

# **Current situation and sustainability of water resource in Taiwan**

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## **Abstract**

Taiwan is in the area of abundant precipitation, however, water shortage is still critical problem currently. Government drives the saving water strategy for many years, yet the results in public daily usage are necessary to verified and the equipment and technology still need to improve. This report comments the water resource management and situation in Taiwan, and presents partial investigation results in public daily usage and saving water equipment.

## **Keywords**

Taiwan, water supply, water consumption, water-saving policy, water resources management

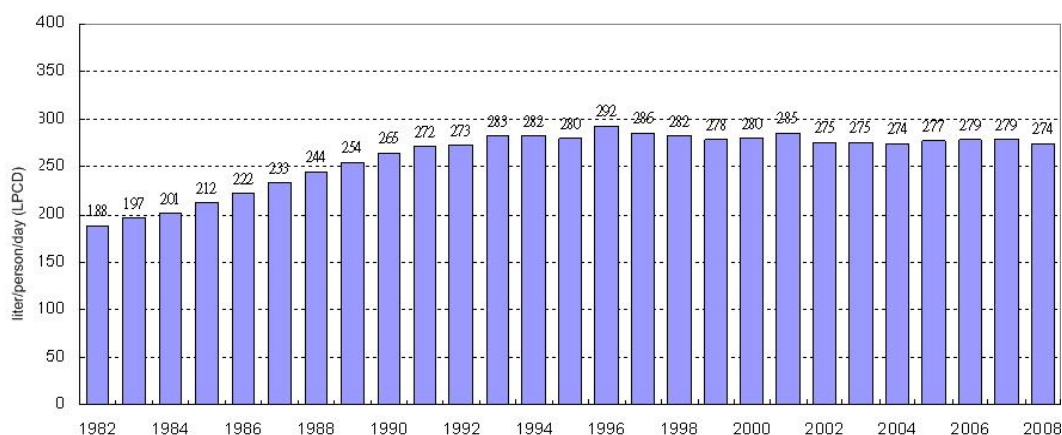
## **1. Overview of water resources in Taiwan**

Taiwan is an island about 600 km long from north to south and 150 km wide from east to west. The Central Mountain Range (also known as the Chungyang Range) runs from the north of the island to the south, and therefore, most of the rivers flow from east to west. Taiwan is in the subtropical region and its average rainfall is up to 2,510 mm, which is 2.5 times as much as the world's average. Because of special geographical conditions, the distribution of rainfall is uneven through a whole year. About 80% of the rainfall is concentrated in the wet period from May to October and most of the rainfall is because of typhoons and storms. The exploitation and deployment of the water resources is thus not easy. Because of the dense population and the industrial and commercial development in Taiwan, the average allocation of

rainwater available per person per year is only about one seventh of the world average. In fact, Taiwan is a country with rich rains but short of water. Therefore, actively enhancing the usage efficiency of water and reducing overall water consumption is the way to achieve the purpose of “sustainable use of water resources”.

## 2. Use of water and water policy

According to the statistics 2008 from the Water Resources Agency of the Ministry of Economic Affairs, the daily water consumption per person in Taiwan, either at home or workplace, is about 274 liters on the average. Figure 1 shows the statistics of the average daily water consumption per person in Taiwan over years. In the urban area, the water consumption tends to be high. The daily water consumption per person in Taipei is about 350 to 400 liters. This has shown a significant difference between the urban and rural areas.



Notes:

Daily-life water consumption per person per day from a bulletin of the Water Resources Agency is calculated as follows:

Daily-life water consumption per person per day (liter) = total quantity of Daily-life water consumption (ton) ÷ number of people using water ÷ 365 (or 366) × 1000

Unit: liter/person/day (LPCD)

**Fig. 1. The change of average daily-life water consumption per day in Taiwan over years.** <sup>(7)</sup>

According to the statistics, the highest proportion of water consumption is for toilet flushing. The daily water consumption is higher than the recommended value by the United Nations, 250 liters. In terms of Taiwan’s population of about 23 million, the

water consumption for toilet flushing per year in Taiwan is up to 550 million tons, which is equivalent to the total storage capacity of 2.3 Shihmen Reservoirs in Taiwan. In addition, every ton of water (i.e. a cubic meter of water) will produce 0.207 kg of carbon dioxide emissions. How to manage water resources and recycle water and how to save water by finding new resources and reducing the usage of water will be important issues we must face.

According to Article 37 of the Building Technical Regulations of Taiwan, “the quantity of the building’s installation of sanitary wares” and existing statistical reports of buildings, till 2007, 81.3% of toilet facilities are the residential type. From the quantity of residential buildings licensed by Ministry of Interior annually and the total quantity of installation of toilet facilities, it can be inferred the quantity of toilet facilities needed for new and renovated buildings every year. The market demand of toilet facilities per year is up to 731 thousands of them. Because of such a large number of toilet facilities, the Water Resources Agency of the Ministry of Economic Affairs has stipulated “the operating points for the water-saving mark”, promoted the water-saving products certification systems, and revised the standards of the volume of flushing water for every usage of a toilet to be below six liters. By doing this, it is inferred that water-saving toilets in Taiwan can potentially save water up to 250 million tons, which is equivalent to 0.62 of the total storage capacity of the Taipei Feitsui Reservoir. This is a considerably efficient way of water saving. In the future, in addition to encouraging public sector agencies, such as institutions or schools, and households to replace old water-consuming toilets, the research and development of water-saving toilets will continuously be encouraged to enhance the popularity of water-saving toilets in Taiwan and to achieve the government’s purpose of water conservation.

**Table1. The estimated water saving potential of six-liter water-saving toilets<sup>(3)</sup>**

Amount of water saved for the water-saving toilet each time	Number of times of usage per person per pay	Amount of water saved per person per day	Amount of water saved per person per year	Amount of water saved per year in Taiwan
6 liters	5 times	30 liters	About 11 tons	252 million tons

Notes:

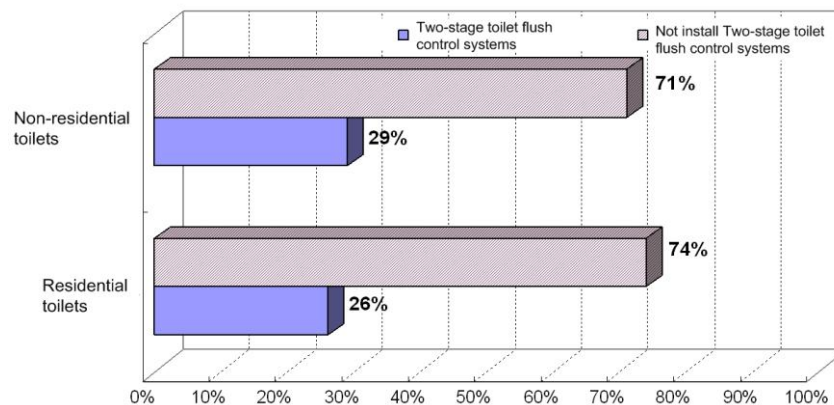
1. Using 365 days per year and using 23 million as the total population in Taiwan to calculate.
2. Using 406 million tons as the total quantity of the storage capacity of the Green Jade Reservoir to calculate.

### **3. The investigation of the status of Taiwan's promotion for water-saving**

Our research team, from October to November of 2011, conducted a survey on the usage of water-saving sanitary wares in Taiwan. At the first stage, a total of 500 questionnaires were distributed and a total of 330 questionnaires were returned. A total of 305 questionnaires were valid. Analyses of the respondents' basic information have shown that 70% of the respondents are under the age of 30. By conducting the survey research, we can understand the respondents' habits of water resources usage and also deliver and promote the concept of water saving. On the other hand, the majority of the respondents are university or graduate students. Moreover, most of the respondents are from the department of architectural planning and designing. By this questionnaire survey, it can help the respondents better understand the installation and planning of water-saving appliances.

After the analyses of the respondents' basic information mentioned earlier, we conducted analyses of the usage of water-saving related sanitary wares. Up to 96% of residential toilets in Taiwan are seat-style toilets and only 4% of residential toilets are squat toilets. We speculated that the age of housings with squat toilets are probably older than housings with seat-style toilets. Over the past 20 years, the proportion of households in Taiwan using squat toilets has greatly reduced. The analyses of respondents' using toilets except for residential toilets have shown an entirely different situation. That is, they use squat toilets more than seat-style toilets. About 65% of non-residential toilets are squat toilets. The reason was that when people in Taiwan go out, they prefer squat toilets that would not be in contact with human body in terms of public health.

The status of the usage of water resources is unique in Taiwan. Although there have been good results from the economical use of water resources after a concert of efforts from various public and private sectors and the advocacy of the government's policies in recent years, so far, up to 95% of residential or public toilets are in existing buildings, the possibility of replacing the toilets with water-saving appliances is low, as it is also time-consuming. For overall respondents of the questionnaire survey, there are 70% of the respondents who have not installed the two-stage toilet flush control systems. This also has potential to improve, as shown in Figure 2.



**Fig. 2. Installation of sanitary wares with two-stage toilet flushing device.**

The mechanism of the sound of running water (the running-water sound machine) is not usually installed either at home or non-residential toilets. The proportion of installation of this type of machines is less than 5%. There might be two cases. One case is that toilet users cover the sound coming from using toilets by consecutively flushing toilets. The other case might be that toilet users do not take any measures to cover the sound coming from using toilets. If it is the first case, it will result in a greater consumption of water. Therefore, we will continue to explore and conduct cross-comparison analyses, hoping to understand the reasons why there is a low percentage of installation of the running-water sound machines and hoping to find solutions.

As for the investigation of the warm-water cleaning toilet seats and greenhouse toilet seats of the sanitary wares, because of Taiwan's humid subtropical climate and people's use habits, there is, at the present time, a low percentage of installation. We speculate that it is related to Taiwan's sanitary appliances, toilet spaces, and pipelines' installation. Besides, the hand-washing device attached to a toilet tank, which is common in Japan, is not usually installed. This is also an effective method to save water. However, this device is installed to save space only when a toilet space is small. In the future, this also has potential to improve.

#### **4. Government's strategies of water resources management and related activities**

To actively cooperate with the government's policies on water conservation, emphasizing the importance of both finding new resources and reducing usage of water. It is hoped that the government agencies and schools can first demonstrate their promotion of the water-saving methods in order to achieve the goal of national water-saving campaign. The Water Resources Agency of the Ministry of Economic

Affairs, in 2007, built “the Government agencies and schools’ water-saving fill-in website”, and implemented the four-saving plans (i.e. saving power, saving water, saving petrol, saving paper) stipulated by the Executive Yuan, and further cooperated with the Ministry of Economic Affairs to advocate the water consumption assessment, providing the government agencies and schools with the fill-in water consumption information to strengthen the government agencies and schools’ statistical management of water consumption and become a platform of the promotion and assessment of water conservation.

As for carrying out the government’s policies, because of the difficult circumstances of Taiwan’s water resources source, water storage, and the allocation of water consumption, effectively finding new water resources and reducing water consumption is necessary. According to the Water Resources Agency, the average domestic water consumption is about 18 billion tons over the past ten years, of which daily life water consumption is 3.5 billion tons (about 20%), industrial water consumption is about 1.7 billion tons (about 9%), agricultural water consumption is 12.8 billion tons (about 71%). In recent years, Taiwan’s strategies of water resources management are to reduce the impact on ecological environments, promote water resources’ sustainable development, and actively promote the rainwater collection facilities. By using buildings or the ground to collect and store rainwater, it can have the function of storing rainwater and can reduce the consumption of water from the main. In the future, the policies on water resources will be aiming towards the following two strategic directions: (1) giving an impetus to the limitations in the total quantity of natural water resources’ exploitation; (2) giving an impetus to the zero growth of consumption of natural water resources in the dry season. As to the limitations in the total quantity of natural water resources’ exploitation, 20 billion tons will be the goal at the present stage.

On the other hand, by cooperating with the government’s policies on “energy conservation and carbon reduction”, attempting to move towards the “water-saving society” of advanced countries, and actively promoting the concept of water saving, the daily-life water consumption has reduced to 271 liters per person per day in 2010. In the future, the daily-life water consumption of 250 liters per person per day will be the goal. In addition, we plan to promote “water saving SCD: saving water, checking leaking, doing recycling”. This includes saving water (S): using the sanitary wares with the water-saving mark; checking leaking (C): paying attention to whether there are leaks of water on appliances; doing recycling (D): recycling wastewater.

As to the water-saving work in Taiwan, in addition to the government's promotion of water saving, there have been non-governmental organizations assisting related activities, such as the Water-saving Service Group of the Industrial Technology Research Institute and Taiwan Toilet Association. It has been thirteen years since the Taiwan Toilet Association was founded. The association participates in domestic and international conferences every year and also actively participates in formulating the norms of the world's public toilets. And at same time, the association also witnessed the growth and progress of the overall service quality of domestic public toilets. For environmental issues and water conservation, the association, in November of 2011, invited Dr. Kanako Toyosada of TOTO Japan to talk about Japan's water-saving trends in water consumption and about reducing carbon dioxide emissions with popularizing water-saving machines.

## **5. Conclusion**

Because of Taiwan's special geographical conditions, it is rather difficult in the exploitation and development of water resources. The government has been actively promoting various water-saving measures and encouraging the public to recycle water and reduce water usage. The government also encourages people to change their water using habits in their daily-life water consumption, and to "save water", "check leaking", and "do recycling" (i.e. the three slogans as mention earlier) as possibly as they can. On the other hand, from the analyses and results of our questionnaire survey on the water-saving sanitary wares, we found that there is still room for improvement on the usage of water-saving sanitary wares. In the future, we hope to be able to save enough water for achieving our goals in water consumption, so as to enhance the effective use of water resources, and to create a sustainable water-saving society.

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## 7. Presentation of Authors

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