

Significance of water circumstances and the saving water in Hong Kong

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Abstract

As response to the call for effective utilization of water resources by the Asian Saving Water Council (ASWC), this paper reviews general situation for water supply, consumptions and water saving measures in Hong Kong. The total water management strategy initiated by the Hong Kong government is also introduced.

Keywords

Hong Kong, per-capita water consumption, water supply, demand management

1. Water resources

Hong Kong is a developed city having a high population of 7 million and limited area of 1100km². Providing a reliable water supply for Hong Kong is a challenge as there are few natural water resources such as lakes, rivers or substantial groundwater sources. Two main fresh water sources in Hong Kong are rainfall from natural catchments and supply from Guangdong Province; desalination was also a source of water supply in Hong Kong.

The mean annual rainfall ranges from around 1300 mm at Waglan Island to more than 3000 mm in the vicinity of Tai Mo Shan. The 1998-2010 average is 2450 mm. A total of 17 freshwater reservoirs for rainwater catchments were built with the total storage capacity of Hong Kong reservoirs is about 586 Mm³. The biggest one is the High Land reservoir completed in 1987 (capacity = 281 Mm³). However, the water catchments from the total rainfall are found insufficient to meet the local water demands. Table 1 shows the water supply history in Hong Kong and the number of days in a year with full water supply.

Daily freshwater supply in Hong Kong is almost guaranteed because a total of 820 Mm³ freshwater (maximum 1100 Mm³) is purchased every year from the Guangdong Province. However, the southern Chinese province is recently suffering from extended

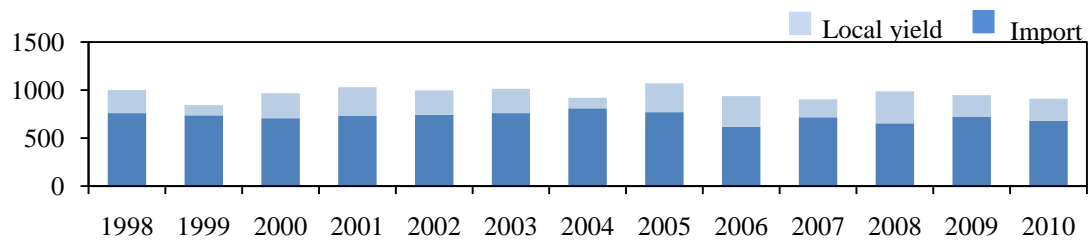
drought seasons so there is a reason to be worried, even if mainland officials assure Hong Kong of its water requirements.

Seawater, using a separate distribution system, is used for flushing toilets and for evaporative type cooling towers for some air conditioning systems.

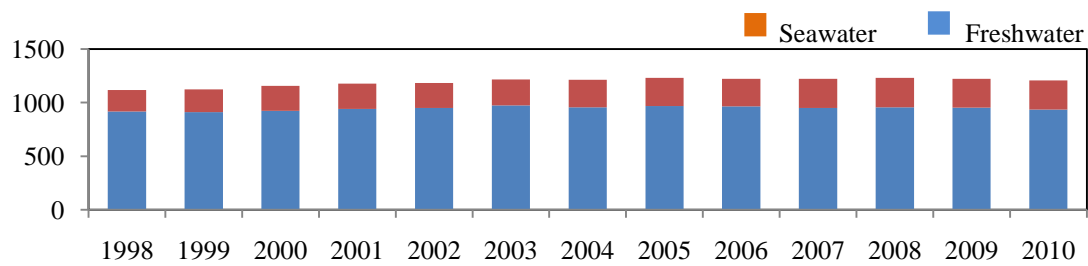
Figure 1 shows the water resources and annual water consumptions of Hong Kong. In 2010, the collected rainfall and imported water are 228 Mm³ and 681 Mm³, and the annual freshwater and seawater consumption are 936 Mm³ and 270 Mm³, which corresponds to per capita daily consumption of 375 Ld⁻¹ and 95 Ld⁻¹ in 2001, and 363 Ld⁻¹ and 105 Ld⁻¹ in 2010 [1,2]. The deficit of freshwater was obtained from reserved water from the prior year. Freshwater is mainly for domestic, service trade and industrial uses. In 2006, it was reported that the domestic sector and the service trade plus industrial sectors accounted for 53% and 32% of the total fresh water consumption in 2006.

Table 1 Key history of water supply in Hong Kong (Hong Kong Water Supplies Department 2008)

Year	Number of days with full water supply in the year	Water supply development
1949-1956	<90	
1957	Between 91-180	Use of seawater for toilet flushing in 2 residential estates Completion of Tai Lam Chung reservoir (20.5 Mm ³)
1959-1960	<90	Water supply agreement with Guangdong supply from Shenzhen reservoir
1963	0	Completion of Shek Pik reservoir (24.5 Mm ³) Severe water rationing 4 hours of supply every 4 days
1963-1964	0-274	
1965	365	Completion of lower Shing Mun Reservoir (4.3 Mm ³) Water supply agreement with Guangdong 68.2 Mm ³ per year of Dongjiang water supply
1968-1976	365	Completion of Plover Cove scheme in 1968 and extension in 1973 (230 Mm ³)
1977	<90	
1978	>274	Completion of High Island scheme (281mM ³)
1981-1982	Between 183-320	Last water rationing in Hong Kong (1989) Water supply agreement with Guangdong (1100Mm ³ /year maximum)
1983-2007	365	(2003) Commissioning of 83km dedicated aqueduct for delivery of Dongjiang water (2006) Water supply agreement with Guangdong flexible supply of Dongjiang water



(a) Fresh water resources



(b) Water consumptions

Figure 1 Water resources and consumptions in Hong Kong

2. Per-capita water consumption

A report on average daily water consumption of Hong Kong resident shows figures of 213 Ld^{-1} in 2003 and 222 Ld^{-1} in 2007 [3]. An increase of water use is expected due to the growth of population, improvement of living conditions and the booming of business activities in the service trade. The Government forecasts the freshwater demand will grow to 1315 Mm^3 by 2030 [4].

A freshwater consumption benchmarking study in 60 families in residential buildings showed that the per capita average daily consumption in winter is 170L (SD=67L) [5]. Another larger scale surveys (over 660 families) on freshwater demands in residential buildings showed a breakdown of average daily water consumption over a year is 227L. Breakdowns of consumptions are shown in Table 2 [6-8]. This figure is very close to the ones reported earlier.

The Hong Kong Water Supplies Department (WSD) has commissioned a survey study of resident water consumption, such as time spent in the shower, size of bathtubs or how often they use their washing machine [3]. Selected households participants will be asked to record their use of water for a week. It is expected an updated results available very soon.

3. Water charges

WSD data showed that water charges only comprise 0.3% of average monthly household spending [9]. Tariffs for domestic users are calculated in a four-tier system as shown Table 3.

Table 2 Breakdown of per capita average daily water consumption in residential buildings

Appliance	Per capita average daily water consumption in residential buildings (L hd ⁻¹ d ⁻¹)
WC flushing (seawater)	(60)
Washbasin	24
Shower	180
Sink	19
Washing machine	4
Total: (Fresh water/ seawater)	227 / 60

Table 3 Water price

Tariffs	Total consumption (m ³)	Total cost (HK\$)
First 12 m ³ – Free	12	0
Next 31 m ³ – HK\$4.16 m ⁻³	43	128.96
Next 19 m ³ – HK\$6.45 m ⁻³	62	251.51
Above 62 m ³ – HK\$9.05 m ⁻³	>62	251.51+9.05/m ³

4. Total water management strategy (WMS) (Hong Kong Water Supplies Department 2008)

Hong Kong government has formulated a total water management strategy for sustainable use of water resources in a balance with water supply [4]. A total water management programme was committed in 2003 and for the period up to 2030. The current directions of water management referenced to a study of the fresh water demand and supply situations in Hong Kong and evaluation of options of water supply and demand management measures in terms of quantity of water saved, water supplied, cost effectiveness, environmental impact and public acceptance commissioned in 2005. The key initiatives under the strategy composed of two aspects as shown in Table 4 below, i.e. water demand management and water supply management:

4.1 Water demand management

Public education, school programmes and publicity programmes are stepped up and organized to promote water conservation. Tips on water conservation and information about water scarcity around the world are introduced. Concept and knowledge on water conservation are promoted in school programme for young generation. An estimate of water saving in a four member household in Table 5 showed for general education that a saving potential of 40% can be achieved by individual practices.

A voluntary water efficiency labelling scheme promotes the use of water saving devices. The labelling scheme indicates the level of water consumption and efficiency of

plumbing fixtures and appliances used in bathroom, toilets, kitchens and laundries. These devices include taps that limit flow, low-flow showerheads, dual-flush cisterns, flow control valves and flow restrictors, appliances such as dishwashers and washing machines of higher water efficiency and are expected to reach 40% market penetration by 2030. The devices have been installed in many new Government projects.

Table 4 Total water management strategy in Hong Kong (Hong Kong Water Supplies Department 2008)

(1) Water demand management	Expected benefit (water saving/harvested) by 2030 (Mm ³ /year)
To enhance public education on water conservation	
To promote use of water saving devices	100
To enhance water leakage control through the programme to replace and rehabilitate aged water mains, and application of new technology to improve pressure management and detection of leakage	85
To extend use of seawater for toilet flushing	30
(2) Water supply management	
To strengthen protection of water resources	
To actively consider water reclamation including reuse of grey water and rainwater harvesting	21
To development the option of seawater desalination	

Table 5 Estimated savings of 228L day⁻¹ from a four-member household (520L day⁻¹) with water saving measures

Water saving measures	Daily water saved per family (L)
Shower: cut each by 2 minutes	96
Tap: turn off while brushing teeth, soaping hands and shaving	26
Sink: wash vegetables/fruits in basin rather than under running water	14
Sink: wash dishes in a filled basin rather than under running water	28
Washing machine: wash cloths only with full load	20
Bath: take showers instead of baths each a week	44

There are 7700 km ageing network of water mains in Hong Kong, of which 6150 km being fresh water mains. Parts of this network were over 30 years and subject to risk of water leakage. A territory-wide replacement and rehabilitation programme is launched

to replace and rehabilitate 3000 km of water mains by 2015. It could be extended for the remaining network beyond 2015 subject to a review on the condition of the network. A comprehensive pressure management in all major water supply zones is used to enhance leakage detection and monitoring. Water mains pressure will be optimised by the installation of flow modulating pressure reducing valves and flow meters to reduce leakage. Each district metering area is served by an electromagnetic flow meter and a global system for mobile communication data logger for transmitting the flow and pressure data to centres via mobile phone networks. Early signs of leakage can be detected for remedial action. A number of small scale pilot schemes have been implemented since 2001 and installation will be provided in other major supply zones.

Seawater is already available for toilet flushing in urban area and most of the new towns, covering about 80% population. The seawater supply network could be extended to other remote areas whenever it is economically justified.

4.2 Water supply management

A water pollution risks and impacts assessment framework is developed for protecting water resources from developments in water gathering grounds. An improvement is started to improve the existing catching water system for safe and effective collection of surface water in 2011. The option of expanding water gathering grounds and reservoir storage is considered to be of very low priority because of high costs and negative environmental impacts.

Pollution prevention and control measures are implemented by the Guangdong authorities to ensure the supply water quality. The Hong Kong Government and Guangdong authorities have worked closely to strive to maintain the quality of raw water from Dongjiang to conform to the national standard for Type II waters (applicable for the abstraction for human consumption in first class protection area) in the 'Environmental Quality Standards for Surface Water, GB 3838-2002'.

A series of rigorous water treatment processes and close monitoring for raw water is also carried out to make the drinking water supply meeting the required safety level. Currently, 100% of drinking water in Hong Kong meets the World Health Organization (WHO) standards.

Pilot schemes of water reclamation from lower quality water to replace high quality water currently used for non-potable purposes (such as toilet flushing and landscape irrigation) has been planned and estimated to save 21 Mm³ of water each year. In a project under the pilot scheme, reclaimed water from a sewage treatment plant (Shek Wu Hui & Ngong Ping) will supply for consumers for toilet flushing and gardening in nearby districts (Sheung Shui and Fanling). Trial schemes of reuse of grey water (Grey water is collected from baths, wash-basins and kitchen sinks) and collected rainwater harvesting for toilet flushing, irrigation, street cleaning and water features are conducted in a new underground public development in Tseung Kwan O.

A pilot desalination plant study (2003-2007) using the reverse osmosis (RO) technology in Tuen Mun and Ap Lei Chau confirmed its viability for Hong Kong and the Government will develop the option of desalination in future.

5. Acknowledgment

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7. Presentation of Author

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