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Nonrevenue Water Management in South Asia: Issues and Challenges

Lessons from an international workshop on sharing of good practices in nonrevenue water management

Background

Nonrevenue water (NRW) refers to water that has been produced but is 'lost' before it reaches the customer. It refers to the amount of water produced that does not earn any revenues for the service provider. The 'lost' water in the system could be a result of real losses (through leaks, sometimes also referred to as physical losses) or apparent losses (through theft, free water or metering inaccuracies).

High levels of NRW seriously affect financial viability of water providers through lost revenues, increased operational costs and, eventually, increased capital costs, all of which impact the quality of the services provided.

In South Asia, levels of NRW are estimated at more than 40 percent, but the accuracy of this estimate is in question, given the absence of both bulk and customer meters. A recent study undertaken by the Water and Sanitation Program (WSP) on cost recovery tariff practices of 23 Indian cities reflects the huge revenue potential of NRW management—between 20 and 50 percent of current operating incomes.[1]

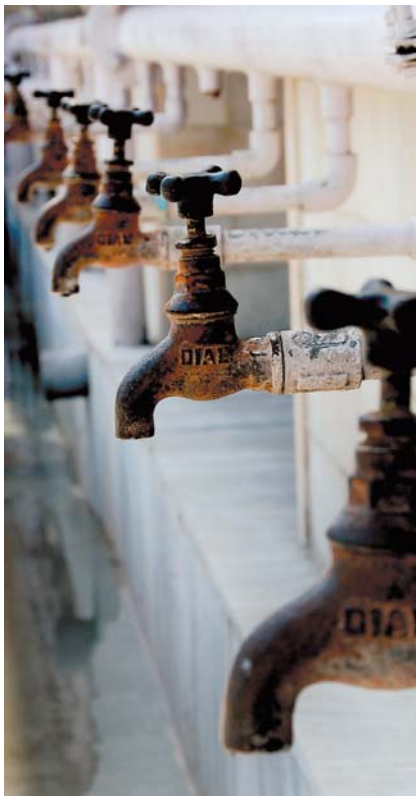
The WSP study demonstrated that dealing with the different components of reducing NRW levels has fairly immediate effects on cost recovery, financial strength, and credit-worthiness, even before any possible tariff increases may be required.

Benefits of Reduced NRW

The approach to reducing NRW includes a set of activities aimed at the optimization of water supply through improved operations, maintenance, and sound management practices of distribution networks. However, most NRW programs that have been sustainable also included institutional and organizational reform.

Dealing successfully with NRW helps contain both physical and commercial losses. Containing and reducing physical water losses reduces the requirement for fresh water, since less of it is wasting away into the ground. This reduces the costs of producing or purchasing fresh water (since less is needed), and also of treating it (much of the water that is wasted has already been treated). It also postpones the need for new infrastructure investment, and extends the life of water resources. It helps in increasing coverage to unserved or poorly served areas, without having to make significant capital investments for supporting expansion in services.

Containing apparent water losses improves cash flows and operating revenues, which allows for enhanced service delivery, including better maintenance of water distribution networks. Improved management of customer connections, customer service, and customer liaison greatly improves billing and collection for water services. This further reduces NRW,



permitting a 'virtual spiral' of mutually-reinforcing system improvements to develop. The overall impact of all these effects is to significantly reduce the long-term cost of supplying water, and to prolong water availability.

Reducing NRW should also go along with improving collection rates as well as with a redesign of tariff structures, especially if the costs of water are not covered under the current tariff rates. Utilities will, however, need to improve operational efficiency so that any of their inadequacies are not passed on through tariff hikes.

[1] For instance, the WSP study showed that in the northern Indian city of Ludhiana, an increase in the customer database could have a revenue potential of Rs. 181 million, even within the current tariff structure. Similarly, in Pune, a reduction in the levels of NRW to 10 percent can have a revenue potential of Rs. 164 million. [USD1 = INR 47, as of October 29, 2009. Conversion rates are from http://coinmill.com; all conversions in the text are approximations.]

About the Workshop: Context and Overview

In February 2009, the Water and Sanitation Program–South Asia (WSP–SA) organized an international workshop on 'NRW Management' to share global and South Asian experiences on how to promote good practices and locate billing and collection within the broader framework of NRW, as well as catalyze further initiatives to reduce NRW.

The workshop was a follow-up event to the 'Customized Clinic on Billing and Collection' in Singapore and Bangkok in May 2007 for revenue officials from six water utilities and municipal water departments in India, Pakistan, and Bangladesh. The focus was on showcasing revenue management best practices in water supply agencies, and for helping participants develop implementation plans to address specific aspects of their billing and collection systems that required attention.

Box 1: Case studies presented at the workshop

Country	City
South Africa	Johannesburg
Malaysia	Penang
Cambodia	Phnom Penh
Vietnam	Hai Phong, Ho Chi Minh City
Bangladesh	Dhaka
India	Rajkot, Thane, Hubli–Dharwad, Belgaum, Gulbarga

The NRW workshop was attended by approximately 70 participants, including water utility managers from India and Bangladesh, water sector specialists, and water utility managers from elsewhere in South Asia, East Asia, and South Africa. Participants represented different possible institutional arrangements for delivering water in South Asia, including state parastatals, municipal departments, municipal corporations, and water companies. The case studies presented at the workshop (see Box 1) are summarized in Box 2.

Box 2: Experiences on nonrevenue water management from across the world

Place	Context	Key actions for nonrevenue water management	Service level outcomes
Phnom Penh Water Supply Authority, Cambodia	• Long civil war destroyed much of Phnom Penh's WSS infrastructure • Poor service outcomes—high NRW, old and poor network coverage, poor supply (10 hours per day with pressure 0.2 bar), low levels of metering • Call for institutional reform for operational and financial autonomy for enhanced accountability to improve services[2]	• Rehabilitating and replacing old pipes, and extending network • Removing illegal connections • Updating consumer database • Initiating computerized billing • Training meter readers and payment collectors • Revising tariffs to reflect true costs and service improvements • Encouraging poor people to connect—subsidizing connection fee and introducing installment system to make it easier to pay	Between 1993 and 2008: • Reduction in NRW from 72 percent to 6 percent • Reduction in staff per 1,000 connections from 22 to 2 • Extension in distribution network from 288 km to 1,500 km • Increase in coverage area from 25 percent to 90 percent • Improvement in water supply from 10 hours a day to 24 hours a day • Improvement in pressure from 0.2 bar to 2.5 bar • Improvement in collection ratio from 48 percent to 100 percent • Improvement in operational ratio from 150 percent to 22 percent
PBA Holdings Board, Penang, Malaysia	• In 1989, Penang Water was corporatized and subsequently privatized to improve its financial soundness • Currently operates under a license issued by the government to source, treat, and distribute water, and bill water users in Penang	• Doing NRW tracking via IWA Water Balance • Implementing DMAs and metered zones for active leakage control • Doing GIS mapping • Taking speedy action to repair pipe bursts, systematic maintenance, rehabilitation, and replacement of pipelines • Keeping control of materials used in water distribution network construction • Establishing meter replacement program and meter reading accuracy • Implementing integrated revenue management system	Between 1999 and 2008: • Reduction in NRW from 24 percent to 17 percent • Reduction in average daily production from 1,094 m liters a day to 896 m liters a day, but with increased coverage and increased daily consumption levels • Increase in customer care units from 6 to 10 • Coverage of 100 percent
Hai Phong Water Supply Company, Vietnam	• Poor service levels including high NRW of 70 percent • Poor distribution network, lack of metering, shortage of water • Poor financial health • Very poor baseline, no network maps, and badly deteriorated network	• Implementing the Phuong model in 1993—a ward-based model for NRW management • Decentralizing responsibility to the company's lowest possible level, that is, the ward • Creating ward-based hydraulic zones with DMAs for implementation of NRW reduction, along with initiating NRW ward plans • Establishing Water Management Team with clear responsibilities and performance incentives for every ward	Between 1993 and 2007: • NRW figures of around 10 percent from 70 percent

[2] The abbreviations used in the text are: DMA = District Metered Areas; GIS = Geographic Information System; IWA = International Water Association; NRW = Nonrevenue water; and WSS = Water supply and sanitation.

Place	Context	Key actions for nonrevenue water management	Service level outcomes
	• Little initiative, commitment or incentive to improve upon performance	• Starting simultaneous investment program to upgrade the water distribution infrastructure	
Johannesburg, South Africa	• WSS reforms came as part of a broader reforms drive, sparked off by financial and institutional crisis • Johannesburg Water created as a corporatized entity in 1991 • High levels of NRW of 38 percent—combination of technical and apparent losses	• Minimizing physical losses including improved data to identify where losses occur, network upgrading and renewal, systematic leak detection and repair, and pressure reduction at night • Minimizing commercial losses by resizing meters for large users, replacing old meters, replacing fixed tariffs with metered volumetric tariffs, and a comprehensive 'cleansing' of customer billing data • Doing meter installation in unmetered areas, accompanied by a substantial upgrading of physical distribution infrastructure, household connections, and repair of household leaks	• Steady decline in overall NRW figures from 38 percent in 2001 to 32 percent in 2004 • All areas have 24-hour water supply • Significant improvement in financial position of water utility
Ho Chi Minh City, Vietnam	• Water supply operations managed by the Saigon Water Corporation (SAWACO), which was established in 1874, and restructured in 2005 • Very high levels of NRW	• World Bank–financed NRW reduction project proposed for leakage reduction and improvement in customer metering and billing • City's water supply network divided into six hydraulic zones and 500 DMAs, and proposing to reduce actual water losses in two of the six zones. Work to be awarded shortly • Performance-based service contracting for reducing and managing NRW levels will use the expertise of a private company contracted by the public utility to carry out a comprehensive NRW reduction program in one zone; incentives and flexibility to ensure accountability for performance; payment linked to actual results achieved in NRW reduction • Other zone will be handled by in-house crews of the public utility, supported by international specialists. Their performance will be compared to the efficiency of the private sector operator	Yet to be implemented
Thane, India	• Poor levels of service accompanied with poor levels of NRW and financial health • Program of converting illegal connections to legal is not popular with politicians or the public, as they prefer to have water tariffs based on a flat rate	• Focused billing and collection plan • Undertaking data cleansing—one agency appointed per ward to inspect approximately 125,000 water connections, legal and illegal. If an illegal connection is found, a meter is installed and the customer is billed • Improving collection efficiency	

(Box 2 continued on next page)

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Place	Context	Key actions for nonrevenue water management	Service level outcomes
		• Doing an annual arrears collection drive every March, where defaulters are cut off from the network, after which a legal letter is sent and they need to pay to reconnect • Creating a credit control task force in each ward, to extract payments from defaulters and unaccounted commercial consumers • Mapping 670 km of main pipelines (two-inch diameter) and of distribution pipes to consumer connections and the meter	
Rajkot, India	• Supply of water only for 20 minutes • Huge commercial losses mostly resulting from an inaccurate database and illegal connections • Poor customer grievance redressal mechanisms • Water scarcity challenges	• Establishing billing and collection plan that focused on data cleansing, regularizing illegal connections, outsourcing, call center, and improving collection rates • Minimizing the use of water tankers to supply water to unserved areas by extending the network • Reducing the supply of free water through standposts, especially where households already have an individual connection, and extending water services as well • Using a call center to address customer complaints regarding service delivery, and billing and collection related complaints • Keen to outsource service delivery in one pilot zone to see if supply hours can be increased	• Increase in billings by 68 percent • Reduction in water tanker trips from 175 to 116 per day • Increase in number of new connections, to 10,394 in 2007–08 and 11,087 in 2008–09
Dhaka, Bangladesh	• Poor service levels and financial health • Many illegal connections • Poor levels of metering	• Installing meters in one of the service zones • Outsourcing of the billing and collection function in another service zone	• 96 percent connections metered in the zone considered for metering
Hubli–Dharwad, Belgaum, and Gulbarga, India	• Part of the World Bank–funded Karnataka Urban Water Sector Improvement Project (KUWASIP) • A demonstration project conceived for providing continuous pressurized water in selected demonstration zones in the three project urban local bodies, that is, Hubli–Dharwad, Gulbarga, and Belgaum, since these towns were receiving water once a week • Operationalized by Veolia Water in 2006; project now providing continuous pressure water since April 2009	• Installing accurate bulk flow meters • Systematically analyzing bulk water meter data • Using step tests and active leak detection • Using pressure management and pressure control valves • Creating network zones • Systematically identifying customers • Billing of customers • Monthly tracking and comparing of system input volume and billed volume	• Increase in hours of supply from two hours every few days to 24–hour water supply • Decrease in volume of water supplied into zones by nearly 18 percent • Replacement of system pressures of half-a-meter of water by over 17 meters • Provision of individual meters to all customers in the zones • Provision of 24-hour customer service where previously there was none • Reduction in NRW from over 50 percent to around 7 percent

Heart of the Matter

Key Observations for South Asia

In South Asia, several factors would need to be considered while embarking on improving NRW management.

The first set of factors concern physical water losses:

- Water supply is intermittent;
- Flow metering is inadequate or nonexistent;
- Network data (pipeline maps and drawings) are inaccurate, out of date or nonexistent;
- Basic working methods require improvement (licensed plumbers, pipe joints, use of household piped connections instead of standposts, and so on);
- Good quality materials may not be available in the local market;
- Losses are camouflaged as free supply through public standposts; and
- The perception of water as a free resource hampers proper metering and charging of water consumption.

The second set of issues concern commercial losses:

- Inadequacies in customer data, including the physical location of customers and their correlation with specific water supply points or meters;
- The lack of sufficiently accurate customer meters;
- Unauthorized connections and illegal connections;
- Poor billing and collection practices; and
- Resistance from vested interests.

NRW reduction initiatives have received increased attention in India and Bangladesh, although they are often presented in other forms. Veolia's pilot projects in Karnataka are continuous, 24x7 demonstration projects, while Rajkot, Thane, and Dhaka presented billing and collection projects. Yet all these utilities were undertaking initiatives as service delivery improvement projects that would eventually have an impact on the overall NRW levels.

Most of the initiatives are relatively recent and have been running for a comparatively short period of time when compared with international cases. While some results on operational efficiency have been

achieved, international experience appears to suggest that these must be sustained over a long period before significant improvements are witnessed.

Main Elements of an NRW Strategy

The case studies presented at the NRW workshop contained several messages relevant to water supply utilities in South Asia today.

Understanding the Magnitude

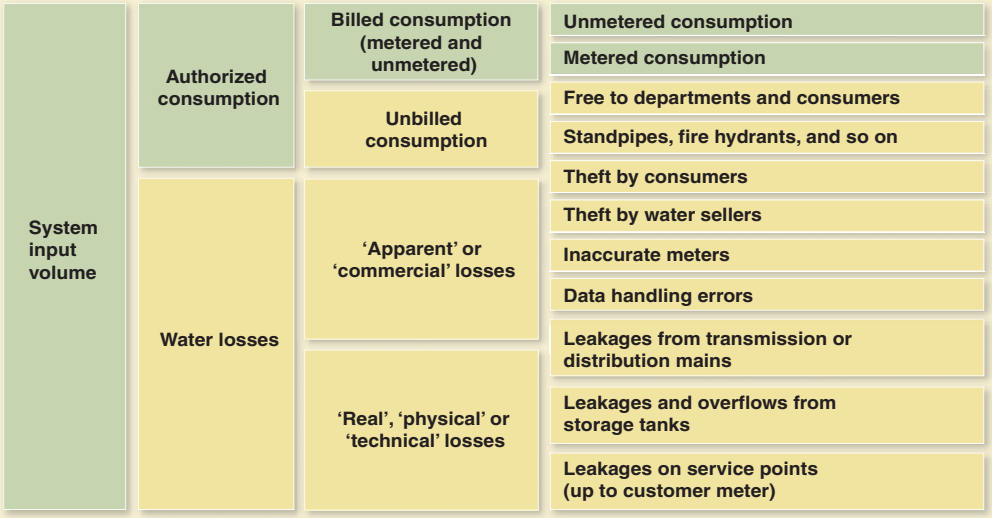
It is essential for every water supply agency to understand the magnitude of NRW even while steadily improving the accuracy of its estimates. The starting point for an effective NRW program is a thorough assessment of the prevailing Water Balance (Box 3), which can help derive the cost or value of NRW and the estimated budget required for its comprehensive reduction. A water audit helps review the Water Balance by estimating how much water is being lost, where and why is it happening, how to reduce losses and improve performance, and how to sustain a strategy that is targeting its reduction and management.

This is important especially in light of the fact that most South Asian water utilities have little idea about the exact magnitude of NRW, especially in the absence or inaccuracy of metering practices. For instance, in the Penang, Phnom Penh, and Vietnam cases, significant focus was placed on making this an integral part of their NRW strategy. The South Asian water agencies at the workshop provided a rough estimate for NRW to indicate the broad components and operational

Box 3: Water Balance: Components of nonrevenue water

The International Water Association has adopted standard terminology around the issue of nonrevenue water which can be represented in the following schematic:

Figure 1: Water Balance (as per the International Water Association)



The diagram highlights the following features of NRW (reading from left to right):

- Every utility should know its system input volume (produced by abstraction from rivers or from tubewells, and so forth; or purchased from other agencies).
- Part of that volume is supplied to consumers as **authorized consumption**, and the remainder is **water losses**.
- NRW is hence the difference between system input volumes and billed authorized consumption. It consists of unbilled authorized consumption, apparent losses, and real losses.
- Authorized consumption has two parts: the part that is **billed to consumers** (both metered and unmetered); and the part that is **not billed**, because it is supplied without charge, such as to municipal departments and certain categories of consumers; and because it is supplied to standpipes, fire hydrants, public fountains, and similar facilities. This unbilled portion of authorized consumption does form part of NRW, but it is by no means the whole of NRW.
- Water losses also come in two forms: **'apparent'** or **'commercial'** losses, and **'real'** or **'physical'** losses. Water that is not physically lost, but only apparently lost, includes water supplied through illegal connections; water stolen for resale; water consumption undercounted by inaccurate meters; and water sales that cannot be invoiced because meter numbers cannot be accurately correlated with customer names and addresses. Physical losses include leaks from reticulation systems (especially service connections); leaks from transmission or distribution mains; and overflow and leaks from storage and balance tanks. Such leaks are often the result of poor workmanship, the use of poor materials, and the lack of maintenance.
- Successful water supply agencies typically monitor the different components of NRW levels as part of normal management practice, at least monthly.

areas that may need immediate attention (Box 4). The discussions focused attention on the need to accurately estimate and address NRW in a less erratic and crisis-driven manner. Some utilities suggested that a dedicated core team may be a good mechanism to achieve a more systematic NRW management.

Once estimates are obtained on NRW through a Water Balance exercise, the exact areas for intervention can be identified and the service provider can focus on the specific localized types of intervention—technical or commercial—to control and manage NRW levels.

Designing a Strategy to Address the Problem

With a Water Balance exercise as a starting point, a reduction in NRW mostly requires a combination of technical and commercial measures, and governance reforms. Service providers will need to have the requisite autonomy and discipline and be made accountable for keeping illegal connections under control. Utilities such as Penang, Phnom Penh, Johannesburg, and a few in India (including Rajkot) used interventions like updating and cleaning of customer databases, improving billing and collection procedures, and effective customer communications and relations for controlling the level of apparent losses. The cases of Hai Phong and Ho Chi Minh City demonstrated how staff incentives could be used to encourage accountability for controlling NRW. Hai Phong and Phnom Penh also demonstrated how operational and financial autonomy granted to utility managers encouraged them to become more accountable for sustainable NRW strategy.

NRW management also requires technical interventions. Regular surveys and inspections of the distribution

Box 4: Developing rough nonrevenue water estimates in South Asia

The international workshop on nonrevenue water (NRW) management featured a working session in which participants estimated the NRW applicable in their own water utility using a simple spreadsheet framework for water audit calculations based on the International Water Association (IWA) Water Balance. The estimates were based on the personal knowledge of utility managers of the basic parameters of their water supply operations, and not on any detailed measurement or research. Accordingly they are not to be regarded as, in any way, definitive. Yet, the exercise required managers to confront the reality of the NRW data applicable to their own operations, and to recognize the specific nature of the NRW that confronts them.

INDIA		PHED Haryana	PHED Bhubaneswar	Gwalior MC	Indore MC	Jabalpur MC	Rajkot MC
Total input volume	m^3	620,000	7,846,410	5,022,000	205,000	2,945,000	5,320,000
Total water loss	m^3	326,570	3,971,410	3,006,225	86,000	2,078,550	2,130,673
Apparent loss	m^3	93,775	325,500	0	58,500	279,000	1,560
Real loss	m^3	232,795	3,645,910	3,006,225	27,500	1,799,550	2,129,113
Nonrevenue water	**%**	**53%**	**51%**	**60%**	**42%**	**71%**	**40%**
of which apparent loss is	%	29%	8%	0%	68%	13%	0%
of which real loss is	%	71%	92%	100%	32%	87%	100%
NRW per connection	L/conn/day	612	2,322	1,119	19	1,711	366
Real loss/km of distribution mains	m^3/km/day	21	78	65	1	24	54
Monthly revenue foregone	Rupees	724,985	15,885,640	12,024,900	1,455,000	13,587,300	9,394,761

Note: (a) MC = Municipal Corporation; (b) PHED = Public Health Engineering Department.

BANGLADESH		Chapai Nawabganj	Dhaka WASA	Gazipur	Manikganj	Narsingdi	Rajshahi
Total input volume	m^3	151,032	49,600,000	23,400	148,180	123,039	1,550,000
Total water loss	m^3	23,827	15,909,200	5,400	71,980	35,439	550,000
Apparent loss	m^3	1,560	930,360	1,560	1,560	1,560	300,000
Real loss	m^3	22,267	14,978,840	3,840	70,420	33,879	250,000
Nonrevenue water	**%**	**16%**	**32%**	**23%**	**49%**	**29%**	**35%**
of which apparent loss is	%	7%	6%	29%	2%	4%	55%
of which real loss is	%	93%	94%	71%	98%	96%	45%
NRW per connection	L/conn/day	207	1,784	82	613	510	931
Real loss/km of distribution mains	m^3/km/day	11	161	6	31	19	16
Monthly revenue foregone	Taka	150,192	99,565,800	16,200	360,900	88,598	3,000,000

Note: (a) WASA = Water Supply and Sewerage Authority; (b) Chapai Nawabganj, Gazipur, Manikganj, and Narsingdi are pourashavas (that is, municipalities); Rajshahi is a City Corporation.

While there are some outliers that seem puzzling, in both countries most of the estimates seem to be within the expected range. The estimates ranged from 16 percent up to 71 percent, and the real losses from 100 percent of NRW down to 32 percent.

The exercise was clearly useful in the discussion it generated among participating utility managers as to the true value of the figures being suggested, and the implications of the estimates arrived at. It is clear that there are few water supply operations that can afford to ignore the issue.

system are made for identifying leakages, with listening devices on pipelines and fittings; systematically maintaining, rehabilitating, and replacing pipelines; and analyzing leakage monitoring through District Metered Areas (DMAs). The distribution network is created into a hydraulic supply system divided into operational zones defined on the basis of service reservoirs, pumping stations, pressure zones or other operational considerations. These operational zones are further divided into DMAs, where total net inflows and the volume of water billed at the consumption end are measured and NRW is calculated as the difference between the two. Appropriate solutions are then applied to bring NRW levels to target levels. Such technical solutions usually involve significant capital investments. The cases of Phnom Penh and Hai Phong demonstrated how ward-based hydraulic zones via DMAs were used for implementation and management of NRW in a systematic manner. Even the Karnataka Urban Water Sector Improvement Project (KUWASIP), in the state of Karnataka in India, demonstrated the success of pilot DMAs in each of the three towns.

A Robust Metering Policy

Essential to effective NRW management is the presence of a robust metering policy that ensures metering not only at all facilities, but also at all the water connections that the provider is serving. This means that flow meters are installed at the outlet of the water treatment plant and storage or distribution tanks, and also in the main conveying system, so that water input figures for the distribution system can be obtained.

Customer meters must also be installed to be able to accurately measure consumption at the consumer end. The cases of Johannesburg and Penang demonstrated especially how an effective metering policy, along with training for staff, ensured that meter maintenance was up to the mark.

Once input and output figures are obtained, maintaining a Water Balance is not difficult and the search for specific solutions can begin. The metering policy must also be supported by a proactive meter maintenance policy that checks for flow meters, and checks and replaces customer meters at the end of their useful life.

Sustained Implementation of Efforts

NRW reduction is aimed at the optimization of water supply through a combination of improved operation and maintenance, sound commercial practices, network refurbishments, rehabilitation and management, and institutional interventions to bring about managerial accountability at an operational level.

Such a strategy does not imply a one-time program but, rather, implementation efforts that need to be sustained over extended periods of time. Water supply agencies need to maintain

a determined strategy of ongoing and continuous efforts to control physical and commercial losses on a proactive basis, supported by a continuous monitoring program to maintain target levels. This was demonstrated in the cases of Penang, Phnom Penh, Johannesburg, and Hai Phong, where the NRW strategies evolved with time, with continuous attention being paid to the different aspects of NRW reduction, ultimately involving a comprehensive improvement of water supply operations. These programs are now institutionalized so that NRW remains at target levels and there is a constant search for improving these levels.

Safeguarding Concerns of Affordability for Poor People

Successful NRW reduction strategies are usually aligned to the issues of access and greater affordability for poor people to connect to the network. This is because poor people are required to be brought under the network as part of any effective NRW strategy. Connecting poor people does not necessarily mean compromising on a service provider's ability to subsidize services for the poorer sections of the population; rather, it allows for improved transparency and accountability, and for ensuring better targeting of subsidies such that they are more equitable and actually reach poor people.

In many cases people in poor settlements, especially in South Asia, have resorted to illegal connections because the service provider refused to connect them due to various reasons (such as lack of land ownership titles,

uncertainty on whether they would be regular customers and pay their bills on time, and so on). An effective NRW strategy that connects poor people to the network would need to suggest means to connect them and encourage them to pay their bills on time.
The strategy could suggest easing the rules and application procedures for getting a connection, rationalization of connection costs, and allowing for a system of installment payments so that poor people are indeed encouraged to connect.

The case of Johannesburg demonstrated how the service provider tackled the problem of meter-based charging practices in poor settlements by using prepaid meters. The basic idea behind prepaid meters is to facilitate those who have been denied access to water, cut down on the vast water losses, and hence improve services to poor people. However, this program has recently proved politically controversial and its progress stalled by adverse court decisions.

Change Management and the Enabling Environment

A critical feature of all successful NRW reduction programs is government support within which the water supply agency can work and be made more accountable. It involves specifically managing change, dealing with management skills and capacities, providing clarity on specific accountabilities, incentivizing good performance, and penalizing poor performance.

Successful NRW strategies also require the presence of a champion—a strong leader—as well as good and effective teamwork committed to the cause for bringing about a corporate culture that undertakes NRW management in a more professional and commercial environment. An effective staff retention strategy would seek to retain and impove upon the skills developed to reduce NRW.

The commitment to ensure that NRW strategies remain sustainable was demonstrated in all the international cases. In Phnom Penh, the approach to NRW reduction included strong and committed leadership, comprehensive management renewal, the introduction of incentives and penalties, and an overall teamwork approach, all of which provided a perfect enabling environment for making such an initiative sustainable. In Hai Phong, too, the ward-level committees were incentivized to meet and maintain the target NRW levels that had been set.

Setting and Monitoring Performance Standards

NRW reduction and management should not be seen as a one-off intervention. It involves not only setting good performance indicators that can be monitored and evaluated, but also institutionalization of monitoring procedures over time. Suitable indicators should be drawn up for monitoring all components of water loss so that the utility can properly establish baselines, as well as track and target all financial, operational, and water resources components of losses. A periodic and systematic monitoring procedure needs to involve reading of all bulk, district, and customer meters for calculating NRW and its elements in each zone in which the system is divided. The process also needs to ensure that these target levels are matched and maintained.

In all the international cases, performance standards were set and staff encouraged to meet these standards. In Hai Phong, Phnom Penh, and Ho Chi Minh City, staff incentives were used to encourage improved accountability for meeting these performance standards. Regular monitoring ensured that performance standards and targets were being met within the specified timeframe. In Hai Phong, monthly ward-level meetings were held for reporting and addressing the community's water supply needs as well as for providing feedback on the ward's performance as per specific standards that were set.

Tariff Rates and Collection Efficiency

Both tariffs and collection rates have a bearing on the design of an NRW strategy, and need to be evaluated even while reducing NRW.

For instance, it is true that official water tariffs in South Asia are significantly below the long-term cost of water supply. Yet when the commercial aspects of NRW are predominant, it may not be strategic to start a long-term NRW program with a tariff increase, as it would hinder efforts to convert illegal connections to legal ones. Instead, reduction in commercial losses would itself yield improvement in cash flows and other financial indicators without any tariff increase. Subsequently, tariff revisions may be initiated, which would be facilitated by the demonstrated improvements in service quality achieved through successful NRW management. Similarly, billing and collection efficiency is another critical component of effective water supply operations that synergizes with efforts on NRW management. On the one hand, efficient billing operations help track NRW more effectively and, on the other, metering undertaken for NRW management enables more efficient billing and collection. High collection rates strengthen cash flows and enhance service provider credibility in the eyes of the customer, thereby adding further momentum to NRW efforts. This was a focus of almost all water utilities that presented their case at the workshop, especially Penang, which focused on an integrated revenue management system for addressing these concerns.

Box 5: Making nonrevenue water strategies work for South Asia

The following points were reflected as being of particular relevance to water supply agencies in South Asia for nonrevenue water (NRW) reduction.

- **Measurement and reduction of water losses.** A comprehensive baseline and situation analysis needs to be undertaken on a regular basis, along with an effective tracking mechanism, to gain a better understanding of the magnitude of NRW and its composition. This can then be followed with specific localized techniques and procedures to address NRW.
- **NRW management delivers improved financial performance almost immediately.** Addressing the commercial aspects, especially of billing and collection efficiency, will make it possible to substantially improve financial performance significantly, before tariff increases become necessary.
- **Successful NRW reduction is the result of a long-term and continuous program** to control physical and commercial losses while also bringing in managerial efficiency and institutional accountability.
- **Private sector capacity can often be useful in NRW reduction programs.** Performance-based contracting with the private sector can help bring in the required technology and know-how, better incentives for project performance, fully-focused and creative solutions for design and implementation, qualified human resources and, in some cases, big investments.
- **A conducive environment needs to support a strong NRW program.** Water agencies must operate under a framework that encourages accountability, autonomy, and incentives for improved performance. Strong leadership must also be present to deliver the required push for an improved work culture and to build relevant local capacity for implementing a sustainable NRW strategy.

The Way Forward

Various programs in South Asia are now promoting enhancement of accountability for improving service delivery, rather than merely focusing on infrastructure creation. NRW strategies can be considered as the building block for achieving the goal of improved services, especially that of continuous supply water systems. This requires not only a technical and commercial focus, but also an attitude of dealing with institutional issues such as political and operational accountability that often hamper the sustainability of NRW strategies.

Service providers will need to be provided with the enabling environment for ensuring that NRW performance improvements can be implemented sustainably. This means clarity of roles and responsibilities of all stakeholders, the right incentives to perform, and clear targets for delivering improved services.

The international workshop on NRW facilitated important perspectives from international presentations, for South Asian cities to look at their own situations and realize how the NRW problem could be formulated, so that at least some 'quick win' solutions could be undertaken immediately. In the end, many service providers left with a feeling that a lot was in their control and they could benefit with some quick interventions, instead of only blaming political constraints for the poor state of services. The workshop was a step in the process though, and the challenge now remains for cities to take this dialog further. Hence:

- Cities that participated at the Clinic in Bangkok and Singapore would need to refine their billing and collection improvement plans further, to contextualize them within the overall framework of NRW reduction strategies.
- Other participating cities and their respective water managers will need to move the agenda forward on the basis of a more informed and systematic understanding of issues and options. This is especially important in the context of urban reforms now stressing improved accountability of service delivery for reaching the goal of continuous water supply. NRW reduction strategies are the first step towards this goal.
- WSP–SA is well placed to continue to provide access to global experience and expertise from different service providers to assist cities and water utilities for technical guidance, identification of emerging good practices from the region, and implementation of knowledge-sharing activities.

Appendix 1: International Workshop on Nonrevenue Water Management

February 3–5, 2009, New Delhi
Program

Tuesday, February 3, 2009		
	Arrival of participants	
Evening	Opening function on the lawns of the hotel coffee shop	
1830 – 1900	Registration; welcome and introductions	Mr. Chris Heymans
1900 – 1930	Introduction and overview: Commercial and technical aspects of nonrevenue water	Mr. Roland Hunter
1930 onwards	Cocktails and dinner reception	
Wednesday, February 4, 2009		
Session 1: Introduction, Overview, and Principles		
0900 – 0915	Opening remarks and quick overview of nonrevenue water	Mr. Nabaroon Bhattacharjee
Session 2: International Case Studies		
0915 – 1015	Hai Phong Water Supply Company, Vietnam	Mr. Do Hung Thang
1015 – 1115	Phnom Penh Water Supply Company, Cambodia	Mr. Khut Vuthiarith
Session 3: Regional Case Studies		
1145 – 1245	Veolia Water, India	Mr. Anand Jalakam
1245 – 1300	Group photo	
1400 – 1500	Rajkot Municipal Corporation, India	Mr. Vijay Anadkat
1500 – 1600	Thane Municipal Corporation, India	Mr. Mangesh Gite
1630 – 1700	Cost recovery principles and nonrevenue water in India	Mr. Ravikant Joshi
1700 – 1730	Summary of the day's key learning points: Discussion	Mr. Roland Hunter
Thursday, February 5, 2009		
Session 4: International Case Studies		
0900 – 1000	Penang Water, Malaysia	Mr. Jaseni Maidinsa
1000 – 1100	Johannesburg Water, South Africa	Ms. Kathy Eales
1130 – 1230	Performance-based nonrevenue water contracting: International experiences	Mr. William Kingdom
Session 5: Regional Case Studies		
1330 – 1430	Dhaka Water Supply and Sewerage Authority, Bangladesh	Mr. Khalid Mahmood
Session 6: Group Work: Measures to Address Nonrevenue Water		
1430 – 1700	Group work on calculating and addressing nonrevenue water	Participants
Closing Session		
1700 – 1800	Next steps: Closure	WSP–SA

Appendix 2: List of Participants

Institution	Name of Participant	Designation
Rajkot Municipal Corporation	Mr. D. H. Brahmbhatt	Commissioner
Rajkot Municipal Corporation	Mr. Vijay Anadkat	Assistant City Engineer
Rajkot Municipal Corporation	Mr. Mahesh Gohel	EDP Manager
Rajkot Municipal Corporation	Mr. Samir Dhaduk	Assistant Manager, Tax
Thane Municipal Corporation	Mr. Dhole Vikas Mahadev	Executive Engineer
Thane Municipal Corporation	Mr. Sameer Lahane	Executive Engineer
Thane Municipal Corporation	Mr. Jamwade Madhav	Superintending Engineer
Government of Orissa, Housing and Urban Development Department (HUDD)	Mr. Sanjeev Das	Executive Engineer, Reform Cell
Government of Orissa, HUDD	Mr. Dilip Singh	Chief Engineer
Office of Chief Engineer, Orissa	Mr. P. B. Rout	Superintending Engineer
Office of Chief Engineer, Orissa	Mr. Sarbeswar Jena	Executive Engineer
Bhubaneswar Municipal Corporation	Mr. Ashimananda Mohanty	Superintending Engineer, PH Circle
Bhubaneswar Municipal Corporation	Mr. Anil Kumar Samal	Executive Engineer, PH Division–I
Bhubaneswar Municipal Corporation	Mr. M. R. Nanda	Executive Engineer, PH Division–II
Bhubaneswar Municipal Corporation	Mr. Dwipayan Pattnaik	Executive Engineer, PH Division–III
Office of Chief Engineer, Orissa	Mr. Upendra Samal	Assistant Engineer
Office of Chief Engineer, Orissa	Mr. N. K. Biswal	Assistant Engineer
Office of Chief Engineer, Orissa	Mr. K. K. Sahu	Assistant Engineer
Orissa Water Supply and Sewerage Board (OWSSB)	Mr. B. K. Soren	Executive Engineer
OWSSB	Mr. P. K. Das	Project Engineer
Indore Municipal Corporation	Mr. Vivek Singh	Additional Commissioner
Indore Municipal Corporation	Mr. C. B. Singh	Municipal Commissioner
Indore Municipal Corporation	Mr. Dharmendra Varma	Executive Engineer
Indore Municipal Corporation	Mr. Sukhbir Singh	Executive Engineer
Gwalior Municipal Corporation	Mr. B. S. Sikarwar	Assistant Project Manager
Gwalior Municipal Corporation	Mr. S. L. Batham	Assistant Engineer (Water Supply)
Gwalior Municipal Corporation	Mr. K. C. Agarwal	Assistant Engineer (Water Supply)
Gwalior Municipal Corporation	Mr. Arvind Sharma	Assistant Engineer (Water Supply)
Jabalpur Municipal Corporation	Mr. Rahul Singh	Assistant Commissioner
Jabalpur Municipal Corporation	Mr. Ajay Sharma	Executive Engineer
Dhaka Water Supply and Sewerage Authority	Mr. Khalid Mahmood	Chief Revenue Officer
Dhaka Water Supply and Sewerage Authority	Mr. Md. Serajuddin	Superintending Engineer
Rajshahi City Corporation	Mr. Md. Parvez Mahmud	Assistant Engineer (Water Supply)
Gazipur Pourashava	Mr. Md. Nazrul Islam	Water Superintendent

Institution	Name of Participant	Designation
Manikganj Pourashava	Mr. Golam Zakaria	Water Superintendent
Narsingdi Pourashava	Md. Shahidul Islam	Water Superintendent
Nawabganj Pourashava	Md. Nazrul Islam	Water Superintendent
Public Health Engineering Department, Haryana	Mr. N. K. Sharma	Official, Public Health Engineering Department, Haryana
Public Health Engineering Department, Haryana	Mr. S. S. Bida	Head of Public Health Engineering Department, Haryana
Veolia Water	Mr. S. V. K. Babu	General Manager
Hai Phong Water Supply One Member Co, Ltd	Mr. Do Hung Thang	Director of Water Meter and NRW Reduction Enterprise
The World Bank	Mr. William Kingdom	Lead Water and Sanitation Specialist
Phnom Penh Water Supply Authority	Mr. Khut Vuthiarith	Manager
PBA Holdings Bhd	Mr. Jaseni Maidinsa	Chief Executive Officer
PBA Holdings Bhd	Mr. Amiruddin Kemat	Business Development Manager
Water and Sanitation Program–South Asia	Mr. Chris Heymans	Regional Team Leader
Water and Sanitation Program–South Asia	Mr. Nabaroon Bhattacharjee	India Country Team Leader
Water and Sanitation Program–South Asia	Ms. Pronita Chakrabarti	Economist
Water and Sanitation Program–South Asia	Ms. Vandana Bhatnagar	Finance Specialist
Water and Sanitation Program–South Asia	Mr. Suseel Samuel	State Coordinator, Orissa
Water and Sanitation Program–South Asia	Ms. Risha Jain	Finance Specialist
Water and Sanitation Program–South Asia	Ms. Vandana Mehra	Regional Communications Specialist
Water and Sanitation Program–South Asia	Mr. Mariappa Kullappa	State Coordinator, Andhra Pradesh
Water and Sanitation Program–South Asia	Mr. Nitin Jain	Extended Term Temporary
Water and Sanitation Program–South Asia	Ms. Heidrun Jeung	Junior Professional Officer
Water and Sanitation Program–South Asia	Ms. Geeta Sharma	Regional Communications Specialist
Water and Sanitation Program–South Asia	Ms. Suneetha Kacker	Extended Term Consultant
Water and Sanitation Program–South Asia	Mr. Sanjay Gupta	Consultant, Communications
Water and Sanitation Program–South Asia	Mr. Ravikumar Joseph	Senior Water and Sanitation Specialist
Water and Sanitation Program–South Asia	Mr. Vivek Raman	Research Analyst
Water and Sanitation Program–South Asia	Mr. Ravikant Joshi	Consultant
Water and Sanitation Program–South Asia	Mr. Md. Akhtaruzamman	Water Utilities Specialist
Water and Sanitation Program–South Asia	Mr. Roland Hunter	Consultant
Water and Sanitation Program–South Asia	Ms. Kathy Eales	Consultant
The World Bank	Ms. Soma Ghosh Moulik	Senior Institutional Development Specialist
The World Bank	Mr. Sreenivasa Rao Podipireddy	Senior Water and Sanitation Specialist
Administrative Staff College of India	Dr. N. Sharma	

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The Urban Think Tank

The Urban Think Tank is a participatory forum, which enables experts and practitioners to address issues related to the service delivery of water supply and sanitation services to the poorest sectors of the community. The Think Tank is also intended to spark policy-level debate and provide a forum where the issues and concerns of municipal managers can be brought forward. Regular meetings have been hosted by the Water and Sanitation Program–South Asia since December 1994.

The 17th Urban Think Tank was held in New Delhi on February 3–5, 2009, and discussed the issue of NRW for urban India. The participants debated the importance of NRW management in the context of current deteriorating services and drew lessons from international and national case studies that were demonstrated at the workshop.

The objective of the workshop, which was consultative in nature, was to improve the understanding of NRW management and catalyze initiatives to reduce it among participating water utilities.

Through the publication of *Nagari*, the proceedings and key issues of meetings are disseminated to municipalities all over India. The purpose of this information note is to share lessons learnt, highlight emerging issues, illustrate examples of best practice, and provide a link between municipalities and other stakeholders to foster a better operating environment in the sector of water supply and sanitation services. We welcome your ideas on any of the issues discussed, and feedback forms are enclosed for this purpose. Please also write to us with any comments and suggestions on topics that you feel are important for managers of local urban bodies.

WSP MISSION:

WSP's mission is to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services.

WSP FUNDING PARTNERS:

The Water and Sanitation Program (WSP) is a multi-donor partnership created in 1978 and administered by the World Bank to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services. WSP provides technical assistance, facilitates knowledge exchange, and promotes evidence-based advancements in sector dialog. WSP has offices in 25 countries across Africa, East Asia and the Pacific, Latin America and the Caribbean, South Asia, and in Washington, DC. WSP's donors include Australia, Austria, Canada, Denmark, Finland, France, the Bill and Melinda Gates Foundation, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States, and the World Bank. For more information, please visit www.wsp.org.

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PARTNERSHIPS: This Think Tank was organized by the Water and Sanitation Program–South Asia. The purpose was to provide opportunities for water supply agencies in South Asia to learn from the experiences of water supply agencies that have succeeded in sustainably reducing their NRW levels. The workshop objectives were to locate billing and collection within the broader framework of NRW, introduce all participants to successful practices from other utilities in the region and globally, and catalyze further initiatives to reduce NRW among participating water utilities. (See section 'About the Workshop: Context and Overview' for more details.)