calculation Formula was amended and added the provision fee in the water cost for disaster preparedness. The water tariff was adjusted from March 2016. This paper will be clearly to know the diffluent before and after the water tariff adjustment.

The provision fee are collected and will be used urgently in the event of disaster in the future. The effect is just like buying insurance. The Water Utility will not be affect the normal operation when the huge expenditure during the disaster. The Provision Fund also can be used on improving the water supply system to enhance the water supply system resiliently and standby capacity to ensure the stability and safety of the water supply in the event of a disaster.

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INTRODUCTION

Taiwan is located on the Pacific Rim Seismic Zone and is also located on the typhoon path. Earthquakes, floods and other disasters often cause damage to the water supply system, affecting the water supply of thousands or even millions of people. In addition to spending a lot of money on water system restoring, each disaster also reduces the income of water fees. If the disaster occurs frequently or a serious disaster occurs, it will have a major impact on the operation and finance of the Water Utility. Therefore, when the water price is adjusted, the risk of disaster should be included in one of the factors of water tariff adjustment for sustainable development of the Water utility.

Taiwan has two main water utilities Taipei Water Department (TWD) of Taipei City Government, and Taiwan Water Corporation (TWC) of the Ministry of Economic Affairs. TWD is mainly responsible for water supply in the Taipei Metropolitan Area. TWC is responsible for water supply in other parts of Taiwan. Due to different geographical and water supply characteristics to make different water supply costs are also caused difference in water price. But in any case, the timing of water tariff adjustment and the reasonable water price are the most important issue of water tariff adjustment. This paper takes the water tariff adjustment of TWD in March 2016 as an example to discuss the provision fee as one of component on the water price structure, and how to push the measures of disaster preparedness. This experience can do as a reference to the other utilities to push the water tariff adjustment in future.

WATER PRICE CALCULATION FORMULA AND WATER TARIFF ADJUSTMENT PROCEDURE

The water price calculation formula and detailed items are determined by the Ministry of Economic Affairs in accordance with the provisions of Article 59 of the Water Law and reviewed every four years. The water price calculation formula is as follows:

Average Unit Water Price = (Cost + Reasonable Profit + Various Taxes) / Water Sales (m3)

1. The **Cost** include raw water cost, purification cost, water supply cost, business expenses, administrative expenses, financial expenses and other operating expenses: including research and development, staff training and other business related expenses. That should be calculated based on the average of final accounts in the last three years. The cost of future business development, disaster prevention and relief expense fund are especially to be considered on this water tariff adjustment.
2. The **Reasonable Profit** as follows:

Reasonable Profit = (Owner's Equity - Donation of Users outside the Donation) × Return on Investment

The return on investment is set at 5% to 9%, but it can be adjusted according to the local loan interest rate and profit margin. The average loan interest rate for nearly 10 years to TWD is 1.16%, only 0.5% in 2018.

3. The **Various Taxes** refers to business tax and profit-making business income tax.
4. The **Water Sales** refers to the average amount of water sales in the last three years when the water price is proposed, and consider the future operational development factors.

The water tariff adjustment procedure of TWD is shown in Figure 1. The water tariff adjustment plan is devised by TWD first, and send to the Taipei City Government Water Price Review Committee for deliberation. After deliberation, it will be passed by the Taipei Municipal Government Council then deliver to the Taipei City Council for review and submit to the Ministry of Economic Affairs and has done the file for reference and assent. TWD will begin to charge the new water price standard after Taipei City Government declare the implementation date.

Figure 1. The water tariff adjustment procedure of TWD

WATER TARIFF ADJUSTMENT HISTORY AND INFLUENCE TO TWD

The water works in Taipei area began in 1885. In 1977 Taipei water supply area was expanded the Taipei Water Works reorganized to Taipei Water Department of Taipei City Government (TWD). There are 4 times of water tariff adjustment of Taipei Water in past 40 years as Table 1. When the return ratio is lower than loan interest rate and need a mount of money to invest the water supply system , is the timing for water tariff adjustment. The purpose of water tariff adjustment in 1975 is for combined some water works into a unity water utility and integrated the water supply system. In 1980 is for reservoir and water system construction funds to meet the water supply needs. In 1994 is for building a strong and resilient water supply system – double and back up water supply system. In 2016 is for strengthening the seismic capacity of water system and raising disaster preparedness funds. After water tariff adjustment the water fee per 100M³ per year is 46.9 US$ that compare with the Gross National Income (GNI) Per Capita of TAIWAN the ratio is only 0.22, is lower than the other countries,

Table 1. The history of water tariff adjustment of TWD

Tariff adjustment date	Water fee 100m³/p/year (US$)	GNI (US$)	Water fee to income ratio(%)	reason and purpose Return ratio is lower than loan interest rate
Mar. 1975	3.96	900	0.44	Combined each water works into a water utility and integrated the water supply system.
Jun. 1980	6.76	2189	0.31	Raising reservoir and water system construction funds to meet the water supply needs.
Mar. 1994	28.7	11040	0.25	Building a strong and resilient water supply system – double and back up water supply system.
Mar. 2016	46.9	21159	0.22	Strengthening the seismic capacity of water system and raising disaster preparedness funds.

In order to let the representatives of all parties and the general public can understand the main direction of water tariff adjustment and the impact of adjustment on future water supply and water fee. Before proposing the water tariff Adjustment plan TWD set the adjustment principle do as a propaganda theme. The adjustment principle as follows

1. To ensure the basic living of the people, nearly 62% of the households will not to be adjust if their average monthly water consumption below 20 M^3.

2. To prevent waste of water, use different water price range, the more water use the higher the unit water price, so as to encourage people to invest in water conservation or water recycling equipment, to reduce water consumption.
3. .After water tariff adjustment TWD will have more money to continue to promote technological innovation, strengthen the safety and stability of water supply systems, and do more service to customers.

The composition of water price includes two parts, fixed charge and variable charge, shows as Table 2. The fixed charge depends on the diameter of water meter, and 50% discount on 13mm meter for taking care of the low income household and is keep and not to be adjusted in this water tariff adjustment. The variable charge is to be adjusted based on water consumption with the principle of more water consumption and more payment. There are 61.88% of households per month water consumption below 20 M^3 will not be adjusted and the variable water charge keep 5 in NT$/$M^3$, but if the month water consumption is more than 1000 M^3 the variable water charge increases 4 times to 20NT$/ M^3. The amount of water fee income of TWD will increase about 30% after the water tariff adjustment. The amount of water fee income of TWD from 2009 to 2018 show as Figure 2.

Table 2. The component of water price of TWD

Fixed Charge (not related to water consumption) 1 NT$ = 0.03 JS$

Diameter of Water Meter(mm)	13	20	25	40	50	75	100	150	200	250	300
Diameter Similarities	1	2	3.7	11	20	54	107	297	590	1,042	1,635
NT$/Month	17(34)	68	126	374	680	1,836	3,638	10,098	20,060	35,428	55,590

Variable Charge (based on water consumption)

Month water consumption (M^3/month)	0-20	21-60	61-200	201-1,000	More than 1,001
Old Variable Charge (NT$/$M^3$)	5	5.2	5.7	6.5	7.6
New Variable Charge (NT$/$M^3$)	5	6.7	8.5	14	20
Households	941000 (61.88%)	516000 (33.93%)	54000 (3.55%)	7900 (0.52%)	1800 (0.12%)

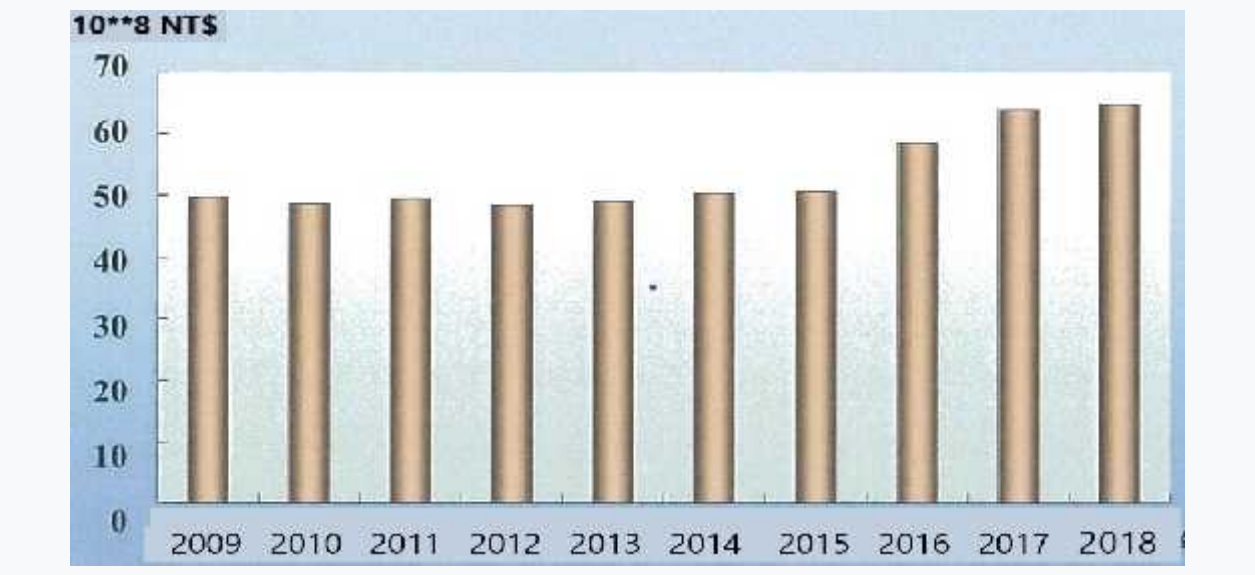

Figure 2. The amount of water fee income of TWD

From the contents of the components of unit cost structure on Table 3, we can see the difference in various costs before and after the water tariff adjustment, such as increase outlays on water resource conservation, employee salaries, maintenance & refurbishment. In especially, TWD increases a new component of provision fee, it will be helpful to disaster preparedness and decrease the damage losses. That will also be a lot of help on making the water supply system in sustainable development.

Table 3. The component of unit cost structure of TWD

Unit Cost structure of TWD (Day of Water tariff adjustment: 1st, Mar., 2016) NT$ = 0.03 US$

	2014		2015		2016		2017		2018	
	NT$/M³	%	NT$/M³	%	NT$/M³	%	NT$/M³	%	NT$/M³	%
Raw Water	0.419	5.37	0.418	5.51	0.430	5.32	0.769	8.46	0.820	9.83
Electricity	0.572	7.33	0.508	6.70	0.448	5.54	0.412	4.53	0.422	5.06
Chemicals	0.128	1.64	0.245	3.23	0.258	3.19	0.181	1.99	0.160	1.93
Capital Expenditure	3.088	39.55	2.937	38.74	2.982	36.91	2.863	31.49	2.780	33.33
Salaries and wages	2.775	35.54	2.700	35.61	2.943	36.42	3.467	38.13	2.766	33.17
Maintenance & Refurbishment	0.452	5.79	0.407	5.37	0.432	5.35	0.812	8.93	0.791	9.49
R&D and Others	0.373	4.78	0.367	4.84	0.395	4.89	0.376	4.13	0.397	4.76
Provisions for Disaster & Losses					0.192	2.38	0.213	2.34	0.203	2.43
Cost per M³	7.807	100	7.582	100	8.080	100	9.093	100	8.339	100
Return Ratio	0.79%		0.88%		2.02%		1.14%		1.44%	

MEASURES OF DISASTERS PREPAREDNESS

TWD propose and implement short, medium and long-term plans of measures of disasters preparedness to establish a water supply system with high strength and high seismic resistance.

- **Building supporting and backup water supply system**

  From 2006 to 2021, the project will cost a total of 750 million US$. The main works include the establishment of a second raw water system, the establishment of a dual water supply system for each water supply district (Taipei water supply system is to be divided into 11 water supply districts). The water purification plant and water boosting stations that needs electricity, adding standby generators to meet the power interrupt, etc...

- **Increasing backup capacity of water purification facility**

  From 2008 to 2019, the project will cost a total of 131 million US$, to build two new water purification plants and improving the old purification plants to increase the capacity of purification equipment from 3.76 million CMD up to 5.26 million CMD. It will make the backup capacity ratio rise up to more than 50% to meet the raw water with high turbidity and to increase mutual support between water purification plants.

- **Changing the aged pipes**

  From 2006 to 2025, the project will cost total of 790 million US$, change the old pipes from cast iron pipes, plastic pipes, concrete pipes into ductile iron pipes. At the same time the old household service pipe of plastic pipes is to be changed into stainless steel pipes. The old pipeline replacement rate is maintained at more than 1.5% per year.

- **Building emergency water supply stations**

  From 2012 to 2019, the budget is 6 million US$. In order to avoid a long-term water supply interruption that be caused by severe earthquake damage. TWD established 45 emergency water supply stations of emergency shelter and refreshed the water supply equipment of 123 schools that can provide each citizen 3 liter of life-supporting drinking water daily for 28 days during water supply interrupt and development of groundwater to set up emergency water supply stations for the use of non-drinking water.

- **Promoting smart water supply system**

  From 2011, TWD begin to put and divide the water supply system into 820 DMAs, and installs the AMR system and enhance the SCADA system. It combine with the geographic information system can understand and control the water supply situation in the water supply area, and early detects abnormal phenomena such as water leakage and treats them betimes. When disaster occurs it can quickly know the extent of water supply impact and improve the efficiency of disaster relief. Through the collection and analysis of big data, we can effectively manage the operation of the water supply system and improve the

operational efficiency, so as to achieve the management performance of effective manpower utilization and energy conservation.

- **Water facilities regeneration**

  From 2020 to 2034, the project will cost total of 600 million US$. The current water transmit trunk and big distribution pipelines, important boosting station and purification facilities are about to reach the end of their useful life or have insufficient seismic capacity. This project is to gradually reinforce or regenerate pipes and facilities under normal water supply condition, strengthening its seismic capacity and extending its service life and increase its performance.

SUMMARY

1. Water tariff adjustment is not an easy task. The water utility must detail the cost analysis, set the future water supply promotion goals, and the impact to customers after water price adjustment to gain the approval of the government and the public.
2. In order to building a sustainable water supply system, the water utility should aim to strengthen the seismic capacity of the water supply system, increase the prevention of disasters and the ability to respond to disasters, so as to reduce the damage caused by disasters and decrease the impact of water supply interruption. All of the works need reasonable water tariff to support it.
3. The provision fee of water price is like to purchase the insurance. It is charged as a part of the water price for disasters preparedness. It will help and decrease the impact to the financial situation of the water utility if the water system occur huge damages. After the water tariff adjustment the increased water fee income will help water utilities to strengthen the water supply water system safe and stability and improve the water service.

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