

## Case Study for the 2006 HDR

### SINGAPORE: AN EXEMPLARY CASE FOR URBAN WATER MANAGEMENT<sup>1</sup>

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#### INTRODUCTION

Even since in 1978, when the United Nations Conference on Human Settlement was held in Vancouver, Canada, provision of universal supply of clean drinking water and adequate sanitation for each person of the world became an important component of the international political agenda. Subsequently, in 1977, the United Nations Water Conference held in Mar del Plata, Argentina, recommended that the decade of the 1980s should be declared as the International Water Supply and Sanitation Decade (hereinafter referred to as the Decade) with the primary objective to ensure that every citizen of the world would have access to clean drinking water and proper sanitation by 1990.

A retrospective analysis indicates that the Decade had a major impact in putting water supply and sanitation higher up in the international political agenda, in both developed and developing countries. It also contributed to accelerated progress in terms of provision of clean water and sanitation to a large number of people, both in actual and percentage terms. However, in spite of this noteworthy progress, the goals for the Decade proved to be too ambitious to reach. The world fell far short of achieving the Decade objectives by its end.

The challenge was subsequently picked up partially by the Millennium Development Goals (MDGs), one of which explicitly stipulated that, by 2015, the objective will be to “reduce by half the proportion of people without sustainable access to safe drinking water.”

This MDG differs in three important aspects with reference to the Decade objectives. First, its objective is more modest: reducing by half the proportion of people who do not have access to water supply compared to the universal coverage championed by the Decade. Second, the MDG, unlike the Decade goals, did not specifically refer to sanitation. This, of course, is somewhat surprising, since water supply introduces new water in the urban areas, nearly all of which subsequently becomes wastewater, which must be collected, treated and disposed of in an environmentally-sound manner. Provision of urban water supply, even if it becomes universal by 2015, by itself will not be sustainable, unless adequate arrangements can be made for wastewater

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<sup>1</sup> Grateful acknowledgement is made to the Public Utilities Board of Singapore for providing up-to-date information on which some of the above analyses are based.

collection, treatment and disposal. Third, the MDG has 50% more time to achieve its objective compared to the Decade: 15 years against a decade. However, current analyses indicate that even though one third of the time period to achieve the MDG goal is over, pro rata progress has been much slower to achieve the final objective.

The sanitation issue was later considered and agreed to at the Johannesburg Summit in 2002. Accordingly, if the MDG for water supply is to be achieved by 2015, an accelerated progress has to be made during the next 10 years. Such an accelerated progress will require that the best experiences in providing access to water supply and sanitation from different parts of the world be carefully analysed and assessed. These best cases could then be modified appropriately for possible application in other developing countries, in line with their social, economic, political, legal and institutional requirements. Regrettably, some 25 years after the Decade started, serious, comprehensive and objective evaluations of the best examples from different parts of the world are still missing at present.

The Third World Centre for Water Management made an attempt to identify the best cases of urban water supply and management in the world based on performance indicators. While it is not possible to make a definitive normative statement, this analysis indicates that the Singapore case is one of the best examples in the world, if not the best.

The Singapore case study has another important implication for the future of urban water management. During the past 10 years, one of the most controversial water issues has been the role of the private sector in water management. During both the Second World Water Forum (The Hague, 2000) and the Third World Water Forum (Japan, 2003), controversy on this issue was very intense. Irrespective of the merits or demerits of any private sector involvement, it should be noted that the private sector currently serves about 4-7% (estimates vary widely) of the urban consumers in the developing world. Based on the latest trends and the best available data and analyses, even the most optimistic forecasts in favour of the private sector mean that the vast majority of domestic consumers in the developing world will continue to receive their water and wastewater services from the publicly-run water companies, at least for the next two decades. Thus, the most fundamental question facing the world at present in this area is how to make the public sector water companies increasingly more and more efficient so that they can meet this challenge within a reasonable timeframe in the future, in a cost-effective, equitable and socially-acceptable manner.

Viewed in this context, an analysis of the water management for Singapore becomes important, especially as it is one of the best examples from any developed or developing country, irrespective of whether a public or private sector institution is managing the water services.

## **WATER MANAGEMENT: CASE OF SINGAPORE**

Singapore is a city state with an area of about 700 km<sup>2</sup>. It currently consumes about 1.36 billion litres of water per day. It is a water-scarce country and thus imports its entitlement of water from the neighbouring Johor state of Malaysia, under long-term agreements signed in 1961 and 1962, when Singapore was still a self-governing British colony. Under these agreements, Singapore

can transfer water from Johor for a price of less than 1 cent per 1,000 gallons until the years 2011 and 2061 respectively. The water from Johor is imported through three large pipelines across the 2-km courseway that separates the two countries.

In August 1965, Singapore became an independent country. The Constitution of Malaysia was amended on 9 August 1965. Under clause 14, this amendment stipulated that:

14. The Government of Singapore shall guarantee that the Public Utilities Board of Singapore shall on and after Singapore Day abide by the terms and conditions of the Water Agreements dated 1<sup>st</sup> September 1961, and 29<sup>th</sup> September 1962, entered into between the City Council of Singapore and the Government of the State of Johor.

The Government of Malaysia shall guarantee that the Government of the State of Johor will on and after the Singapore Day also abide by the terms and conditions of the said two Water Agreements.

The long-term water security was an important consideration for this newly independent nation. Accordingly, Singapore made a special effort to register the Separation Agreement in the United Nations Charter Secretariat Office in June 1966.

The two countries have been negotiating the possible extension of the water agreement. The results thus far have not been encouraging since the two countries are still far apart in terms of their national requirements. Singapore would like to ensure its long-term water security by having a treaty which will provide it with the stipulated quantity of water well beyond the year 2061. In contrast, the main Malaysian demand has been for a much higher price of water, which has varied from 15 to 20 times the present price. While Singapore has said that it has no problem to pay a higher price for the water it imports from Johor, its main concern has been how the price revision will be decided, and not the concept of a higher price per se.

Because of this continuing stalemate, Singapore has developed a new plan for increasing water security and self-sufficiency during the post 2011-period, with increasingly more efficient water management, including formulation and implementation of new water-related policies, heavy investments in desalination and extensive reuse of wastewater, and catchment management and other similar actions.

Institutionally, Public Utilities Board (PUB) currently manages the entire water cycle of Singapore. Earlier, PUB was responsible for managing potable water, electricity and gas. In April 1, 2001, the responsibilities for sewerage and drainage were transferred to PUB from the Ministry of the Environment. This transfer allowed PUB to develop and implement a holistic policy, which included protection and expansion of water sources, stormwater management, desalination, demand management, community-driven programmes, catchment management, outsourcing to private sector specific activities which are not within its core competence, and public education and awareness programmes. The country is now fully sewered to collect all wastewater, and has constructed separate drainage and sewerage systems to facilitate wastewater reuse on an extensive scale.

## **Overall Approach**

A main reason as to why Singapore has been very successful in managing its water and wastewater is because of its concurrent emphasis on supply and demand management, wastewater and stormwater management, institutional effectiveness and creating an enabling environment, which includes a strong political will, effective legal and regulatory frameworks and an experienced and motivated workforce. The Singapore example indicates that it is unrealistic to expect the existence of an efficient water management institution in a country, in the midst of other similar mediocre management institutions, be they for energy, agriculture or industry. Water management institution in a country can only be as efficient as its management of other development sectors. The current implicit global assumption that water management institutions can be improved unilaterally when other development sectors remain somewhat inefficient is simply not a viable proposition.

## **Supply Management**

Singapore is one of the very few countries that looks at its supply sources in its totality. In addition to import of water from Johor, it has made a determined attempt to protect its water sources (both in terms of quantity and quality on a long-term basis), expand its available sources by desalination and reuse of wastewater and stormwater, and use technological developments to increase water availability, improve water quality management and steadily lower production and management costs. PUB, at present, has an in-house Centre for Advanced Water Technology, with about 50 expert staff members who provides it with necessary research and development support.

Over the years, catchment management has received increasing emphasis. Protected catchment areas are well demarcated and gazetted (Appan, 2003), and no pollution-causing activities are allowed in such protected areas. In land-scarce Singapore, protected catchment classification covers less than 5% of the area.

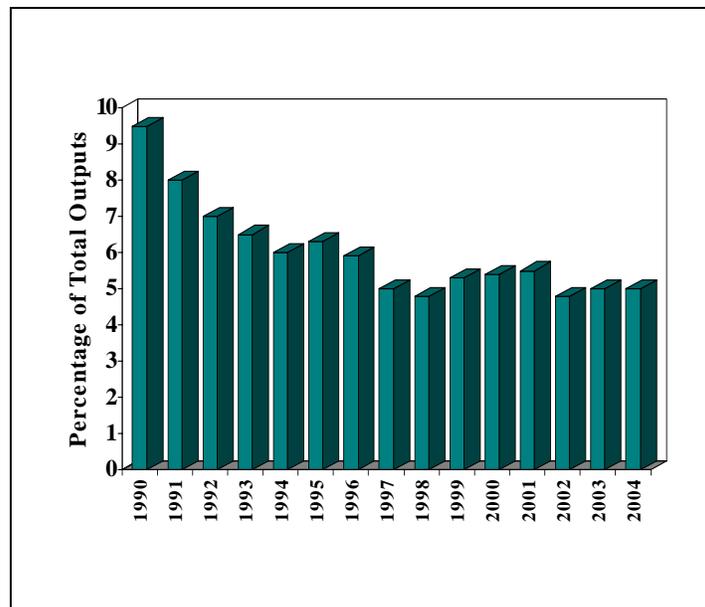
The Trade Effluent Regulations of 1976, promulgated the idea of partly-protected catchments, where wastewater discharges to streams require prior treatment. The effluents must have an acceptable water quality that has been defined. While many other developing countries have similar requirements, the main difference is that, in Singapore, these regulations are strictly implemented. For example, when wastes from pig farms became a major source of water contamination, the Cattle Act was legislated to restrict the rearing of cattle to certain areas in the interest of public health. This also protects the water catchments from animal wastes generated from the cattle farms. At present, half of the land area of Singapore is considered to be protected and partly-protected catchment. This ratio is expected to increase to two-thirds by 2009.

Desalination is becoming an important component for augmenting and diversifying available national water sources. In late 2005, the Tuas Desalination Plant was opened at a cost of US\$119 million. Designed and constructed by a local water company, Hyflux, it is the first design, build, own and operated desalination plant in the nation. The process used is reverse osmosis. The cost of the desalinated water during its first year of operation is S\$0.78/m<sup>3</sup>.

The supply is also being increased through collection, treatment and reuse of wastewater. With a 100% sewer connection, all wastewater is collected and treated. Singapore is probably one of the very few countries where the water utility is reclaiming wastewater after secondary treatment by means of advanced dual-membrane and ultraviolet technologies. This treated water is then mainly supplied to industrial and commercial customers who can better use NEWater's ultra-pure quality. There are now three plants producing NEWater. PUB has recently awarded another PPP project to construct the country's largest NEWater factory at Ulu Pandan. The first year tender price for NEWater was S\$0.30/m<sup>3</sup>, which is significantly less than the cost of desalinated water. The overall acceptance of this recycled ultra-pure water has been quite high.

The source of water is further expanded by reducing unaccounted for water (UFW), which is defined as actual water loss due to leaks, and apparent water loss arising from meter inaccuracies. Unlike other South and South-east Asian countries, Singapore simply does not have any illegal connections to its water supply systems.

As shown in Figure 1, in 1990, unaccounted for water (UFW) was 9.5% of the total water production. Even at this level, it would still be considered to be one of the best examples in the world at the present time. However, PUB has managed to lower the UFW consistently to around 5% in recent years. This is a level which no other country can match at present. In comparison, in England and Wales, the only region in the world which has privatised its water more than a decade ago, the best any of its private sector companies have managed to achieve is more than twice the level of Singapore. Similarly, UFW in most Asian urban centres now range between 40 and 60%.



**Figure 1. Unaccounted for Water, Singapore 1990-2004**

## **Demand Management**

Concurrent to the diversification and expansion of water sources, PUB has put in place a well thought out and comprehensive demand management policy. It is useful to review the progress of water tariffs for water during the 1997-2000 period. The progressive tariff structure used from 1997 to at present is shown in Table 1.

Before July 1, 1997, the first 20 m<sup>3</sup> of domestic consumption for each household was charged at S\$0.56/m<sup>3</sup>. The next block of 20 to 40 m<sup>3</sup> was charged at S\$0.80/m<sup>3</sup>. For consumption of more than 40 m<sup>3</sup>/month and non-domestic consumption, it was S\$1.17/m<sup>3</sup>.

Effective July 1, 2000, domestic consumption of up to 40 m<sup>3</sup>/month and non-domestic uses were charged at an uniform rate of S\$1.17/m<sup>3</sup>. For domestic consumption of more than 40m<sup>3</sup>/month, the tariff became S\$1.40/m<sup>3</sup>, which is higher than non-domestic consumption. The earlier cheaper block rate for the first 20 m<sup>3</sup> of domestic consumption was eliminated.

In addition, the water conservation tax (WCT) that is levied by the Government to reinforce the water conservation message, was 0% for the first 20m<sup>3</sup>/month consumption prior to July 1, 1997. For consumption over 20 m<sup>3</sup>/month, WCT was set at 15%. Non-domestic users paid a WCT levy of 20%.

Effective July 1, 2000, WCT was increased to 30% of the tariff for the first 40 m<sup>3</sup>/month for domestic consumers and all consumption for non-domestic consumers. However, domestic consumers paid 45% WCT, when their water consumption exceeds 40 m<sup>3</sup>/month. In other words, there is now a financial disincentive for higher water consumption by the households.

Similarly, water-borne fee (WBF), a statutory charge prescribed to offset the cost of treating used water and for maintenance and extension of public sewerage system, was S\$0.10/m<sup>3</sup> for all domestic consumption prior to July 1, 1997. Effective July 1, 2000, WBF was increased to S\$0.30/m<sup>3</sup> for all domestic consumption. Impacts of these tariff increases on the consumers can be seen in Table 2.

**Table 1. Water Tariffs, 1997 - 2006**

Tariff category	Consumption block (m <sup>3</sup> per month)	Before 1 July 1997			Effective 1 July 1997		
		Tariff (¢/m <sup>3</sup> )	WCT (%)	WBF (¢/m <sup>3</sup> )	Tariff (¢/m <sup>3</sup> )	WCT (%)	WBF (¢/m <sup>3</sup> )
Domestic	1 to 20	56	0	10	73	10	15
	20 to 40	80	15	10	90	20	15
	Above 40	117	15	10	121	25	15
Non-domestic	All units	117	20	22	117	25	32
Shipping	All units	207	20	-	199	25	-

Tariff category	Consumption block (m <sup>3</sup> per month)	Effective 1 July 1998			Effective 1 July 1999			Effective 1 July 2000		
		Tariff (¢/m <sup>3</sup> )	WCT (%)	WBF (¢/m <sup>3</sup> )	Tariff (¢/m <sup>3</sup> )	WCT (%)	WBF (¢/m <sup>3</sup> )	Tariff (¢/m <sup>3</sup> )	WCT (%)	WBF (¢/m <sup>3</sup> )
Domestic	1 to 20	87	20	20	103	25	25	117	30	30
	20 to 40	98	25	20	106	30	25	117	30	30
	Above 40	124	35	20	133	40	25	140	45	30
Non-domestic	All units	117	25	42	117	30	51	117	30	60
Shipping	All units	199	25	-	192	30	-	192	30	-

Source: BUP, 2005, Personal Communication.

Notes:

1. Water Conservation Tax (WCT) – levied by the Government to reinforce the water conservation message.
2. Water Borne Fee (WBF) and Sanitary Appliance Fee (SAF): Statutory charges prescribed under the Statutory Appliances and Water Charges Regulations to offset the cost of treating used water and for the maintenance and extension of the public sewerage system. SAF is S\$3 per sanitary fitting per month.
3. WBF and SAF charges are inclusive of goods and services tax.

**Table 2. Average monthly consumption and bills per household, 1995, 2000, 2004**

Item	1995	2000	2004
Average monthly consumption, m <sup>3</sup>	21.7	20.5	19.3
Average monthly bill, inclusive of all taxes	S\$14.50	S\$31.00	S\$29.40

Source: PUB, 2005, Personal communication.

Table 2 also indicates that the average monthly household consumption has steadily declined during the 1995-2004 period. The consumption in 2004 was 11% less than in 1995. During the same period, the average monthly bill has more than doubled. These figures indicate that the new tariffs had a notable impact on the behaviour of the consumers, and have turned out to be an effective instrument for demand management. This is a positive development since the annual water demands in Singapore increased steadily, from 403 million m<sup>3</sup> in 1995 to 454 million m<sup>3</sup> in 2000. The demand management policies introduced have resulted in lowering of this demand, which declined to 440 million m<sup>3</sup> in 2004.

In terms of equity, the Government provides specially targeted help for the lower income families. Households living in 1- and 2-room flats receive higher rebates during difficult economic times. For hardship cases, affected households are eligible to receive social financial assistance from the Ministry of Community Development, Youth and Sports.

The current tariff structured used by PUB have several distinct advantages, among which are the following:

- There is no “lifeline” tariff which is used in many countries with the rationale that water for the poor should be subsidised since they cannot afford to pay high tariffs for an essential requirement for human survival. The main disadvantage of such a lifeline tariff is that it also subsidises water consumers who can afford to pay for the quantity of water they actually consume.
- The poor who cannot afford to pay for the current water tariffs receive a targeted subsidy. This is a much more efficient policy in socio-economic terms, instead of providing subsidised water to all for the first 20-30 m<sup>3</sup> of water consumed by all households, irrespective of their economic conditions.
- The current domestic tariff of water consumption up to 40 m<sup>3</sup>/month/household is identical to the non-domestic tariff. Both are set at S\$1.17/m<sup>3</sup>. In other words, commercial and industrial users do not subsidise domestic users, which is often the case for numerous countries.

- The tariff structure penalises all those households who use more than 40 m<sup>3</sup> of water per month. They pay the highest rates, S\$1.40 m<sup>3</sup>, for consumption above this level. This rate is higher than the commercial and the industrial rates, and is a somewhat unusual feature compared to the existing norm.
- Water conservation tax (WCT) is 30% of the tariff for all consumers, except for domestic households who use more than 40 m<sup>3</sup>/month. The WCT on consumption of each unit higher than 40 m<sup>3</sup>/month goes up by 50%, from 30% to 45%, which must be having perceptible impacts on household behaviour in terms of water conservation and overall demand management.
- Water-borne fee (WBF) is used to offset the cost for treating wastewater and for the maintenance and extension of the public sewerage system. It is set at S\$0.30 m<sup>3</sup>/s for all domestic consumption. For non-domestic consumption, this fee is doubled, S\$0.60/m<sup>3</sup>, presumably because it is more difficult and expensive to treat non-domestic wastewater.
- A Sanitary Appliance Fee (SAF) is also levied per sanitary fitting per month. It is currently set at S\$3.00 per fitting.
- There are two components to water tariff. A major component of the overall revenue collected through water tariffs accrue to the PUB recovering all operation and for considering maintenance costs and new investments. However, revenue from WCT accrues to the government and not to PUB.

## **OVERALL GOVERNANCE**

The overall governance of water supply and wastewater management systems in Singapore is exemplary in terms of its performance, transparency and accountability. There is much that both the developed and developing world can learn from the PUB experience. Only some selected critical issues will be discussed herein.

### **Human resources**

An institution can only be as efficient as its management and the staff that work for it, and the overall social, political and legal environment within which it operates. In terms of human resources, PUB has some unique features in terms of management which makes it stand out among its other Asian counterparts.

In vast majority of the Asian water utilities, service providers mostly have limited say on staff recruitment and staff remuneration. Consequently, the utilities are rife with following type of problems:

- Staff, including senior managers, is often selected because of their political connections, rather than their management abilities or technical skills.
- Managers often do not have the skill to manage, even if they had autonomy and authority to manage, which often they do not.
- Water utilities are overstaffed, primarily because of political interference and nepotism. Unions are very strong, and generally are well-connected politically. Accordingly, downsizing is a difficult task because of strong union opposition and explicit or implicit political support. Overstaffing ensures low productivity and low staff morale.
- Utilities are not allowed to pay their professional staff members the going market rates for remuneration, which sometimes could be 2-3 times higher. This means that they are unable to attract and retain right calibre of staff. Many staff moonlight to obtain extra income, and corruption is rife in nearly all levels.
- Utilities are dominated by engineers, and the career structure available for other disciplines like accountants, administrators, social scientists, information technologist, etc., is somewhat limited. This is another disincentive for non-engineers to join.
- Poor management, overstaffing, and promotions because of seniority or political connections ensure that it is very difficult to recruit good staff, and if some do join, it is equally difficult to retain them because of lack of job satisfaction, poor working environment and absence of incentives for good performance.

PUB has overcome the above and other related constraints through a competitive remuneration and incentives and benefits package. The salary and benefit package is generally benchmarked against the Civil Service, which, in turn, benchmarks against the prevailing market. It provides strong performance incentives which is commensurate with the prevailing pay packages for the private sector. In addition, its pro-family policies, commitment to train its staff for their professional and personal development, and rewarding good performers, ensure good organisational performance and development. Consequently, its overall performance has become undoubtedly one of the best in the world.

## **Corruption**

Corruption is endemic in most Asian utilities. However, it is not an issue at PUB, which emphasizes staff integrity as a key organisational requirement. It has taken measures to prevent corruption by staff training on Code of Governance and Code of Conduct, effective internal control processes, regular audits and strong and immediate sanctions against those who may prove to be corrupt. Staff members are required to make annual declarations, which include Declaration of Assets and Investments and Declaration of Non-indebtedness.

Complaints of corruption are promptly investigated and reported to Singapore's Corrupt Practices Investigation Bureau. PUB is a part of the overall Singapore milieu where there are strong anti-corruption laws at the national level with appropriate sanctions that are regularly

implemented. In addition, in recent decades, the Government has consistently shown its strong political will to curb all forms of corruption, and take firm actions against all and any form of corruption (see <http://www.cpib.org.sg/aboutus.htm>).

With a good remuneration package, functional institution, and a strong anti-corruption culture, corruption is not an issue at PUB.

### **Autonomy**

Absence of autonomy is one of the most fundamental problems which affects most utilities of the Asian developing countries. This, in turn, creates a series of second order problems and constraints which further erode the efficiency of the utilities to perform their tasks efficiently and in a timely manner.

A fundamental problem in most Asian cities has been that the process of setting tariffs is primarily controlled by the elected officials, who mostly resist increases because of perceived vested interests. Low levels of tariffs cannot have any impact in terms of managing demands. In fact, low levels of tariffs are not compatible with metering, especially as the cost of metering and processing the resulting information may be higher than the revenue metering can generate. The problem is further accentuated by low levels of tariff collection. Furthermore, politicians have preferred to keep domestic water prices artificially low, and subsidise it with much higher tariffs from commercial and industrial consumers. For example, according to a World Bank study, in India, domestic consumers used 90% of the water, but accounted for only 20% of the revenues (ADB, 2003). Domestic consumers were thus heavily cross-subsidised by commercial and industrial water users.

In contrast, PUB has a high level of autonomy and solid political and public support, which have allowed it to increase water tariffs in progressive steps between 1997 and 2000 (see Table 1). Water tariffs have not been raised since July 2000. This increase not only has reduced the average monthly household water demand but also has increased the income of PUB, which has enabled it to generate funds not only for good and timely operation and maintenance of the existing system but also for investments for future activities.

Such an approach has enabled PUB to fund its new capex investments over the years from its own income and internal reserves. In 2005, for the first time, PUB tapped the commercial market for S\$400 million bond issue. Under the Public Utilities Act, the responsible Minister for the Environment and Water Resources had to approve the borrowing. The budgeted capex for the year 2005 was nearly S\$200 million.

Because of lack of autonomy, political interferences, and other associated reasons, internal cash generation of water utilities in developing countries to finance water supply and sanitation has steadily declined: from 34% in 1988, to 10% in 1991 and only 8% in 1998. Thus, the overall situation has been “lose-lose” for all the activities. The Singapore experience indicates that given autonomy and other appropriate enabling environmental conditions, the utilities can not only be financially viable but also perform their tasks efficiently.

Unlike many other similar Asian utilities, the PUB has extensively used private sector where it did not have special competence or competitive advantage in order to strive for the lowest cost alternative. Earlier, the use of private sector for desalination and wastewater reclamation has been noted. In addition, specific activities are often outsourced to private sector companies. According to the Asian Development Bank (November 2005), some S\$2.7 billion of water-related activities were outsourced over the “last four years,” and another S\$900 million will be outsourced during “the next two years” to improve the water services.

## **Overall Performance**

No matter which performance indicators are used, PUB invariably comes to the top 5% of all the urban water utilities of the world in terms of its performance. Only a few of these indicators will be noted below:

- 100% of population have access to drinking water and sanitation.
- The entire water supply system, from water works to consumers, is 100% metered.
- Unaccounted for water as a percentage of total production was 5.18% in 2004.
- The number of accounts served per PUB employee was 376 in 2004.
- Monthly bill collection efficiency: 99% in 2004.
- Monthly bill collection in terms of days of sales outstanding was 35 days in 2004.

The above analysis indicates that PUB has initiated numerous innovative approaches to manage the total water cycle in Singapore. Many of these approaches can be adopted by developed and developing countries to improve their water management systems. If the MDGs that relate to water are to be reached, the example of Singapore needs to be seriously considered for adoption by developing countries concerned and the donor community, after appropriate modifications.

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