



COMPENDIUM OF GLOBAL GOOD PRACTICES

Urban Water Supply





**INTEGRATED
WATER
MANAGEMENT
POLICY**

**WATER UTILITY
REFORMS**

**LOSS PREVENTION
AND LEAKAGE
CONTROL**

**PARTNERSHIPS
FOR WATER**

**WATER FOR
THE POOR**



an initiative of



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PREFACE

The National Institute of Urban Affairs is the National Coordinator for the PEARL Initiative (Peer Experience and Reflective Learning). The PEARL program ensures capacity building through cross learning and effective sharing of knowledge related to planning, implementation, governance and sustainability of urban reforms and infrastructure projects – amongst cities that were supported under the JNNURM scheme.

The PEARL initiative provides a platform for deliberation and knowledge exchange for Indian cities and towns as well as professionals working in the urban domain. Sharing of good practices is one of the most important means of knowledge exchange and numerous innovative projects are available for reference on the PEARL website. “Knowledge Support for PEARL” is a program supported by Cities Alliance that aims to qualitatively further this initiative. One of its key components is to carry out a thematic and detailed documentation of good practices in various thematic areas related to planning, governance and service delivery.

In an effort to fill the critical knowledge gaps for efficient service delivery in Indian cities, a number of good practices from across the globe have been compiled to address specific issues in the areas of water supply, sanitation, solid waste management, urban mobility, and the incorporation of information & communication technology in service delivery processes. Each volume examines case specific processes, activities and results to garner ways of improving operational efficiency – integrated water management, increasing customer base, corporatization of supply, reducing NRW etc. for efficient *water supply*; waste water treatment programs, pro-poor sanitation policy formulation, reclamation & reuse initiatives and public private partnerships for better *sanitation*; comprehensive waste management strategies, at source reduction and segregation, municipal capacity building, recycling, reuse and resource recovery for effective *solid waste management*; integrated land transport systems, travel demand management, pedestrianisation for EcoMobility and integration of informal systems for enhanced *urban mobility*; and finally e-Government development models; GIS mapping for municipal functions and intelligent service delivery systems using *ICT*.

The compilations assemble good practices from countries like Burkina Faso, Senegal, Ireland, Japan, Cambodia, Bolivia, Brazil, Kenya, Netherlands and Mongolia (Water Supply); South Africa, Denmark, Singapore, Thailand, Indonesia, Pakistan, Uganda, Mauritius, Philippines (Sanitation); Australia, USA, Brazil, Bangladesh, Egypt (Solid Waste Management); Nigeria, Mexico, UK, South Korea, Colombia (Urban Mobility); Germany, China, Peru, UAE (ICT). Cases are examined from the perspective of increasing operational efficiency, enhancing systemic capacity, creating efficient public private partnerships and building long-term sustainability into urban management activities. Priority has been given to cases from developing countries in order to increase adaptability and replicability of key concepts and practices.

Jagan Shah
January 2015

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Firstly, we wish to sincerely thank the Cities Alliance and World Bank whose grant support and knowledge partnership for PEARL has made the documentation possible at a time when urban infrastructure development is one of the main agendas of the Government of India.

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Dr. Debjani Ghosh
Project Coordinator



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INTRODUCTION

URBAN WATER SUPPLY

Water security, or having the right amount and quality of water in the right place at the right time, fosters social and economic progress¹. Adequate, convenient and safe access to water has a positive impact on the citizens' health and productivity, which reflects in the economic growth and enables countries to reach their food security, energy security, and human development goals. On the other hand, scarce or unclear provision of water has implies large health burdens from water-related diseases and exacerbated impacts on poverty.

Apart from the issue of access to water or network coverage, there are other issues which need to be addressed while making provisions for water services. It needs to be considered whether the water supplies are safe, sufficient to meet the per capita water demand, regular (for instance available 24 hours a day and throughout the year), convenient (for instance piped to their home or close by) and available at a price that people can afford.

Despite the world having witnessed unprecedented tech-

nological advances and urbanization in the 20th century, the total number of urban dwellers worldwide lacking improved provision of water at the start of the new millennium was 173 million². To address this, most of the world's governments and international agencies have committed themselves to the Millennium Development Goals which arose from the United Nations Millennium Declaration adopted in September 2000. The most relevant of these for water is the **Millennium Development Goal 7**: Target 10 is to halve, by 2015, the proportion of people without sustainable access to safe drinking water³.

As of 2012, 6335 million people, that is, 89% of the global population, had access to an improved source of drinking water up from 2 billion people or 76% in 1990. This includes household connections, public standpipes, boreholes, protected dug wells, protected springs and rainwater collections. During the decade 2000 to 2010, some 1.3 billion people in developing countries gained access to safe drinking water. However in regions like Sub-Saharan Africa, over 40% of the total population remained without access to improved drinking water⁴. But since it is not yet possible to measure water quality globally, the dimensions of safety, reliability and sustainability are not reflected in this indicator. As a result, it is likely that the number of people using improved water sources is an overestimate of the actual number of people using safe water supplies.

According to the **Census of India 2011**, only 46% households in urban areas have availability of drinking water source within the premises, 42.9% have availability of source near the premises and 22.1% have availability away from the premises⁵.

The United Nations (with the establishment of UN Water), the World Bank (through its Water and Sanitation Program), WaterAid, Global Water Partnership are few of the International organizations that have long been assisting governments across the world in addressing the global water crisis. In July 2010, the United Nations General Assembly recognized the human right to water and sanitation through a resolution. The assembly recognized the right of every human being to have access to sufficient water (between 50 and 100 litres of water per person per



¹ Diego J. Rodriguez, Matthijs Schuring, Nansia Constantinou, Sharing Smart Solutions in Water, The World Bank, 2013

² UN-HABITAT, Water and sanitation in the world's cities: Local action for global goals, Earthscan Publications Ltd: London, 2003

³ Ibid.

⁴ World Health Organization and UNICEF, Progress on drinking water and sanitation - 2014 update, WHO Press, Switzerland, 2014

⁵ Census of India defines 'near the premises' as water source located within 100 meters from the premises and 'away from the premises' as water source located beyond 100 meters from the premises in urban areas

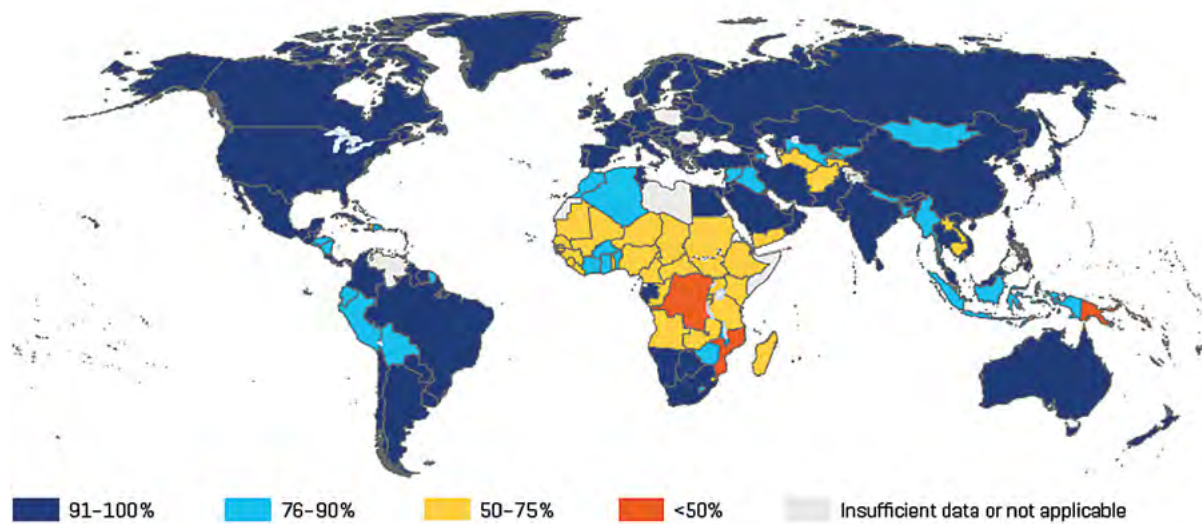
day), which must be safe, acceptable and affordable (water costs should not exceed 3% of household income), and physically accessible (the water source has to be within 1,000 metres of the home and collection time should not exceed 30 minutes)⁶.

To attain water security, governments and water service agencies across the world are undertaking several initiatives to improve access to safe and reliable water sources. The States and international organisations are providing financial resources and helping capacity-building to provide safe, clean, accessible

and affordable drinking water for all. In some countries, water supply is considered as a function of the municipality or the urban local body, whereas in others, a water utility or authority is formed by legislation to carry out water-related functions as an autonomous body.

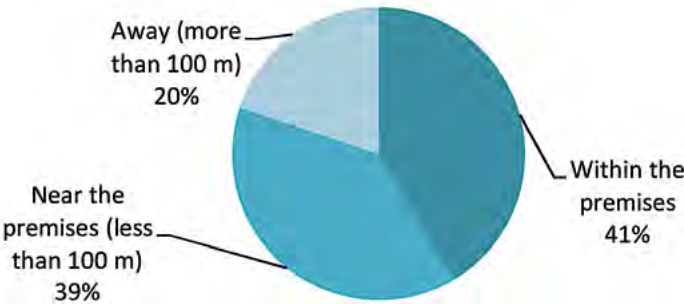
The quality of the institutions and policies through which water services are delivered are crucial to the ability of a given country to provide its citizens enough water to fuel development. Some good practices in water governance, water sector reforms,

MAP SHOWING PROPORTION OF THE POPULATION USING IMPROVED DRINKING WATER SOURCES IN 2012 WORLDWIDE



Source: WHO and UNICEF, Progress on drinking water and sanitation - 2014 update

DISTRIBUTION OF HOUSEHOLDS BY LOCATION OF DRINKING WATER SOURCE IN URBAN INDIA, 2011



Source: Household tables of the Census of India, 2011

⁶ Accessed in September 2014: www.un.org/waterforlifedecade/human_right_to_water.shtml

service delivery and cost recovery from across the world have been profiled here to be replicated in Indian cities.

Key Application Areas

This report is a documentation of case studies that address the challenges in the water sector faced by the cities today, including scarcity of water, management of water resources, high water losses, water for the poor, among others. The initiatives provide a comprehensive guide to cities planning to undertake water sector reforms to improve the utility's performance and enhance the delivery of services. Before replication, the strategies and programs have to be tailored and contextualised specifically to the needs of the city. The key initiatives to improve the water sector in each city have been discussed under the following five thematic areas:

THEME 1 - INTEGRATED WATER MANAGEMENT POLICY:

The case study selected under this theme has illustrated the implementation of an integrated water management by means of a comprehensive policy framework with a focus on conservation and optimum resource utilization.

Singapore - Integrated water resource management: Singapore has adopted an integrated approach to water resource management, enforced by a national water policy and water master plan. The implementation of programs is carried out by a statutory board, Public Utilities Board (PUB), formed for all water-related services.

THEME 2 - WATER UTILITY REFORMS: Under this theme, the two water utilities that have undergone major transformations as a result of undertaking water sector reforms have been selected as case studies.

Phnom Penh, Cambodia - Implementing reforms with good governance: This case is an example of how good governance can transform the performance of a public water utility.

Burkina Faso - Corporate approach to operations: A corporatization approach was adopted by the water utility with the help of a performance-based service contract with an international operator and the government's support through a tariff and investment policy.

THEME 3 - LOSS PREVENTION AND LEAKAGE CONTROL:

The three initiatives chosen under this theme are case studies of methodologies adopted for the prevention of physical as well as commercial loss during water transmission, distribution and metering.

Tokyo, Japan - Physical loss reduction: The initiative involves adoption of continuous technological improvements for reduction of leakage rate from 20% in 1955 to 2.7% in 2010.

Dublin, Ireland - District Metered Areas (DMAs): The project demonstrates the use of a target-cost contract aimed at reducing leakage over a two-year period from 40% to 20% by delineating districts as per the DMA approach.

Sao Paulo, Brazil - Commercial loss reduction: The program is an example of reducing commercial losses by means of a strategy involving replacement of customer meters and the reduction of bad debts.

THEME 4 - PARTNERSHIPS FOR WATER: The theme covers best practices in the provision of water services implemented by means of a partnership between the water utility or the government and other entity, which could be the community, the private sector or an external agency.

Cochabamba, Bolivia - Community participation: An innovative partnership, called as public-private-community partnership (PPCP), was used as an instrument to provide access to affordable water in the peri-urban areas in Cochabamba as an alternate to privatization.

Dakar, Senegal - Private sector participation: This case demonstrates the success of a public-private partnership (PPP) made operational in Dakar, Senegal in 1996 for managing the water system under a 10 year operation and maintenance contract.

Mongolia and Netherlands - Public-public partnership: This case study is a three-year partnership initiated in 2007 between the water authority in Ulaanbaatar, Mongolia and an organization which is a joint venture of two large public water companies in the Netherlands.

THEME 5 - WATER FOR THE POOR: Under this theme, the successful international initiatives undertaken to provide affordable water services to the poor have been discussed.

Kisumu, Kenya - Delegated management model for the informal settlements: The model was adopted in 2004 in Kisumu for the provision of water services to the informal settlements located in the city's peri-urban areas with the help of small scale private water providers.

Indonesia - Pangkalangs for Informal Transport System: This case study demonstrates an alternate water management system, namely condominium networks system, adopted in 1993 to ensure access to water supply in the unconnected neighbourhoods.

THEME 1

INTEGRATED WATER MANAGEMENT POLICY

The effective management of water resources has been a challenge for all developing as well as developed countries, as water remains a scarce resource. Therefore, efficient water resource management and planning accompanied with adequate investment in infrastructure and effective technology are critical in ensuring the long-term sustainability of our water resources. In this context, water policy and governance issues are increasingly taking a centre-stage position for governments around the world with the aim of overcoming the challenges in the water sector. Sound governance and integrated policy making can help create a favourable environment to increase public as well as private sector investments that would facilitate efficient service delivery.

Until the 1980s, the water management policies in most countries traditionally focused on supply-side solutions (e.g. infrastructure, technical solutions, and water harvesting), with little attention given to demand-side issues aimed at encouraging sustainable water use. However, since the 1980s, there has been a shift towards an emphasis of water policy that has moved to meet the diverse economic, environmental, and social demands relative to a scarce water supply while encouraging greater use of market based allocation mechanisms.

India's Water Policy

The Ministry of Water Resources has formulated the National Water Policy to govern the planning and development of water resources and their optimum utilization. The first National Water Policy was adopted in September, 1987, and was reviewed and updated in 2002, and later in 2012⁷.

The major provisions under the policy include the following:

1. It envisages to establish a standardized national information system with a network of data banks and data bases
2. It lays emphasis on resource planning and recycling for maximizing on water availability
3. It gives importance to the impact of projects on human settlements and environment
4. It lays guidelines for the safety of storage dams and other water-related structures
5. It regulates the exploitation of groundwater
6. It sets water allocation priorities in the following order: Drinking water, irrigation, hydropower, navigation, industrial and other uses⁸

In this section, one case study, that of Singapore, has been discussed. The integrated approach to water resource management in Singapore is supported by continuous innovation, technology and R&D. A statutory board, the Public Utilities Board (PUB) has been established to undertake various initiatives and reforms in the water sector. Four national water resources called 'National Water Taps' have been identified and managed by the PUB in a way that the water loop is completed. The PUB has prepared a Water Master Plan to meet the water needs and achieve self-sufficiency in the future. Singapore treats and reuses its waste water (which is referred to as 'used water' in order to recognize its potential for reuse) as part of its conservation and recycling policy.

⁷ Ministry of Water Resources (GoI) website, accessed in September 2014: wrmin.nic.in/

⁸ Ibid.

INTEGRATED WATER MANAGEMENT REFORMS IN SINGAPORE

Location	Singapore
Region	Southeast Asia
Year	1965 onwards
Agency	Public Utilities Board, a statutory board of the Ministry of the Environment and Water Resources under the Government of Singapore
Award	Water Agency of the Year 2006, Stockholm Industry Water Award 2007

Project Aim

To ensure efficient, adequate and sustainable supply of water for all in Singapore, in order to deliver a healthy environment that support the economic activities and a high standard of living.

Context

The small city-state of Singapore has faced the challenges of water scarcity and vulnerability since it gained independence in 1965. Small land mass and limited water storage facilities are the major water challenges in Singapore. Population increase, along with rapid industrial, economic, and social development, has resulted in huge increases in water demand. To meet this burgeoning demand, Singapore has been constantly innovating with new technologies and approaches. Singapore historically has been buying water from its neighbouring country, Malaysia, under two 1961 and 1962 water agreements. The water agreements have been a source of strategic tension between the two countries. This has resulted in water resource management becoming a strategic priority for the government. There has been a clear political intent and wide-spread public support for ensuring national water security and establishing a diversified, clean, safe and sustainable water supply that is sufficient to meet the country's growing demand. Singapore faces five key challenges in water resource management, namely; protecting the water resources, processing safe drinking water in a cost-effective manner, minimizing wastage in the water supply system, water conservation, and closing the water loop.

Project Description

In response to the water challenges, Singapore has adopted an integrated and innovative approach to water management, which, implemented for more than 40 years, has enabled it to attain sustainable and cost-effective water management solutions.

- The strategies adopted for *Adequate and Sustainable Water Supply* include:
 - Managing the weather uncertainties and adaptation to

climate change to ensure water sustainability

- Preparation of a Water Master Plan to meet the water needs for the next 50 years
- The strategy adopted for *Efficient Water Supply* include:
 - Continuous investment in research and development (R&D), technology and innovation to increase efficiency and reduce costs.

Key Results and Impacts

- Through a comprehensive integrated water resource management programme, Singapore has achieved 100% access to safe drinking water as well as basic sanitation for the population.
- With the establishment of the Public Utilities Board as the national water authority, all the water-related activities have been brought under an umbrella, resulting in coordinated efforts in water supply, drainage, sewerage and storm water management.
- On the supply side, the four National Taps provide a resilient 24-hour supply of water and the unaccounted for Water is below 5%, which is one of the lowest in the world. The entire water supply system, from water works to consumers, is 100% metered. Access to water in Singapore is universal, affordable, efficient and of high quality.
- The demand side initiatives have led the per capita domestic water consumption to decrease from 176 litres per day in 1976, to 165 litres per day in 2003, and 153 litres per day today; the target is 140 litres per day for 2030.
- With the holistic approach, Singapore is able to close the water loop and undertake conservation measures to ensure that demand is managed well while increasing supply.

Lessons learnt

- Innovative integrated water management approaches such as the reuse of reclaimed water, the establishment of protected areas in urban rainwater catchments and the use of estuaries as freshwater reservoirs have been introduced along with seawater desalination in order to reduce the country's dependence on water imported from Malaysia.
- Singapore's approach does not rely merely on physical infrastructure, but it lays emphasis on proper legislation and enforcement, water pricing, public education, and R&D.
- The Singapore experience shows that a public sector-owned water utility, with a high degree of autonomy to carry out its role, can be as efficient as a private organization.

Replicability

The importance of context cannot be undermined when evaluating or replicating the success of national water policies. Water policies vary widely as they must be tailored to the specific en-

vironment and circumstances of each country, including the geographical, socio-economic and political context. In India, the issues which need to be considered while framing policies and legislative framework include effective water harvesting, urban flood mitigation, equitable distribution and demand management.

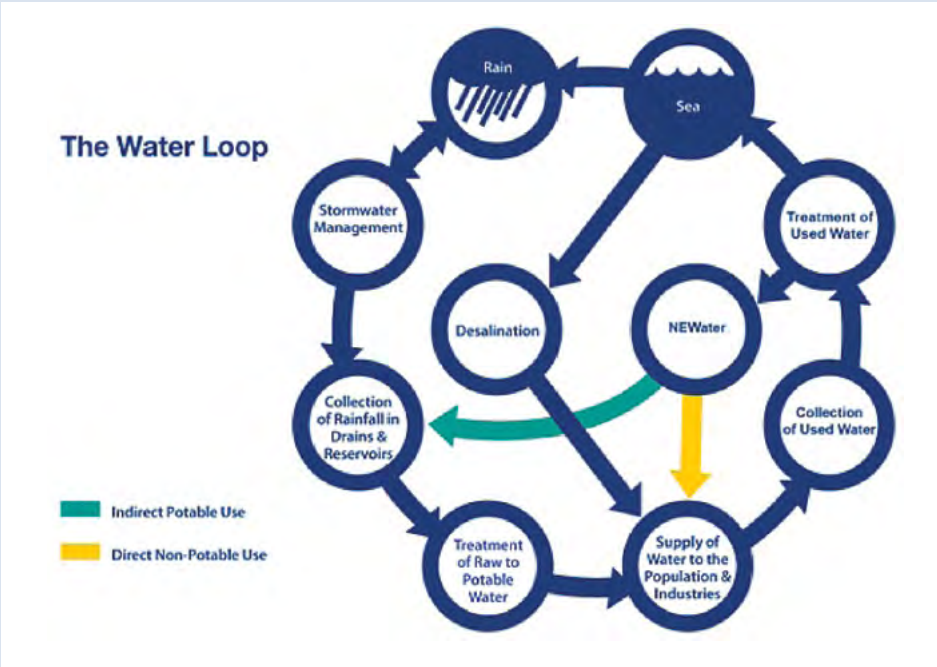
Cities need to adopt an integrated approach to water resource management. Like in the case of Singapore, the cities can benefit from the establishment of a water authority for all water-related functions, including water supply, drainage, sewerage and storm water management. It is essential for the political leadership to prioritize sustainability in water and

Project Implementation

INSTITUTIONAL FRAMEWORK

Within the government of Singapore, the Public Utilities Board (PUB) was formed in 1963, as a statutory board under the Ministry of the Environment and Water Resources, to take charge of provision of drinking water as well as of sanitation and storm water drainage. PUB is Singapore’s national water authority owned by the government, but it adopts a corporate approach in its operations. The Public Utilities Act (Chapter 261) stipulates the responsibilities of PUB. PUB has been afforded a high degree of autonomy in designing policy and spearheading initiatives aimed at providing integrated water management. PUB manages the complete Water Cycle: from sourcing, collection, purification and supply of drinking water, to treatment of used water and turning it into NEWater, sewerage and drainage of storm water. The holistic approach is called ‘closing the loop’.

PUB: this is both a service provider and a regulator, but its regulatory role only encompasses other entities. Water management is closely integrated with land management. PUB works in close collaboration with the Urban Redevelopment Authority (URA), which is Singapore’s national land use planning authority, to prioritize land use planning and zoning that minimize the negative impacts of economic development on the environment. PUB and URA work towards balancing the competing demands between economic development, housing and water catchment, and establishing sustainable clean water catchments in urban areas. The PUB has developed Singapore’s capabilities in water R&D in order to develop new technologies, innovative and large-scale water solutions, and best management practices.



PUB’s approach to closing the water loop

WATER MASTER PLAN TARGETS

Both supply management and demand management are key components of Singapore's water strategy. PUB has developed a Water Master plan to meet the water needs until 2060. The supply side targets in the plan include:

- 90% of Singapore's land area to become water catchment
- NEWater and desalination to meet 50% and 30% of the water needs respectively

The demand side target of the Master Plan is to reduce the domestic water consumption to 145 litres per person per day.

SUPPLY MANAGEMENT

Supply management encompasses an effective legal and regulatory framework catchment management and protection and expansion of water sources.



Water Catchment Map, Singapore

1. FOUR NATIONAL TAPS' STRATEGY

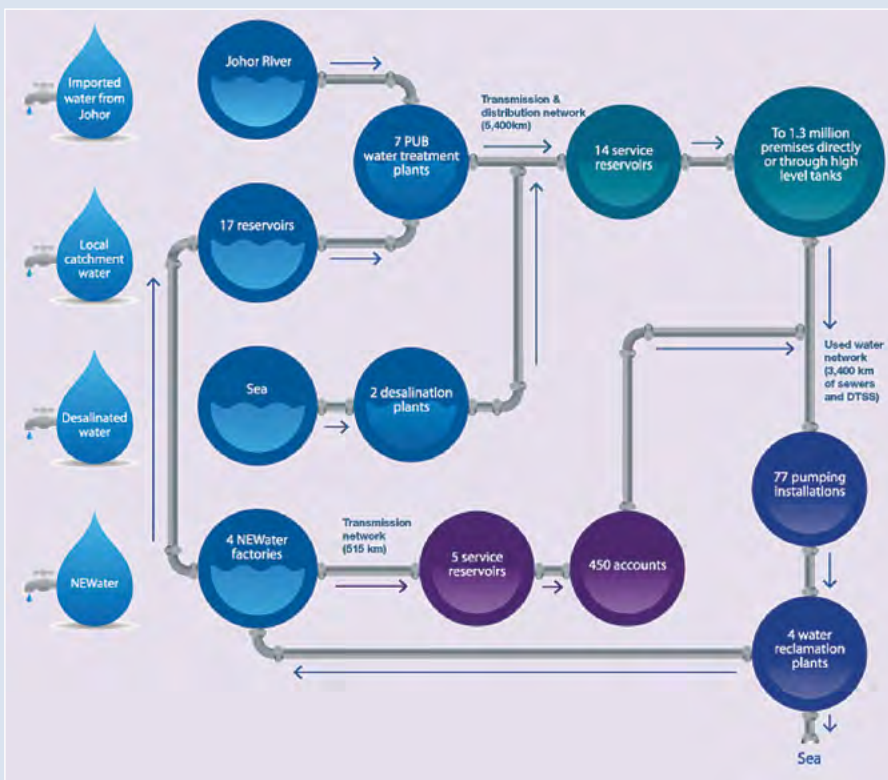
The constraint in supply management is the limited land area to catch and store rainfall, and the absence of natural aquifers and lakes. Singapore addresses this issue by adopting an approach called Four National Taps, i.e., the supply is based on four water sources called 'the four taps':

- **Local catchment:** Singapore is one of the few countries to harvest urban storm water on a large scale for its water supply. Rainwater is collected through a comprehensive network of drains, canals, rivers and storm water collection ponds before it is channelled to the 17 reservoirs for storage. This contributes to approximately 200-300 million gallons per day, depending on rainfall, collected from carefully managed catchment areas.
- **Imported water from Malaysia:** Two water agreements between Malaysia and Singapore were signed in 1961 and 1962, the first of which expired in 2011 and the second of which will expire in 2061. Currently, up to 250 million

gallons (1,100,000 m³) per day is provided. This water enters Singapore via a pipeline at the causeway between Singapore and Johor, Malaysia.

- **Reclaimed water or NEWater:** NEWater is high-grade reclaimed water produced from treated used water that is further purified using advanced membrane technologies and ultra-violet disinfection, making it ultra-clean and safe to drink. The first NEWater plants were opened in 2003, and currently up to 115 million gallons (520,000 m³) per day meets 30% of the demand. PUB plans to triple its production capacity to meet over 50% of the demand by 2060.
- **Seawater desalination:** In 2005, technological advancements and cheaper membrane prices led the PUB to begin desalination to diversify the water sources, with the opening of the SingSpring Desalination Plant. Presently, up to 50 million gallons (230,000 m³) per day of desalinated water is made available, which is only 10% of the demand, due to high costs and energy requirements. By 2060, the PUB plans to expand its desalinated water production ten-fold to meet up to 25% of the water demand.

The four taps strategy aims to reduce reliance on supply from Malaysia by increasing the volume supplied from the three other sources.



PUB's innovative approach, Four National Taps

2. WATER QUALITY AND WATER SERVICE RELIABILITY

Users in Singapore enjoy reliable, 24-hour supply of potable water daily, through-out the year. The water network is designed in loops with alternative feeds to its customers. This ensures that should one feed source become unavailable, another source can be fed into the same network to meet customers' demand. This ensures reliability of the system. It is safe to drink Singapore's water straight from the tap. To ensure that the water supply is clean, water samples are periodically analysed for chemical and bacteria contents at PUB's Water Testing Laboratory.

3. UNACCOUNTED FOR WATER (UFW)

Singapore also increased water supply by cutting down the UFW from 9.5% of total water production in 1990 to 4.4% in 2010. A comprehensive maintenance regime has been set up. Accurate metering has been implemented at drinking water plants before it is distributed, and in customers' premises. Strict guidelines are set to stop water stealing and encourage the public to report water leakage in public premises.

DEMAND MANAGEMENT

The PUB has implemented a comprehensive demand management policy to encourage a change in national behaviour and consumption patterns in relation to the value and usage of water.

1. WATER PRICING

Water pricing has been a central component of demand management, with the aim to dissuade people from believing that water is free and to ensure they use it carefully. The PUB's pricing policy ensures that water is priced to reflect its cost base along the entire production and supply line. The monthly water bill consists of water tariff, water conservation tax, waterborne fee and sanitary appliance fee. Tariffs are set at a level allowing full cost recovery, including capital costs. PUB imposes a progressive 30-45% water conservation tax (WCT) on consumption to encourage water conservation. This tax reflects the cost of supplying water from alternative sources such as NEWater and desalination, as well as costs associated with the on-going R&D activities.

PUB does not artificially lower the price of water across the board as a means to subsidise the poor, so as not to subsidise the rich who can afford to pay for their water consumption. Instead, the government provides direct and targeted financial assistance in the form of Utilities Save (U-Save) rebates to the households living in public housing, as these tend to be the low-income and middle-income households.

2. PUBLIC EDUCATION AND OTHER WATER CONSERVATION PROGRAMS

PUB has implemented various campaigns and programs to educate the public on the need to conserve water and to make it a daily, lifetime habit. The PUB has adopted a three point communication strategy aimed at the public, private sector and government. The strategies are aimed at building a mind-set across stakeholders on the value of water and water conservation. Some such programs include the 'Water-efficient Homes' in 2003 (to promote the installation of water-saving devices), '10-Litre Challenge' in 2006 (to encourage reduction of 10 litres in the daily household water consumption), the '10% Challenge' in 2008 (to encourage non-domestic users to reduce monthly water consumption by at least 10%), and the 'Water Efficiency Labelling Scheme' (for taps, showerheads, toilets and washing machines, so that consumers could make informed choices when making purchases).

3. ABC WATERS PROGRAM, 2006

Singapore has developed a pervasive network of about 8,000km of waterways and 17 reservoirs for its water supply. To realise the full potential of this water infrastructure, PUB launched the Active, Beautiful, and Clean Waters (ABC Waters) Program in 2006. By integrating the drains, canals and reservoirs with the surrounding environment in a holistic way, the ABC Waters Programme aims to create beautiful and clean streams, rivers, and lakes with postcard-pretty community spaces for all to enjoy.

The ABC programme has seen Singapore beautify its canals and simultaneously create urban recreation areas for the public, for example, Singapore's Marina Barrage. Driven by the vision of sparkling rivers with landscaped banks, kayakers paddling leisurely in the streams with clean waterways flowing into the picturesque lakes, Singapore has undertaken the challenge of transforming into a City of Gardens and Water.

4. PRIVATE SECTOR PARTICIPATION

PUB encourages competitive involvement of the private sector in delivering its services. It adopts the 'best sourcing' approach for procurement as part of its 'Price minus' strategy to lower the cost of water supply through open competition. 'Best sourcing' helps PUB enhance production efficiency and improve service quality. PUB outsourced some of its large infrastructure projects through public-private partnerships (PPPs). The Sing Spring Desalination Plant was developed under a design-build-own-operate (DBOO) arrangement with a Singapore company. Similarly, UluPandan and ChangiNEWater plants were built under DBOO agreements with the private sector.

FINANCIAL RESOURCE MANAGEMENT

PUB has performed well in terms of managing its operating revenue and expenses. Investments in assets belonging to the Government of Singapore, comprising used water and drainage infrastructure, are government-funded. Assets belonging to PUB, basically pertaining to water supply, are largely financed by PUB's accumulated surplus. Since 2005, bonds have been issued regularly by PUB to finance part of the investment program, including a US 300 million bond with a maturity of 20 years in 2007. PUB has also achieved close to 100% bill collection efficiency.

sanitation as a policy issue. The water policy should follow the polluter pays principle instead of giving incentives for effluent treatment. Setting the price of water at a level that recovers costs,

while at the same time keeping it affordable for the low and middle income groups is a good practice that can be adopted by Indian cities.

THEME 2

WATER UTILITY REFORMS

Public sector water utilities suffer from inefficiencies in operations which lead to jeopardizing the quality and reliability of service delivery to the users. Therefore, water utility reform and regulation is of utmost importance to make the utilities accountable to the public and improve services. Well-functioning public utilities throughout the world indicate that a corporate approach to water supply—but not necessarily private ownership—is essential for reliable, efficient and equitable operations. Such an approach can help ensure the financial sustainability of water systems and protect the long-term value of water resources. It can also open doors to external expertise and finance from the private sector.

In this section, two water utilities have been profiled as case studies, that is, the Phnom Penh Water Supply Authority (PPWSA) in Phnom Penh, Cambodia and Office National de l'Eau et de l'Assainissement (ONEA), the water utility in Burkina Faso. Under strong leadership and political will, the PPWSA began a drastic reform process in 1993 and transformed itself from a nearly bankrupt organization into efficiently functioning and financially sustainable institution. Similarly, the case of ONEA demonstrates how adopting a corporate approach can lead to the transformation of an inefficient public enterprise into a well-performing public water utility in a poor developing country.

GOOD GOVERNANCE OF THE PUBLIC WATER AUTHORITY IN PHNOM PENH

Location	Phnom Penh, Cambodia
Region	Southeast Asia
Year	1993 onwards
Agency	Phnom Penh Water Supply Authority (PPWSA)
Award	Stockholm Industry Water Award 2010; Ramon Magsaysay Award for Government Service 2006

Project Aim

To transform the water authority from a nearly bankrupt, demoralized and corrupt institution, into a viable, efficiently functioning and financially sustainable institution for improved service delivery.

Context

The Phnom Penh Water Supply Authority (PPWSA) is the water utility that serves Cambodia's capital city, Phnom Penh, and its surrounding areas. During the 1970s and the 1980s, the political and social turmoil in Cambodia took its toll on all the development sectors, including urban water management. By the early 1990s, after years of centralized management, PPWSA as an institution and its overall management were dysfunctional, and as a result, consumers received very low level of service delivery. In 1992, PPWSA provided poor-quality piped water at very low pressure for only 10 hours per day to only 20% of the city's residents. Non-revenue water was extremely high at 72% due to illegal connections, manipulation of bills and physical leakage. Tariffs were extremely low, there was no metering and less than

half of the amounts billed were collected. Staff were underpaid and demoralized; it had only five engineers, and most of its staff members were incapable even of reading meters accurately. Production capacity had fallen from 155,000 litres per day in the 1960's to 65,000 litres per day in the early 1990's.

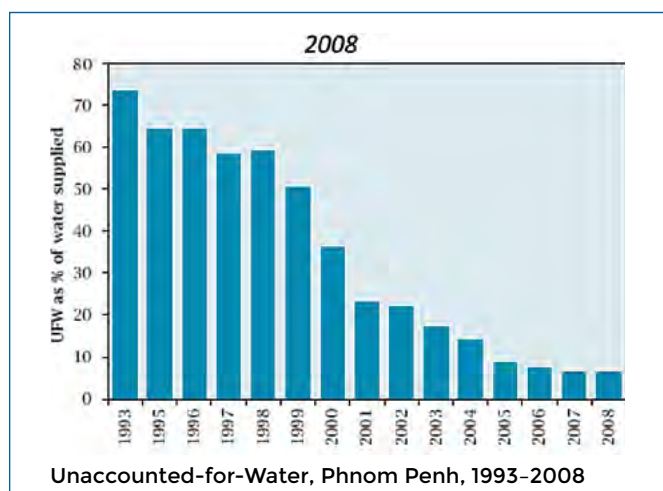
Project Description

The institution underwent a dramatic turnaround from 1993. Staff members engaged in corrupt activities were fired, bill payment was enforced, illegal connections were regularized, metering was introduced and the utility gained autonomy from the municipality in financial and personnel matters. In the next fourteen years the customer base multiplied by nine reaching over 90% of residents, service quality improved from intermittent to continuous supply of safe drinking water at good pressure, and non-revenue water was cut down. Tariffs were increased and the utility went from being bankrupt to making a modest profit. It now has enlightened management, and dedicated and competent staff. Other than good governance, leadership and transparency, significant financial support from external donors, initially through grants and then through soft loans, was also essential in making the turnaround possible. Assistance was provided by the Government of France, the UNDP and the Government of Japan. The Water Development Plan was prepared for the city, to serve as the blueprint for the development of the utility. All the projects and financing had to fit in the framework of the plan.

Project Implementation

In 1993, Mr. EkSonn Chan, appointed as General Director of the PPWSA, refurbished the whole water supply system, improved its management and operating efficiency, as well as introduced cost-effective billing and payment collection methods

TRANSFORMATION OF THE PHNOM PENH WATER SUPPLY AUTHORITY (PPWSA)



UNACCOUNTED FOR WATER (UFW)

A major problem in 1993 was the substantial losses due to UFW, which was over 70%. This was the result of poor quality of staff in PPWSA during the early 1990s. The staff members were demoralized with poor governance, below subsistence pay, lack of discipline, absence of incentives, and pervasive corruption. Therefore, the work culture had to be radically changed by enforcing strict disciplines in a sensitive, fair, and transparent manner. Changing the institutional culture started with the senior officers, who then became the role models. UFW reduction was made possible by having dedicated, competent, and motivated staff in PPWSA.

WATER PRICING AND COST RECOVERY

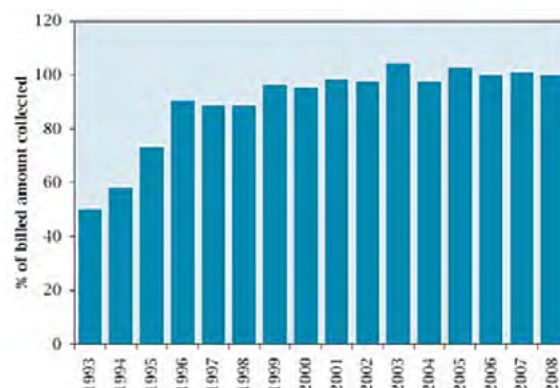
In order to achieve financial self-sufficiency, PPWSA was established as an autonomous public utility, under the Decree No. 52 of 1996, operating as a business-like institution with no political interference, having its own separate financial system. This allowed the utility to retain any revenues in excess of operating costs to improve services, also allowed it to recruit its own staff. The PPWSA decided to maximize its income by:

- reducing UFW significantly so that much of the water produced can be sold to the consumers
- fixing a tariff structure and implementing it fully with a social conscience
- preparing and continually updating a roster of customers on a reliable basis
- restructuring the billing system so that the bills can be produced and delivered on time
- improving the bill collection ratio with incentives, and with disincentives of late or no payment
- increasing the annual profits of by becoming increasingly efficient on a progressive basis

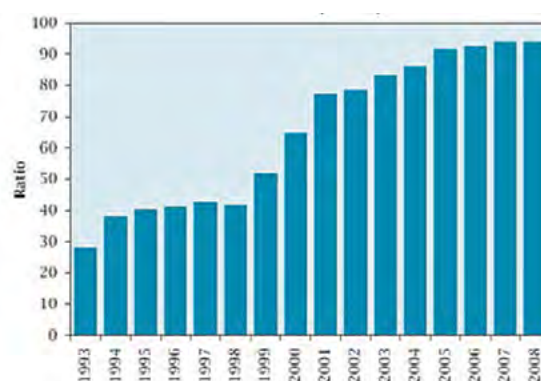
The PPWSA managed to increase the tariff of water without generating any social and political unrest. This was made possible by first providing improved quality of reliable service and conducting a socio-economic survey with respect to the water supply situation. In accordance with the National Water Policy, the tariff was calculated to cover the total expenses of the PPWSA, including operation and maintenance costs, and the depreciation of its assets. Having witnessed significant improvements in the service delivery, the consumers paid for the improved service, as they considered the increase to be very reasonable. This included the poor whose bills declined by 60- 80% of what they had been paying to private water vendors.

By 1995, 24-hour uninterrupted service was available in Phnom Penh. By 2005, with significant reduction in UFW,

over 90% of the water produced was billed, as compared to less than 30% in 1993. The bill collection also doubled from that in 1993, being close to 100% since 1999.



Billing Ratio: Quantity Billed/Total Production, 1993-2008 (in %)



Bill Collection Ratio: Amount Collected/Amount Billed, 1993-2008 (in %)

ACCURATE DATA ON WATER CONSUMERS

Without an accurate database of the consumers, it is not possible to collect revenue from the water users. In addition, this database needs to be kept updated, which means keeping relevant information on the people who move into the city, people who move house but within the city, and also people who leave the city. Such a list is always dynamic, and needs to be continually updated to ensure correct and appropriate billing.

In order to establish a proper database, in 1994 nearly 100 PPWSA members visited all of the houses in the city, over a period of one year, to record their access to water. The survey found that 12,980 households that were ostensibly connected to the system were actually not. They were being billed for water, and many were paying the bills without receiving any water. In contrast, there were 13,901 customers who were connected and receiving water, but were not being billed.

With a grant from the French government, the PPWSA established a fully computerized updated database, which became fully operational in 1996. A benefit of this automated system has also been the elimination of corruption and abuse of power.

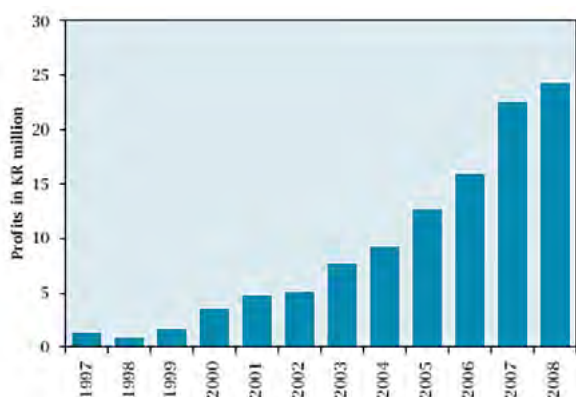
METERING

In order to ensure a transparent and fair system, and bill the consumers correctly, each connection needed to be metered, so as to measure the accurate water consumption. In 1993, only 3,391 connections (12.6%) out of a total of 26,881 were metered. More than 87% of the connections received an estimated bill, which often had no linkage to the quantity of water that was actually consumed. With a policy decision to move to a system of all metered connections, the number of meters installed increased steadily. By 2001, all the connections were metered. In addition, over time more accurate Class C meters replaced less reliable Class B meters, which further increased the income of the PPWSA.

WATER FOR THE ABSOLUTE POOR

The issue of providing clean water to the poor could not be considered prior to 1994 as there was a lack of reliable water services available. Hence, the primary focus and concern of the PPWSA at this initial stage was the rehabilitation of the water system in order to establish a supply system which could then be distributed to the people. Once the supply was restored to a reasonable level, the issue about affordable water for the poor was addressed.

At present, grants from the International Development Association (IDA) and the city of Paris, have enabled the PPWSA to provide subsidies of 30%, 50%, 70% or 100% on the connection fee to the poor households, depending upon their financial conditions. These conditions are jointly evaluated by a committee of the PPWSA with direct help from the local communities. This policy has helped the poor households to save 130,000 to 380,000 riels each year. The number of poor households that has been connected to the system has steadily increased.



Net Profits of Phnom Penh Water Supply Authority, 1997-2008

FINANCIAL SUSTAINABILITY

The amounts billed and amounts collected became almost the same after 2000. This means that the net profit of the Authority has progressively increased every year since 1998. It is the only publicly managed water utility in the developing world which has consistently increased its net profit since 1993.

Indicators	1993 (Before Reform)	2006 (After Reform)
Coverage area	25%	90%
Total connections	26,881	147,000
Metered coverage	13%	100%
Supply Duration	10 hours/day	24 hours/day
Production Capacity	65,000 m3/day	235,000 m3/day
Non-Revenue Water	72%	6%
Total revenue	0.7 billion riels	34 billion riels
Financial situation	Heavy subsidy	Full cost recovery
Staff/1000 connections	22	4

to achieve financial self-sufficiency and increase the net annual profit.

Key Results and Impacts

- Between 1993 and 2008, PPWSA increased its annual water production by 437%, distribution network by 557%, pressure of the system by 1260% and customer base by 662%.
- During the same period, PPWSA reduced UFW losses from 72% of treated water produced in 1993 to only 6.19% in 2008.
- The number of metered connections went up by nearly 5255%, and the users can now drink water straight from the tap. Almost everyone has access to water 24 hours a day.
- Illegal connections were rampant in 1993 with more than 300 cases per year reported. In 2004, this was down to only five cases reported a year.

- In 1993, the ratio of the PPWSA's staff per 1,000 connections used to be 22:1000, but by 2004 this improved to 4:1000. Of its 536 full time staff, 78% are assigned in water supply with the rest in corporate services.

Lessons learnt

- The PPWSA has shown that, with a supportive governance framework, it is possible to reform a public sector utility to implement a management approach similar to that of a private sector company, and make profits with affordable tariffs and timely supply of water.
- The success of PPWSA is a result of factors including a vision and leadership to push through a culture of change, sufficient autonomy to be able to implement reforms as well as donor backing and shared objectives between the various stakeholders.
- Mitigating the financial, social and political risks was made possible by addressing different aspects such as annual reviews of tariffs, a programme to finance the cost of connections for the poor and allowing for flexibility in policy formulation and institutional proposal.
- Community participation, information sharing, transparency and accountability were as instrumental in the implementation of the reforms as the non-interference from political entities, and the leadership, professionalism, integrity and commitment in the team.

Replicability

Public water utilities in many Indian cities perform below their potential, resulting in poor service delivery. Various reasons, including the physical scarcity of water, lack of funds, low paying capacity of the poor, lack of expertise, etc., are given by the water utility managers, political leaders, and members of the water profession as to why it has not been possible to provide clean, drinkable water to the urban centres. But the case of Phnom Penh illustrates that the fundamental reason for low performance of the utilities is poor leadership and governance.

The PPWSA has demonstrated how reforms can be achieved under the most difficult circumstances, and in less than ten years. Undertaking drastic governance and institutional reforms in the water utility can lead to the provision of clean and reliable drinking water supply, and improved service delivery. Autonomy to the water utility and a management approach similar to that of a private sector company based on results and incentives is crucial to the implementation of the reforms. Cost recovery, of capital and operating costs, and water tariffs play an important role making the water utility financially self-sufficient. The process of community participation and an analysis of the socio-economic conditions of the users need to precede revision in the water tariff in order to avoid unrest in the city.

CORPORATIZATION OF THE WATER UTILITY IN BURKINA FASO

Location	Burkina Faso
Region	West Africa
Year	1994-2006
Agency	Office National de l'Eau et de l'Assainissement (ONEA)

Project Aim

To transform the state-owned utility from an inefficient public enterprise into a well-performing public water utility in a poor developing country, with the goal of improving access.

Context

In Burkina Faso, the provision of urban water supply services is the responsibility of a state-owned utility, Office National de l'Eau et de l'Assainissement (ONEA). Until two decades after independence in 1960, water services had been provided by a private operator, which focused on a few rich neighbourhoods of the capital, Ouagadougou. The contract was terminated in

1977, and responsibility for water services was transferred to municipalities until 1985, when ONEA was established as the new national water utility. Its early performance was poor and by the early 1990s the sector had made little progress. More than a third of the urban population had no access to piped water, and urban household connection coverage was only 24%. Service delivery was poor and ONEA was unable to cope with the growing demand that came with urbanisation.

Project Description

A corporatization process spanning two decades since then has led to Burkina Faso's national water and sanitation utility ranking among the few well-managed public water utilities in Sub-Saharan Africa. The government has been committed to reform, which included the successful implementation of an innovative performance-based service contract with an international operator from 2001 to 2006. The governance framework ensures the autonomy and accountability of the service provider and the government supports the sector's long-term financial viability through an appropriate tariff and investment policy.

Project Implementation

CORPORATIZATION IN THE 1990s

In 1994 ONEA was transformed from a quasi-public agency with little autonomy into a limited liability company, 100% owned by the government and essentially governed by private law. An arm's-length relationship was established between ONEA's management and the government, supported by three-year performance contracts (Contracts plans) with explicit operational targets. The board of directors was responsible for the supervision of ONEA's performance and for all strategic decisions, including hiring of staff and their pay scales. The general manager was made responsible for the day-to-day operational decisions. Also, the utility was allowed to cut off service for non-payment of water bills, and its workers subject to private sector (not civil service) rules.

The first decade of corporatization was a success with improved overall performance. By 2001, ONEA's, the water losses, or nonrevenue water, stood at a low 16%. Water rationing was limited, with service averaging 21 hours a day nationwide. The high average tariff (close to €1 per cubic meter), resulted in ONEA becoming cash positive and reporting an accounting profit every year.

CHALLENGES AND INITIATIVES IN THE 2000s

Despite these achievements, ONEA remained a small utility, essentially devoted to serving the richest part of the urban population. Urban water coverage through household connections stood at a mere 32%. Rather than financing further expansion of access, the high tariffs were actually compensating for significant operational inefficiencies: only 85% of residential water bills were collected, and with about 8 staff per thousand connections, labour productivity was mediocre.

Solving the production constraint required the construction of a major dam together with a treatment plant with a capacity of 65,000 cubic meters a day and a 50-kilometer transmission line. This would be a very costly investment, and given the already high tariffs, financing it through additional tariff hikes was out of the question. To make the project financially viable without major tariff increases, ONEA had made significant gains in operational efficiency (especially in labour productivity and bill collection) while doubling its customer base over six years.

A PERFORMANCE-BASED SERVICE CONTRACT

While the donors were willing to finance the investment program, the government was unwilling to delegate management of the utility to a foreign private operator. However, it recognized that there was a gap in the know-how and that it could benefit from outside professional help. The technical assistance approach, involving a service contract, was rejected given the past experiences in the region. In most cases such arrangements had little impact on the operation, because the contracted firm had little at stake.

With the assistance from the World Bank, an innovative performance-based service contract was designed. A professional operator would be contracted to manage ONEA's commercial and finance departments while at the same time completing a series of pre-identified tasks (including setting up new accounting and customer management systems). The operator would be paid a fixed monthly fee for management services along with a bonus or penalty based on achievement of the contractual targets, along with a fixed price for each specified output. Progress against contractual targets was regularly monitored by an independent consultant so as to calculate the variable remuneration. This created a strong incentive for the professional operator to improve performance. Another feature of the contract was an operating investment fund (about \$3 million) to provide the private operator with the flexibility to rapidly acquire equipment and meters.

REFORMS PROCESS TILL 2006

Following an international tender, a private consortium led by the French private operator Veolia was contracted. During the five years of the contract, 2001-2006, ONEA continued to operate as a publicly managed utility. The private consortium sent two permanent staff members, to serve as deputies to local managers of the commercial and finance departments. Many other foreign staff members were sent on short-term missions as advisers. Thus the international operator had mostly an advisory role. Yet because of the performance-based nature of the contract, it also had a clear financial stake in the success of the technical assistance provided.

Under the guidance of the international staff, who had years of hands-on operational experience, the performance of the ONEA improved in line with the objectives of the contract. Bill collection for residential customers increased substantially, and the collection ratio improved to 95% in the fifth year. The international operator put in place new working practices to improve meter reading, established a meter repair workshop, advised on improving customer service, coached ONEA staff in updating the customer cadastre and identifying illegal customers. It helped reorganize work practices to increase labour productivity to 5 staff per thousand connections by 2006. The contract was supported by an investment program of about €200 million financed by a pool of donors (including the European Investment Bank, Agence Française de Développement, KfW, and the African Development Bank).



Inauguration of the Ziga water treatment plant, 2004

Key Results and Impacts

- The increase in water production capacity led to the expansion of the distribution network in Ouagadougou. The total length of the network and the number of household connections almost doubled between 2001 and 2006.
- The number of household connections reached more than 125,000 by 2006, and some 280 additional standpipes were installed in poor neighbourhoods. More than 600,000 people gained access to piped water over five years.
- Improvements in the customer cadastre and meter reading led to the nonrevenue water remaining broadly stable as a percentage of total water distributed.

- The financial situation of ONEA improved markedly, with the revenues increasing by 50%. Efficiency gains, especially in bill collection and labour productivity, were passed on to customers through a gradual decrease in average tariffs in real terms of about 8%.

Lessons learnt

- The government rejected the World Bank's approach to have the private sector play a significant role in providing water services in Burkina Faso in the 1990s. Instead, it adopted the approach to integrate certain principles of market-oriented sector reforms into its own policies. This resulted in an

COVERAGE AND OPERATIONAL PERFORMANCE OF ONEA DURING THE CONTRACT PERIOD (2001-06) AND IN 2008

Indicator	2001	2002	2003	2004	2005	2006	2008
Household connections	72,500	78,500	84,000	90,000	100,000	125,500	168,000
Connection coverage (%)	32	33	33	34	36	43	50
Improved coverage (%)	53	54	54	54	56	63	73
Estimated population served (millions)	1.2	1.3	1.4	1.5	1.6	1.8	2.4
Nonrevenue water (%)	16	14	15	17	18	18	17
Collection ratio (%)	85	83	78	88	93	95	95.4
Labor productivity (staff per 1,000 connections)	7.9	7.2	7.1	7.2	6.4	5.0	4.5

Source: ONEA

Note: Connection coverage is the share of the urban population with access to water through a household connection.

Improved coverage is the share of the urban population with access to water through a household connection or a standpipe.

increase in the performance of the public utility.

- The case illustrates that the public water utilities can perform well, even in poor countries like Burkina Faso, if the governments refrain from interfering in the utility's operations, keep the management accountable, and ensure that the tariffs are enough to recover costs.
- The private sector can contribute effectively with a contextual performance-based contract, having realistic contractual targets and an incentive bonus based on objective criterion.
- The quality of human resources is vital in improving the performance of the utility. Competent and dedicated professionals were appointed by the government as ONEA staff and were paid higher average salary than typical civil servants to build work ethic in the utility.
- Also, since the international staffs were not in direct management positions, this contributed to a strong sense of ownership and accountability by the ONEA staff.

Replicability

In India, most of the public-owned urban water and sanitation utilities are in a dismal state, performing below their potential and resulting in the widening of the gap between demand and supply. In this context, the case of transformation of ONEA in Burkina Faso shows that corporatization of the water utility, i.e., increasing cost recovery and improving the efficiency of service provision have been important elements in the turnaround of the utility. Corporatization, which requires autonomy for a water utility from political interference and operational arrangements like that of a business entity (comprising transparent management, reward for employees to perform, and internal control systems in the form of audits), is a critical element that can lead to the water utilities delivering better public services. In India, the water utility reforms can be brought about by competent operational management, sustained commitment from the government, financial support from donors, and an innovative partnership with the private sector.

THEME 3

LOSS PREVENTION AND LEAKAGE CONTROL

Non-revenue water (NRW) or unaccounted for water is the difference between the volume of water put into a water distribution system and the volume that is billed to customers⁹. NRW comprises the following three components:

- **Physical losses** comprise leakage from all parts of the water supply system caused by poor operations and maintenance, lack of active leakage control, and poor quality of assets.
- **Commercial losses** are caused by customer meter under registration, data-handling errors, and theft of water in various forms.
- **Unbilled authorized consumption** includes water used by the utility for operational purposes, water used for fire fighting, and water provided for free to certain consumer groups¹⁰.

It is estimated that the total worldwide cost of NRW is \$14 billion annually, capable of serving 200 million people¹¹. Indian cities

suffer from high non-revenue water or unaccounted for water losses which fall under all the three above stated categories. In the case of Delhi, for instance, NRW losses are estimated at around 42%, which includes 16% lost in transmission and 24% lost in distribution¹².

In this section, three case studies have been discussed. The first of these is Tokyo city for its achievements in physical loss reduction since it has made considerable progress in reducing its NRW to as low as 2.7% in 2010 though continuous technological improvements. The second case study is that of District Metered Areas (DMAs) in Dublin, Ireland, where a target-cost contract was used as an instrument with the aim of reducing leakage over a two-year period from 40% to 20%. The third case study is that of commercial loss reduction in Sao Paulo, Brazil, where a two-fold approach is adopted focusing at the replacement of customer meters and the reduction of bad debts to achieve overall reduction in the commercial loss incurred by the water utility.

⁹ Bill Kingdom, Roland Liemberger, Philippe Marin, The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries, The World Bank, Washington DC, 2006

¹⁰ Ibid.

¹¹ Ibid.

¹² IL&FS Ecosmart Limited, City Development Plan: Delhi, Department of Urban Development, Government of Delhi, 2006

WATER LEAKAGE PREVENTION CONTROLS IN TOKYO

Location	Tokyo, Japan
Region	Asia
Year	1955 onwards
Agency	Tokyo's Bureau of Waterworks, Tokyo Metropolitan Government

Project Aim

To make the best use of the limited water resources by conducting prevention and early repair of water leakages from the distribution system.

Context

Tokyo's water supply serves about 5 million m³ of water every day to 12 million citizens in Tokyo. The water is supplied by four rivers Tone, Ara, Tama and Sagami, which flow into the Metropolitan area. The treated river water is then pressurized and supplied to customers as tap water through underground pipelines. As of Fiscal Year (FY) 2010, there were over 26,000 kilometres (16,155 miles) of distribution pipes under the Tokyo metropolitan area. Water pipes laid underground are constantly exposed to the danger of leakage, and the leakage can cause secondary disasters such as poor water flow, road collapse, and flooding of the buildings and inundation. Most leakage is caused by:

- 97%, due to cracked or corroded pipes
- 3%, due to ageing of distribution pipes

It has become increasingly important to prevent water leakage to ensure maximum utilization of limited water resources. The value of leakage prevention has been recognised as equivalent to new water resource development.

Project Description

Tokyo's Bureau of Waterworks has developed efficient systems in the field of detection and control of water leakage technology. Control of water leakage is one of the most critical aspects of Tokyo's system. Compared with other large cities, Tokyo has maintained an extremely low rate of water leakage from its vast network of underground pipes. In addition to routine checks and repairs, renewal of aged pipes and replacement of lead feeder pipes with stainless steel pipes are a major priority. This has succeeded in reducing vast amounts of water leakage over the past 50 years. The Bureau has adopted 'same-day-repair work' approach, i.e., leakages are repaired on the same day that they are reported. Efforts are made to carry out early detection for leaks and the Bureau regularly replaces pipes and improves pipe materials (i.e. from cast iron to ductile cast iron for distribution pipes).

PHYSICAL LOSS PREVENTION

The reduction in NRW is among the key imperatives for water utilities, as expanding water networks without addressing water losses will only lead to a cycle of waste and inefficiency. Much of the water lost is from leaking water mains, service line pipes and connections, and pipe breaks; a considerable amount of which can be prevented with a leak detection program. An effective leakage control program is an important part of water supply management. Numerous leak-detection technologies and approaches are available in the world today. Some Indian cities are even moving towards adopting some of these technologies. An example of this is the Helium gas-based leak detection pilot in Pimpri-Chinchwad. Another example is that of Surat city where the Surat Municipal Corporation (SMC) has set up a NRW cell as an institutional response to the issue.

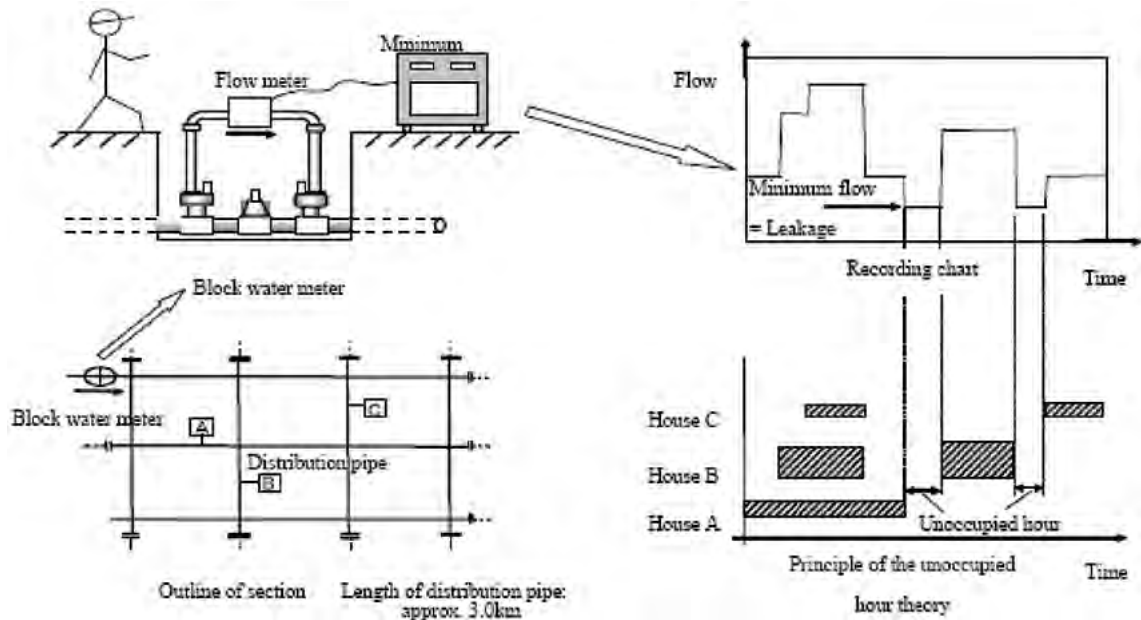
Project Implementation

The measures undertaken for leakage prevention include:

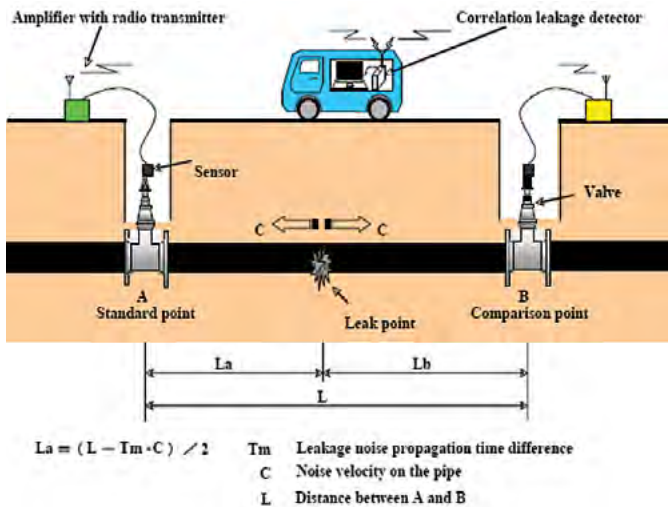
- **Underground leakage:** Leaks are detected by using electronic leak detectors. The potential leakage quantity is estimated by using night flow measurement tools.
- **Replacement of pipes and improvement of pipe materials:** From cast iron to ductile cast iron for distribution pipes, as these have higher strength and better earthquake resistance; and from lead to stainless steel for service pipes laid under public roads.
- **The K-Zero project** (K stands for Keinenkan in Japanese which means 'aged pipes') has been in place since 2002. The project was launched to completely replace existing aged large-diameter pipes (400 mm or over) with new pipes. As of today, 99% of the old pipes have been replaced.
- **Monitoring of service pipes** - These account for 97% of the total number of leakage repairs so early prevention of leakages is essential.
- **Training and Technical Development Centre:** This centre was newly established in 2005, and has been contributing to leakage prevention through research and development.
- **Computerized system:** This calculates and gathers whole information on leakages using the computers like the causes, details of each repair work, the cost for repairs.

Some of the following methods are being used for leak investigation in Tokyo:

1. **Minimum night flow measurement** is a leak investigation method that has been developed to carry out works in the



Theory of minimum night flow measurement method



Minimum flow meter

Theory of the correlation method

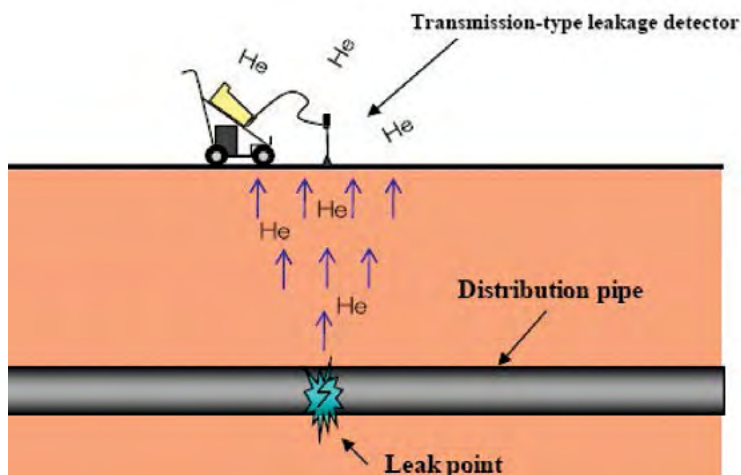
midnight idle time (unoccupied hours) of water usage in a certain block.

First, the gate valves surrounding the block to be investigated are closed and the water from other blocks is shut down. Then the water is sent into the block through minimum flow measuring equipment set in the block water meter and the flow rate is measured. The minimum flow rate measured during the vacant period is considered to be the water leakage.

2. **Correlation method:** In the correlation method, the position of leakage is detected by using a correlation type leakage detector (a combination of correlation analyser, sensor,



Correlation type leakage detector



Transmission-type leakage detector

amplifier, wireless transmitter, etc.). Correlation method has a benefit that enables investigation regardless of noise of cities and depth of pipes buried.

3. **Transmission-type leakage detector** is the equipment used to detect leakage in a pipe. Chemically inert helium gas mixed with water or air is injected into the pipe and the detector is used to detect the helium gas leaked from the pipe and seeped through the ground.

Energy Saving System

The City's Water Supply Operation Centre manages all data relating to water supply through a computerized system which monitors and controls activities 24 hours a day, 7 days a week. This ensures that water supply is stable from the purification plants and water supply stations. The system contributes to the efficient management of both water supply and pump operation.

Water-saving equipment

The City requests the manufactures to develop and supply water saving equipment including, taps, tap plugs, toilets, and washing machines. These are being fitted wherever possible throughout the system. Water-saving plugs were also developed and distributed to customers for free.

Key Results and Impacts

- The measures undertaken have succeeded in reducing water losses over the past 50 years:
 - 1945 - Leakage rate 80%
 - 1955- Leakage rate 20%
 - 1960 - Adoption of a ductile iron pipe to a distribution pipe
 - 1980 - Adoption of a stainless steel pipe to a service pipe
 - 1992 - Leakage rate 10.2%
 - 2007- Leakage rate 3.3%
 - 2008- Leakage rate 3.1%
 - 2009- Leakage rate 3.0%
 - 2010- Leakage rate 2.7%
- Tokyo's focus on same-day repair work has helped to



Inspectors using the transmission-type leakage detector

drastically reduce the leakage rate, from 20% in 1955 to approximately 3.0% in 2010.

- The method of detecting and repairing leaks has halved the amount of water wasted by the city in the past ten years from 150 million m³ to 68 million m³.
- In the mid-1980s, there were about 58,000 cases of leakage repairs. In 2008, reports of leakages dropped to about 15,000 cases and have been decreasing since.
- CO₂ reductions: The amount of CO₂ emissions reduced by reduction of leakage rate is about 67,100 tons of CO₂ (equal to the amount of carbon dioxide emitted by about 61,600 cars).
- Energy efficiency: The amount of electricity converted from the volume of water prevented from being wasted (with respect to the amount wasted in 1956) was 164MkWh in 2010.
- Financial savings: The electricity charges saved by diminution of leakage rate (with respect to the amount of the wasted in 1956) is about ¥2.4 billion yen (\$23.6 million USD) in 2010. The cost for implementing leakage control is about ¥7.2 billion yen (60.3M USD) annually, and the expense prevented by leakage control is about ¥20.6 billion yen (172.4M USD).

Replicability

Tokyo's measures to control leakage can be adapted to other cities and can play a major role in utilizing the limited water resources and curtailing the associated CO₂ emissions. Tokyo's model for water leakage control can be applied to Indian metropolitan cities which have sufficient budgetary allocation for the water sector or can arrange alternate sources of investment to provide for the capital costs required. In the long run, the model can become financially sustainable by making energy savings as it has been proved in the case of Tokyo. Electronic leak detectors can be used to detect leaks in the distribution network. This can enable the early prevention of leaks. The same-day-repair approach can be replicated by the water utilities to reduce the water leakages and computerized system for monitoring of pipes can further increase the efficiency.

NRW REDUCTION WITH A PERFORMANCE-BASED CONTRACT IN DUBLIN

Location	Dublin, Ireland
Region	Europe
Year	1997
Agency	Dublin City Council

Project Aim

To reduce leakage over a two-year period from 40% to 20% (in volumetric terms, from 175,000 to 87,000 cubic meters per day).

Context

In 1994, the City of Dublin had to deal with a severe water shortage. This was caused by decades of underinvestment in the distribution network, combined with the absence of systematic active leakage control, which had allowed physical water losses to reach very high levels. The first reaction was to ask for funds to build new treatment plants and expand existing ones. However, funding was not made available because of the high level of leakage. A comprehensive study identified that the volume of water leaking away from the distribution network every day was approximately 175 million litres of water, more than 40% of the existing treatment capacity.

Project Description

In 1997, the 'Dublin Region Water Conservation Project' (DRWCP) was started with a focus on reducing physical water losses from the distribution system in the city, and it was co-financed by the European Commission. With the set target of 'reducing leakage over a two-year period from 40 to 20%', an experienced water-loss-reduction contractor was engaged in the project.

The Conservation Project was led by Dublin City Council, which and along with Wicklow, Dun Laoghaire/Rathdown, South Dublin, Fingal and Kildare County Councils, put in place a network of water meters and telemetry to track the distribution of water throughout the Dublin Region. In 1996, eight consortia were invited to submit bids for the two year contract, which focused on specified physical loss reduction.

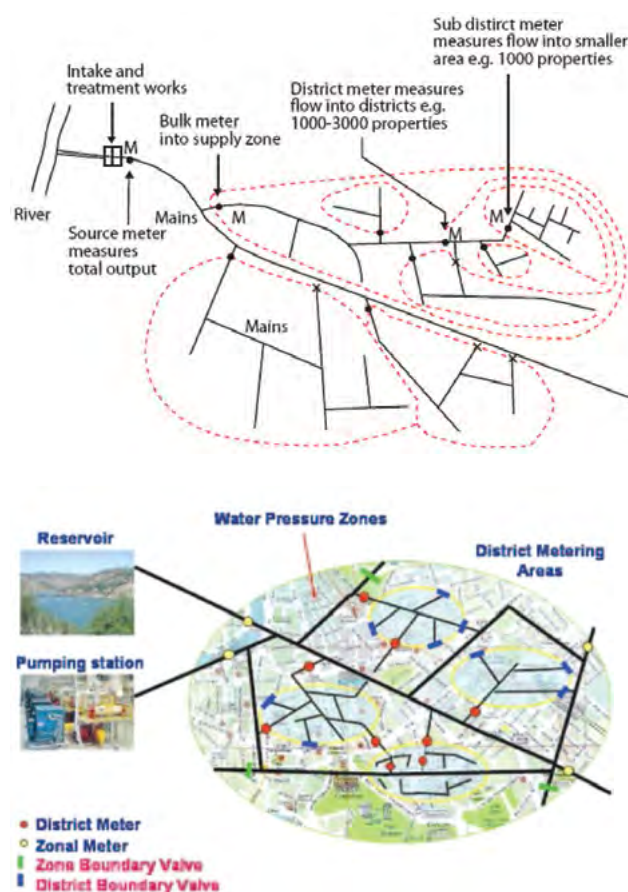
The contract was designed essentially as a 'target-cost contract', and the target was expressed in monetary terms (total cost of leakage and contract cost for the duration of the project) – taking the overall objective to reduce leakage to 20% into account. It included a bonus and penalties mechanism to provide some incentive for performance, based on a methodology combining actual project expenses with the marginal cost of physical losses. The contract was assigned to a U.K. water utility, whose remuneration in the winning bid covered a management fee, technical labour, and all leak detection equipment. The contractor was responsible for:

- establishing District Metering Areas (DMA) throughout the

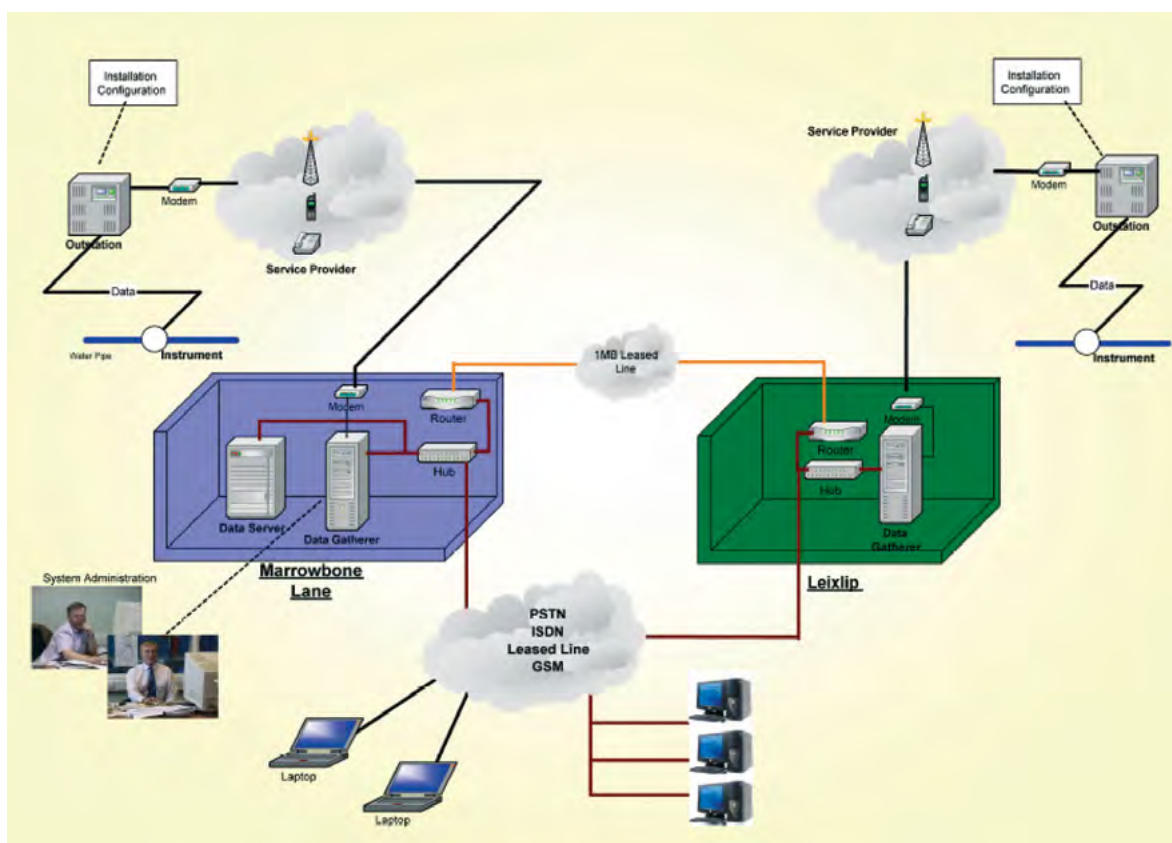
DISTRICT METERED AREA (DMA) FOR NRW REDUCTION

The concept of District Metered Areas (DMAs) was first introduced to the UK at the start of the 1980s by the then UK Water Authorities Association. For the purpose of DMA, a district is defined as an area of the distribution system that can be isolated by valves and for which the quantities of water entering and leaving can be metered¹³. The subsequent analysis of flow and pressure, especially at night when a high proportion of users are inactive, enables leakage specialists to calculate the level of leaks within the district. This is used to determine where the maintenance work should be undertaken to reduce leakage based on the comparison of leakage in different districts.

TYPICAL DMA LAYOUTS



¹³ Accessed in September 2014: www.abb.co.uk/cawp/seitp202/8b1bac80a0dcc280c1257707004aba9d.aspx



Dublin Region Telemetry System

network

- locating and repairing leaks
- installing pressure-reducing valves
- performing some network rehabilitation
- training of the Dublin water utility staff

A total of 500 small DMAs (less than 1,000 connections each) were established, covering the entire distribution network, 200 of which are in the city. Some 15,000 leaks were repaired, and about 20 kilometres of mains were replaced under the project. The DMAs allow for monitoring of the flow and pressures across the city with the telemetry system. The telemetry system provides real time data on flows and pressure across the city and region. The active leakage Control teams track the leakage. A find and fix leak programme has been adopted for faster detection and repair.

The contract comprised (a) approximately \$15 million as a competitively bid management fee, technical labour, and equipment component and (b) approximately \$21 million as compensation events (CE) to cover all of the costs of repairs and rehabilitation, reimbursed on a cost-plus basis. This final cost of \$36 million can be compared with the original contract price of \$30 million. The penalty for not reaching the 20% leak reduction target was calculated at only 2% of the contractor bid remuneration, though it represented a significant portion of the contractor's profit element.

Key Results and Impacts

The total leakage was reduced from 175,000 m³ to about 125,000 m³ per day at the end of the contract. The project reduced leakage from 42.5% to 28%. Although the 20% leakage target was not achieved, the project was considered a success. This is because the savings made were sufficient to end the water crisis and re-establish continuous supply throughout the system in only two years. There was broad consensus that the original 20% target was not realistic, given the short duration of the contract.

Replicability

Most Indian cities have very high percentage of non-revenue water due to theft and transmission losses. There is a need to put in place a system through which the gap between supply and the billed quantity of water can be monitored effectively and the water losses can be minimized. To implement this system, the city can be divided into District Metering Areas (DMA) and the supply can be monitored to these DMAs. Through flow meters, the water utility can keep a check on the water supplied within the hydraulic boundary and compare it with the connections consuming the supply. The gap will indicate the extent of non-revenue water in each area. The DMAs have to be fully metered in order to get exact consumption in the area. The water saved by implementing this system can be used to expand the city's network in areas that are water starved.

COST RECOVERY AND BILL COLLECTION IN SAO PAULO

Location	Sao Paulo, Brazil
Region	Latin America
Year	1999
Agency	Companhia de Saneamento Básico do Estado de São Paulo (SABESP)

Project Aim

To reduce the commercial loss incurred by the water utility in Sao Paulo by undertaking a two-fold approach focused at the replacement of customer meters and the reduction of bad debts.

Context

Traditionally in Sao Paulo, the commercial management, including identifying and replacing under-registering meters, as well as bill collection, had been left to the in-house crews. It was estimated that Companhia de Saneamento Básico do Estado de Sao Paulo (SABESP), the utility that serves the Sao Paulo Metropolitan Region, was losing revenues in the equivalent of a million cubic meters per day. Faced with this situation, SABESP recognized the need for dealing with the replacement of customer meters and the reduction of bad debts (which are not, strictly speaking, part of NRW, but have a similar negative impact on the utility's financial equilibrium).

Project Description

SABESP has set up a system to ensure commercial water loss reduction with the help of the local private sector. Leakage reduction is routinely carried out by a series of leak detection contractors that are paid per length of distribution network

COMMERCIAL LOSS REDUCTION

There are different approaches that are being adopted for commercial water loss reduction worldwide. Water pricing is one such instrument to reduce the NRW losses. Pricing water at appropriate rates, with the possible addition of other levies, is often considered a highly effective policy instrument for governments trying to encourage prudent water usage. More recently, appliance rating systems have become common, and in some instances, such as in Australia, water efficient appliances attract rebates. Conversely, water inefficient appliances may be subject to additional taxes. Differential pricing strategies for commercial, agricultural and household use offer further policy alternatives. The case here focuses on adopting a strategy for water metering and registering of connections in Sao Paulo, which is another instrument to reduce commercial losses. In India, Bengaluru has adopted an approach for commercial loss reduction through bulk metering and the use of intelligent operating systems.

surveyed, and about 40% of the 26,000-kilometer network is surveyed every year.

Key Results and Impacts

- The total volume of metered consumption increased by approximately 45 million cubic meters over the contract's three-year duration.
- The value of bad debt to be negotiated and partly recovered

INCREASE OF LARGE CUSTOMER METER ACCURACY

In the Sao Paulo Metropolitan Region, a large number of customers are industrial, commercial customers and the large condominium buildings, which account for a major portion of SABESP's revenues. The SABESP therefore pays particular attention to the meters of these prime customers. Although this had always been done by its own staff, many of these large meters were significantly under registering compared with their true levels of consumption.

In order to address this issue, SABESP tendered a series of turnkey contracts for meter replacement. The project target was to replace the meters of 27,000 large revenue accounts identified by SABESP. Five 36-month performance-based contracts were put in place, and each contractor was responsible for the analysis, engineering and design, supply, and installation of the new meters. There was no up-front payment, and the contractor pre-financed the entire investment. The contractor was entitled to a payment based on the average increase in consumption volume, calculated through a formula.

The concept of performance payments—rather than just paying for supply and installation—was chosen because resizing and flow profiling of the meters were the most critical activities in the contract. Given the high daily consumption of the large customers concerned, proper calibration significantly increased metered flows and billing. By linking payments to the improved meter accuracy, SABESP ensured that the contractor would focus on these critical issues.

REDUCTION OF BAD DEBTS

Local private firms in Sao Paulo were contracted to negotiate unpaid invoices and collect the agreed-upon amount in the selected service areas. The scope of the contracts included the domestic and commercial customers. Several contracts were tendered, covering all of SABESP's branches. The initial contracts started in 1999 for a duration of two-years. The contractors were remunerated by retaining a percentage of the debt collected. That contractor that bid the lowest percentage figure was awarded the contract in each branch.

The percentages of debt collected and received by contractors varied among branches from 6% to 20%. The remuneration included a premium if collection was higher than 80%, increasing the total payment to between 8% and 25% of the debt collected. In addition, a bonus was paid to the contractor when the invoice was fully paid in cash by the customer. A termination clause allowed either party to terminate the contract in case the recovery ratio would be below 30% of the contractual bad debt amount.

through the initial contracts was about US\$65 million. At the end of the contract, a total of US\$43 million, or 78% of this amount, was effectively collected by the contractors, which was well beyond SABESP's expectations.

- The revenues of SABESP increased by Brazilian reais (R\$) 172 million (US\$72 million). Of this, R\$42 million (US\$18 million) was paid to the contractors, with a net benefit to SABESP three times as high, at R\$130 million (US\$54 million).
- The contracts were extended for a period of two years (until 2003), and in 2005 similar contracts were being put in place.

Lessons Learnt

- **Scoping.** The limited, but clearly defined scopes in both the contracts led to a focused approach.
- **Incentives.** Both projects provided strong incentives for the contractors to perform, while still allowing good profitability for the client. The meter replacement contract was not driven by financial needs, but the objective was to introduce incentives for optimizing the calibration of the new meters.
- **Performance indicators and measurement.** The contractors were reimbursed based on a percentage of the increased revenues. In the case of the meter replacement project, a formula was introduced to account for the impact of the contractor's activities on metered volumes, as opposed to seasonal and other variations in consumption levels.

This proved to work effectively.

- **Sustainability.** The contracts for reduction of bad debt have now become standard practice for SABESP. The customer meter accuracy improvement project was a one-time removal of the backlog of meter replacements. It is now easy for SABESP to maintain the accuracy of these meters on a regular basis.

Replicability

The water utilities in most Indian cities are faced with similar issues of inefficiency in bill collection and cost recovery mechanisms, which results in revenue losses. The approach adopted in Sao Paulo of contracting for the large meter replacement is similar to a build-operate-transfer (BOT) model under public and private partnerships. This model can be replicated in cities where the utility has a significant number of large customers and a high tariff for the top consumption categories, for it to be cost effective. For the successful implementation of the performance-based contract, one of the necessities is a clearly defined set of objectives and scope, which can be measured against certain appropriate performance indicators, also identified in the contract. The performance-monitoring procedures are critical towards the end of the contract, which have to be linked with the revenues and profits of the stakeholders involved in the project.

THEME 4

PARTNERSHIPS FOR WATER

The role of participation in urban development and delivery of services is being recognized globally as an empowering tool. The participatory process is known to create an environment of conflict resolution among the various actors involved in the project, provided it is truly representative of the different sections of the community. The ultimate purpose of adopting this approach is to ensure that the socio-economic benefits from access to potable water can be sustained by and for the communities and other stakeholders. Initiatives for the provision and distribution of urban water have been successfully implemented using the participatory approach in cities like Jakarta (Indonesia), Surakarta (Indonesia), Manila (Philippines) and Kuala Lumpur (Malaysia). Many other cities are also moving towards adopting a participatory and collaborative decision-making approach.

In this section, three kinds of partnerships have been discussed that can be adopted for the successful delivery of water

services. The first of these is the case of engaging the community in Cochabamba, Bolivia, with the help of an innovative public-private-community partnership (PPCP) initiated in 2003 (as an alternate to privatization) as an instrument to provide access to affordable water in the peri-urban areas. The second case study is that of a public-private partnership made operational in Dakar, Senegal in 1996 for managing the water system under a 10 year operation and maintenance contract. The case demonstrates the role that the private sector operator can play in carrying out operations and planning of the capital expenditure program for achieving efficiency in the distribution system. The third case is that of a public-public partnership initiated in 2007 for a period of three years between the water authority in Ulaanbaatar, Mongolia and Vitens Evides International, an international joint venture of two large public water companies in the Netherlands.

AN INNOVATIVE PUBLIC-PRIVATE-COMMUNITY ENGAGEMENT IN WATER SUPPLY MANAGEMENT IN BOLIVIA

Location	Cochabamba, Bolivia
Region	Latin America
Year	2003
Agency	SEMAPA Municipal Water Service, Fundación Pro Hábitat, Water committees, Agua Tuya
Award	World habitat Awards Finalist 2009

Project Aim

To extend the access to affordable water to peri-urban settlements in Cochabamba through an innovative public-private-community partnership.

Context

The South Zone of the city of Cochabamba, with approximately 100,000 inhabitants, is the area of highest demographic growth in the municipality and is home to the majority of destitute migrants. Only 5% of households in the area have domestic running water. The majority of the families purchased water from tankers, paying up to 20 times more than the middle and high income households in the Central and North Zones of the city who had piped water connections from the municipal water company. The source of the tanker water was unknown and vulnerable to contamination. In 1999 and 2000, there was an attempt at privatization of the main water utility, SEMAPA Municipal Water Service, which was faced with violent protests, also known as 'water wars'. This forced the national government rethink its policy on water privatisation and ultimately led to the retraction of a number of concessionary contracts to international companies. In this context, the project was initiated in 2003 by the Bolivian NGO, Fundación Pro Hábitat.

Project Description

This project involves the community-managed supply and distribution of water through an innovative partnership between an NGO (Pro Hábitat), the municipal water company (SEMAPA), a locally-based private company (Agua Tuya pipe manufacturer) and local communities to extend access to affordable water in peri-urban areas of Cochabamba, Bolivia. Water committees with democratically elected members have been established within each community to manage the water systems. The Agua Tuya pipe manufacturing company constructs secondary piped water systems on behalf of the water committees, while coor-

COMMUNITY PARTICIPATION

Community participation has been cited by civil society groups and international organizations as an effective tool in improving access to basic services, especially among the urban poor. An imperative for adopting participatory approaches lies in reconciling the diverse interests to form cohesive partnerships between the state, the community and the civil society groups, which will result in improved service delivery and meaningful empowerment for the communities involved. In India, initiatives are being undertaken to foster such partnerships. One such partnership was formed in Tamil Nadu, where the Change Management Group, a group of engineers of the Tamil Nadu Water Supply and Drainage (TWAD) Board, carried out reforms by engaging in a democratic partnership with 145 village panchayats¹⁴.

dinating with SEMAPA so that the systems meet the required standards. Costs are met by the local communities through micro-credit loans provided by Pro Hábitat through a revolving fund to finance the cost of construction, which are then repaid by residents in twelve monthly instalments.

Project Implementation

Each system includes a community water tank that is filled with water from tankers. The tank is situated in a high location and the distribution takes place through gravity via a secondary piped water system to each individual household. Each household is supplied with an individual connection and a water meter. The water committees are responsible for the management and maintenance of the system, as well as reading the meters and collecting payment from each household for the water consumed. Residents are trained in management of the water systems, the appropriate use of water resources and solid waste management.

One or two members of each community are paid to read the household water meters and collect payment from families for the water consumed. In addition, thirty-two people from participating communities have been trained as plumbers. They now work independently, providing their professional services to the community.

Project costs

The costs of the water systems were covered completely by the residents. Total capital costs for the construction of the water systems were US\$174,850, of which US\$35,000 was the initial cash payment made by residents and the remaining balance

¹⁴ Vibhu Nayar, Democratisation of Water Management: Establishing a Paradigm Shift in Water Sector, Tamil Nadu Water Supply and Drainage (TWAD) Board



A family celebrates its water connection



Laying of a pipeline

of US\$139,850 was provided through loans from Pro Hábitat, repayable in twelve monthly instalments. Interest rates were kept low at 12% (compared to 18% for commercial loans), with affordable monthly instalments of US\$10-13.

Funding for Pro Hábitat's work in capacity building, technical assistance and monitoring has been provided by a range of donor agencies at different stages of the project, including Homeless International, MISEREOR and Oxfam GB, as well as the organisation's own revolving fund.

Innovative Aspects

- The public-private-community partnership is innovative in terms of the funding for infrastructure and management of the services. It provides a viable alternative to the public-private partnership model promoted by water privatisation entities.
- Capacity building of the water committees in the management of the water systems and other administrative aspects ensures the sustainability of the process.
- The water distribution systems were developed according to the geographic conditions of each community and designed so as to facilitate connection to the main network in future.
- The project involves an innovative funding system that combines public-private investment with community resources and micro-credit through a revolving fund.

Method of Overcoming Barriers

In order to overcome the scepticism of the community, Pro Hábitat worked with the community leaders, explaining in community assemblies, the possibilities, risks and responsibilities associated with the project and using its political impartiality to gain the trust of the residents. Certain groups within the community refused to take part in the project. Pro Hábitat carried on with the project with those residents who wished to be involved. As the project progressed, many of those initially opposed, decided to become involved.

Key Results and Impacts

Environmental Sustainability

The project uses locally manufactured high density polyethylene

(HDPE) pipe, which is highly durable, provides protection from contamination and requires significantly less energy to fabricate, transport and install than other pipe materials. This is in accordance with Pro Hábitat's policy of using locally-sourced, low-cost materials in all its projects. The project carries out regular 'clean-up' campaigns and initiatives for solid waste management and drainage systems, as well as educational events on themes relating to contamination, water and habitat.

Financial Sustainability

Under normal conditions, community members would need to pay the municipal water company US\$215 in order to be connected to the water distribution network and the company owns the network. Through the project, each household invests between US\$120 and US\$156, and is a shareholder in the system, giving them greater negotiating power with SEMAPA.

By combining its partners' resources, the project overcomes the problem of the prohibitive costs of new secondary water connections, and reduces end-user water cost by over 60%. In addition to having access to safe, potable running water at much lower costs, some residents have subsequently been able to build their own kitchens and toilets, either with their own resources or through loans from Pro Hábitat, thus improving their living conditions.

Social Sustainability

The project has benefitted 1,709 families from eight communities in the South Zone of the city. The communities have been responsible for the management of the project, through the existing leadership structures and the new democratically elected leaders elected of the water committees. Throughout the process, decisions were made through community assemblies, with the participation of all residents. The participation of women in leadership positions is actively encouraged. Women represent 40% of leaders of the water committees and their participation in community assemblies relating to the water systems is 37%, compared to 15% in the general community assemblies and decision-making processes. The process of organisational strengthening enabled the communities to negotiate subsequent

projects with the local authorities, such as the provision of sanitation infrastructure and services.

Lessons Learnt

- The success of the project in facilitating access to water-related services can be attributed to the strong socio-political component – in addition with the technical and financial considerations. This has been achieved by promoting participatory water governance.
- Collaborating with other groups and organisations, where each is able to contribute to the project within its own area of expertise, will strengthen the project.
- A new project should only be initiated once there is acceptance by the majority of the population, and it is important to keep open the possibility for additional households to join if and when they wish to do so. Decisions should not be forced and if there are strong divisions within a given community it is best to cease activity and wait until a consensus is reached.

Replicability

A large proportion of the urban population remains without the piped water supply in Indian cities, like in the case of the South

Zone communities in Cochabamba. The case study illustrates how the provision of affordable water supply can be made to the unconnected communities, while at the same time empowering them by making them as stakeholders in the project.

The ward committees, area sabhas and resident welfare associations (RWAs) in Indian cities can be exploited as effective instruments for engaging the communities in urban water management. Partnership can be formed between the citizens groups (RWAs, etc.), especially those of the urban poor, and NGOs or civil rights groups working in the water sector. A local private water provider can be involved to provide technical support to the communities as they design, build or supervise the construction of alternative community-based systems of water distribution. The project can be financed using state and national government funding, donor organizations as well as funds from the community. Investment needs to be made towards strengthening of the capacities of the community members and leaders, so that they can manage the water systems in a democratic, transparent, efficient and sustainable manner. The innovative public-private-community partnership (PPCP), including the community as a key partner in the process, is a viable alternative to the public-private partnership model promoted by the water privatisation entities.

PUBLIC-PRIVATE PARTNERSHIP TO IMPROVE EFFICIENCY IN DAKAR

Location	Dakar, Senegal
Region	Africa
Year	1996 onwards
Agency	National Water Company of Senegal (SONES), Senegalaise des Eaux (SDE), the Ministry of Water, World Bank

Project Aim

To implement institutional reforms in the urban water sector to improve efficiency and service delivery, and establish a long-term financially viable method for Dakar’s urban water sector.

Context

With a population of over 2.4 million in the Dakar metropolitan area, less than 56% of the population was receiving potable water from the existing system. The original water utility, SONEES,

PRIVATE SECTOR PARTICIPATION

Private sector participation in water services has worked as a solution in certain cities to meet the high costs of financing water infrastructure. The OECD indicates that France and the UK need to increase their water spending to around 20% of GDP to maintain water services at current levels¹⁵. The US Environmental Protection Agency estimates that it will need to invest US \$23 billion annually over the next 20 years to maintain its water infrastructure¹⁶. Consequently, many governments have turned to the private sector to manage and develop their water infrastructure by means of Public Private Partnerships (PPPs). These have met with mixed success; some PPP contracts have been terminated due to weak regulatory and institutional framework. Some successful examples of PPPs in water services have been implemented in Colombia (Cartagena), Argentina, Cote d'Ivoire, Senegal (Dakar), Morocco and Manila (Philippines)¹⁷. In Nagpur city in India, the Nagpur Municipal Corporation (NMC) has implemented a 25-year Public-Private Partnership (PPP) project for the provision of continuous water supply on a city-wide scale.

¹⁵ Managing Water for All: An OECD perspective on pricing and financing, OECD 2009
¹⁶ Mary Tiemann, Safe Drinking Water Act (SDWA): Selected Regulatory and Legislative Issues, Congressional Research Service, 2010
¹⁷ The World Bank, Water and Sanitation Program

FINANCIAL AGREEMENT

A major portion of the US\$ 300 million investment in the public-private partnership came from World Bank loans to the government, but the reform was supported by the strategic use of private finance, both from the private operator (who financed some of the investments) and from local private banks that provided a line of credit to assist SONES with its cash flow. The financial objectives were defined in the contract, stating that there would be no on-going operating subsidies from the state, and the only support would be in the form of World Bank financing through its credit lending window. The contract also stated that water tariffs would be increased gradually, set initially at a constant rate, but adjusted according to progress in reaching the financial equilibrium.

Using a financial model, viability studies were conducted, taking into consideration several factors to predict when the system would attain financial equilibrium. It was predicted that with improved network efficiency and increase in consumer tariffs at a rate of no more than 3% per year, the project would attain financial equilibrium in 2003. The model also allowed the government to calculate a 'ceiling rate' for the price to be offered in a bid by the private operators – a price beyond which private sector management would be uneconomical. The private operator does not have any decision-making role in setting tariffs, nor is the fee paid to the contractor based solely on the tariffs to be collected. The operator collects the tariffs, retains a portion of the fee (normally between 50-70%) and gives the balance to the government. The government's portion is used to pay for the investment costs of the system.

CONTRACT PROVISIONS

SONES was authorized to manage the sector through a 30-year concession contract signed by the state, represented by the Ministry of Water. SONES also signed a sector development contract (Contract Plan) with the Ministry, which outlined its investment obligations (and was included in the Request for Proposals for the private sector contract). A ten-year *affermage* contract governing operation of the system was signed between three parties: the Republic of Senegal, represented by the Ministry of Water, SONES, and a private operating company, S n g laise des Eaux (SDE), formed specifically for this purpose.

SOCIAL CONNECTIONS

Along with recognizing cost recovery and financial sustainability as important factors, the need for a social dimension to the reform was addressed by providing subsidies for the low income, low volume consumers. Three types of subsidies were introduced:

1. Low income households would be provided with subsidized connections through the 'social connection' program financed by the government and World Bank funds.
2. Public stand posts would be constructed in areas where there were people without private connections, financed by the government with funds from the World Bank project, and water would be supplied to these stand posts at low rates. The stand posts would be managed by private operators recruited by SDE in consultation with the local community.
3. Users with low levels of consumption would receive subsidies financed by cross subsidy between customer categories and delivered through an Increasing Block Tariff (IBT) with a 'social tariff' for household consumption less than 20 cubic meters in two months. The IBT structure is implemented in the following way – a subsidized 'social tariff' for levels of consumption below 20 cubic meters in a 60 day period, regular tariff for consumption over this and a dissuasive tariff for consumption over 100 cubic meters per 60 days.

In September every year, a draft capital improvement plan is prepared for the next three years that indicates the improvements to water supply infrastructure that SDE proposes to make. The proposal identifies each project by name, location, description of the proposed work and the proposed year of implementation. SONES reviews the plan, holds discussions with SDE and makes decisions on which projects are to be implemented and what changes (if any) are to be made to the original proposals. Once an agreement is reached, it becomes part of the contract documents for the next year.

METHOD FOR OVERCOMING DISPUTES

The contract outlined a dispute resolution procedure that allowed for the use of a 'conciliateur', an objective third-party sector professional to be called in to help settle disputes. A consultant who had been involved in the preparation of the transaction helped SDE and SONES renegotiate the contract in 1998, when it ran into a dispute. The successful renegotiation of the targets had a dramatic effect on the financial health of SDE and underlines the maturity and strength of the institutional structure of the reformed Senegalese water sector.

formed by the Senegalese government in 1983, was unable to exercise full control over planning for the sector, to set tariffs at a sufficient level to recover costs, or to settle unpaid bills. The Senegalese government recognized the need for large scale investment to improve the storage and distribution of water in Dakar and to satisfy the growing demand for water services.

It was decided that the institutional framework for the water sector would be driven by the three principles: accountability, autonomy, and incentivization. The water sector would be centrally coordinated by an experienced and competent asset-owner (a state asset holding company), and private sector water operations companies would be invited for competitive bids for the contract. It was anticipated that, by creating a public-private partnership, the increases in efficiency would alleviate the burden of the state to subsidize the water sector. Through the improved service delivery, the government aimed to expand water supply coverage from 56% to 82% by 2015.

Project Description

The reforms consisted of dissolving the state-run water company Société Nationale d'Exploitation des Eaux du Sénégal (SONEES) and creating a new asset-holding company Société Nationale des Eaux du Sénégal (SONES) that owned all the fixed assets for the government and functioned as an independent sector regulator. SONES was created as a financially autonomous unit that could employ qualified staff and was responsible for investments and setting of tariffs. The production and distribution of water services was placed in the hands of an operating company run by a private operator which would own at least 51% of the water facility, with the other 49% owned by a mixture of Senegalese investors, former employees of SONEES and the state.

This public-private partnership has been operating in Dakar since 1996, with Ségala des Eaux (SDE), a subsidiary of a major French water company, managing the water system under a 10 year operation and maintenance contract. The terms of the contract allow the government to fine SDE on failing to achieve the specific performance targets.

Project Implementation

Ségala des Eaux (SDE) was established in December 1995 as majority-owned by the French company by a competitive bid. The state took a nominal and symbolic 5% share, and former SONEES staff was granted 5% of the shares. The French company owned 57.84% of the remaining 90%, and private Senegalese investors owned 32.16%. SDE was responsible for some investments every year, SONES was responsible for owning sector assets, planning and financing investments (excluding those done by SDE) and monitoring SDE activities.

While the state retains the right to extract water, the production, storage and distribution of water is run by an operating company controlled by a private professional firm with experience in the management of water systems. The compensation of the operator was linked to specific goals for efficiency of the network (measured by reduced unaccounted for water, increased billing and collection efficiency, etc.). Another provision was that

the private operator also should contribute part of the funding for capital expenditures – while the investment responsibilities would remain a function of the public sector, carried out by a financially autonomous agency, the private sector was guaranteed a reasonable rate of return on these investments.

The financial autonomy of the new state holding company was going to create incentives to design a sustainable investment program and to lobby the government for adequate tariff increases. To ensure the success of this arrangement and the autonomy of the agency, the new state holding company was a small unit employing qualified staff, under conditions that were distinct from the civil service. The agency would have independent contracting authority and would retain the assets and the right to process water for public use.

A law was passed by the National Assembly, implementing the institutional reform of the urban water supply sector in 1995. The law authorized the creation of SONES to be governed by a 1990 law related to para-public sector enterprises. A new operating company to manage the distribution system, and eventually be privatized, was also created out of the dissolved SONEES. The government also committed to guarantee employment for permanent employees of SONEES. Thus, SONEES employees were divided between the operating company, which retained 1,394 of the staff members and SONES, which retained 50 to manage strategic development, long term planning and oversight in the sector.

Key Results and Impacts

- The program has been successful in improving the quality and quantity of water delivery in Dakar. Since the reform began, the yearly water production has increased from 96.3 million cubic meters in 1997 to 113.88 million cubic meters in 2003, an 18% increase.
- The number of clients increased substantially, from 241,671 in 1996 to 327,501 in 2001, an increase of over 35% with the addition of 400 standpipes.
- The reform has had positive outcomes for the poor, due to the incentives for the operator to provide 'social connections'.

Lessons Learnt

- The case demonstrates that if a private operator takes over operations and is given some responsibility in the planning of the capital expenditure program, greater emphasis can be placed on introducing efficiency in the distribution system than on water production.
- The contract model chosen, an *affermage*, was modified by the addition of strong financial incentives to reduce leakage and improve billing and collection efficiency.
- The use of the cash flow equilibrium model to guide the sector to financial health was an effective innovation, which helped the decision makers analyse the various options available.

Replicability

The success of the reforms in the Senegal water sector is being replicated in the other Sub-Saharan countries as well. In order for the

model to be replicated in Indian cities, the partnership contract between the public and private entity must clearly define the relationship between the stakeholders and their respective roles and responsibilities. The contracts should also include a dispute settlement mechanism with the involvement of an outside entity. The partnership can work if the water sector is centrally coordinated by a competent state asset holding company, and the operations are controlled by a private sector water operations company. Government regulation should be limited, without fully relinquishing control. Consistent efforts should be made in order to make the water sector financially viable. Investments may be invited from external support agencies or from sources of private sector finance, after meeting pre-defined conditions.

Like in Senegal, the contract for a public-private partnership for water supply can be designed for Indian cities in a way that the supply is provided to the urban poor at an affordable price. The operator can be paid on the basis of a water supply rate that does not vary according to the category of the connection. The *affermage* contract can be chosen, which uses a fixed water supply rate regardless of the type of customer serviced, unlike a concession contract, in which the operator makes his revenues and thus makes his profits directly from the tariffs. Thus, there will be no disincentive to install subsidized connections for the low income households, and the operator will not be tempted to divert water supply from customers in lower tariff categories to those in higher ones.

PUBLIC-PUBLIC PARTNERSHIP BETWEEN NETHERLANDS AND MONGOLIA

Location	Utrecht, Netherlands and Ulaanbaatar, Mongolia
Year	2007-2010
Partners	Vitens Evides International (VEI), Utrecht, Netherlands, Water Supply and Sewerage Authority (USUG), Ulaanbaatar, Mongolia

Project Aim

To enable the water authority in Ulaanbaatar, Mongolia in becoming a financially sustainable and autonomous water utility with the assistance from Vitens Evides International, Netherlands.

Context of the Partnership

The Water Supply and Sewerage Authority of Ulaanbaatar City (USUG), established in 1959, is a municipally owned water utility responsible for drinking water provision and wastewater treatment in the Ulaanbaatar city. The USUG serves about 90% of Ulaanbaatar’s total population of approximately 1.03 million people: 40% by piped water supplied mostly to apartments, 20% through pipeline-connected kiosks, and 30% through truck-supplied kiosks. The kiosks serve mostly the people in *ger*²⁰ areas.

PUBLIC-PUBLIC PARTNERSHIPS

A public-public partnership (PuP) is a collaboration between two or more public authorities or organizations to provide services and/or facilities, by means of transferring technical skills and expertise, and improving capacity of one partner within international and national development projects. PUPs in the water sector have been around for over 20 years and are being implemented in all regions of the world. The first such initiative was started as a training partnership by the Yokohama Waterworks Bureau in the 1980s to help the staff in water utilities in other Asian countries. Far more countries have hosted PUPs than PPPs in the water sector¹⁸.

PuPs are being perceived as a tool to work with partners to reform public water utilities, improve services and realise the right to water on the ground. PUPs’ work can be divided into five broad categories: training and developing human resources, technical support on a wide range of issues, improving efficiency and building institutional capacity, financing water services, improving participation.

There are two broad categories of PUPs: international PUPs (partners from different countries) and national PUPs (partners in the same country). International PUPs include those between water operators in Sweden and Finland and the municipalities of Estonia, Latvia and Lithuania; PUPs between Amsterdam Waternet and the city of Alexandria (Egypt), etc. National PUPs include the support provided by SANAA in Honduras for rural water services, among others. In India, a national PUP has been started as a partnership between the Tamil Nadu water operator and its counterpart in Maharashtra¹⁹.

¹⁸ David Hall, Emanuele Lobina and Violeta Corral (PSIRU), Olivier Hoedeman, Philip Terhorst, Martin Pigeon and Satoko Kishimoto (TNI), Public-public partnerships (PUPs) in water, Public Services International Research Unit (PSIRU), Transnational Institute (TNI), 2009

¹⁹ Ibid.

²⁰ The so-called *ger* areas are peri-urban informal settlements where migrants of mostly poor families from the countryside have settled in *gers*, the traditional Mongol tent. Some 60% of the Ulaanbaatar population live in these areas, poor or non-existent basic physical and social infrastructure services.



USUG Management Team with observer in camp outside Ulaanbaatar



One of several team building activities

Private vendors or non-governmental organizations (NGOs) serve the remaining 10% of the population. There are wide differences in consumption among residents. People in apartments consume an average of 262 litres per capita per day while average consumption in ger areas is around 10 litres per day. Tariffs are low and do not permit the USUG to cover depreciation, interest and non-operational costs from the income.

Vitens-Evides International (VEI) is the international joint venture of two large public water companies in the Netherlands – Vitens and Evides. Both companies have over 100 years of operational experience and together provide affordable and reliable water services to approximately 7.7 million people. VEI provides knowledge and expertise to water utilities in the developing countries and since 2002 it has engaged in water operators' partnerships with water utilities in Mozambique, Yemen, Mongolia, Vietnam and Ghana. Utilities and local authorities in the Netherlands benefit from a law permitting them to apply up to 1% of revenues for international water, sanitation and hygiene initiatives.

The facilitator of this Water Operators' Partnership (WOP) was the Netherlands Ministry of Foreign Affairs through the Directorate General for International Cooperation, which runs the Netherlands' official development cooperation programme. The Netherlands annually spends 0.7% of its gross national product on development cooperation. The water sector allocation in the development cooperation budget has increased from 2.4% in 2011 to 4.1% in 2012.

Project Description

The cooperation between the USUG and the VEI originated in September 2006 when the companies signed a memorandum of understanding to engage in a Water Operators' Partnership. The arrangement was for the VEI, as an expert partner, to provide management and technical support to the USUG. The partnership would help enable the water authority to meet the growing demands in Ulaanbaatar and to improve and extend its water services. The partnership commenced in November 2007 with

both the partners signing an implementation memorandum. The three-year partnership proposal included a framework of activities to be implemented from November 2007 to October 2010, and their expected results. A Steering Committee was formed to oversee the partnership comprising of the Ulaanbaatar Municipality as Chair of the Steering Committee; the USUG as implementing partner and financier; VEI as implementing partner and financier; and the Dutch embassy in Beijing representing the Netherlands Ministry of Foreign Affairs and its Directorate-General for International Cooperation as observer to the Steering Committee and financier.

Key Results and Impacts

- The main impact of the VEI-USUG partnership on USUG's performance is its enhanced capacity, mostly through training inputs, to improve operational efficiency.
- **Water supply operations improvement:** The partnership led to the up gradation of the operational control system for efficient decision making. The connection of 26 kiosks to the main distribution system was provided. The Balanced Scorecard introduced enables managers to assess performance against 20 Key Performance Indicators. Metering of 288 household connections in apartments in a pilot district in Ulaanbaatar resulted in reduction of average domestic consumption from 262 litres per capita per day to 100 litres per capita per day.
- **Financial autonomy:** The financial forecasting model developed with VEI is being used not only to make financial projections but also to design measures aimed at increasing financial sustainability, such as tariff increases, and to calculate the effects of such measures. Recommendations were made to adjust future tariffs gradually to achieve full cost recovery.
- **Sustainable water resources management:** Water production and water quality is being monitored with samples being taken from the well fields and several locations in the distribution network to ensure resource sustainability.

Project Implementation

The partnership agreement was implemented by the partner agencies under the following aspects:

REVIEW AND DIAGNOSIS

The performance of the USUG was reviewed by VEI's visiting experts, together with the concerned USUG managers and staff, to define the problems and agree upon recommended solutions. Recommendations involved procurement of equipment and software, development of new systems and procedures, preparation of master plans, capacity building, and training in Mongolia and exposure visits to the Netherlands for USUG staff. Some recommendations took the form of policy advice, for example, on tariffs and debt service.

OPERATIONAL PERFORMANCE IN WATER SUPPLY

The review of the water authority's operational performance revealed several important areas for improvement.

- **Unsafe and unreliable water:** Over 30% of the water authority customers get their water from truck-supplied kiosks, having high costs and contaminated water.
- **Wasted water:** Consumption of the city's apartment residents was very high at an average of 285 litres per capita per day due to low tariffs and absence of household water meters.
- **Inefficient supply systems:** Operations of the central water supply system in Ulaanbaatar's core apartment area had high energy consumption and fluctuating pressure levels.
- **Non-revenue water:** The non-revenue water was found to be 23.8% of the production.

OPERATIONAL IMPROVEMENTS

An improvement strategy was designed by the partners for optimizing the pumping operations and the distribution network in the city. With the help of VEI, USUG upgraded and standardised the operational control equipment at two of the water authority's six pumping stations. A database of operational data from the pumping stations was designed and installed. A calibrated free water distribution hydraulic modelling software package (EPANET) hydraulic model was used twice to analyse options for improving the water distribution network. VEI helped the authority develop a Balanced Scorecard, a widely accepted tool for monitoring, assessing and evaluating the performance of a utility. This gave the water authority's management team operational performance information for better decision-making. The partners prepared an Operational Master Plan for 2010-2020 including recommendations for the development of water services in the city, prioritising investments, improving planning and operations and continued capacity building.

FINANCIAL AUTONOMY

VEI helped the water authority develop financial forecasting model to make financial projections, design improvements. VEI advised that Ulaanbaatar seek to aim for full cost recovery and increase tariffs annually until USUG's costs are covered; that they find a solution to deal with debts; explore ways to increase efficiency by reducing water wastage and energy consumption, improve billing and collection, and reorganize the water authority accordingly. From 2007 on, VEI's financial expert visited the USUG each half year to review the financial figures, income statements and balance sheet for the preceding six-month period. The authority's finance department staff has now had sufficient training, both in Mongolia and in the Netherlands to make the financial analyses themselves.

SUSTAINABLE WATER RESOURCES MANAGEMENT

The measures undertaken during the partnership implementation included groundwater monitoring whereby sensors were installed at USUG's central well field to assess the sustainability of the city's water resources. One engineer was trained in operating the sensors, data processing and interpretation, and was made responsible for continued groundwater monitoring in USUG. Other measures were Geographic Information Systems (GIS) introduced to USUG with the procurement of GIS licenses and the training of USUG staff in 2008. VEI trained the USUG staff in GIS water utility applications including well-field mapping, hydrological analysis and asset management.

Further, a well field protection strategy was developed based on hydrological description and a GIS-analysis of pollution risks. The strategy carries regulations and directives for the conservation of existing groundwater resources and protection from polluting industries and construction activities. VEI helped USUG with the design, equipment and setting up of a new integrated drinking water and wastewater treatment laboratory. Two USUG technicians were trained in a Vitens laboratory in the Netherlands for the purpose.

TRAINING AND CAPACITY BUILDING

Opportunities were provided for the staff of the USUG to enrol in university programmes and other courses in Netherlands, receive on-the-job training in Ulaanbaatar and to participate in exposure visits to Vitens' offices and facilities in the Netherlands. Examples include: One Ulaanbaatar engineer has completed an MSc programme on urban water supply at UNESCO-IHE Institute for Water Education in Delft. Three employees enrolled at the NHL University in Leeuwarden for short courses in water services management. By the end of June 2010, 36 Ulaanbaatar water authority employees had participated in exposure visits to Vitens in the Netherlands. The exposure visits were organized in the fields of customer care, human resources management, financial management, operational control and automation, reducing wastage, laboratory operations, groundwater modelling and monitoring, and the management and institutional aspects of water utilities.

- **Training and capacity building:** The partnership has provided a considerable amount of new equipment, software, systems and procedures. One outcome has been the reorganization of the water authority, establishing two new departments, to take account of the new functions and tools, and for continuous improvement of technical operations, current asset management, and planning new projects. Other outcomes included an operations reference manual on advanced wastewater treatment, the 2011 business plan and a strategic five-year plan and team building activities for the reorganized units to ensure sustainability beyond the partnership period.

Lessons Learnt

- **Commitment:** The financial and human resources were invested for the success of the partnership by both the partners as well as the governments of Netherlands and Mongolia.
- **Capacity building focus:** The emphasis of the partnership was not merely on the exchange of technical know-how, but on the capacity building and staff development for long term benefits.
- **Sustainability:** The on-the-job training, combined with exposure visits, helped reinforce the adoption of new practices, as shown by the continuation of activities such as GIS, hydraulic and financial modelling, team building, and business planning beyond the WOP period.
- **Preparation Time:** The one year period before the partnership was crucial for the VEI and USUG officials to take part in

preliminary exchange visits and plan a meaningful collaboration.

- **Flexibility:** The partnership provided flexibility, as shown by the partners being able to realign USUG's proposed reorganization according to the new sector reform principles.

Replicability

The partnership illustrates how public water organisations operating in the developed world can collaborate with water utilities in the developing countries, to share their expertise and experience in the operation and maintenance of water supply in the city. In India, public-public partnerships can be used as an instrument for making the water services utilities financially sustainable and autonomous companies, which would provide water and sanitary services to the residents in an efficient, reliable and cost-effective way. Knowledge management and sharing platforms can be created for this purpose to promote partnerships between various water authorities.

The water authorities or municipal corporations in smaller cities in India can partner with the cities like Nagpur, Pimpri-Chinchwad and Hubli-Dharwad to promote their capacity building efforts. The water utilities in the case of larger cities and metros, international collaborations with agencies like the Phnom Penh Water Supply Authority (PPWSA), Singapore's Public Utilities Board (PUB) and Burkina Faso's Office national de l'Eau et de l'Assainissement (ONEA) can prove fruitful. The utilities could seek financial assistance from multi-lateral and bi-lateral agencies, national and state governments as well as their own resources to support the partnership.

THEME 5

WATER FOR THE POOR

In developing countries, more than half of the urban population lives in unplanned or informal settlements where the quality of life is substandard and even inhuman. Such settlements suffer from the lack of access to basic infrastructure facilities like water supply and sanitation, which have a direct or indirect impact on the well-being of public health and environment. In this context, the supply of safe drinking water becomes a management issue for the municipalities and water utilities that raises concerns about inequitable service provision. The lack of access to safe drinking water and sanitation is directly related to poverty, and, in many cases, to the inability of governments to finance satisfactory water and sanitation systems.

Although several initiatives have been launched to supply safe drinking water to urban populations, efforts still fall short of the required targets as far as access by the poor is concerned. The direct and indirect human costs of these failings are enormous, including widespread health problems and excessive use of

labour (particularly for women, who are forced to travel long distances to obtain water and wait in queues at a community water source). People without access to piped municipal water services often rely on alternate and informal water sources, which may or may not be clean and safe drinking water sources.

In this section, two case studies have been profiled, that adopt a focused approach to providing water services for the urban poor. The first of these is the case of Kisumu, Kenya, where the delegated management model was adopted in 2004 for the expansion of water infrastructure facilities to the unconnected informal settlements located in the city's peri-urban areas. The second case study is that of an alternate water management system in Parauapebas, Brazil in 1993 for the provision of affordable water to the poor. The city has undertaken the construction of condominium networks instead of traditional network systems to ensure access to water supply in the unconnected neighbourhoods.

DELEGATED MANAGEMENT MODEL FOR PROVISION OF WATER SERVICES TO KISUMU'S INFORMAL SETTLEMENTS

Location	Kisumu, Kenya
Region	Africa
Year	2004
Agency	Lake Victoria South Water Services Board (LVSWSB), Kisumu Water and Sewerage Company (KIWASCO), Master Operator, Nyalanda Community

Project Aim

To find a sustainable solution for providing water supply to the unconnected low-income settlements in the peri-urban area of Kisumu.

Context

Kisumu, the third largest city of Kenya, has approximately 60% of its population residing in peri-urban settlements. The coverage of water and sanitation services was very low, with only 8,000 active water connections. To a large extent, water services were being provided by small-scale private operators, well or borehole owners, owners of the few functional connections who resell water to their neighbours, and nearly 1,000 retailers. As the utility struggled to serve the growing population and the poor in particular, the utility partnership with small-scale providers proved to be significant in serving the poor in Kisumu.

Project Description

The Kisumu Water and Sanitation Project (KWSP), financed by the French Development Agency (AFD) for a total amount of €20,000,000, is an innovative public-private partnership aimed at rehabilitating and expanding water and sewerage infrastruc-

²¹ Tova Solo, Independent water entrepreneurs in Latin America – the other private sector in water services, World Bank. 2003

SMALL-SCALE WATER OPERATORS

The poor in cities are often served by small-scale private water operators, such as water carriers, fountain owners, tanker operators, etc. These small scale water providers operate extensively to serve the unconnected settlements of urban poor in developing countries. While some small scale service providers are community-based, not-for-profit organizations, the majority are small private vendors, with a significant share of capital financing coming from private sources, selling water on a commercial basis.

A study of six Latin American countries showed that small-scale private providers provide water to 25% of the population with water in seven cities. Many operators provide water through tanker trucks or animal-drawn carts. Others operate water distribution networks fed by wells, as it is the case in Asunción, Paraguay, and in Sanaa, Yemen. Small-scale operators can be owned by individual entrepreneurs or can take the form of cooperatives, as it is the case in Honduras²¹. Small-scale operators do not always comply with technical norms and the quality of the water they provide or their tariffs are often not regulated. There have been initiatives worldwide to regularize and formalize the services of these operators to enable them to serve the poor better.

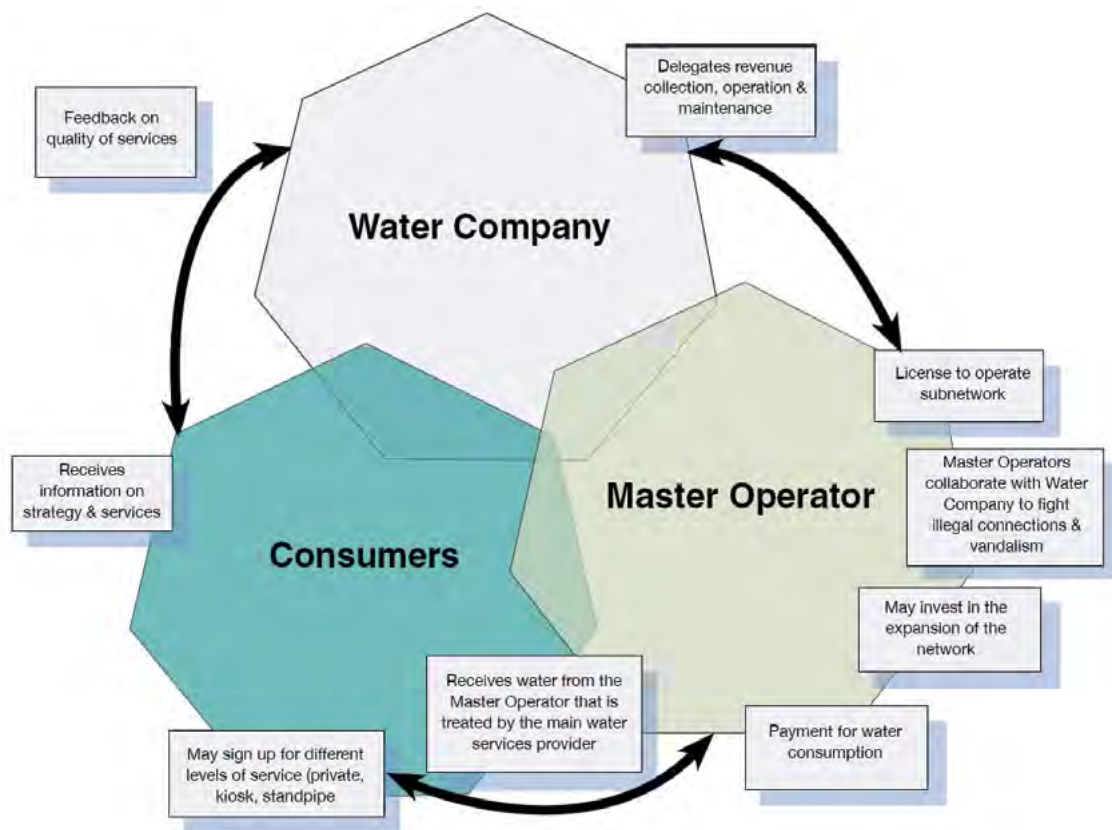
ture and enhancing services to the city's unconnected peri-urban areas. A component of the KWSP is the Nyalanda Water Supply Project (NWSP), which covers Nyalanda, Kisumu's largest low-income settlement with approximately 14,000 households. Although the settlement is located in close proximity to the existing water network, it remains grossly underserved. Under the Kenyan National Water Act 2002, the Lake Victoria South Water Services Board (LVSWSB) in Kisumu has contract-



An aerial view of Nyalanda in Kisumu



Water standpipe in Nyalanda



Relationship between the water company (utility), master operators, and consumers

ed the Kisumu Water and Sewerage Company (KIWASCO) to operate water supply and sanitation services. The Delegated Management Model for water services has been adopted, which is a partnership between the water utility and private operators. In this approach, the water utility sells bulk water to the private operator (private entities or community-based organizations) who then sell it to households or kiosk vendors. The private operator is competitively selected and contracted to operate and manage the network. The operator is responsible for billing, revenue collection, and minor maintenance. The network extensions to non-serviced areas (tertiary distribution and customer care) are also delegated to the private operators based on output-based aid schemes. The main water service provider offers contractors, termed 'master operators' (MOs), a bulk supply tariff.

Project Implementation

In order to address the problems of low coverage of water services in the peri-urban areas, the Water Company has taken the following initiatives:

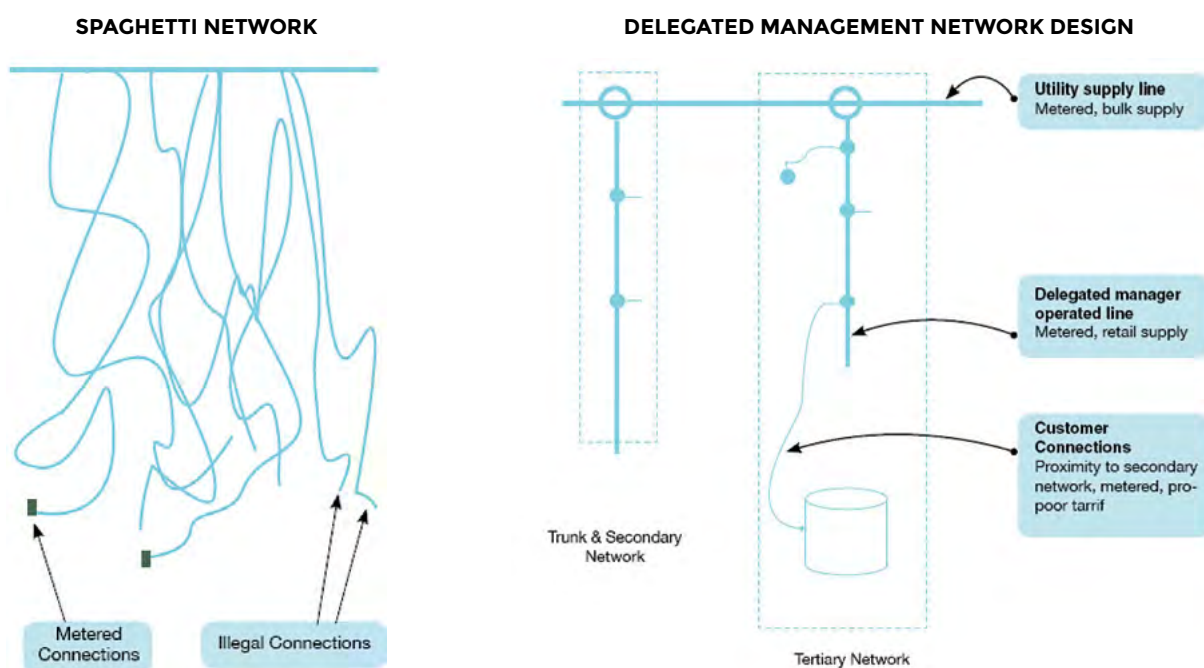
- Employing five staff members on a part-time basis, involved in a *pro-poor unit aimed at addressing service improvement in slums*.
- The staff of this unit includes the managing director, technical and commercial managers, among others.
- *Reducing the price of water to kiosks in slums* from Ksh 80/cu meter to Ksh 35/cu meter (US\$1.10 to US\$0.48).

- *Developing a special metal box to lock water meters to prevent tampering*. A total of 103 such meter locks have been installed, which has resulted in more accurate billing of water supplied to the kiosks.

This model has community participation as a core strategy; the target community is involved in all aspects of the selection process including reviewing applications, short-listing applicants, interviewing finalists, and recruitment. Since operators are selected from the same geographical area, they are known to the community. This helps in preventing vandalism and illegal connections, and aids revenue collection.

To ensure fair selection of operators and to counter corruption, the water company has put in place a transparent and competitive bidding process in consultation with the target community. The application forms that are appropriate for local conditions and norms are been created for the bidding process with the assistance from the community. The application forms are made available at easy form assigned public places. As the informal sector service providers do not have bank accounts and keep their savings either at home, or invest in land or rental units, documents ranging from land titles to bank statements are accepted as 'proof of financial viability'.

The first phase of the NWSP was envisaged as a pilot project covering approximately 10,000 inhabitants. It consisted of the installation of five parallel pipelines (600 meters each), connected



Meter chamber on Line 1



Master Operators undergoing hands-on training

to and metered from KIWASCO's mains. It was then replicated in the remaining areas of the settlement under phase I and II of the project. A total of 12 lines are operating in the entire settlement. The design of the system involved the transfer of the existing 600 connections to the master operator lines, as well as shifting from the old 'spaghetti lines', that were rampant with leaks and illegal connections, to a structured network.

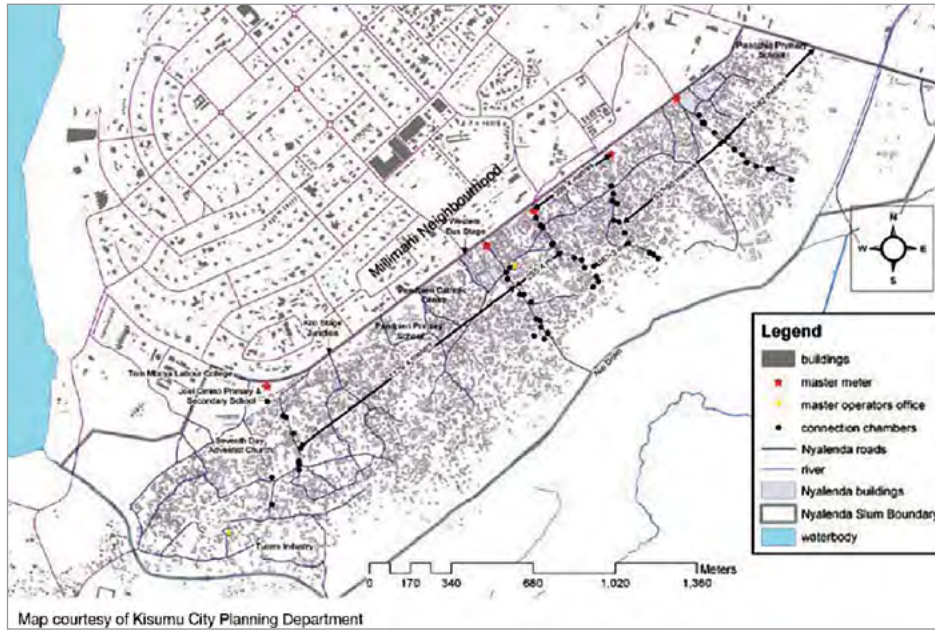
A community outreach campaign is conducted prior to any capital works to allow the community to voice any concerns and to assist with design (for advising on the best locations for the lines) and implementation. Adequate financial and human resources have been allocated to address the three components of community mobilization, namely, forming a community committee, holding a communication strategy workshop and community mobilization.

Key Results and Impacts

- The delegated management model made it possible for the

low income households to have an individual connection at reduced prices in the place of paying high prices for poor service. The tariffs translate in reduced connection and consumption costs for the users, from US\$56–21 for a connection, and between 10–25% less on water prices depending on the consumption band.

- The model allows the development of a range of services (private connections, shared standpipes, commercial kiosks) to match the demand of households. Customers have reported improvements in the water quality and reliability.
- The model officially recognizes that rising block tariffs may be detrimental to households that resell water and offers a commercial tariff that does not rise with increasing levels of consumption.
- The model reduces the administrative costs of the water company and improves its operational efficiency (by reducing nonrevenue water and increasing revenue collection per capita).



Nyalenda Water Services Project Phase I - Delegated Management Model, KIWASCO

- The business risk is minimized through a prepayment system. The private operator pays Ksh 15,000 (US\$210) deposit to the water company, domestic customers pay Ksh 1,000 (US\$14) deposit to the private operator, and kiosk customers pay Ksh 5,000 (US\$70) deposit to the operator. The operator and water company can withhold the deposits in case of non-payment.
- KIWASCO has benefited from the model, as it has increased its revenue collection three-fold from customers in Nyalenda and is now moving towards reducing unaccounted-for water.

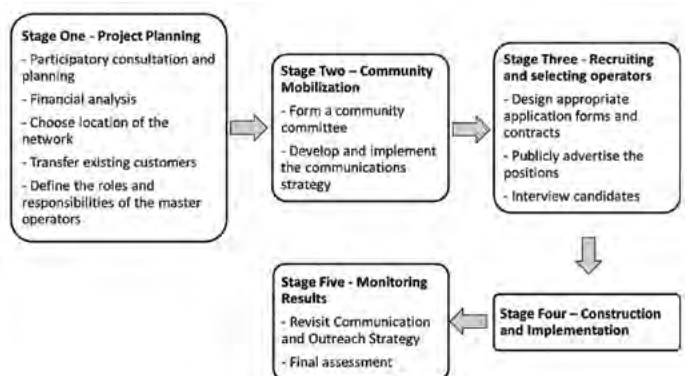
Lessons Learnt

- **Policy changes:** The changes in the 2002 National Water Act reforms allow for public-private partnerships and recognize small-scale providers in the management of water services.
- **Political will:** The LVSWB and KIWASCO have demonstrated that political will can solve the challenge of serving the poor, and have assigned a strong mandate to the water company to improve services in uncovered areas.
- **Project planning:** In order to facilitate smooth implementation, the detailed action plan should include: (a) financial analysis to determine tariffs; (b) a participatory methodology for selecting the project area; (c) designing a process for transferring existing customers (where applicable); (d) defining the roles and responsibilities of the operator; and (e) developing a thorough communication and outreach strategy.
- **Community mobilization:** Allocating adequate financial and human resources is critical to ensure community participation. The earmarking of funds for the outreach campaign prior to any capital works contributed towards the ease of implementation of the project. The community engagement should be continuous at all stages of the project.

- **Recruiting and selecting operators:** The transparent and competitive bidding process organized by the utility for selecting operators had a significant role in the success of the project.

Replicability

The Nyalenda model is replicable in other contexts as well; as it has been done in Manila in the Philippines. In India, a large proportion of the urban population, mostly the poor and those living in informal settlements, remain without access or with inadequate access to safe drinking water. In the absence of drinking water source within their premises, slum dwellers are often left with little choice except to wait in queues at a community water source, which may or may not be a treated water source. In this context, the Delegated Management Model can be used for water service provision in low-income areas, if there is a strong political will and a supportive policy framework put in place. The following methodology can be adopted for implementing the delegated management model:



The partnership between the water utility and the service provider, contracted through a competitive bid from within the community, can lead to extending the coverage into low-income areas and formalizing the services. The model can help the water utilities to reduce the non-revenue water (from illegal

connections), increase revenue for water utilities, and provide higher quality service at more affordable prices to the poor. In the delegated management approach, it becomes possible for utilities to think about informal settlements as markets where services may be provided in a financially viable manner.

NON-CONVENTIONAL CONDOMINIAL NETWORKS IN PARAUAPEBAS, BRAZIL

Location	Parauapebas, Brazil
Region	Latin America
Year	1993
Agency	Municipal Prefecture of Parauapebas (PMP), Companhia do Vale do Rio Doce (CVRD), The World Bank

Project Aim

To ensure access of water supply and sanitation in unconnected neighbourhoods by the construction of condominial networks instead of traditional network systems.

Context

The City of Parauapebas, located in the northern region of Brazil, has a population of 1,76,582 and has a well-planned urban form as well as physical and social infrastructure. Established less than 20 years ago, the city owes its rapid growth to the development of rich iron ore deposits by the mining company, Companhia do Vale do Rio Doce (CVRD). By the early 1990s, the infrastructure systems started deteriorating and served only a small area of the city. In terms of water supply, only 1,000 residents occupying the CVRD company condominiums had access to regular supply. An additional 5,000 residents of downtown neighbourhoods had piped delivery of untreated water from the local river, whereas another 15,000 people relied on contaminated water from wells, public fountains or municipal tankers.

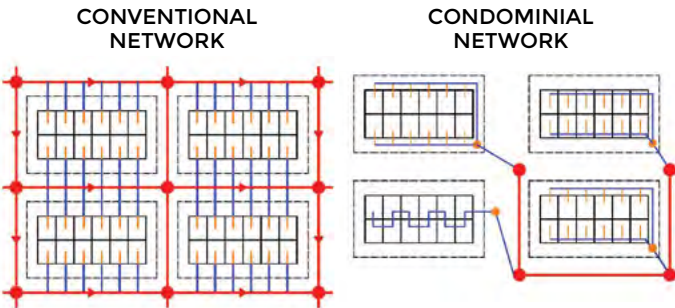
Project Description

In 1993, a collaboration agreement was signed between CVRD and the Municipal Prefecture of Parauapebas (PMP) for securing a loan of US\$7.8 million (later increased to US\$14.5 million) from the World Bank to finance the expansion of water and sewerage services in the city. The initial project design entailed a conventional system of networks to serve 90% of the city's population with a provision of 250 litres per capita per day. During the implementation of the project, it became apparent that the funding was insufficient for covering the cost of the planned conventional systems. In order to complete the project within the original

ALTERNATE WATER MANAGEMENT SYSTEMS

An alternate water management system was developed in Brazil during the 1980s and was first employed in the city of Natal, called as the 'condominial approach'²². The idea for the condominial approach was born with the vision of attaining universal coverage, in accordance with requirements of minimal costs and an ability to adapt to diverse urban environments.

Currently, the condominial water supply and sewerage systems are operating, in over one hundred localities, in at least three countries serving 5 million people with 10 million meters of condominial branches. This includes systems in diverse situations representing all forms of housing, topography and income, slums, wealthy neighbourhoods, flat and steep topography, low and medium densities, metropolitan cities and rural towns. The key instrument of this approach was the 'condominium': a neighbourhood unit where there is certain homogeneity amongst neighbours regarding: the houses, culture, income, problems and, thus, solutions. Unlike the conventional network where the water supply connection is provided to each household, in a condominial network the supply from the main branch is provided to the condominium from where the individual households draw their connection as shown in the figure.



²² Jose Carlos Melo, The Experience of Condominial Water and Sewerage Systems in Brazil: Case Studies from Brasilia, Salvador and Parauapebas, The World Bank, Lima, 2005

COST COMPARISON (1997 USD) FOR WATER SYSTEMS

	Original conventional design		Proposed condominal design	
	Total cost	Cost per connection	Total cost	Cost per connection
Excavation	454,000	88	101,000	19
Pipes	407,000	79	129,000	25
Total	629,000	94	373,000	56

budget, it was decided to switch the network designs over to the condominal system after a feasibility study highlighted the technical and financial merits of the unconventional system.

Key Results and Impacts

- The water coverage rate in the city increased fourfold over the period 1998 to 2004, increasing from 18% to 82%. The meter coverage, which peaked at 77% in 2000, has subsequently declined to 62% of the total due to the expansion of the overall system coverage.
- The implementation of the condominal system for water supply has proved feasible on a large scale in Parauapebas at a relatively low cost. The system has demonstrated its versatility in the challenging peri-urban environments, where conventional systems have been unsuccessful.
- The operation and maintenance problems posed by condominal systems for the utility company are less severe than those posed by conventional systems.
- The large-scale social mobilization during the implementation of the condominal network has enabled the residents to be empowered and take decisions about system design issues at the level of each condominium.

Lessons Learnt

- The condominal network is an innovative method for reducing the investment cost for the expansion of the water supply networks to unconnected areas. The technology simplifies the design and characteristics of the pipelines, making it physically easier to connect households.
- The success of the model depends on the clarity in the development of new relations of co-responsibility for services between the regulator, the service

provider and the user. The model introduces a participatory component in the implementation phase of the project.

- The overall capital cost savings of implementing the model, as compared with the conventional technology, is 40-50%. The decentralization of facilities in the model reduces the transportation costs associated with concentrating large volumes of fluids at single geographical points to feed large-scale plants in a conventional system.
- Apart from the financial benefits, the flexible condominal layout allows working in irregular, informal urban settlements, steep slopes and rocky terrain.
- Better hydraulic functioning is another advantage of the model. Smaller diameters allow greater buoyancy and more efficient transportation, especially in high density areas.
- A sound legal framework related to the construction standard along with a fair fee structure for both the connection to and use of condominal systems is important to ensure that the residents benefit from any cost savings associated with the choices they make.

Replicability

The model of the condominal system for water supply is replicable in the unconnected areas in the Indian cities, like the slums, unauthorized colonies, urban villages and peri-urban areas,

Overview of coverage, metering and distribution losses							
%	1998	1999	2000	2001	2002	2003	2004
Household coverage	18	56	74	74	79	82	82
Meter coverage	46	72	77	70	60	64	62

INSTITUTIONAL FRAMEWORK

An appropriate regulatory framework was developed for the delivery of water services to the unconnected areas, which was introduced as a Municipal Law. This law incorporated principles for determining and updating the water service fees and service quality provisions.

Prior to the development of the condominal system in the city, the limited service available had been provided by the CVRD to its employees. Following the expansion of the system, the responsibility was transferred to the municipality, which had no prior experience with the construction and operation of water systems. An outside engineering firm was therefore hired to build the system. The subsequent operation and maintenance of the system was contracted out to a private operator. The responsibility of regulating and overseeing the work of the contractor was held by the Municipal Water and Sewerage Service created within the local authority.

NETWORK DESIGN

(a) Public distribution network: The unconventionally designed public distribution network covered 287 kilometres of streets with a total length of 43 kilometres. Given that a conventional network would have been laid out along the full extension of the road network, this represents a reduction of 85% in the public water supply network needed, resulting in savings in terms of reduced excavation, breaking and resurfacing of sidewalks, fewer materials, as well as a more minor disruption of urban life in the execution of the works.

(b) Condominial branches: The condominial branches for water were routed along the sidewalks to provide individual connections to each plot for subsequent metering of use. The condominial branches of the water network were placed at an average distance of one meter from the front of the plots and at a depth of approximately 0.40 meters. Connections to each plot were made into the condominial branches at the most convenient points in each case.



Design of condominial water distribution network in a residential block in Parauapebas

FINANCIAL ASPECTS

There was no formal connection fee for the service. All the households purchased the materials required to complete the condominial branches and household connections, as well as contributed their labour for the execution of works. The tariff structure consisted of a fixed monthly fee of US\$2.78 and a social tariff of US\$0.25 per cubic meter for the first 10 cubic meters of monthly consumption. Residential consumption beyond the social tariff threshold, as well as all non-residential consumption, was charged at a rate of US\$0.99 per cubic meter.

SOCIAL IMPACT

The price bid by the winning construction company for the development of the condominial systems was high due to the cost associated with the development of the condominial branches. In order to resolve this, the community labour was mobilized for the construction of the condominial branches. This led to the large-scale community participation in the construction of the condominial branches. Overall, the social mobilization process involved 60,000 people organized into 800 condominiums.

This was facilitated by entering into a dialogue process with the community, whereby the rationale for the decision was explained and the rules governing the process publicly consulted. The consultation process was implemented by local grass roots organizations, including churches, social clubs, trade unions, political parties and community associations. A set of rules were developed for the fair and transparent division of labour between the community and the municipality for the implementation of the project; the municipality undertaking the technical tasks involved in the execution. A pilot project was implemented within a limited area of the city to further gain people's support.

OPERATIONAL ASPECTS

In the operation of the condominium water networks, the overall shorter length of the network led to the reduction in maintenance per connection and distribution losses. The structure of the condominium network facilitates the introduction of macro-metering and condominium-level meters, which both contribute to reducing leakage and allow smaller areas of the network to be isolated to minimize the disruption of service during repairs. The network design reduces the number of junctions, thereby reducing losses and illegal connections.

During 2002 and 2003, the breakages on the public network accounted for approximately 3% of breakages on the system, and amounted to around 0.7 maintenance incidents per kilometre. Approximately 93% of the breakages on the system were concentrated in the condominium branches. Almost half of these were related to the meter serving the condominium. With regard to metering, condominium systems allow for household meters and facilitate macro-metering as a result of the block structure of the network design.



Installation of the
Public Water Network



View of Condominial
Water Branch



Installation of micro-meter in household
connection, Parauapebas

where its implementation would require lower capital costs than the conventional systems, as illustrated in the case of Parauapebas. For the municipalities that are low on financial resources, especially in smaller cities, the condominium network is an ideal system.

The per capita design water consumption of 250 litres per capita per day is unsustainable to be achieved in Indian cities, and should be reduced to an optimal level while setting project

targets, while replicating the model. However, the basic concept remains valid: the cost of the public distribution network can be substantially reduced if the supply is to condominiums (or co-operatives) rather than to individual households and if the in-condominium pipework is installed by the condominium members. It is important for community mobilization efforts to be promoted; educational messages relating to proper system use and maintenance can play a crucial role in all stages of the project.

ANNEXURE

CONTACT DETAILS OF IMPLEMENTING AGENCIES FOR THE CASE STUDIES

Location	Source of Information	Agency's Contact
Theme 1: INTEGRATED WATER MANAGEMENT		
Singapore	<ul style="list-style-type: none"> • "Good Practices in Urban Water Management: Decoding Good Practices for a Successful Future" edited by Anand Chiplunkar, Kallidaikurichi Seetharam, Cheon Kheong Tan, accessed in July 2014: www.adb.org/publications/good-practices-urban-water-management • "Water Management in Singapore" by Cecilia Tortajada, accessed in July 2014: www.kysq.org/docs/Tortajada_2006.pdf • "Singapore: An Exemplary Case For Urban Water Management" by Cecilia Tortajada, accessed July 2014: waterwiki.net/images/c/cb/UrbanWaterMSingapore.pdf 	<p>Public Utilities Board (PUB) Headquarters, 40 Scotts Road #22-01, Environment Building, Singapore 228231 Tel: (65) 62358888 Email: PUB_One@pub.gov.sg Website: www.pub.gov.sg/water</p>
Theme 2: WATER UTILITY REFORMS		
Phnom Penh, Cambodia	<ul style="list-style-type: none"> • "Water Supply of Phnom Penh: An Example of Good Governance" by Asit k. Biswas, Cecilia Tortajada, accessed in July 2014: lkyspp.nus.edu.sg/iwp/wp-content/uploads/sites/3/2013/04/2010_Water-Supply-of-Phnom-Penh_Water-Resoufces.pdf • "Public Provision for Urban Water: Getting Prices and Governance Right" by Eduardo Araral 	<p>Phnom Penh Water Supply Authority Office 45 st.106, Sangkat Srah Chork, Khan Daun Penh, Phnom Penh, Cambodia Tel: 855 23 724 046 Email: Admin@ppwsa.com.kh Website: www.ppwsa.com.kh/en/</p>
Burkina Faso	<ul style="list-style-type: none"> • "Corporatizing a water utility: A successful case using a performance-based service contract for ONEA in Burkina Faso" by Philippe Marin, Matar Fall, and Harouna Ouibiga, accessed: openknowledge.worldbank.org/handle/10986/10507 	<p>Office national de l'eau et de l'assainissement (ONEA) Ouagadougou, Burkina Faso Website: www.oneabf.com</p>
Theme 3: LOSS PREVENTION AND LEAKAGE CONTROL		
Tokyo, Japan	<ul style="list-style-type: none"> • c40.org/case_studies/tokyo-world-leader-in-stopping-water-leakage • "Prevention of Water Leakage in Tokyo, 2013" by Bureau of Waterworks, Tokyo Metropolitan Government 	<p>Bureau of Waterworks Tokyo Metropolitan Government 8-1 Nishi-Shinjuku 2-chome, Shinjuku-ku, Tokyo 163-8001 Tel: +81-3-5320-6336 Email: international_affairs@waterworks.metro.tokyo.jp</p>
Dublin, Ireland	<ul style="list-style-type: none"> • "The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries" by The World Bank Group, accessed July 2014: • siteresources.worldbank.org/INTWSS/Resources/WSS8fin4.pdf 	<p>Water Services Division, 68-70 Marrowbone Lane, Dublin 8 Tel: 01 222 0600 Email: customerservices@dublincity.ie</p>
Sao Paulo, Brazil	<ul style="list-style-type: none"> • "The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries" by The World Bank Group, accessed July 2014: • siteresources.worldbank.org/INTWSS/Resources/WSS8fin4.pdf 	<p>Companhia de Saneamento Básico do Estado de São Paulo (SABESP) Website: site.sabesp.com.br/</p>

Location	Source of Information	Agency's Contact
Theme 4: PARTNERSHIPS FOR WATER		
Cochabamba, Bolivia	"Water Solutions through Selective Management" by World Habitat Awards, accessed: www.worldhabitatawards.org/winners-and-finalists/project-details.cfm?lang=00&theProjectID=18A21699-15C5-F4C0-994C6EDACF22F69C	SEMAPA Municipal Water Service Street Kapac Yupanqui No. 2336 PO Box: 1647 Cochabamba - Bolivia Tel: 4290755 -56 -57 Website: www.semapa.gob.bo
Dakar, Senegal	"Dakar, Senegal: Case study (Water)" by Special Unit for South-South Cooperation, UNDP, accessed: www.esc-pau.fr/ppp/documents/featured_projects/senegal.pdf	Société Nationale des Eaux du Sénégal (SONES) Route du Front de Terre Hann Dakar, 400, Senegal Tel: 221 33 832 20 38 Email: sones@sones.sn Website: www.sones.sn
Netherlands and Mongolia	"Water Operators' Partnerships in Asia: Case Study III" by Global Water Operators' Partnership Alliance (GWOPA) and UN HABITAT, accessed: www.zaragoza.es/contenidos/medioambiente/onu/821-eng.pdf	Vitens Evides International Reactorweg 47, 3542 AD Utrecht P.O. Box 1205, 8001 BE Zwolle The Netherlands Email: secretariaat.vei@vitens.nl
Theme 5: WATER FOR URBAN POOR		
Kisumu, Kenya	<ul style="list-style-type: none"> • "Global Experiences on Expanding Services to the Urban Poor" by Water and Sanitation Program, World Bank, 2009, accessed: www.wsp.org/sites/wsp.org/files/publications/SA_GUIDANCENOTES_globaleg.pdf • "Improving Water Utility Services through Delegated Management" by Water and Sanitation Program, World Bank, 2009, accessed: www.wsp.org/sites/wsp.org/files/publications/Af-imp_through_delegated_mgmt.pdf 	Kisumu Water and Sewerage Company Limited Nafaka House Oginga Odinga Street - Makasembo Road P.O Box 3210 - 40100 Kisumu, Kenya Tel: +254 57 202 4100, 202 3977, +254 721 757 382 Email: info@kiwasco.co.ke Website: www.kiwasco.co.ke
Parauapebas, Brazil	"The Experience of Condominial Water and Sewerage Systems in Brazil: Case Studies from Brasilia, Salvador and Parauapebas" by Jose Carlos Melo, The World Bank, accessed: www.wsp.org/sites/wsp.org/files/publications/BrasilFinal2.pdf	Municipal Prefecture of Parauapebas (PMP) Website: www.parauapebas.pa.gov.br/



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