JUNE 2009
VOLUME 4 ■ ISSUE 2

water utility management
INTERNATIONAL

ANALYSIS

FEATURES

water21
magazine of the | International Water Association
IWA Publishing

US collaboration releases utility management case study document

Six associations representing the US water and wastewater sector, in collaboration with the US EPA (Environmental Protection Agency), have released a document titled 'Effective water and wastewater utility management case studies', a companion to last year's 'Effective utility management: a primer for water and wastewater utilities'.

This companion piece provides concrete examples and 'how to' assistance for utility managers through profiles of four utilities that successfully applied the primer concepts and tools to progress effective management practices and achieve long-term sustainability.

The Effective Utility Management (EUM) collaborating associations – the American Public Works Association (APWA), American Water Works Association (AWWA), Association of Metropolitan Water Agencies (AMWA), National Association of Clean Water Agencies (NACWA), National Association of Water Companies (NAWC), the Water Environment Federation (WEF), and EPA – have been working together over the past two years to promote effective utility management across the water sector, based on a series of ten attributes of effectively managed utilities and five keys to management success identified originally in a report released by the group in May 2007.

The new case study document illustrates how four utilities used the attributes and keys, along with example measures and a self-assessment tool found in the primer, to improve management operations, bring a crisp and cost effective focus to their initiatives, and supplement both their internal and external communications. ●

World Bank provides guidance on successful water and sanitation reform

The World Bank has issued a new report on the guiding principles for successful reform of urban water supply and sanitation sectors, which aims to provide practical guidance to its own teams advising on the implementation and design of urban water supply and sanitation sector reforms.

The report's three main chapters discuss how to measure the performance of an urban water and sanitation service, explain apparent performance gaps (if these exist) and how to design and implement reforms so that they increase access to infrastructure, improve operational efficiency and increase the reliability, sustainability and affordability of the service.

The report is based on a number of pieces of analytical research either already published by the Bank or due for publication on a range of topics such as governance, service efficiency and public-private partnerships.

It also provides a range of case studies to illustrate the various reform topics that it covers, either of successes or of the consequences of failure to reform (see Analysis page 4). ●

Banks set up multi-country Islamic infrastructure fund

The Asian Development Bank (ADB) and the Islamic Development Bank (IDB) have agreed to set up Asia's first major multi-country Islamic infrastructure fund.

The Islamic Infrastructure Fund, which has a target of $500 million, will make Shari'ah-compliant equity investments in the 12 countries that are borrowing members of both development banks, currently Afghanistan, Azerbaijan, Bangladesh, Indonesia, Kazakhstan, Kyrgyz Republic, Malaysia, Maldives, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan. Most of Asia is in urgent need of additional spending on infrastructure, the ADB says, but infrastructure in the target countries is frequently worse than the Asian average.

Robert van Zwieten, director of ADB's Capital Markets and Financial Sectors division, said: 'In Indonesia, only 39% of urban dwellers have access to piped water, only 9.5% of roads in Afghanistan are paved and only 42% of Bangladesh's population has access to electricity. Without added investment to change that, economic growth and poverty reduction will be held back.'

The investment is the ADB's first Sharia'ah-compliant fund. Such instruments are structured to comply with Islamic law, which bars investment in interest-bearing securities or in forbidden activities such as gambling. ●

water utility management INTERNATIONAL

EDITORIAL

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Water Utility Management International focuses on the interests of utility executives, policy makers and advisors around the world engaged with the key management issues faced by water and wastewater utilities. As well as senior utility managers, the publication will be of interest to regulators, consultants, contractors, academics, and financial, technical and legal professionals.

Utility reform and achieving efficiency are central themes of the publication, encompassing topics such as benchmarking, investment planning, consolidation, public / private sector roles, leadership, IT, and human resources. Other regular themes include financing, regulation, charging policies, procurement, corporate governance and customer issues.

For more information, visit:
www.iwaponline.com/wumi/default.htm

PUBLISHING

Publisher
Michael Dunn

Water Utility Management International is published four times a year (March, June, September, December) by IWA Publishing. Statements made do not represent the views of the International Water Association or its Governing Board.

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12, Caxton Street,
London SW1H 0QS, UK
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Email: publications@iwap.co.uk
Web: www.iwapublishing.com

SUBSCRIPTIONS

Water Utility Management International is available as either a print or an online subscription.

2009 price (4 issues):
£187/ €282 / $373
(IWA members: £164 / €246 / $328)

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Portland Customer Services
Commerce Way, Colchester
CO2 8HP, UK
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Or visit:
www.iwaponline.com/wumi/default.htm

Design & print
Layout: IPL Print & Design Ltd
Original design: John Berbuto
Printed by Hobbs the Printers, UK

ISSN (print) 1747-7751
ISSN (online) 1747-776X

Banks fund St Petersburg wastewater treatment improvements

The city of St Petersburg in Russia will reduce the amount of untreated sewage discharged into the Baltic Sea to just 6% of total effluent in three years' time thanks to a new project jointly financed by the European Bank for Reconstruction and Development (EBRD), the international community, the Russian budget, the local government and the city's water utility.

The EBRD funds will be used to upgrade St Petersburg's Northern wastewater treatment plant and to finance the construction of a tunnel pumping station in the main underground collector sewer for the north of the city.

Currently, 85% of the effluent discharged into the Gulf of Finland is biologically treated because of a series of projects over the last 12 years funded by Russia's neighbours and international institutions. The new project will take this figure to 94% by 2012.

The city's ultimate goal is to eliminate all discharges of untreated sewage to reduce pollution and safeguard the vulnerable Baltic Sea.

The EBRD will contribute a 15-year loan of €17.5 million ($24.4 million) and a €6 million ($8.37 million) grant from its Shareholders' Special Fund to the €187.1 million ($260.96 million) cost of the project.

The borrower is the city water utility, whose official name is the State Unitary Enterprise Vodokanal of St Petersburg. The Nordic Investment Bank (NIB) is also lending €25 million ($34.87 million) and the European Investment Bank (EIB) another €17.5 million ($24.4 million). The project is also receiving financial support from the governments of nearby Finland and Sweden.

The Neva Discharge Closure project, like several previous major environmental schemes in the area, is part of a programme launched by the Northern Dimension Environmental Partnership (NDEP) and is backed by a €24 million ($33.47 million) grant, the largest ever allocated for a single project by the NDEP Support Fund.

The NDEP was set up by the international community in 2001 to tackle the region's main pollution problems, particularly in north-west Russia. ●

Business

SOUTH AFRICA: Johannesburg Water announces major infrastructure spend
Johannesburg Water has announced that it will spend R500 million ($61.5 million) over five years to replace a large swathe of ageing water pipe infrastructure, in an attempt to finally cure leaks and bursts in the system.

EGYPT: OCI claims best bid for Cairo wastewater treatment plant
Egypt's Orascom Construction Industries (OCI) has said that its joint venture with Spain's Aquila submitted the best bid for a 250,000m^3/day capacity wastewater treatment plant for Cairo. OCI said the bid value was $459 million, but that bids are still being evaluated. The winning consortium will build and operate the plant for 20 years.

ZIMBABWE: Reports claim need for $40 million spend on Harare water system
News reports from Zimbabwe claim that Harare requires over $40 million to refurbish its water treatment plant and improve the capital's water supply. Reports suggest the city could be suffering up to 45% leakage. Major repairs to the plant have already begun, following the city's decision to take control of its water supply from the state utility, Zinwa.

ABU DHABI: Adwea agrees finance for major desalination project
Abu Dhabi Water and Electricity Authority (Adwea) has agreed a deal to finance construction of the $2.5 billion Shuweihat Two power and desalination plant. The new plant will have a daily capacity of 1500MW and 1MGD (454,610m^3/day) but its location has not yet been decided. The 1.2km^2 plant will be built as a turnkey project by Siemens Energy and its partners Doosan Heavy Industries and Samsung Engineering and Construction. The plant is due to go into operation in September 2011.

MACAO: WABAG announces new subsidiary with Coloane plant startup
With the start-up of operational management of the large-scale Coloane wastewater plant in Macao, WABAG has announced it has gained both a new subsidiary, in the form of WABAG Water Services (Macao), and a further order. The 130,000 m^3/d Coloane wastewater treatment plant has been enlarged and updated on the basis of SBR (Sequencing Batch Reactor) technology.

GREECE: Country announces moves to privatise water utility
Greece's finance ministry has announced that the country will begin the privatization of its second-largest water utility, Thessaloniki Water (Eyath), by starting the procedure to find a strategic investor for the utility. The first step will be to choose the government's advisors, and the government says that foreign companies have already shown an interest.

US: Black & Veatch wins Georgia water development and conservation project
Black & Veatch has been chosen by the Georgia Environmental Protection Division to help prepare water development and conservation plans for three of the state's regional water planning councils. The project is part of the state's comprehensive water management plan, which focuses on development of water plans for all ten of its regions. The company will work with the neighbouring Middle Chattahoochee, Upper Flint and Lower Flint-Ochlockonee regional planning councils, using water resource assessments and population projections for up to 40 years in the future to develop realistic estimates of future water use. These will then be compared to the available resources to identify any shortfalls. The company will then work with the councils to choose the right mix of new water source development and water conservation actions.

Record EPA budget includes significant funding for water and wastewater

The US EPA's 2010 budget includes $3.8 billion for maintaining and improving outdated water infrastructure and wastewater, the regulator has announced.

The funding will support efforts around the country to build and renovate an estimated 1000 clean water and 700 drinking water infrastructure projects, support green infrastructure and create thousands of technical and construction jobs. Funding will also be available to help communities repair and upgrade aging networks of drinking water and wastewater pipes that are overwhelmed and breaking down.

The budget includes a $475 million multi-agency Great Lakes initiative to protect and clean up the world's largest freshwater lakes through restoration efforts, invasive species control, non-point source pollution mitigation and protection of critical habitats.

The funds also support key efforts to protect, maintain, and restore the Chesapeake Bay and the Anacostia river, Puget Sound, San Francisco Bay, Lake Champlain and other large water bodies.

The EPA will also make significant investments in its greenhouse gas emissions inventory, including new analytical tools and upgraded testing capabilities, and it will coordinate with other agencies on research and green initiatives. ●

World Bank approves funding to support sustainable river basin development

The World Bank has approved a loan for $840 million in support of the Matanza-Riachuelo river basin sustainable development project. The loan will support the government's integrated basin cleanup strategy, which aims to progressively eliminate discharges to the Matanza-Riachuelo river, thus improving water quality and environmental conditions.

The Matanza-Riachuelo river is polluted by industrial discharges, wastewater from households not yet connected to sewerage systems, overflows from contaminated storm drainage systems and other sources. In order to resolve these issues, the project will improve sewerage services in the river basin and other parts of the province and in the capital city, Buenos Aires, by expanding transport and treatment capacity.

The funds will also support reductions in industrial discharges to the river, by providing industrial conversion grants to SMEs (Small to Medium-sized Enterprises) and promoting improved decision-making for environmentally-sustainable land use and drainage planning, as well as piloting urban drainage and land use investments in the river basin.

The project will also strengthen the institutional framework of the basin agency, ACUMAR, for the ongoing and sustainable clean-up of the river basin. ●

Loans and Tenders

BURKINA FASO: World Bank provides IDA grant for urban water sector project

The World Bank has provided an IDA (International Development Association) grant of $80 million to Burkina Faso to help with its urban water sector project. The project aim is to support the improvement and expansion of potable water and sanitation services in the cities of Bobo-Dioulasso, Dédougou, Koudougou and Ouagadougou. The operation follows a project to supply water to the city of Ouagadougou from the Ziga dam, which was funded by IDA and around ten other donors.

LESOTHO: World Bank loan supports water sector improvement

The World Bank has provided $16.5 million to Lesotho for the second phase of its water sector improvement project, which has three aims: to support the country in developing and sustaining an environmentally sound, socially responsible and financially viable framework for the Metolong dam and water supply programme (MDWSP); increasing the quantity of safe, bulk water supplied to Teyateyaneng; and strengthening institutions and related water sector instruments.

ALBANIA: EC provides funds to upgrade and rebuild infrastructure

As part of its pre-accession partnership, the European Commission has announced that it will grant €60.9 million ($86.24 million) to Albania for 24 projects in administrative reform, education and rural infrastructure, to align Albania closer to other European states as a precursor to EU membership. The parties also signed an agreement to help Albania rebuild a village near Gerdec that was damaged in a munitions explosion last year, with the funds financing a school, water supply and wastewater system.

JORDAN: EIB lends funds for water transfer project

The European Investment Bank (EIB) has signed a $100 million loan with the Jordanian government to finance construction of a pipeline to bring 100M.m^3 of water each year from Disi, in the south of the country, to the capital, Amman. The project will include construction of 325km of pipeline.

ZIMBABWE: NGOs fund Bulawayo water and wastewater improvement

News reports from Zimbabwe press say that Non-Governmental Organisations (NGOs) are funding the rehabilitation of Bulawayo's decrepit sewer and water networks to prevent outbreaks of waterborne diseases. Residents have voiced fears about flows of raw sewage in various districts due to bursts in aging sewer pipes. NGOs include World Vision, UNICEF, Africa Sales and residents associations.

INDONESIA: ADB approves infrastructure development funding

The ADB (Asian Development Bank) has approved investment of up to $140 million in the government-backed Indonesian Infrastructure Financing Facility to support urgent infrastructure development in Indonesia. Critical infrastructure shortages are holding back economic growth and poverty reduction in Indonesia but private-sector investment has been low because of the dearth of long-term financing from banks or through the capital markets. The facility will provide financial assistance in the form of long-dated debt instruments, equity, or guarantees for infrastructure projects. Through this move the bank aims to attract six to seven times more private sector investment to Indonesia's infrastructure sector than there currently is.

EUROPE: EBRD takes stake in equity investment vehicle

The EBRD (European Bank for Reconstruction and Development) is to take a minority stake of up to €80 million ($114 million) in Aqualia Equity Investment which will make investments in full or partial water cycle concessions, acquisitions, service contracts and contracts for the construction and management of hydraulic infrastructure in the Bank's countries of operations. This operation will support and expand private sector participation in the water utility sector in Central and Eastern Europe, including Hungary, Slovak Republic, Romania, Poland, Russia and other countries of operations. The project will play a key role in supporting a major international water operator as it expands into new markets. The investment will help to restructure and improve water and wastewater operations in its target markets, ensure availability of funding sources necessary to address urgent infrastructure needs, thereby promoting long-term sustainability.

World Bank report advises on reform processes

A new report from the World Bank lays out a structured approach to reforming urban water and sanitation sectors that can be applied to different countries. **LIS STEDMAN** looks at how the report aims to act as a source of reference for both Bank teams and consultants in terms of developing better service provision.

The World Bank's new document on guiding principles for successful reform of urban water supply and sanitation sectors is described as 'a structured methodology to help think outside the box'. As the text points out, there is no such thing as 'one size fits all' and the approach used in a French-speaking west African country may well not be directly replicable in an English-speaking south Asian country.

If solutions differ, issues are often similar, the report adds. This allows the authors to propose a structured methodology for engaging in the reform process and for building a broad consensus on the design of its key components.

The practical, unifying nature of the report is also stressed. The authors note: 'Several reports have recently been published by the Bank on specific topics related to urban water supply and sanitation (WSS). Bank teams involved in operations may not always be aware of such reports, let alone publications by other institutions, even if the new website of the Bank water practice makes a large volume of information available. Also, Bank teams involved in operations often do not have sufficient time to read lengthy papers and extract what is needed to advise on specific reforms. This report is also meant to be a sourcebook, pointing Bank teams to relevant Bank publications and indirectly to publications by other institutions, as well as summarizing key issues covered while proposing a logical framework for establishing a link between them.'

The report is also intended to improve the output of consultants. As it says, 'Bank teams are seldom responsible for directly advising governments on the reform process. The performance of consultants engaged by governments, and sometimes by the Bank, to carry out such tasks has been variable either because of irrelevant experience, ambiguous terms of reference (TORs) or inadequate guidance provided during reviews of consultants' reports. This report should help to draft more focused TORs.'

The report, like many, is also aimed at helping countries to get on track to meet their Millennium Development Goals (MDGs), as it is acknowledged that many in sub-Saharan Africa and south-east and southern Asia will struggle to achieve their targets in time.

The report introduces the typical reasons why even well-developed infrastructure may not guarantee good service – unreliable supplies, unsustainable charging systems, unsustainable resource depletion, and supplies that are, despite complex tariffs, unaffordable by low-income groups.

The report focuses on improving the service provision of official providers – given that they may have limited coverage and poor performance, they are often not the sole providers of services, with backyard wells and boreholes and small entrepreneurs with tankers or water vendors also a part of the picture.

The first chapter provides a quick analysis of the United Nations Children's Fund (UNICEF)/World Health Organisation (WHO) Joint Monitoring Programme data for monitoring the evolution of access to urban watsan infrastructure, and reviews the IBNET (International Benchmarking Network) indicators for measuring efficiency, reliability, financial sustainability, environmental sustainability and affordability of piped watsan services, given the normal lack of reliable data.

Chapter 1 also stresses the need to understand the role of substitutes when the official service is insufficient. The following chapter provides a summary of the proposed methodology for assessing the 'accountability framework' of urban water and sanitation sectors, which it defines as the 'set of mandates of its key actors, contractual arrangements that clarify both interaction between actors and the instruments used by each actor to implement their mandates'.

This segment focuses on key functions of the sector: policy formulation, asset management and infrastructure development, service provision, financing of operations and economic regulation of the service. It also recommends that attention be paid to incentives, either productive or counter-productive, which influence performance, and suggests identifying vested interests that may be affected by moves towards better practices.

Chapter 3 provides a summary of recommendations for design and implementation of reform, focusing on a number of key issues. One is the involvement of stakeholders in reform, because as the report says, 'reforming a non-performing urban WSS sector often leads to emotional debates that could rapidly get out of control if not properly framed.' The service quality and operations efficiency diagnostic therefore aims to provide rational arguments for engaging in constructive dialogues with key stakeholders. The report notes that 'identifying the losers in the reform process is as essential as identifying the winners to estimate the potential economic return of the reform.'

Another key recommendation is to revisit water and sanitation policies. The report notes: 'Options for structuring urban WSS sectors should be investigated as part of the reform process. This might include decentralizing or aggregating operations, splitting or combining drinking water production, distribution and wastewater collection and disposal operations or merging them with other network services, such as electricity distribution.' Resource management issues such as trading of water entitlements also need to be clarified, it adds.

The third key recommendation is to change the culture of water and sanitation service providers. The report recommends that service providers be corporatised, and that the selection procedures and operation of boards of directors, management teams and staff of such entities are clarified. Contractual commitments between providers and governments, which are often the main source of finance for utilities, also need to be considered. Instruments to increase accountability also need to be developed, the report adds.

Another requirement is to optimise water and sanitation asset management and infrastructure development. This requires a special focus because, as the report notes, 'significant inefficiencies can result from inadequate demand assessment, planning, design, procurement and project implementation procedures, as well as substantial diversion of public funds through fraudulent or corrupt practices.'

A further recommendation is to improve service provision through internally-developed programmes, which would include outsourcing non-core functions. The report also notes: 'Improving technical operations usually requires a special focus on reducing non-revenue water (NRW) and energy consumption, improving procurement of goods and parts and increasing staff productivity.' Customer relations, metering and billing and collection

procedures also normally need to be overhauled, it adds. 'A special focus on public customers, who could represent a large share of sales revenues, and low-income customers is often needed,' the report concludes.

The document also recommends improving provision through private sector partnerships, and the findings and recommendations of several Bank notes and toolkits are summarised. The focus is on the key steps for designing and implementing successful Public Private Partnerships (PPPs), the limits of these structures for raising commercial finance, and the allocation of risks and responsibilities, development of institutions to manage them and choosing private operators.

Financing operations in a sustainable and affordable way (a key MDG requirement) is also recommended. The report advises: 'Gradually transferring the burden of financing the full cost of the service to customers and building the creditworthiness of service providers so that financial markets can eventually be accessed make sense in developing countries whose governments are often faced with fiscal constraints and debt ceilings.' This can be a long process, and easing the transition often means that developing infrastructure is undertaken through a mix of cash generation, debt and grants, the latter of which have to be designed to encourage efficiency and phased out in the short to medium term.

Regulating the service in a transparent and predictable manner is also advised. The report observes: 'While economic regulation has often been associated with PPPs, it is mostly about stopping the monopoly abuse of WSS service providers that could provide a bad quality service and charge price above costs to increase their profits or cover their inefficiencies; thus public service providers should be regulated as should private ones.' The report provides a summary of recommendations for regulatory arrangements and key operating principles for a regulator.

A further key recommendation is implementation of water and sanitation reforms. Prioritised issues suggested include fixing the sector's financial situation (via a mix of actions such as balance sheet cleaning and cost-saving programmes), building in the autonomy of service providers, transferring infrastructure development responsibility to corporatised service providers, and development of plans to increase the quality of service and consumer accountability. The report also recommends that consultation should be maintained throughout the reform process. It concludes: 'If credible actions plans reflecting the above are submitted, the chances of mobilising financing for rehabilitating and expanding the infrastructure at favourable terms should greatly be increased.' ●

World Bank project aims to improve Egypt's sanitation

Egypt's Integrated Sanitation and Sewerage Infrastructure Project, financed by the World Bank, is aiming to improve and expand water supply and sanitation to the Delta and Upper Egypt. **LIS STEDMAN** looks at what the project entails.

Egypt's Integrated Sanitation and Sewerage Infrastructure Project (ISSIP) project is being financed by a World Bank loan of $120 million. The latest Bank statistics on Egypt show that 98% of the urban population have access to an improved water source, and 86% of urban residents have access to some form of improved sanitation. However, the rural sanitation figure is weaker, with 58% having some form of access but just 13% of the population having access to sewerage systems.

The participants in the recent workshop that introduced the new project were a complex mix of senior officials from the two lead agencies in the Ministry of Housing, Utilities and Urban Development, the National Organization for Potable Water and Sanitary Drainage (NOPWASD) and the Holding Company for Water and Wastewater (HCWW, responsible for financial and technical sustainability of a number of governorate-based utilities), and representatives from a range of other ministries covering health, water resources and international cooperation. Also present were members of the donor community, local councils in the target areas and staff from the project's implementing agencies as well as regional units of NOPWASD and HCWW.

The project is seen as an integral element in the Egyptian president's priority national village sanitation programme, and is in line with ongoing efforts to extend the potable water supply and create sanitation for the governorates in the Delta and Upper Egypt.

The sustainable development of water resources in the country faces a number of challenges, including a rapidly-increasing population, water quality deterioration and limited resources, burgeoning industrial and agricultural demand, fragmented water management and cost recovery issues.

ISSIP is seen as a model for coordination among the country's development partners, and is also intended as a showcase for integrated planning as it covers the same region and is closely aligned with the Integrated Irrigation Improvement and Management Project (IIIMP), which is also Bank funded. The aim is to pioneer a cross-sector implementation model that is a practical demonstration of IWRM.

Vijay Jagannathan, the World Bank MENA Water Sector Manager, explains that the history and hydrology of the Nile Delta area mean that for millennia people have been building canals, taking water from the Nile for both irrigation and potable uses. 'It is one integrated system of irrigation and drinking water. The downside is that upstream there are big cities like Cairo, and a number of others – there are 60 million living in the Delta, and one of the main concerns is pollution of the river and canals. It means farmers using water for irrigation have to stand in sewage water, it is so polluted.'

What the Bank found, working with the Egyptian government on the IIIRP, was that it was not enough to improve the way the water reached the farmers, Mr Jagannathan says, but it was also necessary to improve the quality. 'That is what led to this project. Initially it was all supposed to be one project, but the problem was so huge we had to separate it out.'

The project concept will combine the traditional approach of constructing sewer systems to take and treat black water, and will also try to work out the optimal way to treat the water before it is allowed to flow back into the canal system, he adds. 'There is a technical challenge over the size of the treatment plants. You have got villages scattered all over, but you get economies of scale with relatively large treatment plants. The problem is you need to spend huge amounts of money getting the sewage to them in the first place.' The treatment works will instead serve 'village clusters', a compromise between size and distance to treatment.

The project will additionally leverage the Bank's donor coordination expertise and the experience of other donors in the sector. Co-financing is being

provided by GTZ and the Netherlands. Dr Hussein El Atfy, first undersecretary at the Ministry of Water Resources and Irrigation (MWRI), told the two-day workshop that '[there] is no doubt that the water supply and sanitation sector is one of the significant service provision sectors with strong environmental and social aspects. In this regard, the project will contribute positive environmental and social impacts, resulting from the overall improvement of the water quality in a number of drains and canals in the project area. We are looking forward to the establishment of the monitoring and evaluation system across the two ministries as an important strategic planning and management tool.'

World Bank country director Emmanuel Mbi told the meeting that the Bank was particularly pleased to have a solid partnership with the Egyptian government to help improve access to sustainable rural sanitation services. He noted: 'The project's approach to rural sanitation service planning and delivery will ensure that the rural communities will be able to access this service and see the impact on their living conditions and environment. We are pleased that the design of the project and the collaboration among the different partners that are involved in its implementation demonstrates in many ways a new model for doing business.'

The ISSIP and IIIMP projects link for the first time in an Egyptian context irrigation and agricultural drainage work with potable water and sanitation services, a combination that would not have been considered in the past, when planning focused on individual villages and hotspots. The global move to IWRM has changed this approach, according to Dr Abdel Qawy Khalifa, chairman of the Holding Company for Water and Wastewater. He told the meeting: 'We look forward for the project's new approach in planning and low cost technology adoption to be replicated across the country under the national strategy for sanitation in a bid to deliver improved sanitation services to all Egyptians, increasing urban coverage to 100% and rural coverage over the coming five years from the current 7% to 40%.'

The new approach also provides a first-time link between access to investment in rural sanitation and quantifiable water quality and health improvements in a given hydraulic basin, according to World Bank task team leader Ayat Soliman. She noted: 'The partnership between Ministry of Housing, Utilities and Urban Development and Ministry of Water Resources and Irrigation in planning sanitation resources is in line with the overall water management and monitoring programs. Using village clusters to reflect this planning model is an important element of the new approach, and we are pleased that it is being adopted in the overall national strategy for rural sanitation.'

The project has now completed its first stage and is moving towards tendering for the various component projects. Mr Jagannathan says that the construction phase will last at least four years, as much of the construction is in densely populated areas. ●

PUBLICATIONS

Water and Sanitation Services

Public Policy and Management
Editors: Jose Esteban Castro and Leo Heller

Despite the progress being made towards water and sanitation service (WSS) provision, driven by Millennium Development Goal (MDG) targets of halving the world's population without access to services by 2015, there is still a large problem with regards to access to clean water supplies and adequate sanitation.

The editors felt there was a lack of debate and detailed information regarding the relations between technology and public policy and that greater organisation was needed in order to support policy design and planning with regards to its interaction with other areas such as health and water resources. The issue of service provision is addressed by taking a historical view of public policy and management, and where these have failed. Conceptual models are discussed and the drawbacks of current models, including the debate surrounding public-, market- and community-led WSS systems.

The first chapters cover the underlying social problems which affect the provision of services, and the potential negative impact of approaching service provision in purely profit-driven terms. The financing of services and the transfer of pipe infrastructure developments from the northern developed countries to southern developing countries are covered, including the challenges facing each. Water management and the operation of sewerage systems are discussed, focusing on experiences in Europe and the issue of affordability with regards to increasing WSS in developing countries. The issue of integrating technology and policy is addressed in order to develop a more successful implementation of WSS, and the history surrounding the development of current frameworks and the changes needed with regards to policy surrounding public health. In the second half, country and regional experiences taken from around the world are used to reflect the range of policies in existence worldwide and the challenges which affect their implementation. These chapters cover decentralisation in European and Nordic countries, financing WSS in poor urban areas in South Asia and the debates and conflicts surrounding access to water and sanitation in both developing and developed countries.

Earthscan, February 2009
352 pp. Hardback
ISBN 9781844076567
Price: £65.00
To order, visit: www.earthscan.co.uk

Workforce Planning for Water Utilities' Successful Recruiting, Training, and Retaining of Operators and Engineers

Water Research Foundation Report 91237 + CD-ROM
Authors: A Manning, T Brueck, M Isbell, and P Brink

Several factors are converging simultaneously to create a 'perfect storm' in today's utility workforce: the mass exodus of utility employees that is anticipated due to retirement in the next ten years, the increasing diversity in the current workforce, fewer US college graduates earning science or technical degrees, and values differences in younger generations of employees entering the labour market. A shift in approach to utility operations is required in order to be prepared for this pending labour crisis.

The objectives of this project were to identify: future labour pools for engineer and operator positions; utilities' short and long term needs for operators and engineers; 'attractors' that will draw the younger generations to utilities as a highly desired place of employment; recruiting, training, and retention methods that have elicited successful results in other industries and guidelines for applying those strategies in the utility industry; recommendations for improvements in training and certification programmes; and elements of utility culture that will build an organization's reputation as an employer of choice to multiple generations of employees.

Primary research consisted of a survey of utilities that identified the current state of the industry in terms of success of recruiting, training, and retaining operators and engineers. Also, interaction with students and young professionals took place, first in a 'reverse career fair' conducted at ACE and WEFTEC that involved completion of an online survey that assessed important job factors for the GEN Y population and then in focus groups also conducted at ACE and WEFTEC.

Secondary research was conducted that included identifying successful recruitment and retention strategies from other industries and completing a demographic analysis on new and existing pools of potential workers as well as channels to reach those pools. The results of the research were then compiled into industry-wide and utility specific strategies for recruiting and retaining engineers and operators.

IWA Publishing, 20 April 2009
ISBN: 9781843392491
224 pp. Paperback
Price: £120.00/US$240.00/€180.00
IWA members price:
£78.00/US$156.00/€117.00
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Toolkit aid for town water supply provision

As the urban population in developing countries increases, improved services are required to meet the demand, but often poor utility management structures and a lack of skilled workers hinder expansion and improvement in smaller urban areas. **SIMON GORDON-WALKER** explains the development of a business planning toolkit designed to assist the development of urban water supply provision, and improving operational efficiency in towns.

It may seem an obvious thing to say, but successful organisations are those that know what they are doing and do it well. 'Business planning' is precisely about the first part of the statement, and for water utilities it provides a basis for professional management of one of the most important life enhancing services. Many water services organisations have long been managed by professional managers in circumstances of stable political environments imbued with a culture that promotes and supports public service, and an altruistic commitment from government bodies that allows the poorest and needy to benefit from access to essential community services. However many are not. It is commonplace to talk about the untold sums of Dollars, Yen, Sterling and Euros that have been spent in Africa on water and sanitation; about the 'here today gone tomorrow' consultants and experts; about 'this' or 'that' new institutional model and the plethora of career developing reports from the brightest brains in our international funding institutions and research establishments. However, the condition and prospects of water services in many parts of the Africa and Asia remains low, especially in small urban areas or 'towns'. Locally, good expertise is drawn away from managing utilities as the brightest engineers get sucked into the consultancy world and become detached from delivering services to people and communities. Therefore, based on a project in Ethiopia where four town water utilities were provided with training and advice in preparing initial business plans, a business planning toolkit for the planning of an affordable town water supply has been developed (see box).

Government role in providing water services

Governments all over the world have rightly placed themselves under a lot of pressure to achieve better water and sanitation coverage for developing countries. The Millennium Development Goals (MDGs) aim to halve the proportion of people without access to water and sanitation services by 2015. Most governments in developing countries have consistently failed to deliver affordable and sustainable water and sanitation to the poor. It is difficult to summarise the causes for this failure as each situation is different and complex. However, some broad problems cut across many public utilities and municipal services, such as bad financial management, low funding priority, lack of staff experience and qualifications, absent or weak customer service orientation, political interference, and little or no independent regulation or oversight.

Many of these problems have been attributable to weak governmental and utility management capacity. Since the mid 1990s the introduction of policies to encourage the involvement of private sector participation (PSP) has been seen as an important measure to tackle many of these underlying causes of the failure of water utilities in developing countries to deliver improved access to water and sanitation to their communities and in their service to the poor in particular. Some progress was no doubt made by some international companies investing to improve water services in these countries. Nevertheless in some important areas such as capacity building, community participation, finance and institutional reform, major problems persist and international

Business planning toolkit

A toolkit for 'Planning affordable town water supply' has been developed to help towns develop their own business plan. The toolkit is a disc with a Pro-forma and an Excel workbook with guidance notes that can be used to create a financial model of the town water utility. It is user-friendly and provides guidance, explanation and examples to help the person using it.

The toolkit works by first using the Pro-forma and guidance notes to start writing a business plan. The approach links technical design to willingness to pay. This may result in new construction being done in a phased approach that will ensure that the town water utility is financially sustainable.

The user is guided to the input screens of the spreadsheet indicated on the welcome page of the financial model. The model works by taking data and financial inputs on costs on operations and investments and inputs on revenue such as tariffs to provide a long term projection of costs and revenue and provide a financial profile of the utility. The data inputs areas are clearly marked and a HELP text is available for each input.

The financial results are the predicted performance of the town water utility over a 20-year period. Financial performance is measured by the results of: the profit and loss account; the cash flow; the balance sheet; and selected indicators.

The results from the toolkit show how costs for investment and operations match income from customers and therefore whether the utility can remain financially viable.

Although the toolkit is a stand-alone document and spreadsheet, it is advised that some training takes place. Training course material and guidance documents are available for the application of the toolkit.

Information and documentation regarding this can be downloaded free of charge from: www.waterbusinessplanning.com

water utilities as private sector investors and their sponsors have been re-assessing their roles in a way that will make a significant impact towards achieving the MDGs. Without adequate management capacity within the governing institutions of the water sector, no reform processes can be entirely successful.

Urban centers in Africa and Asia are growing rapidly. It is expected that the current 60% rural/40% urban split in these regions will soon shift to the current 25:75 split found in Europe and the Americas. Much of this growth is taking place in smaller urban centers or 'towns'. At present between 20% and 40% of the population live in towns, but as villages grow and develop to become towns, and towns get bigger, the number of people living in towns in Africa, Asia and Latin America is expected to double within 15 years, and double again within 30.

Increase in urbanization

In terms of water supply, the standard of service in towns is typically the worst in the urban sector, and is deteriorating as more and more people either live in towns or depend on them for their livelihoods. In confronting this challenge, new approaches are emerging that address the need for improved, sustainable services and expansion to keep up with growth in demand.

From the point of view of water supply, towns must be understood to have a mix of urban and rural characteristics. Within their boundaries there is wide variation not only in the physical density of settlement, but also in the range of different types of consumers, socio-economic groups and classes of housing. This is true of most urban settings, but for towns, with their smaller revenue base, it is even more important not to overlook any potential customer group.

Performance of national utilities in towns has been poor where the classic public sector national utility model has had a broad range of responsibilities including planning, investment, service provision, quality and performance monitoring, and sometimes policy and standard setting. In most countries, performance of these organizations has fallen well short of promise. Fundamental to this has been the expectation of providing universal services at very low or no direct cost to consumers, and a failure to understand or provide the means to do so. High failure rates in towns can be attributed to overly centralised management and related bureaucratic complexities that leave no person directly responsible for the quality of services and reward no one for good performance. Decisions made at the head office are based on standard practices for all towns. They do not take local conditions, consumer preferences and willingness to pay into consideration, and lack customer relations and operation and maintenance capacity at town level. The tendency is to minimize financial losses by minimizing services in towns.

Municipal water departments lack autonomy and professional capacity – where management has been decentralised to local government, decisions are moved to a local level but often resources are not, and the results have not been good. Operation and maintenance is carried out through creation of a municipal water department, or less formally by assigning tasks to the existing works department. In most cases, performance has been poor due in large part to a lack of management and financial autonomy, and to weak managerial and technical skills. Officials do not appreciate what is involved in improving operational efficiency and in expanding the system. Often, decisions about water supply are influenced by political considerations and water revenues are used to finance other pressing municipal activities (sometimes understandably and this is certainly not unknown in so called developed countries). Accountability is usually imprecise and not based on business plans with agreed performance targets, and technical staff have other municipal duties and few performance incentives. As a result, the strategy is generally one of keeping the operation afloat rather than improving and expanding services.

In recent years, good success has been achieved in rural villages with a 'bottom up' approach based on 'community management' and development of local supply chains for goods and services. Urban utilities have also benefited from this decentralization process by being able to consolidate their operations in larger, more profitable urban centers.

Municipal water departments are most common in towns, but other approaches are emerging. These approaches are characterised by decentralisation away from central government and greater autonomy. They include community water associations, town Water Boards, and possibly small-scale private water companies. Also, aggregated approaches are being tried, including existing, larger utilities absorbing smaller towns, and through creation new regional entities.

Lack of maintenance, poor operational efficiency and inability to expand to meet growth in demand have ruined more water systems than anything else.

Credit: Simon Gordon-Walker

Systems are often designed and built without consulting end-users, using standardised approaches that do not meet their needs. Furthermore, tariffs are often set at a higher administrative level and do not reflect system operational and investment needs. Even contracting of operators, where this has taken place, has tended to be centrally managed. These issues reflect a centralised planning process with little attention to building local management capacity. As a result, autonomy is limited to nominal control of operations and bank accounts.

Above all else, it is apparent that town water supply has been managed as a 'business without a plan'. Investments and designs have not been cross-checked against water sales and projected revenues or customers' expressed willingness to pay. No plans have been made to improve operational efficiency or for expansion – or to secure the professional support needed to develop these. Financial management, reporting and auditing have been inadequate, and transparency and accountability have deteriorated. At best, towns have been provided with the 'business case' document required for 'one-time' investment financing – but not with the capacity to understand, develop and update their business plans as an ongoing process.

Poor sustainability of water services

Various technical and financial issues affect sustainability of town water supplies as outlined in this section. Since the technical issues are financial in nature, the two are combined here. Taken together, the fundamental issue is the introduction of management reforms and planning processes that make for a viable business.

Government and donor financing of town water supply projects have often failed to result in sustainability. Towns

have been selected for investment without regard for their capacity to manage and maintain the systems, nor with any attention given to the willingness and ability of the local population to pay the ongoing running costs of the system. Where tariff and management reforms have not been addressed in conjunction with water supply and sanitation improvements, facilities have quickly fallen into disrepair and the utilities have remained financially weak, unable to secure financing for required rehabilitation or expansion from any source but the government.

Strict design standards have led to poorer service in towns. Many town water supplies have been designed and constructed based on standards appropriate for larger urban centers, but unaffordable to town customers. Excess capacity means unnecessary production and maintenance costs. The result has been rapid deterioration of the systems as revenues have been insufficient to provide for ongoing operation and maintenance. It is not unusual to find a town water supply system that serves only the core of the town, often with daily interruptions in service, and with no attention paid to fringe areas. New customers cannot be connected to the system and many residents must purchase water from vendors at high prices or resort to unsafe sources.

Growth in individual towns is uncertain in terms of demand and location, and so it makes sense to expand the system only when actual demand and settlement patterns are known. Responding as quickly as possible to demand for private connections is then critical to bring revenues up to cover costs. This calls for a dynamic planning/expansion process.

The revenue base in towns is small, often insufficient even to cover the fixed costs of a local operator, not including the cost of specialist services to advise on business planning, efficiency improvement, and expansion. Provision of public standpipes alone does not take advantage of the more affluent households in a community who would be willing to pay considerably more for house connections.

Subsidies too often finance poorly performing utilities and wealthier customers connected to the system instead of those truly in need. Low tariffs and high connection fees are common. This combination only benefits the relatively wealthy people who can afford to connect to the system. The poor often cannot afford connection fees and are left to pay more for water obtained from vendors or neighbours – or pay indirectly by spending increased time fetching water from alternative sources and in terms of poorer health. Subsidies to utility operations that are not appropriately targeted at the poor and performance-based have created disincentives for efficient operations and have wasted public funds.

Decentralisation in many countries has shifted responsibility for water supply and sanitation to the local level. However, local governments do not have sufficient resources to fully fund needed improvements to water supply and sanitation, and do not appreciate what is involved in managing a water supply system. As a result, town water supply facilities fall into disrepair while local officials wait for financial support from central government. Even when financing is provided to rehabilitate their facilities, towns tend to 'go it alone' without securing the technical support needed to plan expansion and operate their system effectively. To make matters worse, revenue from water sales is often used to finance other pressing government functions, and decisions about the water system are often influenced by other political considerations.

The importance of business planning

Business planning helps town water utilities to plan operations, investments and finance in a sustainable and affordable way.

- It provides a means to share information with employees, customers, political leaders and potential investors, so that there is agreement on the utility's plans.
- It makes sure that investment decisions take account of what consumers want and are prepared to pay for;
- It ensures that revenues are sufficient and that the utility is financially sustainable;
- It helps the utility to monitor financial and technical performance;
- It supports performance-based contracts with employees or a private operator, by helping to identify and agree on performance targets;
- It helps to support activities needed for performance improvements, such as water quality monitoring, bench marking, and external audits.

For town water supply, business planning is the process of outlining how the utility will develop over time to provide the level of service required by its customers, owners and regulators.

In traditional project-based approaches to town water supply, where systems have been designed and built by the Government and handed over to the town on completion, the business planning process has often been overlooked. Often, design has been restricted to technical, economic and financial feasibility studies prepared by consultants without adequate stakeholder consultation. If those who inherit management of a water supply system have not been involved in its design and do not understand the choices made or what is required for sustainability, they may be reluctant or unable to maintain tariffs at a level required to cover costs and to pay for adequate maintenance of facilities or to retain qualified staff and contract for professional support.

The business plan is not a static document. It will need to be adjusted over time to take into account actual performance and changed circumstances. Generally, the business plan should be revised every three to five years and updated on a rolling basis each year between these revisions. Annual budgets and requests for tariff adjustments should be prepared and reviewed in the context of the business plan to ensure consistency with the longer term plans of the utility.

Business planning is best understood as an iterative process. Initially an assessment of regulatory requirements, current service levels and operations and demand assessment are carried out, which serve as the basis for identification of an initial technical design and a management and operations plan. The design is then cross-checked to customer willingness and ability to pay and a financial projection is prepared. If the design cost is not affordable, if customers would not be willing to pay the cost of the system or if the utility could not be financially viable, the design and/or management and operations plan must be revised. ●

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Water demand management for an urban area: the case study of Dwarka, a sub-city of Delhi

As a consequence of urbanization and associated environmental impacts, the issue of providing water to the growing urban population of India is becoming critical. Traditionally the solution has been to draw increasing volumes of water into cities and discharge waste at ever increasing levels to the receiving environment. This approach has been found inadequate for water deficient urban environments in India, so there is urgent need to change from the existing supply side approach to an alternative water demand management approach. **RABIDYUTI BISWAS**, **DEEPAK KHARE** and **RAMASURBRAMANIAM SHANKAR** in this paper aim to review some of the demand management techniques from case studies across the world and their applicability to India. Some of these techniques like water harvesting and wastewater recycling are already mandatory in Dwarka, a sub-city of Delhi, but rarely in practice, therefore to demonstrate the benefit of these techniques Dwarka has been considered as case study.

In India, 310 million people or 30% of the country's total population live in urban areas (Mathur, 2007). As a consequence of urbanization and associated environmental impacts, the issue of providing water services to the growing urban population is becoming critical (Paris statement 2007). The challenges however are more due to the urbanization associated with higher standards of living, which lead to increased per capita demand of water, depletion of conventional sources like surface and groundwater due to unregulated extraction of water, and reduced replenishment of the groundwater. The quality of existing sources is also deteriorating due to pollution. The densification of population living in urban areas and associated constructions results in an increase in impermeable areas such as paving and roofs. These permanent physical changes result in changes to runoff patterns, frequency of flooding and drainage problems in some locations (Jounathan, et al., 2005).

The traditional approach of increasing supply is not sufficient to meet the increasing demand. Water supply systems in urban areas of India have offered linear solutions, drawing increasing volumes of water into cities and discharging waste at ever increasing levels, thereby causing stress on the receiving environment. The conventional supply management options for India's urban areas have been found to be inadequate. Water demand management techniques have been experimented with in various situations, with positive results along with increases in supply in various parts of the world, but such techniques have not been applied in India to augment the demand supply gap of the urban water supply. This paper aims to review the various water demand management techniques through using references from representative case studies across the world. Various aspects of water demand management approaches and techniques such as metering, toilet retrofit, rainwater and greywater reuse, water saving fixtures and their efficiencies will be discussed. Further in this paper, the potential of some of the demand management approaches and techniques for Dwarka, a sub-city of Delhi are evaluated to suggest some policy guide lines for the city for better water management.

Urban water management approaches

Generally water management approaches in the context of urban areas are of two types – supply side management approaches and demand side management approaches. The supply side management approaches include increasing the quantity of supply from existing sources – large projects (dams, reservoirs, long distance water transfers etc.), additional sources (rainwater harvesting for a larger context) or alternative sources like extraction of groundwater. In the context of India the crisis of water is viewed as a crisis of availability of water. Thus the solution is prescribed as being increasing the availability of water for use i.e. in bringing more of the finite quantum of water available in nature into the usable category

through supply side solutions in the form of big projects (Iyer, 2007). The consequences of large projects are not always positive, especially when urban centres are far from the water sources. The unregulated extraction of groundwater in urban areas with rapid depletion and pollution of groundwater levels is a serious concern. Water harvesting is also not gaining proper momentum in most of the urban areas as an alternative source of water because of limited rainy days. The traditional supply-oriented approaches have proved to be insufficient to deal with strong competition for available water, growing per capita water use, increasing population, urbanization, pollution and shortages of funds (Kolokytha and Mylopoulos, 1999).

However, demand side management reduces misuse by introducing pricing policies, for example compulsory installation of water meters, water conservation, water harvesting and its direct use to reduce the potable water demand, increase wastewater recycling and reuse, reduce leakages, increase the installation of water saving devices, maintaining pressures, maintaining 24-7 supply systems and so on. By limiting demand, resources are conserved and environmental impacts can be reduced.

Urban water demand management

Urban water demand management aims at achieving desirable demands and desirable uses. It influences demand in order to use a scarce resource efficiently and in a sustainable manner. The water demand management approach (also referred as soft path water management) refers to the use of improved techniques rather than large physical investment, in new water infrastructure such as dams, canals and well fields (Agthe, et al., 2003). The examples of soft path management in residential cluster may include: raising price of water to reduce the quantity of water demand; offering water bill rebates to encourage xeriscaping in new and existing houses; and updating building codes for new construction and resale properties to force installation of low flow toilets, shower heads and faucets. There is a need to evaluate the benefits of proposed alternatives, both structural and nonstructural as well as to identify the optimal combinations of these alternatives (Holtz et al., 1978). The optimum integration of these techniques within conventional water supply systems in order to form a coherent water management strategy is necessary. The concept of demand management is widely gaining recognition worldwide and its effectiveness in practice depends on the political will to implement the available possible measures. In many water-using sectors there is the scope for water demand management, especially in India.

The different techniques within the urban water demand management are generally classified into three categories: economic techniques, structural and operational techniques, and socio-political techniques.

Economic techniques rely upon a range of incentives and disincentives (taxes, rebates, subsidies) to promote water conservation and demand reduction, aiming to change the behaviour of water users. Water pricing is a fundamental economic tool to influence water demand. The rebate programmes used to promote the water conservation and demand reduction include water bill rebates, distribution of free toilet retrofit kits, council tax rebates etc.

Structural and operational techniques used in different cities for water conservation and demand management are metering, toilet retrofitting with water saving devices, controlling flow, pressure reduction, leakage detection and repair, rainwater harvesting, and wastewater recycling and reuse etc.

Socio-political techniques refer to policy options to encourage water conservation and demand reduction, the creation of the institutional and policy environment that enables the reduction of reduce water demand by the user. The commonly used socio-political measures are public awareness, information, and education. Socio-political techniques also include the promotion of the advantages of all demand management practices and partial privatization of some parts of the water system.

Review of urban water demand management

Economic techniques

Maddaus (1984), Renwick and Green (2000), Campbell and Johnson (1999), and Maddaus (2001) have assessed the outcomes of different demand management programmes and their implementation. Maddaus (2001) analyzed the effect of metering and variable charges of water. White and Howe (1998) and White and Fane (2002) evaluated the potential cost effectiveness of a range of demand management policies such as price increases, outdoor water use restrictions, shower head rebate, washing machine rebate, etc. considered for implementation at two locations in Australia.

Campbell and Johnson (1999) investigated the impact of various conservation measures on the water prices for the residential users in Phoenix, Arizona, over the period 1990 to 1996. The study shows that water price can be an effective conservation method. Another study shows that a 10% price increase reduces demand by 3.4% and increases revenue by 6.6% (Agthe, et al., 2003).

As per the study by Maddaus (2001) the water consumption declined by 13% in the year 1999, compared to what it was before the rate change in Davis, California. The studies by Maddaus (1984), Renwick and Green (2000), Campbell and Johnson (1999), and Maddaus (2001) were ex-post in the sense that they measured consequences of demand management policies after those policies were implemented. However, planning studies can be ex-ante in the sense that they analyze expected consequences before policies are implemented.

Structural and operational techniques

Metering, retrofitting and using dual systems are among the most popular structural and operational methods used to reduce water demand in the urban water sector. Leidal (1983), Barclay (1984), Bishop (1995), and Gumbo (1998) presented the results of using metering and other water saving devices, whilst Haney and Hagar (1985) indicated the water savings achieved through using dual supply and greywater systems. Greywater reuse systems have been investigated by Dixon, et al. (1999), Sayers (1998), and Nolde (1995), and the benefit of the system for water management discussed.

Metering is not a direct conservation measure, but it is a means of accounting for all uses in the system such as easier leak detection and repair, and enables demand management programmes such as volumetric pricing structures to encourage reductions in water use. Maddaus (2001) analyzed the effect of metering and variable charges of water based on use in Davis, California, USA. The installation of water meters typically reduced consumption in the range of 10-30% and sometimes as high as 50% (Maddaus, 2001). Studies for metering cities in British Columbia, Canada present evidence for a 15-20% reduction in residential water use (Leidal, 1983). Preliminary results from analysis of metering programmes in New York City, New York, USA report 12-25% savings for the first two years (New York City, 1997). Washington experienced a 43% reduction in water consumption during peak summer months as the result of a metering programme and an aggressive pricing structure (Water Conservation Guidelines, 1993).

Residential retrofitting resulted in a 20% drop in water use in Ontario, Canada by using water saving devices (Barclay, 1984). Dual systems or 'greywater systems' can save up to 39%

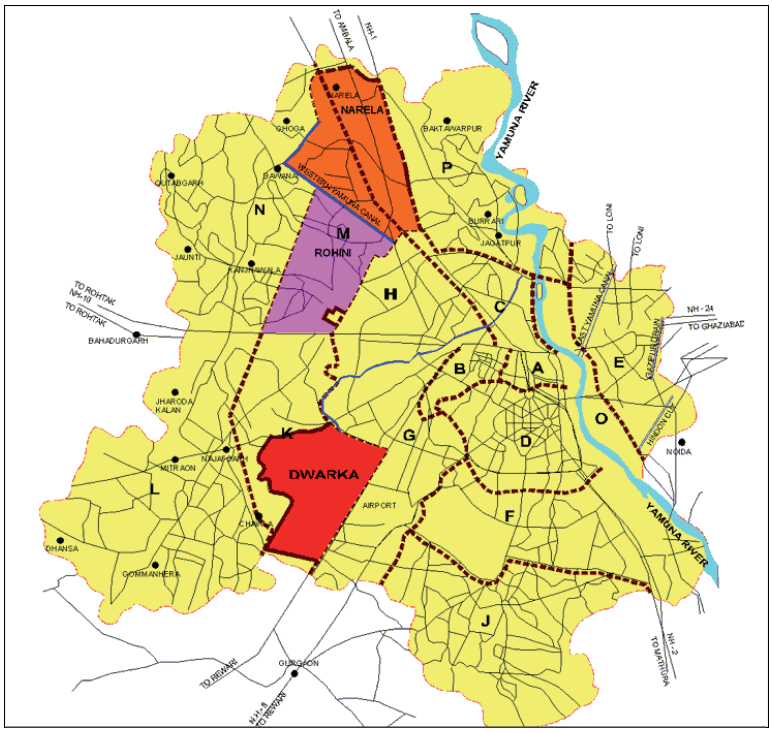

Figure 1: Map of Dwarka; Source: Website of DDA, 2006 (www.dda.org.in)

of water for indoor uses (Haney and Hagar, 1985).

Gumbo (1998) estimated the quantity of water used for flushing, which constitutes about 30% of total domestic water use. Adjusting floats in existing installations, or simply putting one or two standard bricks in the cistern would reduce cistern capacity by 10% or more. Each household would reduce its consumption by approximately 3%. Federal law in the US prohibits sale of toilets that exceed a maximum water flow capacity of 1.5 gallons (5.7 litres) (Agthe, et al., 2003), but in urban areas of India the majority of people use toilet cisterns with a capacity of ten to12 litres, which uses water of drinking water quality for flushing.

Maddaus (1984) presented many studies comparing water conservation programmes. Results of the several (water conservation) demonstration projects have been presented, which include the effects of water-saving fixtures, water pressure, and water metering on household water use. The principal quantitative results presented by the Maddaus (1984) have been summarized in Table 1.

Renwick and Green (2000) presented the results of various California water conservation programmes and the effects of each (restrictions, rationing, retrofit kits, a public information campaign, rebates and affidavit requirement) on residential water consumption. Retrofit kits were distributed for free, which included low-flow showerheads, tank displacement devices, and dye tablets for leak detection. This measure resulted in a 9% reduction in residential consumption.

Greywater is normally collected from hand washbasins, bathtubs/bathrooms, washing machines and dishwashers (Khare et al., 2006). Several filtering methods are available to treat the greywater before it is collected in a storage tank. The water is pumped into storage at a higher elevation and then distributed by gravity. Greywater contains less organic matter and pathogens than wastewater from a mixture of sink and toilet waste residue. Thus, greywater can be reused for domestic purposes such as toilet flushing and irrigation. Greywater reuse systems have been investigated (Dixon et al., 1999; Sayers, 1998) in several countries and there are also systems in the market that allow houses to be retrofitted with greywater recycling systems. The technology used varies among different countries, with greywater usually treated to higher levels and applied to larger housing estates in Germany and the UK (Nolde, 1996; Dixon et al., 1999; Sayers, 1998).

Various qualitative and monitoring studies conducted by Haney and Hagar (1985), Nolde (1996), Naisby (1997), and Khare et al., (2006) have demonstrated the various aspects (efficiency, treatment required, type of treatment) of greywater reuse. Theoretically, greywater can replace the water required for toilet flushing. This can constitute up to 34% of a household's total water consumption (Haney and Hagar, 1985). Haney and Hagar (1985) reported a reduction of 39% in main water supply through indoor uses of greywater, while Khare et al., (2006) reported a 35% reduction for a group-housing scheme in Dwarka, India. Sayers (1998) claimed that domestic main water supply demand could be reduced by 30.6% through the reuse of greywater, and Karpiscak, et al., (1990) claimed that about 31% of the total water budget can be recycled as greywater, representing the largest source of water savings. Smerdon et al., (1997) estimated that about 30% of water usage could be saved if a greywater system was installed. Karpiscak, et al., (1991) described a desert house in the US where water-conserving fixtures, greywater recycling and water harvesting reduced potable drinking water use by up to 50% without major expense or change in lifestyle.

Dube and Zaag (2003) shed light on some of the possibilities and constraints of both choices, whether to go the demand management route, or to continue constructing new infrastructure through a case study of the city of Masvingo in Zimbabwe. The paper first looks at the long-term water use pattern of the city as a whole and the factors which have caused the observed pattern using multiple linear regressions. In projecting future demand, the paper then considers a number of interventions that could influence demand, which include leakage control, pressure management, awareness campaigns, free technical advice to water users, and a new tariff structure. Water losses in the city are around 15%. Some of these losses are the result of high static pressures, pipe bursts, leaking valves and reservoirs and water treatment processes. Static

Table 1: Results of water conservation programmes (Maddaus, 1984)

Water conservation measure	Observed water savings
Installation of water meters	20%
Reduction of pressure from 30 to 40 psi	3-6%
Fix toilet leaks	36.34 litres per capita per day (lpcd)
0.5 gallon (1.9 litre) per minute shower head	52.23 lpcd
Three gallon (11.35 litre) per minute shower head	27.25 lpcd
Retrofit kits	15.1 to 26.5 lpcd
Water-efficient washing machine	6.43 lpcd
Water-efficient dishwasher	3.78 lpcd

Table 2: Relative benefits of different water demand management techniques on water saving. Source: Compiled by Rabidyuti Biswas.

	Demand management measures/ techniques	Saving in water demand	Author/references
A	**Economic Techniques**		
1	10% price increase	3.4% reduced demand and 6.6% increased revenue	Agthe, et al., 2003
2	Increase in price	13%	Maddaus, 2001
B	**Structural and operational techniques**		
3	Residential retrofitting	20%	Barclay, 1984
4	Dual systems or greywater systems	39%, indoor uses	Haney and Hagar, 1985
5	Install water meters	20%	Maddaus, 1984
6	Fix toilet leaks	36.34 lpcd	Maddaus, 1984
7	0.5 gallon (1.9 litre) per minute shower head	52.23 lpcd	Maddaus, 1984
8	Three gallon (11.35 litre) per minute shower head	27.25 lpcd	Maddaus, 1984
9	Retrofit kits	15.1 to 26.5 lpcd	Maddaus, 1984
10	Water-efficient washing machine	6.43 lpcd	Maddaus, 1984
11	Water-efficient dishwasher	3.78 lpcd	Maddaus, 1984
12	Installation of water meters	10-30% sometimes as high as 50%	Maddaus , 2001
13	Metering	15-20%, 43%	Leidal, 1983, Water Conservation Guidelines, 1993
14	Putting one or two standard bricks in the cistern	3%	Gumbo, 1998
15	Water saving fixture, greywater recycling	Up to 50%	Foster, 1991
16	Greywater system installed	30%, 35%	Smerdon et al., 1997, Khare et al., 2006
17	Recycling of wastewater	40%	Gupta and Gupta, 2006
18	Reduction of supply pressure	7%	Dube and Zaag, 2003
19	Pressure management	25-40% cost reduction	Burn et al., 2002
C	**Socio-political techniques**		
20	Restriction on selected water use and rationing plan	65%	Dziegielwski, 2003
21	Restrictions of water use	29%	Renwick and Green, 2000
22	Rationing	19%	Renwick and Green, 2000
23	Public Information Campaign (PIC)	8%	Renwick and Green, 2000

pressures are between 80 and 90 m for most of the city. It was necessary to reduce pressures to between 30 and 60 m in order to reduce water losses by at least 7%.

Burn et al., (2002) analyzed the effect of employing demand and pressure management techniques on the cost of a water reticulation system. The analysis was based on the cost of supplying a cluster of 4000 households serving a range of hourly demands using pipes of various pressure classes. Demand management reduces costs by 25-40% and pressure management increases the savings further to 55%.

Socio-political techniques

During 1976-77 in California, restriction on selected uses of water and rationing plans were reported to reduce water use by up to 65% (Dziegielwski, 2003). Restrictions were also covered as part of Renwick and Green's (2002) analysis of California water conservation programmes and include the prohibition of certain water uses, such as washing down sidewalks or driveways, and banning landscape irrigation during peak evapotranspiration hours, which achieved a 29% reduction in consumption. In rationing, a fixed quantity of water was allocated to each household and severe marginal price penalties were imposed for exceeding the allotment. This measure reduced the residential consumption by 19%. The public information campaign helped in alerting households to shortages, attempted to motivate more water efficient behaviour, and provided information on ways to reduce the usage. A reduction of 8% residential consumption was observed from this measure.

Urban water demand management in India

The studies related to the concept of water demand management are qualitative in India. Detailed investigations related to practical implementation, feasibility, economic analysis, water saving efficiency etc. are very few. The water conservation and demand management options suggested include the use of low flow toilet fixtures, recycling of rainwater, and reuse of greywater for toilet flushing. (Suryawanshi, 2006; Gautam, 2006; Chakrabarti et al., 2006; Jain, 2006; Khare et al., 2006; Kapila, 2006).

Khare et al., (2006) demonstrated the feasibility of greywater recycling for a group housing apartment in Dwarka. They found that about 35% of the domestic water supply can be saved by using recycled greywater.

Kapila, (2006) has presented different type of treatment processes suitable for the wastewater recycling for industrial use. Membrane technology, in particular using a membrane bioreactor in addition to tertiary treatment, has been found to be suitable and economical for reuse of wastewater for non-potable uses. Further, with reverse osmosis treatment this can be used for potable purposes.

Gupta and Gupta, (2006) presented some of the successful examples of water conservation and recycling of treated wastewater achieved in commercial and official buildings across India. The ITC Green Center, Gurgaon, India has achieved a 40% saving of water through wastewater recycling. The office complex of Grundfos Pumps Private Ltd, Chenni, India has also achieved about 40% saving in potable water use through recycling of wastewater. Detail studies of wastewater reuse and its integration with other water supply sources have not been reported.

Major urban water demand management techniques

The major water demand management techniques as implemented in different cities are found to be as follows:

- **Economic techniques**: water pricing and tariff structure; tax benefit; and rebate (incentives) etc.
- **Structural and operational techniques**: water metering; in-house retrofitting with water saving, flow controlling devices and fixtures; recycling and reuse of wastewater and rainwater harvesting; leakage detection, reduction and repair; and dual supply systems, etc.
- **Socio-political techniques**: encouragement of water conservation; education and training – public awareness, in-school education, promotion of the advantages of all demand management practices, training and education of the staff in water related agencies; partial privatization of system; restrictions; rationing; affidavit requirement etc.; reduction of illegal connections; institutional measurements and

Table 3: Various demand side management measures and range of their efficiency as considered. Source: Compiled by Rabidyuti Biswas.

Demand management measure	Range of water saving efficiency	Reference	Adopted values (efficiency) for the present study
Rainwater harvesting (RWH)	10-15%, 30-60%	CPWD, 2002	Estimated
Greywater recycling (GWR)	15%, 27%, 39%,	Haney and Hagar, 1985; Khare et al., 2006	Estimated
Toilet retrofitting (TR)	15%, 20%, 25%,	Maddaus, 1984; Barclay, 1984; Dube, Pieter van der, 2003	20%
Metering (M)	15-20%, 10-30%, 43%	Leidal, 1983; Maddaus, 1984; Lisa A. Maddaus, 2001; Water Conservation Guidelines, 1993	20%
Public information campaign (PIC)	8%	Renwick and Green, 2000	8%

effective legislation; and regulations for water demand management and water reuse.

The relative benefits of some of these techniques of water demand management for water saving from different case studies from the literature are compiled in Table 2.

However, these techniques are not considered in India in a comprehensive and integrated manner. The applications of many of these techniques are feasible in urban areas of India and proper application of these techniques can reduce water demand substantially. To demonstrate the benefit of these techniques Dwarka has been taken as case study. Dwarka is predominantly multistoried group housing developments so therefore the water demand management measures rainwater harvesting, reuse of greywater, toilet retrofitting, metering, and a public information campaign are considered feasible to implement, and the quantity of water saving for these options are estimated. The water saving efficiency (water saved as a percentage of total water supplied) of the water demand management measures considered for Dwarka are presented in Table 3.

Case study Dwarka

The Dwarka sub-city is a part of the urban extension of Delhi in the Planning Zone K (Nazafgarh District) with a population of one million and a total area of 5648 hectares (Figure 1). Dwarka enjoys a semi arid climate with about 80% of the annual rainfall received during the south-west monsoon period between July and September (27 rainy days). The average rainfall is around 611mm. About 70% of the housing in Dwarka is group housing of multistoried development with minimum plot size of 4000 m², with 48.54 % residential, 7.05% commercial, 14.33% transport, 19.94% recreational, 3% public semipublic and 0.94% government land uses.

Urban water management in Dwarka

The Master Plan for Delhi 2021 has considered the water requirement 360 lpcd (litres per capita per day) with a breakup of domestic and non-domestic of 225 lpcd and 135 lpcd respectively. Therefore the total domestic water demand of Dwarka for the projected population of one million is 225mld (million litres per day). Dwarka is getting around 50% of their demand from the Delhi Development Authority (DDA) (bulk received from Delhi Jal Board and from bore wells). The residents manage the rest of their demand by procuring water from government tankers or purchasing water from private tankers or groundwater extraction within their plots. Almost all Group Housing Societies and plotted housings have their own private bore wells, leading to the over-exploitation of groundwater, and the amount of freshwater is decreasing at a rate of 0.5 m per annum. The estimated breakup of the per capita water demand (Khare, et al., 2006, Table 4) clearly shows that 40% of the domestic demands in Dwarka need not to be potable water and recycled greywater can be used instead.

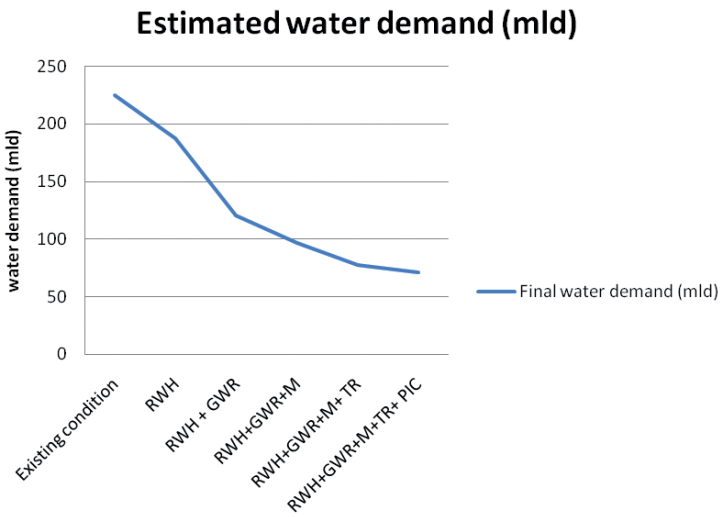

Figure 2: Integration of water demand management options in Dwarka

Water demands management measures for Dwarka

Rainwater harvesting potential

The Central Groundwater Authority made it mandatory for buildings (for plot area 100 m² or more) in Delhi to make provision for rainwater harvesting. The bylaw is applicable for Dwarka also. However the implementation of the same is not being monitored by the government agencies concerned. A primary survey (2008) undertaken by one of the authors of this piece, Rabidyuti Biswas, showed that the group housing societies have made some provisions for rainwater harvesting but its technological appropriateness and maintenance is doubtful. Plotted developments do not have the provision of rainwater harvesting, however through the bylaw exists the potential for adopting rainwater harvesting for domestic use.

Considering 50% of the total developed area as rooftop along with paved areas, the total potential water which can be harvested from rainfall was found to be 37.76 mld (Table 5), with savings of around 16.78% of the total demand.

Wastewater recycling potential

The Delhi Government has modified the building bylaws (GOI notification

Table 4: Estimated break up of Domestic Water Demand in Delhi. Source: Khare et al., 2006

	Purpose	Potable water at 30 gpcd (135 lpcd)	Non-potable at 20 gpcd (90 lpcd)
1	Drinking	5	
2	Cooking	10	
3	Washing cloths	30	
4	Washing utensil	20	
5	Washing hand and faces	10	
6	Bathing	60	
7	Floor washing		30
8	Flushing of toilets		60
	Total at 225 lpcd	135 lpcd (60%)	90 lpcd (40%)

28 July 2001) to promote reuse of wastewater in buildings where daily wastewater generation is 10,000 litres or more. DDA initiated use of dual water supply systems in Dwarka in 2002-03 to promote the reuse of rainwater and recycled wastewater. The Master Plan for Delhi 2021 has also emphasized the recycling of treated wastewater through dual supply systems, however, these concepts have not been implemented in Dwarka until today. The primary survey (2008) revealed that people do not even know that wastewater recycling is mandatory for all group housing developments, because the wastewater generation from such development is always more than 10,000 litres per day.

Literature shows that the treatment of black wastewater requires elaborate treatment facilities which are not cost effective, but greywater can be treated and reused. The greywater generated from the group housing development in Dwarka is 100 lpcd (Khare, et al., 2006). When calculating the quantity of greywater for reuse, an amount of 80% of greywater generated (of 100 lpcd) (Table 6) is considered. The total amount of greywater available for reuse is found to be 80 mld, which gives a saving of 35.5% of total domestic demand (Haney and Hagar, 1985 estimated 39%).

Water metering

There is no individual metering system in the group housing developments in Dwarka. The bulk water is metered at the group housing or community level. Therefore, all the members in group housing share equally the total water bill. On the plotted development although a meter is there, the authority does not bill for the metered consumption. A lump sum amount of Rs.157 ($3.18) per connection per month is charged. As the water bill is not charged on actual consumption by the consumer, people do not care for water saving and there are no incidences within the housing of water saving toilets or any other water saving fixtures. The saving due to metering is considered as 20% of the demand (Maddaus, 1984 estimated 20%, Lisa A. Maddaus, 2001 estimated 10-30%, Leidal, 1983 estimated as 15-20%) (Table 2). The total domestic water saving due to implementation of metering is estimated to be 45 mld (Table 7).

Toilet retrofitting

The primary survey (2008) mentioned earlier in this piece revealed that the average toilet flush cistern capacity of the households in Dwarka is ten litres. A market survey also undertaken by Rabidyuti Biswas showed that conventional toilet flush cisterns available in Delhi ranged from nine to 12 litres in capacity, and water saving dual flush cisterns were available with a capacity of three to six litres. The unit cost of the water saving dual flush cisterns was higher in the market however, so people prefer to purchase the cheaper toilet, but the use of water saving dual flush systems can save up to 60% of water used for toilet flushing and about 17-20% in total water demand. So for toilet retrofitting a 20% saving is considered (Barclay, 1984 estimated 20%). Total daily domestic water saving due to toilet retrofit and water saving fixtures are estimated as 45mld (Table 8).

Awareness programme

Besides rainwater harvesting and greywater recycling there are water saving equipment and fixtures, which can be used by people to reduce wastage of water and thereby reduce demand. The primary survey (2008) showed that even educated people in Dwarka have no idea about such equipments and techniques. Also, in India water use equipment and fixtures with water saving ratings as now available for electrical equipments and appliances are not available on the market. Therefore public information campaigns can make people aware of such techniques. Substantial amounts of water saving can be done by adopting such techniques and approaches, so the daily estimated water saving due to an awareness programme (considered as a saving of 8% as estimated by Renwick and Green, 2000) can be 18mld (Table 9).

Integration of five demand management techniques

All these options are combined to estimate the water demand reduction. Options A, B, C, D, E, and F are considered and cumulative saving is calculated (Table 10 and Figure 2). It is observed that a net daily saving of up to 68.42% is possible if all these techniques are implemented and the present estimated requirement of 225 mld can be reduced to only around 71.05 mld.

Table 5: Estimated water harvesting potential for Dwarka

Water demand management measure	Total Area (ha)	Built-up , rooftop and all paved area (ha)	Rainfall (mm)	Runoff coeff.	Total runoff (m^3)	Potential saving (mld)	Water requirement (mld)	Saving (%)
Rainwater harvesting	5648	2824	610	0.80	13,781,120	37.76	225	16.78

Table 6: Estimated potential of reuse of greywater in Dwarka

Population	Total greywater potential (80% of 100 lpcd) (mld)	Water requirement (mld)	Saving (%)
1 million	80	225	35.56

Table 7: Estimated potential saving due to metering in Dwarka

Saving from metering (%)	Potential water saved from metering (mld)	Water requirement (mld)
20	45	225

Conclusion

It has been observed that a considerable amount of reduction in water demand can be achieved if some of these water saving techniques are implemented in Dwarka. If the government initiates these schemes with proper policy and technological support in a phased manner, the scarcity of water in Dwarka will be largely reduced.

Table 8: Estimated potential saving due toilet retrofitting (low water flushing system, bath/ shower, water saving faucets) in Dwarka

Saving from toilet retrofitting (%)	Potential water saved from toilet retrofitting (mld)	Water requirement (mld)
20	45	225

Table 9. Estimated potential saving due educational awareness campaign in Dwarka

Scenario	Water demand management measure	Existing demand (mld)	Saving (%)	Saving (mld)	Final water demand (mld)
A	Existing condition	225.00	0	0	225.00
B	Rainwater Harvesting (RWH)	225.00	16.78	37.76	187.25
C	RWH +Greywater Recycling (GWR)	187.25	35.56	66.58	120.66
D	RWH+GWR+Metering (M)	120.66	20	24.13	96.53
E	RWH+GWR+M+ Toilet Retrofit (TR)	96.53	20	19.31	77.22
F	RWH+GWR+M+TR+ Awareness Campaign (PIC)	77.22	8	6.18	71.05
	Total saving in mld			153.95	
	Total saving in %			68.42	

Table 10: Estimated demand after the integration of demand management options in Dwarka

Saving due to awareness campaign (%)	Potential water saved due to awareness campaign (mld)	Water requirement (mld)	Net water requirement (mld)
8	18	225	207

However, this requires a serious effort by the government. Some of the policy considerations that can be given immediate attention by the government are listed below:

- Government should consider seriously the demand water management approaches rather than only focusing on increasing supply.
- A comprehensive plan should be prepared for each water division, subdivision, zone or sector along with urban water policy or municipal water policy to ensure wise use of water and which should incorporate principles of water demand management. The policy must also state the strategies for implementation and monitoring of water demand management.
- Appropriate bylaws should be developed to incorporate water saving measure within the buildings to limit the inefficient and wasteful use of water.
- National Performance Standards or Water Saving Rating for water fittings, appliances and devices should be prepared. Government must seriously consider introducing appropriate technology that does not use more water than required, such as automatic or push taps, automatic or water less urinals, water saving dual flush cisterns, low flow shower, water saving washing machines and introduction of appropriate fiscal incentives for water harvesting, water recycling and use of water saving equipment.
- Water metering is to be instigated for all consumers, and billing should be based on the actual consumption of water by the consumer.
- Stakeholders involvement and raising awareness of water saving and use of appropriate equipments is urgently required. Public awareness campaigns on water conservation must be encouraged through the print and electronic media. Awareness must particularly be targeted at consumers at the household level and at public institutions.
- Efforts must be made to train staff in the water supplying institutions for approaches and aspects of water demand management. Such education must emphasize the significance of water demand management and must also promote a change in peoples' attitudes towards efficient use of water resources. The role of service providing authorities, Resident Welfare Associations (RWAs), Non-Governmental Organizations (NGOs) and politicians for promoting water demand management approaches should be defined. ●

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Tariffs and pricing policies: an opportunity to network with Far East water professionals

Tariffs and pricing policies are pivotal issues challenging sustainable water services. **DR RENATO PARENA,** Chairman of the IWA Specialist Group on Statistics and Economics, reports on the Group's contribution to the workshop on tariffs and pricing held in Japan earlier this year (see also following article).

The Japan Water Works Association (JWWA) and Tokyo Metropolitan Waterworks Bureau (TMWB) organised in Tokyo, 2-3 February 2009, their 5th Japan Regional Workshop on 'Tariff and pricing for sustainable water services'.

IWA holistically sponsored the event that was chaired by Professor Hideki Ide from Keio University, Japan, and Paul Reiter, the Executive Director of IWA.

On the one hand, utilities' financial resources depend strongly on water charges, while on the other, the top customers' concern lies with the level of water rates and water supply.

The impact of climate change, the deterioration of water infrastructure, massive urbanisation and economic recession all challenge the maintaining of a sustainable water supply in the future, as well as keeping a sound infrastructure asset base, getting enough water resources and supplying safe and reliable drinking water.

Properly designing a water tariff structure which is able to fully cover the costs of providing water services and cope with the utilities' economic, social and environmental inputs is thus the vital top issue challenging water professionals all around the world.

Using the above as a starting point, the workshop intended to focus on the topic of 'Tariff and pricing for sustainable water services', aiming at utilising the experience and knowledge presented by an international panel of speakers in order to seek measures that best meet the challenges facing sustainable water supply.

The IWA Specialist Group on Statistics and Economics was invited to deliver its know-how and experience gained during years of activity in the international water community through its chairman, who presented the results from the last survey, undertaken in 2007, on water regulation and water charges around the world, and two case studies on water service charge and regulation in Italy, specifically in the city of Torino.

International charging and regulation of water services

Internationally, comparing water prices and regulation systems involves relating different organisational systems, overarched by different rules for accounting and allocating costs, and different political priorities that may strongly influence the operators' performance levels and then require close explanation of the regulatory regimes that underpin water pricing policies.

Direct links between tariffs and regulatory schemes do exist: pricing principles emphasise the need for water prices to be based on both 'economic and environmental efficiency' and 'broad (social) equity' goals rather more strongly than in the past, and stress the desirability of consumption-based pricing and (more generally) of improving pricing signals in order to move towards efficient and sustainable use of natural resources.

That is the reason why good governance schemes are vital in order to give the water sector a proper functioning framework, as water policies cannot be effective without a clear breakdown of responsibilities between public authorities, service operators and financing organisations.

Most updated information on charging water levels and policies, for a significant number of countries in the world, shows that water is charged differently worldwide by using both Uniform and Increasing Block models, which seem to be the most applied rate designs, and where the first one shows in general a higher trend.

Experience suggests that expressing prices in a uniform currency (normally US$) allows for information to be compared; nevertheless, when comparisons cover different periods, movements in the exchange rate due to the depreciation of the common currency may enhance or depress the gap checked during the time period.

Therefore, when analysing economic data as part of evaluating growth in prices, particular attention needs to be paid to the influence the double digit depreciation of US$ exerts against both the Euro and in general all other currencies of considered cities.

The Millennium Development Goals concern above all developing countries where many water-related difficulties are challenging the access to water services.

Tariff structure is thus a crucial issue, to make and maintain an affordable price for water, whilst also securing a stable revenue stream that finances both daily operation and the future improvement of water services.

Relating drinking water charges to the average annual Gross Domestic Product in the country (which can be assumed as a broad indicator of economic living standards) may depict a macro idea of how water charges might be related to the average domestic richness, from which a first approach to water charges affordability can be drafted.

This seems to show that water charges are generally coupled to a considerable degree to affordability, and that they have a low priority in a household's budget. Nevertheless, the treatment of non-payments greatly impacts on access to water, while macro-economic development, population growth and other demographic changes, rather than water policy, influence water demand.

Consumers' 'willingness to pay' for safe drinking water can be demonstrated, but in many cases it is the politicians' 'unwillingness to charge' that is the real obstacle to tariff increases. When a water utility does not recover the costs of providing its service, it is often

unable to extend the system, leaving poorer and marginal areas unconnected to the water grid.

Consumers who are connected often receive poor-quality water and intermittent service because there is not enough revenue for treatment and maintenance. Unconnected poor consumers generally pay much more for water than consumers with access do.

So the challenge is finding a way to subsidize services while tariffs are raised to cost recovery levels without undermining the incentives to make service provision, billing, and collection more efficient.

Particularly where the high price of piped water makes collecting water bills inconsistent, a clear distinction should be made between customers who cannot pay and those who do not want to pay for water services.

Those who cannot pay need to be helped with subsidies that are well targeted and effective because no 'one-size-fits-all' approach exists.

Those who do not want to pay for the drinking water delivered to their homes need persuading that they should pay, so that potential financial crisis and subsequent reduced access to water can be avoided.

Continuously improved customer relationships, tailored tariffs and payment policies are thus the unavoidable prerequisites to reconciling water costs and water rights, given that mostly in developing areas the low paying capacity of customers does not always make the 'full cost recovery' principle realistic, so a move should thus be made towards 'sustainable cost recovery' criteria.

Water service charges and regulation in Italy - the case study of Torino

The Italian water sector, where local public water services are the responsibility of each Municipality which owns, by civil law, the connected assets, is historically a publicly-owned context. Since the early 1990s the sector has been under a deep reform, which aims to continue both the process of transferring to the regions the competences for water use, and the adherence to European directives that mostly affect the procedures to be observed when water services need to be contracted out.

The so-called 'Galli law' green-lighted the reform in 1994, aiming to re-boost lacking investments and overcome the widespread mushrooming of water operators, most of which were small and inefficient, through the promotion of the entrepreneurial management of Integrated Water Services (IWS). This was to be underpinned by water industry development and infrastructure improvement within the wider context of environmental safeguard.

A new market-oriented business organisation focusing on the criteria of efficiency and cost effectiveness, as well as a new charging policy fully covering operation and investment costs and granting adequate return to the invested capital became the milestones of the reform.

In accordance with the reforming law, the IWS includes every process of the water chain, from raw waters catchments to treated water returned to the environment, and has to be managed by water companies within territorial dimensions wide enough to allow entrepreneurial operating conditions (Optimal Territorial Areas (OTAs), basically covering hydro-graphic basins).

In every OTA, which actually covers the territory of each Italian Province, the lowest number of entrepreneurial water operators may exist while the encompassed Municipalities decide the organisational model of the IWS, even entrusting the local regulator for controlling activities.

Local regulators may currently appoint the water operator in charge of the OTA's IWS by public tender (that is the normal way) or, under particular conditions, by direct appointment (that is the alternative 'in-house providing' way) to a pre-existing local public water operator.

The appointed operator is required to operate the IWS with regards to the Master Plan (this has to be considered to be a substantial part of the under-signed concession contract) and is entitled to use, preserve and refurbish the water assets owned by the served Municipalities. On maturation these assets and the new constructed ones will be transmitted to the successor operator against a book value reward.

When analysing the Master Plans in a significant number of OTAs, the National Supervisory Committee found an average general need for new investments of around €35 ($46)/year per inhabitant (€16 ($21)/year in drinking water services and €19 ($25)/year in sewerage and wastewater treatment services) on an average plan period of 25 years.

More than €51 billion ($68 billion) is thus expected to be globally invested in Italy to both improve the IWSs and realize the goals the reforming law was aiming for in 1994!

The drinking water tariff is fixed by the local regulator in a general context of full cost recovery and is based on a national 'standard methodology', which is defined by law, is oriented towards capping prices, and is implemented as an increasing block tariff.

Sewerage and wastewater treatment related fees (44% of IWS reference tariff) are structured using the Uniform model and charge the consumed volumes (as measured for drinking purposes).

Drinking water, sewerage and wastewater treatment fees are then coupled with a connected fixed charge to send customers a strong price signal, aimed at making them aware that the water service is not free and, at the same time, water uses need to be limited and the full cost covered.

The predicted tariff dynamic coming from the Master Plans analysed by the National Supervisory Committee, compared with the weighed average water charges existing before the reform, is expected to raise the IWS prices from €0.88 ($1.2) to €1.32 ($1.76)/m^3 on average and without inflation.

The city of Torino is located at the feet of the Alps, and is the capital of the Turin Province, in the north-western Piedmont Region.

The OTA of Turin Province includes 306 Municipalities (48% in the highlands and 52% in the lowlands) where more than 2.2 million people live, mostly in the lowlands (86%).

In late 2004 the OTA's local regulator undersigned the contract which 'in-house' appointed SMAT (Societa Metropolitana Acque Torino SpA), a globally publicly owned Plc. who merged the previous entities historically managing drinking water and wastewater services in Torino, to operate the IWS according to the 20-year Master Plan, that was approved in 2002.

SMAT, as the OTA's water operator, is committed to maintaining and upgrading the existing infrastructures (to increase efficiency and reliability in provided service) and to implement new small and medium infrastructures (in extension, improvement or replacement purposes), using €750 million ($1 billion) in investments over 20 years. Realizing new large infrastructures (to improve quality and quantity of raw water sources, to extend the sewage network to the unserved areas and to upgrade the wastewater treatment capacity) will require a further €590 million ($788.8 million) of investments in the same period.

The €1.34 billion ($1.79 billion) to be invested in the 20-year plan period will be split 33% to the water supply service, 42% to the sewerage service, 19% to wastewater treatment and 6% to general actions.

Such a huge investment is predicted in the Master Plan to be underpinned 70% by the internal cash flow, 26% by

long-term senior debt and 4% by public free contributions.

After the first four-year period of OTA's in-house assignment, SMAT reported a significant growth in both turnover (near doubling from €121 to €245 million ($161.8 to $327.6 million)) and annual investments (a fivefold increase from €15 to €70 million ($20.1 to $22.8 million)), while the average unit water charge increased from €0.66 ($0.88)/m^3 to €1.11 ($1.48)/m^3. The annual water bill in 2007 scored around €216 ($288.9) for 200 m^3 consumed.

Conclusions

The international experiences presented at the Regional Workshop in Japan basically confirmed what the Specialist Group on Statistics and Economics has been verifying through its institutional networking activity and periodic survey.

All over the world, sustainable water service provision needs to incorporate a triple bottom line: the utility's stable financial sustainability, the water for all social target, regardless of consumers' income, and the water conservation signal.

Water charging worldwide is approached in different ways and seems generally coupled to a considerable degree to affordability.

Properly designing a water tariff structure able to fully cover the costs, to grant financial stability and to cope at best with the above three issues is thus the top challenge for water professionals all around the world.

On the demand side, water charging sustainability and the treatment of non-payers greatly impact on access to water, while macro-economic development, population growth and other demographic changes, rather than water policy, influence water business.

This emphasises therefore the importance for water professionals to increase their understanding of the broader social, economic and political context, while politicians and other key decision makers need to be better informed about water resource issues in order to provide solutions combining an optimal debts recovery rate and universal access to water.

The Tokyo Regional Workshop greatly contributed to such a purpose. ●

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Structuring tariffs: getting the most from water rates

Setting the charge for water services was the topic of debate at the tariff and pricing workshop held in Japan earlier this year, covered in the preceeding article. **LIS STEDMAN** speaks to IWA executive director **PAUL REITER** who co-chaired the workshop about the link between an effective tariff structure and a sustainable water service.

Appropriate, effective tariffs that accomplish a spectrum of results are becoming an increasing focus as the inherent possibilities become apparent.

IWA Executive Director Paul Reiter says that a key message when considering tariffs is to 'start with what you are trying to accomplish. What a tariff has to do as a minimum is to recover the cost of service. Fundamentally they have to do that job.' Typically, these costs are recovered through the water rate, though some utilities have a mixed funding system, with some money provided through the government and the remainder through the tariff.

'An aspiration for utilities in developing countries is working to full cost recovery so they are not subsidising through outside sources,' Mr Reiter observes. 'In lower income countries, in many cases the tariff is set to cover operational costs with the goal of moving to full cost recovery over time.'

Tariff structure

The way in which the tariff is structured makes a difference, he explains. 'Tariffs can be a very important tool, not just in recovering the cost of service but in shaping consumption.'

A tariff can be built around a single fixed charge, he continues. 'And it is surprising, even today in the UK the tariff is largely structured around that concept.' In most countries, metering is in place, which enables more sophisticated tariff structures.

'A tariff can be used as a tool for creating more efficient use of water,' Mr Reiter says. 'Some utilities have increasing block rates, some have a different philosophy of decreasing blocks – the more you use the cheaper the water is, and some take a uniform block approach. Utilities are roughly evenly divided between these three.'

Logically, decreasing block tariffs tend to be found where water is ample and increasing block tariffs are more frequently used where water is scarce (such as in Australia and the US). The uniform block tariff is found where circumstances are somewhere in between these extremes, and is normally used in conjunction with a fixed charge.

Mr Reiter explains: 'If you introduce a meter, the most basic thing that you have to decide is how much revenue recovery will be from the fixed charge to customers and how much from the variable charge.' If there is a variable element, a cost per cubic metre must also be set.

Variable block tariffs work on the principle of a set price per unit for a certain amount of water, then when a threshold is reached this either falls or rises (or remains the same) depending on the type of tariff.

'With these ideas in mind, in general, depending on whether scarcity is an important part of the utility's consideration, rates will be used to shape demand,' Mr Reiter adds. 'The tariff is a way of both recovering costs and influencing demand.'

In terms of larger objectives, utilities have to ask whether they simply want to recover costs, or whether they also want to influence demand either negatively or positively. 'Another dimension is the impacts of costs on low income and elderly customers,' he

explains. 'Pricing for the poor is a recognition you have to think through – there has to be a strategy within the rate design that will address this.'

One way of addressing this is through a differential or concession rate – where the price is either funded through other ratepayers, or via a government subsidy. In the US, for instance, the ratepayers subsidise such concessions, whereas in Australia this is achieved through government subsidy.

Development of an effective tariff

What then makes a good tariff? 'A good tariff must recover costs,' explains Mr Reiter. 'A good tariff in an upper-income country will recover cost, and shape demand in a way that is consistent with the circumstances that the utility faces, typically through an increasing block rate, and it would be a tariff that recognises that you've got a community of people including the poor and it would address that.'

There is a trade-off in the increasing block scenario between putting the revenue requirements on the commodity charge, he notes, against the fixed element of the charge. 'If the fixed charge is too small, there can be instability – revenues can vary too much, for instance if there is a drought. If it is too big, there is no incentive to save water. A good tariff strikes a balance between water usage efficiency, price signals around this, and revenue stability.'

In lower and middle-income countries, where there is a history of undercharging, this ideal has to be modified to reflect people's ability to pay, he adds. 'We say as a minimum you should cover your operation and maintenance expenses, and bit by bit grow the tariff so that over time it covers all costs. Sometimes in really poor countries you can't do much more than cover operation and maintenance costs.'

If a utility does not collect enough money, it will systematically starve its systems and create chronic problems. 'Even in developed countries, people are afraid to lift rates to reflect what the system needs,' Mr Reiter observes. 'It's a bit like having a car and not maintaining it. This is common among utilities around the world. An adequate level of revenue collection is key to being able to sustain a system.'

He adds: 'If you look at the evolution in thinking, 40 years ago thinking of tariffs strictly meant recovering costs, but bit by bit people have come to understand the power of a pricing scheme to achieve other objectives.' Tariffs vary to extremes across the world, still – some are very sophisticated and in some countries, there is a very simplistic approach.

'In a country the size of the US it varies greatly,' he says. 'If you think about Australia, before, climate change impacts [tariffs] varied widely. Now, in most places resources are in short supply and you see very creative pricing schemes, even in China. If water is short, we have got to take all the measures we can to get the incentives right.'

One of the principles is that rates in increasing block scenarios are built to send signals that equal the long run marginal costs, he adds. 'This is sitting behind the scenes and guiding the thinking.'

The fifth IWA workshop 'Tariff and pricing for sustainable water services' held in February in Tokyo, Japan, was part of a series held almost every year in the country. 'It is built around the issues that Japanese members feel are really important, and this was one such,' Mr Reiter explains. The workshop was attended by international experts who spoke principally on different aspects of rates and rate design.

'This workshop raised a whole range of issues from developed and developing countries,' he adds. 'Some speakers focused on one and others on the other, and some on both. There were also broader-based presentations and I gave an international report, then there were a variety of case studies. It was a very well received and very successful workshop. The JWWA (Japan Water Works Association) sponsored it, and was very pleased with the outcome.' ●

Triple Bottom Line reporting and management for improving utility performance

Triple Bottom Line (TBL) reporting is a method of defining criteria to measure company success as well as developing long term strategies, and it was the subject of a workshop held at the IWA World Water Congress in Vienna, 2008. In this paper, **STEVE KENWAY, CAROL HOWE, SHIROMA MAHEEPALA, TONY KELLY** and **CHERYL DAVIS** explain how TBL can be used to improve water utility performance (see also following article).

Water utilities globally face multi-dimensional pressures. Costs and infrastructure needs continue to rise and consumer, ratepayer, regulator, staff, shareholder, media, political and board expectations are increasing. A growing skills shortage threatens future workforce viability and forecast climate and environmental changes could undermine previous planning and investment (Means et al. 2006). How can utilities cope with these competing pressures and build the trust necessary to resolve them? What philosophies and tools are available to guide them through future challenges?

This paper clarifies the concept of the Triple Bottom Line (TBL). This is sometimes known as 3BL or Corporate Responsibility. This paper identifies how implementation of TBL reporting and management can help address these challenges. The paper is drawn from a project to develop an informative and practical guide to the reporting and management of TBL performance (Kenway et al. 2007). The project methodology included a wide literature review, detailed case studies of three utilities and a workshop representing 15 utilities from the United States, Australia, United

Kingdom and Canada. The concept of public reporting of TBL performance has global application and is argued here as a beneficial and manageable step for water utilities.

What is TBL?

At its narrowest TBL is viewed as a framework for measuring and reporting performance. At its broadest it aims to capture all approaches necessary to ensure utilities (and policy makers) make balanced decisions and maximize benefit from company activities. TBL principles include development of long-term value-adding strategies, transparency, partnership building (Elkington 1998) and efficient use of natural capital (Foundation 1997; Hawken et al. 1999). Critics argue that the term TBL is misleading and suggest that actual social or environment 'bottom lines' cannot be calculated like a profit or loss statement (Norman and MacDonald 2004). TBL advocates argue that the simultaneous pursuit of environmental, social and economic goals is critical to longevity and profitability. However, TBL can help find more sustainable solutions by focusing attention where a gain in one dimension is not at the cost of others.

We defined TBL reporting and management as the systematic planning, management, performance improvement and public disclosure in environmental, social and economic dimensions at local, regional and global scales. The environmental dimension concerns organizational impact on living and non-living ecosystems, land, air and water. The use of water, energy and materials, rates of effluents, emissions and wastes, biodiversity and river health are powerful performance indicators. The social dimension concerns impacts on public health, other stakeholders, customer satisfaction, labour practices and human rights. The economic dimension concerns financial performance as well as indirect economic impacts. Explanation of these and other performance indicators, the benefits of reporting, a stepped approach to production of TBL reports and necessary internal measures to develop to have reportable performance have been described (Kenway et al. 2007).

How can TBL principles help water utility performance?

Water utilities and managers often have close association with the environment, it is the source of their main product. Typically too, utilities operate with long planning horizons. TBL reporting can help improve the understanding of the existing urban water system in environmental, social and economic terms. This can help find sustainable solutions to emerging challenges. For example, TBL methodologies can guide the evaluation of options when investment is necessary to comply with often vague local goals such as 'improving water quality as far as possible'. A wide range of tools including life-cycle costing, embodied energy analysis, life cycle assessment, conjoint analysis, least-cost planning and externalities valuation can help estimate environmental, social or economic impacts, or parts of them, in isolation.

TBL principles help deliver performance gains by directing investments to solutions where environmental, social and economic benefits are greatest – and thereby manage a wider set of risks. By better understanding the use of energy, raw materials and other inputs, energy use or consumption of energy-intensive materials can be minimised. This can help avoid future water price increases. Public reporting of TBL performance further improves benchmarking and tests the rigour of strategies (GRI 2002; Victorian Water Industry Association 2002).

Many forces will continue to drive the need for improved TBL performance. These include the competition that globalisation brings, the need for increased trust in business operations and the costs that carbon and other natural resources accounting will add to businesses. Many steps are necessary to achieve TBL performance improvement. A critical element is that strategic and business plans include goals in all TBL dimensions. Asset management plans and service levels need to articulate TBL benefits and performance targets. Formal management systems, stakeholder engagement, wider training TBL programmes, a supportive organisational culture, and participation in benchmarking activities, including public reporting, are all supportive approaches.

Conclusions and recommendations

Adoption of TBL principles will help utilities identify areas for improvement in their urban water system and deal with future challenges relating to water. While guidance is available regarding how to produce public TBL reports (Kenway et al 2007; Victorian Water Industry Association, 2002; GRI, 2002), there is a noticeable void detailing the internal measures or methods necessary to deliver this performance. Many utility managers will feel more comfortable with public reporting once internal systems are established to track TBL trade-offs that are occurring with decisions. This will help give managers confidence that progress is being made simultaneously in environmental, social and economic dimensions. Development and incorporation of a balanced performance indicator set (e.g. including energy use, greenhouse emissions and total wastes) in typical benchmarking programmes such as the IWA Water and Wastewater performance indicators (Alegre et al. 2006), and AWWA (American Water Works Association) Qualserve programmes (Lafferty and Lauer 2005) will help improve TBL management of water globally. ●

Acknowledgements:

American Water Works Association Research Foundation and CSIRO Land & Water and Water for a Healthy Country Program for their support together with all contributors acknowledged in the report (Kenway et al. 2007).

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How can the Triple Bottom Line deliver greater value to water utilities?

Triple Bottom Line (TBL) reporting can be used to improve water utility performance. At the IWA World Water Congress a gathering of water sector practioners utilised an innovative workshop methodology to share insights on how water utilities could apply TBL to produce better outcomes (see also preceeding article). **STEVE KENWAY, PAT McCAFFERTY** and **FRANCIS PAMMINGER** summarise the key conclusions and emerging themes.

Triple Bottom Line (TBL) management – the systematic improvement of environmental, social and economic performance – is gathering momentum in the water sector. Water utilities across the globe are dealing with the challenges of water shortages, environmental degradation, cost pressures and rising community expectations. A workshop convened by the Sustainability Specialist Group of the International Water Association (IWA) at the World Water Forum, Vienna, September 2008 focused on how TBL thinking and measurement can help water utilities address these challenges. Key Performance Indicators (KPIs), tools and processes was a particular focus of the workshop.

In the past decade, a suite of approaches and tools have emerged to support the increasingly challenging decisions that water managers must make, with TBL thinking advocated as far back as 1997 (Elkington). However, embedding TBL into the business systems and cultures of water utilities has progressed slowly.

In seeking to leverage the collective wisdom of the assembled group, the workshop adopted the World Café approach (Dunn 2004). This is founded in the comfortable conversations that occur between small groups. The World Café process is designed to enable key themes to emerge by facilitating, recording, sharing, aggregating and prioritising issued raised in natural conversations.

Four formal presentations were delivered to set the context. Steven Kenway of CSIRO (Commonwealth Scientific and Industrial Research Organisation), Australia summarised a recent guidebook for TBL in water utilities (Kenway et al 2007). He clarified how TBL principles, tools and reporting will help utilities address emerging challenges including skills shortages, burgeoning and sometimes conflicting legislation and rising energy prices.

Peter Van Den Steen of UNESCO (United Nations Educational, Scientific and Cultural Organization), The Netherlands, challenged the use of TBL KPIs at utility level. He suggested that this could lead to harmful sub-optimisation. He concluded that it is better for politicians to develop an overall vision of the city and for all managers, including water managers, to measure progress towards that vision.

Cheryl Davis of San Francisco Public Utilities Commission put forward that a primary benefit of TBL reporting is that it reconfigures how we define our challenges. It offers transparency to us and our stakeholders. Cheryl also summarised the 'sustainability toolbox' which has been recently added to IWA's website (www.iwahq.org) and contains resources to help with understanding TBL and sustainability.

Harry Zhang of CH2M Hill, USA identified that there is a growing need for a practical tool that can map water use and assess risks for global companies. Harry described such a tool called 'Global Water Tool' that has been developed for the World Business Council for Sustainable Development (WBCSD). The Global Water Tool enables creation of Global Reporting Initiative (GRI) Water Indicators, inventories, risk and efficiency performance metrics and geographic mapping.

These contrasting presentations sparked vigorous discussion including the appropriate scale for optimisation. Some felt strongly that catchments, regions, nations or other scales were more appropriate levels around which to manage TBL as opposed to utilities or cities.

The debate moved on to address the following questions:

- What TBL KPIs or related tools or processes can deliver the greatest value or performance benefits to water utilities and why?

World Café process in action. Credit: Pat McCafferty

- How might TBL KPIs influence strategy and decision-making in water utilities?

Five key themes emerged from the discussion. These included:
- KPIs need to reflect circumstance
- Time-frames are important
- KPIs need to be meaningful and aligned
- Formalisation of KPI selection processes is warranted
- Awareness of TBL analysis tools is surprisingly low

TBL KPIs need to reflect circumstance

It was recognised that water utilities around the world are faced with different critical issues, and hence TBL KPIs need to reflect these issues. In some countries access to adequate reliable water, minimising water loss (non-revenue water) or having equitable tariff structures are critical. While in developed countries addressing total life-cycle costs (not just immediate cost-benefits), energy use, greenhouse gas emissions and raw materials use are more important.

Distinction was also noted between private and public companies, because financial indicators often have greater emphasis with privatisation.

Service disruptions, regulatory non-compliance and staff turnover rates and engagement levels (surveyed) were seen as good indicators as was benchmarking of best planning practices. It was recognised that KPIs need to 'look beyond utility borders' particularly with regard to social and environmental impacts. For example, considering the influence of policy on customers behaviour, not just on operational impacts. There is also a need to recognise that some KPIs cannot be quantified but are still important.

Time-frames are important

The relative importance of KPIs can change over time, however in the long-term they may merge. For example, externalities of climate change associated with greenhouse gas emissions end up being paid for in the long-run. It was suggested that 'Length of planning horizon' could be a good indicator to test the 'think long-term' principle which is central to TBL approaches. Sometimes decisions to improve short term results can have negative repercussions in the long term and this needs to be considered. Indicators therefore need to be time-bound to be meaningful.

It was also recognised that organisations also often take a 'journey' in relation to building and analysing TBL KPIs. For example the selection of a particular KPI (say environmental), may affect other outcomes that the business is seeking to achieve. Over time patterns emerge identifying the linkages, and the KPIs themselves change to reflect that understanding.

KPIs need to be meaningful and aligned

To have a genuine impact on decision-making, KPIs have to influence effort and investment. Board-level KPIs for strategy and finance should align with organisational KPIs addressing strategy and operations. Participants agreed that 'what gets measured get done', and that the performance assessment of managers, when linked to TBL KPIs, was a critical success factor in achieving improvement in KPI results.

Where financial incentives or penalties exist for employees these should be balanced across all KPIs endorsed by the organisation. This could improve the linkage between executive actions and plans with day-to-day project operations and organisational vision and values. In a similar vein, 'nesting' or at least demonstrating the alignment of TBL KPIs from utility, through city to national and global scale is warranted to ensure that sub-components of the system are not optimised in isolation of – or to the potential detriment of – the whole.

Formalisation of KPI selection processes is warranted

A key issue with indicators related to how they are set and agreed. This is important because it is effectively trading environmental, social and public goods. Negotiated and transparent agreement on TBL KPIs between the utility and government are recommended to maximise public benefit and improve transparency.

There is a need for a framework and process supporting the identification of specific KPIs at a suitable spatial and temporal scale. This will lead to different indicators and targets in each region.

Awareness of TBL analysis tools is surprisingly low

At the workshop in Vienna it was found that TBL analysis tools and processes were neither well understood nor widely used. This is surprising given the group was articulate in and experienced with TBL in general. This suggests that a major gap exists here and that capacity building programmes are warranted at many levels.

In reflecting on the workshop objective the authors of this article believe the concept and application of TBL can deliver greater value to water utilities. In many utilities this is already occurring (Kenway 2007). Specifically it does this by helping systematise performance by clarifying goals, involving stakeholders and measuring performance simultaneously in the increasingly interrelated environmental, economic and social dimensions. However, for benefits to be realised, the concept has to be seen as important and embraced at all levels through an organisation – including its integration into business strategy.

Small groups discuss and prioritise emerging issues in answer to agreed pre-defined questions. Credit: Pat McCafferty

There are a number of ways that adoption of TBL principles and KPIs could be accelerated. For example, environmental and social indicators recommended by IWA could be strengthened, for example to include reporting of energy use and greenhouse gas emissions. Development of training and capacity building programmes and fostering and rewarding public TBL reporting are also suggestions. ●

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Other references mentioned in this article or meeting notes from the workshop are available from s.kenway@uq.edu.au.

Acknowledgments

Cheryl Davis, Peter Van Den Steen and Harry Zhang for contributing presentations and comments. Bruce Beck and members of the Management Committee of the IWA Specialist Group on Sustainability in the Urban Water Sector for supporting and encouraging the concept of a TBL workshop. All workshop participants are thanked for contributing ideas.