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Water Demand Management in Singapore: Involving the Public

Cecilia Tortajada · Yugal K. Joshi

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Abstract Water demand management requires the implementation of instruments and strategies that consider pricing, mandatory water conservation requirements and the engagement of the public and private sectors as well as of the society at large. In the case of Singapore, water is treated as an economic good. It is priced to recover the full costs of production and to reflect the scarcity of the resource and the high cost of developing additional water sources. Within a framework for water conservation, public education, information and awareness instruments have played a very important part in making the public appreciate the importance of conserving the resource. This paper analyses the water demand strategies that have been developed in the city-state, with emphasis on education efforts and on the results obtained in terms of water conservation. Lessons learnt from this study can provide very useful experiences for cities in developed and developing countries on the type of policies that could be successful in reducing consumption as well as in providing alternative supplies of water for both the domestic and the industrial sectors They also provide useful insights on the different ways to make the public realise the importance of using water sustainably for its long-term conservation even when immediate access to clean water may not be an issue.

Keywords Public involvement · Water demand · Water conservation · Water pricing · Singapore

1 Introduction

The increasing complexities of managing water resources efficiently and effectively have necessitated of decision-making processes, institutions and technologies that emphasize

C. Tortajada (✉)
Third World Centre for Water Management, formerly Lee Kuan Yew School of Public Policy,
National University of Singapore,, Avenida Manantial Oriente No. 27, Los Clubes,
Atizapan, Estado de México 52958, Mexico
e-mail: cecilia.tortajada@gmail.com
URL: www.thirdworldcentre.org

Y. K. Joshi
Northern Railway, formerly Lee Kuan Yew School of Public Policy,
National University of Singapore, Delhi West, P.K. Road, New Delhi 110055, India
e-mail: hiyugal@gmail.com

efficiency of water conservation from multiple viewpoints (Brooks and Brandes 2011). Equally important for the implementation of government's policies and strategies has been the gradual involvement of more sectors and actors who can make positive additions with their participation to the complex task of efficient water resources management.

Different to the 'old' style to manage water where central governments were the only parties involved in decision-making, more inclusive partnership modalities are being set all over the world. There is a vast body of literature that documents attempts to draw in an increasing number of actors in decision-making progresses including more public sector institutions, industries and businesses, academia and society groups, and, most important, the general public (Bourblanc 2010; Edelenbos et al. 2003; Edelenbos and Klijn 2005; Hommes et al. 2009; Jones et al. 2011; OECD 2011; Priscoli 2004; Söderbaum and Tortajada 2011; Tortajada 2006, 2007, 2010a, b; World Bank 2006). The overall experience has been that involvement of actors through consultative, deliberative and engagement processes in decision-making should focus in developing partnership modalities as well as in establishing cooperative management structures. Without these elements, effective participatory processes are unlikely to succeed (Hering and Ingold 2012; Lenihan 2009).

Ideally, for participation strategies to have a long-lasting impact, they should not be limited to merely encouraging participation of the public but to actually look for *public engagement* (emphasis of the authors) by introducing governance aspects. This approach is likely to set a much broader involvement framework for the interest groups as well as open the possibility to achieve outcomes that could become models for understanding better kinds and degrees of participation (for more detailed discussions on this issue, see Pierre and Peters 2000; Hajer and Wagenaar 2003; Söderbaum and Tortajada 2011).

Governance aspects, when incorporated in public processes in spite of their complexity, provide the possibility to engage participants to play a more comprehensive role. Members of the public can act as advisors, co-decision makers or cooperating partners depending on their expertise as well as on the degree to which they are willing to collaborate in the processes established. The obvious gains of more meaningful degrees of interaction and participation would be the better understanding of the goals that are commonly discussed. This, in turn, is likely to lead to the joint decision of compromises and trade-offs between competing values and priorities and finally reach strategies on how to proceed. Engagement processes have thus more possibilities to achieve a more transparent, accountable and responsive outcome. They are also likely to lead to broader public acceptance and support for initiatives that would have been improved through communication, collaboration and cooperation among those involved (Lenihan 2009; Söderbaum and Tortajada 2011). After all, it is the engagement of the different parties that determines the degree of success of implementing long-term strategies (Hering and Ingold 2012; Holway and Arboleda 2012).

This paper presents an account of public participation in water resources management in Singapore from the time of its independence in 1965. It discusses the key policy choices the government has taken along the years for the management and conservation of the country's water resources, the reasons thereof and the results that have been obtained.

The unique water relationship between the public and the government is presented as well as how education, information and communication strategies have become essential tools to promote water conservation practices. The relevance of a study on water management in Singapore relies in the fact that the city-state is one of the very few countries, if not the only one, that has developed a holistic framework where policy choices for water resources (or any sector for that matter) have never been taken solely based on the needs of one sector. Instead, they have traditionally been taken within a larger and more complex political vision that has considered the impacts that decisions in one sector may have on other sectors and on

the overall growth and economic development of the city-state (Tortajada et al. 2013). Therefore, Singapore's lessons learnt can provide valuable experiences for cities in developed and developing countries on holistic policy implementation and management of water resources as part of an overall development framework.

2 Politics and Policies in Public Involvement

One of the most, if not the most important and significant political development in Singapore, has been the emergence and continuance of a one-party system since the country first achieved self-government in 1959. From the time of the independence in 1965, political stability, predictability and continuity have ensured economic and social success, allowing the ruling People's Action Party (PAP) to plan ahead for future challenges, trying to engage the people who would help to chart the course of the country (Lee 2011).

The PAP developed a unique governing style by forming a constitutional representative government, endorsing authoritarian decision-making and concentrating power in a few executives (Chan 1991). Such political decision-making mindset could be seen in governmental and public activities and initiatives, and consequently, also reflected on public engagement plans regarding water conservation. Singaporeans were quick to respond to practical programmes but, in general, were content to follow their leadership and left initiatives to politicians. Turnbull (2009:322) mentions that, while most people accepted effective PAP leadership, the government's activities "tended to deaden the sense of involvement on the part of the community as a whole".

As expected, the tone and tenor of public engagement campaigns have changed throughout the years, with civil society groups becoming part of several initiatives. The government's idea of these groups was of "a kind of apolitical activism" (George 2006:42) that could complement official activities. As Ho (2000) mentions, the political system established specific parameters that may impose practical constraints on citizen's involvement in policy-making. This struggle has shaped the civil society-State relationship even in present day Singapore.

Public involvement has included consultative mechanisms for which the State has provided platforms or initiated opportunities where the views and ideas of professionals, experts, relevant social groups and the public may be articulated or heard. This procedure was used, for example, during the preparation of Singapore's National Vision Statement, Singapore 21 (Government of Singapore 1999). The committees thereof established included Members of Parliament (MPs), civil society groups, activists, lawyers, unionists, businessmen, professionals, etc. These groups interacted with the public and listened to their points of view on five main issues: consultation and consensus vs decisiveness and quick action; less stressful life vs retaining the drive; needs of senior citizens vs aspirations of the young; attracting talent vs looking after Singaporeans; and internationalization/regionalization vs Singapore as home. This public consultation brought some positive changes in the relationship between the public and the State since it showed that the government was interested in listening to the views of the society.

In Singapore, as in many other places, 'apolitical' civil society organisations that align with the State and its institutions in order to further fulfil the goals and interests of the government are preferred over those who occasionally compete with and challenge the government's viewpoint. For such 'apolitical activist organisations', in the like of social welfare organisations, the State prefers the term 'civic society' rather than 'civil society', "thus privileging a civic republican notion of citizenship where the emphasis of citizenship

[is] not on individual rights, but on civic and national duty" (Chong 2005:10). The participation of civic societies in water demand management in Singapore has not been any different, and their activities have flourished under the government's support.

2.1 Political Leadership

In Singapore, good political leadership has always been cited as the major factor behind its prosperity and affluence. It has been the belief among the elites that leaders are the best judges of the country's destiny. It has also been considered that the general public's level of knowledge, understanding and interest in political matters does not always enable it to make meaningful decisions about issues that can affect the fate of the country (Ho 2000). As Wagner and Fernandez-Gimenez (2008) report, this is a reflection that is not uncommon in other countries mostly due to the multiple dimensions of social capital such as norms of reciprocity, trust and networks and to the complexities resulting from the different kinds of network connections.

In Singapore, the previous understanding has been vindicated with its impressive transformation as well as its continuing economic growth. The fact that the government has been able to instil trust among the public has made the public relatively inconsequential in governmental and policy matters. Trust has also been fundamentally necessary to bring effective policy changes through an efficient government, effective legislation implementation, efficient performance of its utilities and other government agencies, constituency work and public campaigns (Ghesquière 2007).

It is to the credit of Singapore's leadership that despite its elitist policy-making approach, it has remained open to alternative course corrections. Various mechanisms like Feedback Units, Service Improvement Units, Citizen's Consultative Committees (CCC) and various meeting platforms with elected representatives, have opened up opportunities for the different groups of the public that seek to contribute to decision-making with policy inputs. For example, since the early 1960s, PAP leadership promoted the establishment of grassroots organisations with the objective to improve the relationship between the government and the public. Community Centres and People's Associations (PA) were made the focal point for community integration through vocational, recreational and sports activities.[1] CCC have been considered catalysts for generating a cohesive sense of community at the constituency level. They were established to transmit government's policies to the public and to relay their demands back to the government (Lee 1978). Throughout the years, the committees have enhanced the capacity of political leaders to govern, undertaking the major responsibility of managing and conducting multiple official as well as educational campaigns to change social habits (Chan 1991).

At the end of the 1970s, Residents' Committees were also established in all public housing estates to foster community cohesion. The government ensured that middle and senior level administrators were part of these committees in order to learn about the societal concerns.

The traditional shortage of public fora and civil society organisations has made the relation of Members of Parliament with the public to be of fundamental importance in Singapore. MPs are expected to act as mediators between the government and the members of the society and develop close linkages between them. For instance, MPs are expected to

[1] The People's Association (PA) was established in Singapore as a statutory board on 1 July 1960 with the objective to promote racial harmony and social cohesion in a multi-racial society. Its focal point is the more than 200 community centres.

attend the 'Meet the People' sessions organised weekly at CCCs to develop better and closer relations with the people. They are also expected to play an important part in the implementation of national goals in their respective constituencies and organise all related campaigns. In terms of water resources, they have been instrumental in mobilising the public and get it involved in conservation campaigns. The 'Save Water Campaign', the 'Anti-Spitting Campaign' as well as the 'Keep Singapore Clean and Pollution Free' campaign are some of the earliest examples of activities organised by local MPs in cooperation with the CCCs and their constituency branches (Chan 1976).

Following is the account of a series of programmes, strategies and campaigns launched by the government throughout the years to engage the public in water conservation practices.

3 Public Involvement as Part of Water Demand Management Measures

Singapore is considered to be a water scarce country in spite of receiving an average of 2,400 mm/year of rain. This is because of its limited size (580 km^2 in 1965 becoming 714 km^2 in 2011 due to land reclamation) and thus the constraint area where rainfall can be stored (Department of Statistics Singapore 2012, http://www.singstat.gov.sg/stats/keyind.html. Accessed on 24 October 2012). Moreover, water supply systems have been developed considering the increase in water demand resulting from economic development, an impressive 30-fold rise in Gross Domestic Product (GDP), over 20 % land augmentation due to land reclamation, and a tripling population.

Strategies have included the expansion of catchment areas, water supply and demand strategies (including pricing and non-pricing mechanisms), water pollution control and large investments in research and development mostly in technology in order to develop non-conventional sources of water, such as very high quality treated wastewater (NEWater or used water, as it is known locally[2]) and desalination. Partnerships between public, private and 'people' sectors in addition to sustained education, information and communication campaigns have been very strong components of the strategies aiming to achieve long-lasting attitudinal change among the public and the industries towards conserving water (Tan et al. 2009; Tortajada and Joshi 2013).

A historically important source of water for Singapore has been the imports from Johor, Malaysia, which will last, at least, until 2061. Four water agreements have been signed with this purpose: in 1927 and 1961 (neither of them are in force anymore) and 1962 and 1990, allowing Singapore to import water from Johor and allowing Johor to buy treated water from Singapore.[3] [4]

From independence in 1965, the reliance on external sources of water to support the economic growth and social development of the city-state, have made the leadership aware of the importance of formulating a clear vision and implementing long-term planning and

[2] NEWater is very high quality recycled treated wastewater. It is supplied both for direct non-potable use (DNPU) to commercial and manufacturing processes that require water for cooling, and for indirect potable use (IPU) by introducing water into reservoirs for subsequent retreatment at the several waterworks for drinking purposes. In order to try to change the overall negative popular impression towards recycled water, wastewater was renamed as 'NEWater' or 'used water' and wastewater treatment plants renamed as 'water reclamation plants'. More importantly, the new terms were part of a strategy which objective was to change the mindset of the population, stressing the new approach to water management by communicating to the public the need to look at water as a renewable resource that could be used over and over again. For further information, see PUB, http://www.pub.gov.sg/about/historyfuture/Pages/NEWater.aspx and Tan et al. 2009.

[3] For more information on the water agreements, see Singapore Parliamentary Debates 2003a, b, c, d.

[4] Both 'Johor' and 'Johore' are used in the agreements.

forward-looking policies and strategies to diversify and conserve its internal sources of water. As part of an overarching framework of security that would provide the city-state with enough flexibility to achieve increasingly ambitious development plans, water self-sufficiency has been one of Singapore's main goals (Chong 2010; Kog 2001; Luan 2010; Lee 2005, 2010; Singapore National Archives 2007; Tan 2009; Tan et al. 2009; Tortajada et al. 2013).

Historically, water scarcity, dependence on imported water and increasing water consumption have been a reason for political preoccupation, compelling the government to look for alternative water sources and strengthen water conservation efforts. Since 1968, public awareness on environmental matters, including water resources, has been raised in Singapore. The first initiative for this purpose was the 'Keep Singapore Clean' campaign, organised by an inter-sectoral committee headed by the then Health Minister. This was probably one of the earliest examples of governmental inter-agency collaboration, which later on became a normal practice. This campaign to build public awareness was followed by others focusing on pollution, food hygiene, infectious diseases, waste management, sanitation, anti-spitting, anti-littering, river clean-up and global environmental issues. Campaigns have normally been preceded by the introduction of an environmental or public health law and followed by strict law enforcement. Schools were (and continue to be) of fundamental importance for education purposes on environmental matters.

3.1 Sustained Efforts Aimed at Water Conservation

Like in all other countries, the concept and implementation of water demand management has been an evolutionary process in Singapore. During the 1960s and 1970s, steady increases in water demand were considered to be good indicators of economic growth and national development. Higher production and sales of water, electricity and gas were seen as a positive sign of progress and proxies for rapid industrial, commercial and housing developments, consistent with rising standards of living.

Following a serious drought in 1971, the idea of high water demand as a sign of progress started to change. By 1972, total annual water sales as well as average daily consumption in the domestic sector had increased significantly. Total water sales had become 159.4 million m^3 (Mm^3) compared to 147.8 Mm^3 in 1970 (Ooi GL, unpublished work) and average daily consumption stood at 5.98 m^3/s (113.8 Mgal), representing a 10.38 % increase from the previous year. Industries were using 20.93 % more water compared to 1970 (PUB 1972).

In November 1972, the Public Utilities Board (PUB, the national water agency of Singapore) launched its first large-scale consumer-oriented campaign. 'Water is Precious' sought to make the public aware of the growing importance of water and also to inculcate water saving habits. Numerous community activities were organised highlighting the practical dos and don'ts for conserving water (PUB 1973) and press, radio and television publicised extensively the campaign among the public.

In 1973, water tariffs were modified and an increasing block tariff system was introduced to raise PUB's total income and prevent wastages in the domestic sector. Thanks to these mechanisms, Singapore saw negative growth in domestic water consumption for the first time since 1967 (Ooi GL, unpublished work). Along economic instruments, a series of educational initiatives were put in place. School children were identified as a major target group and programmes to educate them on water conservation were implemented. These efforts continue until now.

In 1976, after another serious drought, PUB published appeals to large water users, such as hotels, coffee shops, laundries, etc., to avoid wasting water (PUB 1976). Slogans such as

'Don't wait till the last DROP - Save water now' were displayed in public places, disseminating the need to save water. The 'Water is Precious' exhibition was revived and ministries, agencies and associations including the Prime Minister's Office, the Ministry of Culture and the PA collaborated, worked and toured 12 community centres together to reinforce the importance of water conservation.

The year 1977 began with the inauguration of Upper Peirce Reservoir (PUB 1977), an event that set the pace for the massive urban re-development of the city-state that would follow in the coming years. This made PUB continue looking for new sources of water, implementing further water supply and demand instruments and re-emphasising the importance of water conservation practices to both domestic and industrial users (Joshi et al. 2012).

In 1978, PUB got itself a new slogan: 'Adapt, Innovate and Prosper', perhaps a timely indicator of change in the agency's approach and attitude that saw the beginning of outreach programmes regarding its roles and responsibilities. Additionally, this initiative included the implementation of multiple initiatives to raise water's profile among the public, such as the 'Meter Reading Contest' with the participation of 8,163 individuals, and tours to water treatment works and power stations for new employees, students, organised groups and overseas visitors to learn about the work of the utilities. One year later, with the objective to bring the public close to the water bodies, an initiative was launched to open up two of the reservoirs (Kranji and Upper Peirce) to recreational use after more facilities were made available at these locations (PUB 1978, 1979).

As conservation efforts intensified, increasing population and the rapidly growing industrial sector continued to push for sharp increases in water consumption. Between 1972 and 1981, and in less than one decade, overall water consumption in Singapore increased by 46 % (51.2 % alone in the domestic sector) (Ooi GL, unpublished work). As such, it became imperative to deliver the conservation message to consumers through more effective means other than information campaigns. PUB thus implemented several concurrent initiatives. These included the establishment of a Water Conservation Unit in 1981 as part of the agency to work on water conservation in the domestic and non-domestic sectors and advice on the most suitable policies to be adopted (Tortajada et al. 2013). One of the unit's roles was to liaise with large water industrial consumers and provide overall support on how to reduce water consumption. Furthermore, this information exchange, which became a regular feature in the following years, facilitated feedback to PUB, which proved to be a very useful element to formulate additional strategies for water conservation.

That same year, as part of the implementation of a Water Conservation Plan, officers from the Water Conservation Unit visited some 4,000 domestic and non-domestic consumers. A further 640 commercial and industrial consumers followed PUB's indications to appoint water controllers to monitor water consumption (PUB 1981).

Also in 1981, efforts to preserve water saw the launch of a one-month long 'Let's Not Waste Precious Water' campaign and the participation of PUB officials in talk shows in schools, colleges and vocational institutions to encourage water conservation attitudes (PUB 1981). In spite of these persuasive measures to engage the public through information, awareness raising and education, water consumption remained significantly high. It was thus considered that the revision of water rates was the best alternative to promote more efficient water use. The Straits Times, the highest-selling newspaper, published PUB's proposed tariff revision strategy and welcomed it as a measure seeking to reduce the 7.7 % growth rate in water consumption registered in 1980 (Business Times 1981).

In 1983, national water conservation campaigns echoed the previously organised, one-month long 'Let's Not Waste Precious Water' campaign. While these were launched to raise

greater awareness both among the public and the industry, this time efforts focused mainly on the commercial and industrial sectors given that industrial water consumption had increased from 29 % to 36.4 % in a decade (1973 to 1983). By the third quarter of that same year, the Water Conservation Unit had inspected the facilities of 7,500 large water consumers and persuaded more than 70 % of them to adopt water conservation measures. According to PUB (1983), these efforts reduced industrial annual water consumption by 11 %. To reinforce the achievements of the water saving campaigns among the non-domestic sector, the government began providing incentives to those consumers who cut their water use. For example, a 50 % investment tax allowance for water conservation equipment was announced for those industries that had substantially reduced their water consumption (PUB 1983).

In 1984, as a result of the awareness visits to promote water conservation practices in the industrial and commercial sectors, more than 700 commercial establishments installed water saving devices such as self-closing delayed action taps and constant flow regulators (PUB 1985). Industries were also encouraged to use industrial water instead of potable water.

Two years later, in 1986, a different method was used to further promote water conservation messages and educate the public on the steps to be taken in case of an emergency. The Singapore Civil Defence Force, PUB, several grassroots organisations and approximately 3,500 households participated in an 'emergency' water exercise (PUB 1986). This activity was meant to target the population born after independence and that had never experienced a water crisis. The net result was positive, albeit modest, since domestic consumption that year dropped only by 2 % compared to the previous year (Ooi GL, unpublished work). The positive results of the water exercise are assumed as there are no evaluations available which indicate the direct impact of the initiative.

At that time, it was thought that water conservation campaigns required a further boost through formal education, foreseeing this could have a long lasting impact on the young population. Therefore, in 1987 a water conservation course was introduced at secondary level to make students understand Singapore's water challenges (PUB 1987). Educational kits were distributed at schools as these remained the focus of public education campaigns in the 1990s and beyond.

Throughout the same years, an unusually long dry period forced Singapore to once again make public appeals to cut down on unnecessary water use by 10 % and conserve falling reservoir stocks (The Straits Times 1990b). Extensive and intensive campaigns bore fruit and in 1 month, from March to April 1990, daily water consumption was reduced by 11.2 %. This improved the level of reservoir stocks and it was no longer necessary to implement water rationing that year (PUB 1990). Once again, newspapers played their part during this period. They published stories echoing the 1960s drought and rationing, reminding the public the difficulties faced back in those days and urging them not to waste water (Tan 1990; The Straits Times 1990a).

Unfortunately, once the dry season was over, and despite the extensive use of information, awareness and education campaigns as tools for water conservation, domestic and non-domestic consumption increased once again. To complement the non-pricing strategies, in 1991, a Water Conservation Tax (WCT) was introduced as a pricing tool to discourage excessive water consumption (Tan et al. 2009). A 5 % tax was to be levied on monthly domestic water use above 20 m^3, and a higher 10 % rate would apply to non-domestic consumers. In spite of this economic measure, and its subsequent increases in 1992 and 1995, water consumption in those years increased annually more than 3.99 % for domestic use and more than 6.2 % for non-domestic consumption (Ooi GL, unpublished work). In 1997, the WCT was applied to domestic consumption from the very initial level of use in order to reinforce the message of water conservation.

4 Further Outreach Efforts

At the rate water consumption was increasing, there was the risk that it would double every 16 years. With this in mind and taking into consideration the efficacy of the different public engagement methods used until then, PUB focused on even wider reaching mass-scale conservation campaigns. This approach was encouraged by the Singapore Green Plan (launched in 1992), which charted the strategic directions the city-state would be adopting to achieve its sustainable development goals (see Ministry of the Environment 1993 and Ministry of the Environment and Water Resources, http://www.mewr.gov.sg/sgp2012/about.htm. Accessed on 24 October 2012). The extensive public consultations the plan encouraged inspired policy-makers to emulate a similar type of engagement process for other campaigns as well. In fact, this was the beginning of 'public consultations' as an engagement tool in environmental issues in Singapore.

With time, dissemination methods made use of both conventional information tools and more audience-friendly approaches. In 1995, in an unusual campaign that ran for 6 days, an island-wide water rationing exercise was conducted involving 30,000 households in 20 constituencies. During this period, water supply was interrupted for 14 h each day (PUB 1995). The aim was to shake up public inertia and remind Singaporeans about the importance of water. There are also no evaluations available that can indicate the direct impact of the exercise both in terms of perceptions of the public and on water conservation efforts.

In 1997, water tariffs were again revised encouraging greater fiscal incentives for customers who had complied with the recommendations proposed in the many information campaigns. It was thought that higher water prices would draw attention to water management's need to 'conserve' and 'value' the resource. As in previous cases, information on these fiscal measures was disseminated through massive campaigns. At the same time, PUB implemented new outreach and education programmes, including establishing a new Water Conservation Centre with interactive exhibitions (PUB 1997).

In addition to tariffs increase and awareness programmes and campaigns, efficiency measures have also been widely implemented. During the 1995 'Save Water Campaign', free thimbles were distributed to reduce excessive pressure and flow by fitting them into household tap nozzles, showerheads and hose connections. From 1999, thimbles have been installed in all washbasin taps at single new HDB flat.[5] In 2003, the maximum flow rates imposed on the non-domestic sector were reviewed and reduced between 25 %-33 %. These maximum flow rates were also imposed on the domestic sector for the first time.

Further measures have been put in place ever since. In 2006, PUB launched the 10-l challenge as an 'umbrella programme' seeking to get the population to reduce its daily per capita water consumption by 10 l. As part of the initiative, PUB and the Singapore Environmental Council introduced the voluntary Water Efficiency Labelling Scheme (WELS) to provide water consumption and efficiency information to help consumers make informed choices on their purchases of water fittings and products (PUB 2008). In 2009, the mandatory WELS was implemented, which refers to a grading system of 0/1/2/3 ticks to reflect the water efficiency level of a product. It applies to taps, mixers, dual-flush low capacity flushing cisterns, urinal flush valves and waterless urinals.

[5] HDB (Housing and Development Board) is the statutory board of the Ministry of National Development responsible for public housing in Singapore. The term 'HDB flat' is commonly used to refer to low-cost apartments built by the Board.

Figure 1 presents an overall view of the response of the domestic sector to public education efforts and price increases that have been implemented between 1985 and 2011.

As it can be observed, the several pricing and non-pricing water conservation strategies implemented throughout the years have resulted in gradually, albeit slow, lower domestic per capita consumption. This number has decreased from 172 l/day in 1995 to 153 l/day in 2011. The present objective PUB has set is to reduce domestic consumption to 147 l/capita/day by 2020.

Overall, long-term conservation efforts have been positive, but they have required vast and sustained efforts of the water agency to remind the public once and again on the importance of water conservation. An achievement is that domestic per capita consumption has continued decreasing, even when the last tariff increase was in 2000, but much more needs to be done. This is consistent with Randolph and Troy (2008) in the sense that many times there are considerable gaps between the stated attitudes of the public and their manifested actions. In this case, educational, efficiency and pricing-related campaigns implemented along the years have been necessary to make the public aware of the importance of water conservation. Clearly, policy development needs further attention in order to develop mechanisms with which is possible to make effective the intended support of the public for more water conservation in terms of sustained reductions in water use. Discussions on issues as basic as the type of information provided to the public are very relevant, since it may well be that the messages disseminated may not coincide with the interests of the public with their consequent lack of interest (Hommes et al. 2009). It would thus be useful for the water agency to go back to the drawing room and develop mechanisms to reinforce learning from experiences of public involvement not only in other cities but also outside the fields of water and environmental management (Orr et al. 2007).

5 Strategies and the Logic Behind Them

With more than half of Singapore's land acting as a catchment area, it became important for PUB to make the population aware of the fact that they were living in water catchment areas. It was crucial for people to know that 100 % of the rain falling in the neighbourhoods was collected and transported to reservoirs and treatment plants before being distributed to their homes. PUB thus decided to attempt to increase the public's understanding about this 'cycle'[6] and make it more water-responsible. These efforts also involved a movement away from schemes that were outside of the realm of the thinkable for PUB just a few years back and which have included opening the reservoirs for the use of the public.

The idea of promoting activities near the reservoirs was contrary to the limitations imposed in the past by the water agency. This was a paradigm shift from the times when littering, industrial pollution and silt discharge represented very serious problems that prompted the authorities to keep the public away from reservoirs. With the adoption of advanced treatment technology and the premise that if the public carried out activities in the water it would be the last to pollute it, PUB began planning the development of a 'personal' relationship between the public and the water bodies (PUB 2004). A communication strategy was thus formulated to disseminate messages in more subtle and emotional ways but with more permanent impacts. Water would be made attractive to draw public interest and awareness would be adopted to raise attention on PUB's activities.

[6] For information on storm water collection in Singapore, see PUB http://www.pub.gov.sg/water/Pages/singaporewaterstory.aspx. Accessed on 17 January 2013

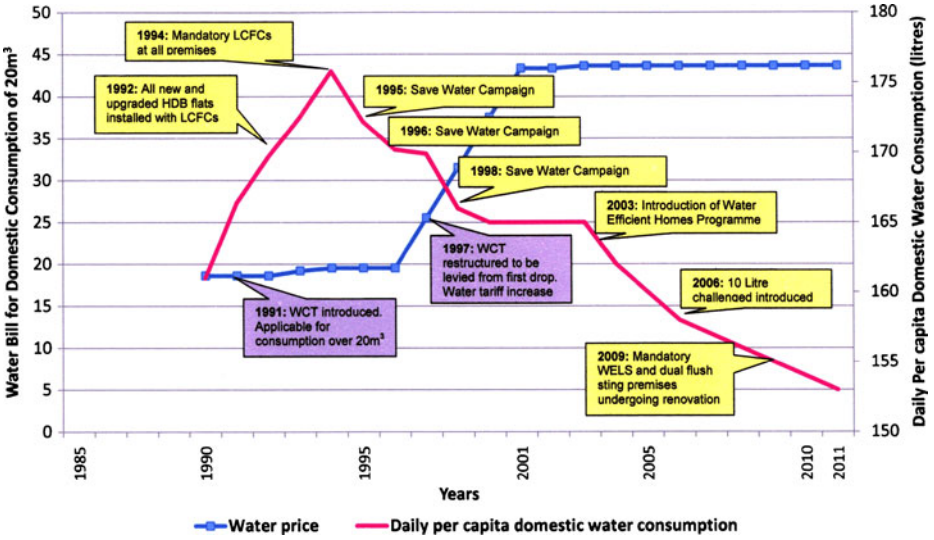

Fig. 1 Impact of pricing and non-pricing initiatives on per capita domestic water consumption from 1989 to 2011 (All figures are in Singapore dollars. Daily per capita of domestic water consumption is based on 1998 Population Data. Source: Public Utilities Board, personal communication)

Therefore, in 2004, activities encouraging the public to enjoy water and develop a relationship with it were introduced in what became the '3P' ('People, Public and Private') approach. Until now, the goal of this network has been to build the affinity of the public with water so that people gradually take ownership of the water bodies and stewardship in their conservation. 'Partnership' has became an innovative term used in this approach to gain societal support as well as that of the private sector to fulfil water demand management goals. The scheme indicates PUB's objective to remain pragmatic whilst incorporating to water policies contributions coming from different stakeholders based on their capacity, capability and commitment.

Another and more recent initiative is the 'Active, Beautiful and Clean (ABC) Waters' programme that integrates waterways with parks to create new community spaces. At present, 20 such projects have been implemented.

A summary of the policy milestones for water supply and demand management, including education and awareness efforts between 1963 and 2010, can be observed in Table 1.

As observed, water demand management strategies have been considerably comprehensive over the years and have included multiple pricing, efficiency, financial and awareness initiatives for domestic and non-domestic sectors and for the society at large. Even then, the fact that the public has been invited to adopt water conservation practices through pricing and non-pricing mechanisms does not necessarily mean that individual consumers have changed permanently their behaviour towards water conservation. As mentioned earlier, difficulties and limitations of educational and awareness campaigns in changing behaviour are well documented (e.g. Randolph and Troy 2008). These may be due to perception of entitlements, prevailing attitudes and patterns of behaviour but also to numerous and complex additional practical issues that influence internal and external water use such as the environment where people live and work and the extent to which a culture of change is encouraged and also perceived. As mentioned by Pretty (2003), laws, regulations and economic incentives can trigger changes in practices, but not necessarily on behaviour or

Table 1 Policy milestones for water demand management 1963–2010

Year	Policy/Programme	Description
1963–1964	Water Rationing	Mandatory; emphasised the conserve aspect of water. It led to a 13.4 % observed drop in conservation
1968	Keep Singapore Clean Campaign	Emphasised the 'clean' aspect of water in terms of water pollution and public health
	Environmental Public Act	
1971	First 'Water is Precious' Campaign	It reminded the public the importance of water conservation. It also emphasised water rationing in the 1960s. It succeeded in reducing consumption by 4.9 %
1972	Bukit Timah Flood Alleviation Scheme Completed	
	First Water Master Plan	
1975	Water Pollution and Drainage Act	
1977	Singapore River Clean-up launched	
1980s	'Let's not Waste Precious Water' Campaign	
	'Let's Save Precious Water' Campaign	
	Ministries of Environment and Education worked together to develop a better understanding of environmental issues among students (e.g. through Learning Journeys)	
1981	First Water Conservation Plan	Past problems, promotion of conservation and commitment to 'water for all'
1983	Mandatory installation of water-saving devices like constant flow regulators and self-closing delayed action taps in communal environments	Mandatory measures introduced to complement the 1981 Conservation Plan
1987	Successful completion of Singapore River Clean-up	Strong indication that clean waterways and adequate sanitation were possible and that Singapore was well on its way to achieving 'water for all' in both the distributive and aesthetic/access sense to the community.
	Last Night Soil Bucket phased out	
1990	First Annual Clean and Green Week	One of the earliest indicators of a more engagement-based approach
1991	Water Conservation Tax	Mandatory requirement to complement the focus on engagement.
1992	Mandatory installation of low capacity flushing cisterns (LCFCs)	
	Singapore Green Plan formulated with extensive public consultation	Singapore Green Plan is an early example of the government's understanding that effective public participation would be key for public awareness. It was also the beginning of the second stage in the strategies on water education, which changed from a more top-down mandatory approach to a greater inclusion of participatory bottom up and voluntary measures
1993	Singapore Green Plan Exhibition week also launches the Singapore Green Plan initiatives	
1994	Network of Environmental Education Advisors (EEAs) is established as a platform for communication with teachers	Strengthening of awareness to change behaviour for young people to promote water conservation
1995, 1996, 1997	'Use Water Wisely' Campaign	Emphasises the 'conserve' and 'value' aspects of water as well as the community involvement
1997	Increase of water prices	Introduction of greater fiscal incentives focusing on the 'conserve and value' aspects
	100 % sewerage in Singapore by modern standards	

Table 1 (continued)

Year	Policy/Programme	Description
	Mandatory use of LCFCs in all new and ongoing building projects including all residential premises, hotels, commercial buildings and industrial establishments	
1998	'Turn it off. Don't Use Water Like There's No Tomorrow.'	Voluntary/behavioural campaign used to reinforce fiscal incentives
	Founding of the Waterways Watch Society to encourage the practice of clean waterways, inspired by the Singapore River Clean Up	
1999	Start of NEWater Study	Constant search to expand and secure alternate sources of water supply
2000	NEWater Plant at Bedok commissioned	
2001	PUB changed to assume role of Singapore's new Water agency. Transferred from Ministry of Transport and Industry to Ministry of Environment	Corporate slogans makes marketing easier, but also summarises supply and demand management strategies easy for the public to remember, while also indicating all the necessary elements of the approach
	Introduction of the Water for All: Conserve, Value, Enjoy slogan	
2002	NEA (National Environment Agency) formed as a statutory board under Ministry of the Environment	Recognition of the different elements of demand in the private domain of the individual's behaviours at home. A shift from more public based strategies in the past
	Master Plan for Water Demand Management in the domestic sector	
	Singapore Green Plan reviewed	
2003	Then PM Gog Chok Tong launches NEWater to the public	Importance of acceptance of NEWater by the public
	NEWater is labelled the third National Tap	
	Launch of 'Water Efficient Homes Programme' (WEH)	Domestic demand management strategy to target specific areas for conservation in domestic use emphasising the 'conserve' and 'value' aspects of water
	Maximum Allowable flow rates 25–33 % to reduce water wastage- mandatory	
	Punngol South Riverwatch Society formed	Emphasis of volunteering and community involvement in saving water and valuing waterways and resources
2004	Ministry of the Environment became Ministry of the Environment and Water Resources (MEWR)	
	Reservoirs open for recreational facilities	The 'enjoy' aspect of demand management is highlighted through the opening of recreational facilities
	Water Hub established	
	Launch of Water Efficient Buildings Programme	The Water Efficient Buildings Programme is expanded to include buildings
	Community Development Councils (CDCs) take turns to launch the Clean and Green Week henceforth	
	NEA starts the Student Environment Champions programme as an extra-curricular activity	
	Launch of Corporate and School Partnership Programme (CASP) to encourage corporations to develop means to educate students on water issues and technical developments as part of their CSR programmes	Ownership is emphasised through the involvement of Community Development Councils, students and corporate groups
2005	Launch of programmes for the younger generations such as Water Wally, mascot of PUB Singapore, Water Detective Programme for Schools, etc.	PUB branding continues, with a focus on the younger generation
	Singapore Green Plan Reviewed	Community involvement is emphasized through the development of the Riverwatch Society.

Table 1 (continued)

Year	Policy/Programme	Description
	Launch of SingSpring Desalination Plant as Singapore's 4th National Tap	
	Launch of 'Our Waters Programme'	Ownership by schools of the importance of water conservation
	Punngol South Riverwatch Society adopts Sungei Serangoon waterway stretch	
2006	ABC Waters Programme launched	The launch of the 'Active, Beautiful and Clean' Waters programme promotes ownership of demand management principles
	'10-Litre Challenge' launched	
	Voluntary Water Efficiency Labelling Scheme (WELS) launched	
2007	Clean and Green Week rebranded as Clean and Green Singapore - changed from a weekly to a year-long initiative	The change to a year long initiative provides more opportunities for participation
	Launch of Water Efficiency Fund	The Water Efficiency Fund provides funding, support and access to water saving fittings and initiatives
	WaterMark Award and EcoFriend Award launched to reward individuals and organisations and raise awareness about water and environment related issues	Leadership in the water sector is rewarded and publicly recognised by giving such initiative value and prestige
2008	First Singapore International Water Week (SIWW)	
	'10 % Challenge' launched	The 10 % challenge makes water saving a competitive activity
2009	Water Efficiency Labelling Scheme made mandatory (MWELS)	Mandatory Labelling was introduced to publicly make firms accountable for the water efficiency of their products and for the consumer to make informed choices
	Dual flush LCFCs made mandatory for all new premises and those undergoing redevelopment	The voluntary aspect of water complemented the mandatory aspect through the Water Volunteers Programme, which explicitly encourages leadership in the water sector
	Launch of Water Volunteers Programme	
2010	'Water through my lens' photography competition launched by PUB and the National Youth Achievement Award	The enjoyment aspects and building awareness through creative developments- the non-limitation of water awareness to technicalities, rather, emphasizing its broad applicability is emphasized in this scheme

PUB internal documents and website; Tan et al. 2009; The Straits Times (several years); personal communication with PUB staff

attitudes on permanent basis. As efficient as Singapore's water resources management system is, the so-called four-taps will not last eternally if not used effectively. It is thus of fundamental importance to educate and to engage the public in more and better ways since this multiplies the opportunities for long-term conservation of the water resources.

6 Final Thoughts

This paper has discussed the overall water conservation strategies that have been implemented in Singapore in terms of pricing and non-pricing instruments as well as their results during the last almost 50 years.

It is important to note that the city-state's unique political environment ensures holistic policy-making, thus influencing the level at which initiatives are implemented. Graffy (2006) mentions that institutional fragmentation and communication on water scarcity, for example, make it very difficult to formulate common social and policy public agendas. This would not be a concern in Singapore, since there is one agency responsible for overall water issues, including the development of a policy agenda, management practices, infrastructural development and governance-related considerations. Policy and public agendas and related priorities for water resources management have also been traditionally set at the national level and as part of an overall development framework, and not on sectoral basis. Additionally, coordination and collaboration among ministries, agencies and sectors have been strongly encouraged in spite of their complexity. Overall, the different PUB policies, programmes and projects that have been implemented for water demand and supply management form a holistic strategy for managing water resources under one umbrella: the vision for growth of the city-state which is supported by every other sector.

Singapore's water demand management strategy has had a strong emphasis on 'valuing' water and thus on pricing it. This philosophy is based on the responsible use of water where the underlying principle is that the next sources of water could cost much more than the current ones (PUB 2011). This argument establishes the foundations of a realistic water-pricing regime that reflects the value of this resource to ensure its long-term responsible use. Nevertheless, valuing clean water involves much more than paying a price for its provision. It is about appreciating its fundamental importance for social and economic development, security, environment conservation and overall quality of life.

In the case of public involvement strategies to achieve the above goal, there has been a very strong emphasis on information and feed-backs, but not so much on policy-making. This is, active involvement of the public has not been in terms of development of plans or policies but rather on their implementation where they are able to become partly responsible for the outcomes. In daily life, members of the society are expected to participate actively by acting responsibly, adopting more efficient practices and changing their attitudes and behaviour. As mentioned by Bush et al. (2005), different levels of participation depend on specific policy objectives. With the present strategies of public involvement, the hope is that people will strengthen commitment towards policy principles.

Using the slogans which are so popular in daily life in Singapore, one could say that in the early days following independence, the focus of the government was much more on ensuring 'water for all' in terms of assuring resource availability for overall growth and economic and social development. At that time, the public was engaged more passively with the help of campaigns encouraging them to conserve water. The government's approach became broader when it was evident that coverage of supply had been mostly solved. While continuously stressing the importance of water conservation, policies started encouraging the public to develop ownership and a 'personal' relationship with water, hoping people would be more conscious in the use of water resources.

As present, PUB's philosophy (as well as slogan) 'Water for All: Conserve, Value, Enjoy' embodies the different elements of water supply and demand management, which in turn capture the objective of the awareness programmes that have been implemented. The supply-management side is represented in the 'Water for All' element, which includes the four national taps: water from local catchments, imported water from Johor, NEWater and desalination. It also addresses the different sources of water, the inadequacy of natural sources to meet the increasing demand and the importance of self-sufficiency for the city-state. In contrast, the phrase 'Conserve, Value, Enjoy' summarises the three elements of demand management which imply that the public should reduce its water consumption (conserve), develop ownership of the

water bodies (value) and take the opportunity to embrace water on their daily activities (enjoy). The message is very comprehensive since it addresses three separate types of human behaviour which are complementary to each other.

Overall, 'Water for All' underscores a form of State-society unwritten agreement around water, its access and its long-term sustainability. It is about the public appreciating the limited sources of water and about the State's efforts to secure these sources and constantly innovate to improve performance of existing sources and introduce new ones. Similarly, while 'Conserve, Value, Enjoy' is about the behaviour of the public, it equally underscores the State's efforts in communicating measures, introducing technologies and design elements that would enable individuals to have access to clean water on daily basis. It is also about water bodies and open spaces that are made accessible for the public in a way that is pleasant.

Successful public education strategies to achieve the previous philosophy require the achievement of specific targets such as reduction in water consumption per capita. As such, the objective of public involvement strategies is to change the societal behaviour towards greater conservation in daily water use by directly influencing their attitudes and behaviour. Nonetheless, in evaluating the impact of the conservation strategies, the main problem would be that the strategies often target large sections of the population, becoming difficult to assess which part of the reduction in water use results from 'hard' programmes such as laws, regulations and financial incentives and disincentives, which part results from the 'soft' side of conservation such as education, information and awareness, and which one results from the interplay between both of them. Assessments are thus fundamental to understand the type of policies on water conservation that are necessary at present and will be needed in the future and on how to involve the public more actively.

As discussed by Hommes et al. (2009), interaction and communication between actors with different perceptions and a connection between these perceptions regarding policy choices could be a feasible alternative to further engage the society in water conservation. Additionally, as noted by de Garis et al. (2003), challenges for long-term planning regarding public participation are growing in number and in complexity. Changes and innovations on principles of public participation and on their active involvement need to be studied and integrated in policy-making. This will be the next challenge for Singapore in terms of long-term planning and policy making: make the public realise through sustained engagement, that even if clean water supply may not always be the big question at present, the sustainable use of water resources should be the ultimate goal.

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