Optimal Non-Revenue Water Management

The World Health Organization estimates that about 900 million people in developing countries lack access to improved water sources. Without safe water, 1.5 million children die from diarrhea each year. Meanwhile, about 45 million cubic meters of clean water is lost per day due to pipe leaks, and 35 million cubic meters per day is not paid for. Better management of these losses could increase the number of households receiving safe water, produce positive health and economic benefits, and improve service sustainability. RTI International recently developed a computer model to assist utility managers, regulators, ministries, and donors to determine optimal water losses and plan loss reduction programs.

Most of the underserved populations live in poverty zones in and around cities, where illegal water connections, leakage, and unregulated water distributors are rampant. In many cities, poor people pay higher prices to have clean water delivered, often 10 times higher than rates paid by wealthier neighbors. As a result, urban water utilities often struggle to cover high water production costs with low revenues and low-quality service.

The World Bank estimates that physical and commercial water losses, known as non-revenue water (NRW), represent a financial loss of over US$5 billion a year for developing countries. With reduced NRW, utilities can expand water coverage for the poor, ease scarcity problems, reduce production costs, delay capital investments, increase utility revenue, or finance sanitation improvements.

RTI has developed a new model that calculates the financially optimal NRW for utilities in developing countries. Financial models used in developed countries determine the "economic" (or optimal) level of physical losses. The models compare the expense of loss control interventions—such as leakage surveys and pipe repairs—to the savings in water production costs. If the interventions are infrequent, the cost of loss control will be less than the potential savings. Therefore, more frequent interventions make financial sense and would result in lower losses. However, very frequent interventions could cost more than the savings, so it is important to determine the optimal point where costs and savings balance.

Also, these models do not account for commercial losses—a major problem in developing countries—or near-term capital expenses and they require data that are often not readily available in developing countries. Consequently, policy makers resort to arbitrary targets for acceptable levels of NRW that are not based on local conditions or financial realities.

RTI's model pinpoints the optimum NRW for a specific utility by comparing the marginal costs of controlling both physical and commercial losses to the marginal revenues from water sales and the marginal savings in operating and capital costs. Utilities that lack data on all the model parameters can use default values based on trends in developing countries. The model has moderate to low sensitivity to inputs, so results do not differ significantly if input data are estimated.

Running the model provides valuable guidance for utilities, regulators, central governments, and donors. For utilities (municipal, regional, or national), the model provides the optimal NRW level in comparison to actual NRW; leak survey frequency; meter replacement frequency, as well as financial parameters such as operation and maintenance cost savings; revenue increases; and additional outputs. Utilities can also apply the model to portions of their service territories, such as zones in a city or specific cities in regional or national utilities. All this information allows for better NRW planning, target setting, funds allocation, and budget justification for NRW control.

For central government officials and regulators, the model allows for accurate and reasonable target setting and prioritizing investments toward utilities that are furthest from their optimum NRW. It estimates the expected investments required to optimize losses, as well as the payback period in years on those investments. The tool allows donors to identify utilities that need the most assistance and monitor progress toward targets.

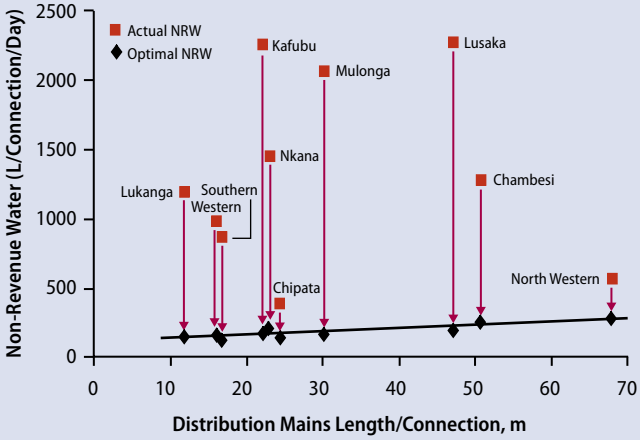
Projects to reduce NRW can be integrated with efforts to improve service to the urban poor. Pro-poor projects often involve water tariff restructuring and targeted subsidies, upgrading distribution networks, providing additional kiosks, and eliminating illegal connections. These efforts can reduce NRW and increase customer base and revenue for the utility. At the same time, NRW reduction in other areas can recover water that can then be used by the urban poor. The two activities reinforce each other.

RTI has applied the NRW model in 30 countries—including national, regional, and municipal water utilities—to generate the results outlined above and to examine the overall financial attractiveness of NRW reduction. In general, large revenue increases are likely for utilities that optimize NRW. In Zambia, application of the model to regional water utilities demonstrated the potential to provide improved service to the poor by optimizing NRW, while also improving revenues by selling the recovered water.

- In the three regions of Zambia with the highest actual NRW, optimizing NRW could finance expanding urban water coverage from 74% to 100% and increase revenue by 75%. In all regions of Zambia, optimizing NRW could raise urban water coverage from 71% to 94% and increase revenue by 56%.

Actual and Optimal NRW for Zambia Commercial Utilities

The model output for Southern Water Supply Co. in Zambia reveals, based on 2006–2007 data, that actual NRW was 857 liters per water connection per day (L/conn/day), when the optimal level would have been 123 L/conn/day. Achieving optimal levels would require a leakage survey of the water lines once a year and a replacement of water meters once every seven years. By achieving optimal NRW, the Southern Water Supply Company could increase its revenues by 26%.



Source: Alan Wyatt, RTI

- In both cases discussed above, the investment required for the initial NRW reduction amounts to less than half the per capita costs of building new water supply plants, with a payback period of just 2–3 years.

RTI is now developing standard procedures and annual improvement targets for NRW optimization based on actual NRW activities in five countries in Africa, Asia, and Latin America.

A detailed methods report describing the model is available at http://www.rti.org/publications/rtipress.cfm?pid=14987.

More Information

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