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Water Security: the Story of a City-State
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Singapore: a water-stressed country (no more.....)

- Up to 2005, Singapore was classified as a “water-stressed” country by the World Resources Institute (WRI’s 2005 Report)
- The country has only 139 m$^3$ per capita of annual renewable water resources within its boundaries, which is far less than the average of Asia and the world’s.

- Average Annual Rainfall: 2400 mm
- Water Demand: 1.3 mil m$^3$ per day
- Supply of water and modern sanitation: 100%
- Unaccounted for Water: 5%
Imported Water from Malaysia

- Water from Malaysia was ensured by two agreements - the 1961 and 1962 Agreements which allow Singapore to draw up to 336 million gallons per day (1.53 million m³)
- The two agreements expire in 2011 and 2061
Sustainable Water Resource Management in Singapore

4 National Taps
- Local catchment water
- Imported water (Johor)
- NEWater
- Desalinated water

3P Approach
- “Conserve Water”
- “Value Our Water”
- “Enjoy Our Waters”

Source: Public Utilities Board
Diversifying water sources

Imported Water  Local Catchments  NEWater  Desalination
Expanding Local Catchments

Collecting Every Drop of Rain
NEWater

- Singapore Water Reclamation Study (NEWater Study) initiated in 1998
- In 2000, a prototype NEWater plant began
- Uses advanced dual membrane (Ultrafiltration and Reverse Osmosis) and Ultraviolet disinfection system
- After two years of monitoring, NEWater has been certified to be in line with the parameters and standards set by the US Environmental Protection Agency and the World Health Organization
- Now supplies high grade water primarily for non-potable applications, e.g. to wafer fabrication plants, high-end electronic companies and cooling towers.
Desalinated Water

- In 2005, SingSpring, a subsidiary of Hyflux, commenced operation of the first desalination plant in Singapore.
- Capacity to produce 30 million gallons (136,000 m³) per day.
- Since 2011, the desalination program produces around 30 percent of Singapore’s water.
Managing the entire water cycle

From sourcing, collection, purification and supply of drinking water, to treatment of used water and turning it into NEWater, drainage of storm water.
Managing Demand: Singapore’s Water Conservation Strategy

Pricing
Reflect the strategic importance and scarcity value of water

Voluntary
Promote ownership of water conservation

Mandatory
Cut down on excessive flow and wastage of water

Source: PUB
The sustainable management of water resources requires both a holistic perspective of resource management and an integrated response to the interplay of water with environmental, economic, social and institutional factors. A sustainable urban water system “should not have negative environmental effects even over a long time perspective, while providing the services wanted, protecting human health and the environment at the expense of a minimum of scarce resources”.
Assessment and Monitoring

Water Use
1. Internal renewable freshwater per capita and its use
2. Total Water Used
3. Sectorial distribution of water used
4. Percentage of water tested that meets WHO Guidelines for drinking water quality
5. Proportion of total water use that can be met by 'un-conventional'

Urban Water System
6. Energy use per cubic meter of water treated to drinking water quality
7. Percentage of unaccounted for water compared to total water produced

Sanitation, Wastewater Treatment and Reuse
8. Percentage of a country’s population that has access to an improved source of sanitation.
9. Wastewater Treatment Coverage: Proportion of wastewater generated that is treated to secondary treatment level
10. Percentage of wastewater recycled (for potable and non-potable purposes).

Surface Water quality
11. Monitoring water quality of surface water reservoirs (qualitative)

Marine Pollution
12. Discharge of pollutants into coastal waters (qualitative)

Testing and Validation

Indicator 1: Internal renewable freshwater per capita and its use
The FAO defines “absolute water scarcity” as having less than 500 m3 per year per capita of internal renewable freshwater resources in a country and “water stress” conditions as having between 500 and 1000 m3 of water per year per capita in a country (FAO, 2012). According to PUB, Singapore currently has internal renewable freshwater resources of 179 m3/capita*, which explains why the city state is classified as “water stressed”, and ranked low in this indicator in some international ranking systems.

- Total domestic water consumption relatively low compared to other cities
- Singapore has good water quality, and waste water treatment and recycling.

Comparison of Singapore’s performance with other cities

Unaccounted Water Compared to Total Water Produced

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Total domestic water use per capita (liters/capita/day)

- Singapore: 153
- Melbourne: 140
- Seoul: 124
- Chicago: 199
- London: 200
- New York: 162
- Hong Kong: 295
- Tokyo: 240
- Stockholm: 200
- Copenhagen: 200
- Boston: 108
- Shanghai: 155
- Taipei: 165
- Sydney: 275
- Oslo: 180
- Helsinki: 200
- Bangkok: 220
Thank You