WSUP
Water & Sanitation for the Urban Poor

PRACTICE NOTE

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How would improved services to slum areas impact on water demand in your city?

Urban utilities are often unwilling to extend or improve services to unserved areas for fear that not enough water is available. This Practice Note introduces an Excel-based modelling tool that projects the water demand implications of slum water improvements in a given city.


Yard tap connection in Kenya

Why was this modelling tool developed?

In discussions with utilities about connecting slum areas to the water supply network, a common response is "there isn't enough water". But how can we be sure? While water utilities worldwide are under pressure to improve their coverage and quality of service to low-income areas, most have no means of forecasting what the demand implications of those improvements might be. As part of its 2012–2015 DFID-funded research programme, WSUP set out to bridge the gap by commissioning a tool that could quantify the relative impact of improved water service provision in slum areas within the context of a water basin serving a city.

What qualifies as an improved service?

This study is based on the idea that service can be improved along two key dimensions: bringing supplies closer to people's homes (improved *accessibility*) and better continuity of supply (improved *reliability*). Table 1 presents a two-dimensional matrix that can be used to describe existing and future service levels. In order to assess the impacts of service improvements in a given location, the user of the tool will need to understand a) how the population of their city is currently distributed within the service levels presented in Table 1, and b) the expected changes in consumption when populations move between service levels (see next page).

Table 1. Service levels (source: water@leeds, 2013)

Water supply is	Predictable		Unpredictable	
	Available > x days per week	Available < x days per week	Available > x days per week	Available < x days per week
At home	Highest level of service			
In the yard				
Delivered to home				
Carried to home				Lowest level of service

Increasing accessibility

Increasing reliability

Case study results: Nairobi and Accra

To input into the model, fieldwork was conducted in Nairobi (Kenya) and Accra (Ghana) to obtain average per-capita water consumption values for different service levels in each city. The data revealed that providing a new yard tap connection to the 350,000 residents of eastern Nairobi who currently carry water home (or get it delivered) would increase city-level water demand by only 0.6% (with four-day supply) or by 3% (with a reliable seven-day service). By contrast, providing in-house connections to all consumers would have a significantly greater impact in the two locations, increasing total water demand by 51% in Nairobi and by 56% in Accra (reduced to 34% if leakage rates were tackled effectively). While any utility must form their own judgements on the viability of different service improvements, these forecasts suggest that many thousands of low-income consumers in Nairobi and Accra could benefit from a much improved level of service – a yard tap connection – with only a small increase in demand at the city level.

The model in action

The modelling tool is an Excel workbook with four tabs. It has been kept as simple as possible to ensure it remains user-friendly and accessible to non-specialists. The first step in using the tool is to populate the first tab – titled 'Consumption and energy' – with primary data for per-capita water consumption by service level; energy use in kilowatt hours per litre consumed; simple population growth projections; and leakage rates. The population for each service level is then defined on the second tab, titled 'Population and service level'. Here the model can be constructed at city level, district level or at a smaller scale: data availability is the only limitation. For every geographical unit (ward, district, etc.) a new row is added corresponding to a subset of that population with the same service level (eg, a yard tap connection with low reliability).

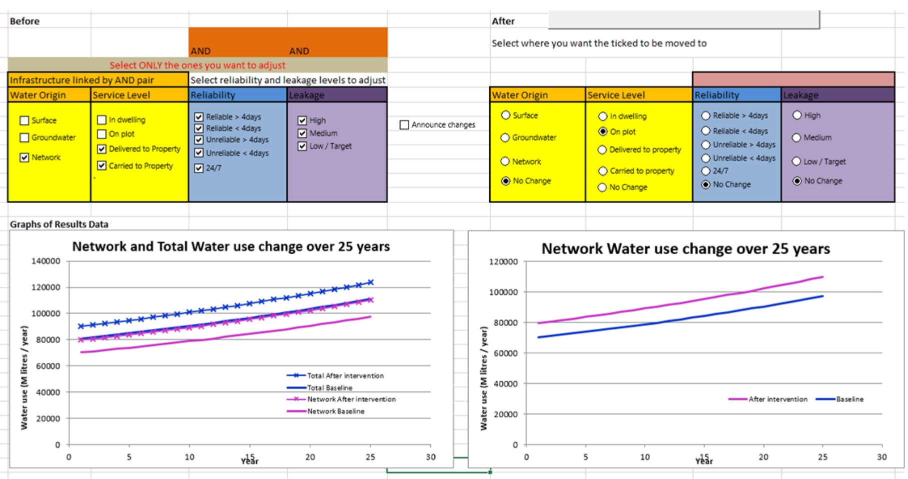
Figure 1. Screenshot of population and service level data for Nairobi.

Population and service level

							Level of service - Select only one in each row			
Ward name	Sub name	Leakage rate	Pop. Growth rate	Population	Delivery Technology	Water Origin	In dwelling	In plot	Delivered to	Carried to property
Embakasi	a	Medium	Moderate	245956	Mechanised	Water Company Network	Reliable > 4 days			
Embakasi	b	Medium	Moderate	494420	Mechanised	Water Company Network		Reliable > 4 days		
Embakasi	c	Medium	Moderate	8777	Mechanised	Water Company Network			Unreliable > 4 days	
Embakasi	d	High	Moderate	216266	Mechanised	Water Company Network				Reliable > 4 days
Embakasi	e	Medium	Moderate	53964	Mechanised	Groundwater	Reliable 24/7			

Once the first two tabs are complete, baseline estimates of water and energy use can be calculated. It then becomes possible to simulate the impact of future intervention scenarios by selecting geographical populations – or population subsets – and defining the new service level or leakage rate to which they will be moved. Using the above example, the user might decide to target all consumers in Embakasi who currently obtain water from the network and either carry it home or get it delivered, and move them to an in-house connection with 24-hour supply and an unchanged leakage rate. Once these selections have been made, the model moves populations to new service level categories and calculates the post-intervention water and energy demand. The results are displayed on a graph as a simple comparison between the baseline situation and the simulated change.

Figure 2. Interface for defining scenarios and the resulting graphs.



Year	Baseline				After intervention			
	Total Population	Total Water use (M litres/yr)	Network Water use (M litres/yr)	Energy Use (GWh/yr)	Total Population	Total Water use (M litres/yr)	Network Water use (M litres/yr)	Energy Use (GWh/yr)
1	3139094	80750	70277	17148	3139094	90154	79680	19029
2	3176206	81734	71149	17355	3176206	91244	80659	19257

Limitations

The tool is subject to a number of limitations. It is of course highly dependent on the quality of input data: where detailed local data is not available, only rough estimates at the city level can be made. To get realistic estimates of demand, fieldwork needs to be conducted in areas of the city that represent the range of service levels. The tool does not claim to assess feasibility of the various options for improving services: investment needs, land tenure and other issues that impact on service extension must be taken into account. While the tool is therefore not a replacement for detailed planning and design, it offers practical support to utilities in determining the demand-side impacts of slum water supply improvements. Full reports of this work and the Excel tool are free to download at www.wsup.com.

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