The Zimbabwe Water Forum provides a platform for Government and Development Partners to share international best practices in the water sector between Zimbabwe and other countries. The forum was formed through a partnership between the Ministry of Water Resources Development and Management, the Multi-Donor Trust Fund and the World Bank and is hosted by the World Bank’s Zimbabwe Country Office and the Urban WSS Thematic Group.

Modeling the water sector in South Africa and Zambia

Ian Palmer visited Harare, Zimbabwe, to share his experiences of long-term investment planning for the water sector in South Africa and Zambia and the benefits of developing models to support policy and budgeting processes.

Understanding investment needs and options in Zimbabwe

The water sector in Zimbabwe has suffered from years of neglect. Over the past ten years, hyperinflation and economic stagnation have resulted in inadequate investment and maintenance in water-related infrastructure. This failure to maintain and rehabilitate infrastructure over an extended period was strongly implicated in the cholera epidemic that infected 90,000 people and resulted in more than 4,000 deaths. Poor maintenance has also led to flooding and to the pollution of water sources. Reliable water supplies and safe treatment of human waste are necessary not only to support public health, but also to underpin economic recovery and growth.

It is critical for Zimbabwe to develop a sustainable and affordable water-sector investment plan. Experiences in using infrastructure planning and investment models in South Africa and Zambia are shared in this policy note to highlight lessons that may be applicable to Zimbabwe and other developing countries.

Using scenario-based models to develop a sector investment plan

Scenario-based modeling can enhance water-sector planning by clarifying the trade-offs between different policy and investment choices and increasing transparency and robustness in policymaking and budget planning.

The development of a water-sector infrastructure investment-planning model involves:

- **Understanding the key features of the current situation** including population, customers (households, institutions, businesses), levels and standards of service for water supply and sanitation, water production/treatment capacity, water produced/treated, water consumption, losses and non-revenue water, wastewater, condition of infrastructure, financial flows, and the efficiency of key institutions;

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Ian Palmer headed Palmer Development Group, a development consultancy, since its inception in 1990 until 2009. He remains a director of the firm and is an Adjunct Professor at the University of Cape Town. His particular interests are in high-level infrastructure planning that integrates technical, socio-economic and financial aspects. While the majority of his work has been in South Africa, he has worked in Botswana, Malawi, Zambia, and Mozambique.
Constructing a view of the future (usually in the form of scenarios) and estimating key growth factors (or changes) related to population, customers, economic activity, income levels, service levels, water use, wastewater flows, the efficiencies of the utilities providing the services, and the extent and pace of rehabilitation;

Estimating investment and operating costs through current and future demands, typically by making use of unit cost factors by component of service: for example, the cost to provide a new urban full-pressure connection, or the cost to expand the capacity of water treatment capacity by a ‘step increment’;

Developing scenarios for investment financing by evaluating potential finance sources such as cash flow from operations, long-term debt, and government grants;

Testing affordability and financial viability by modeling the tariffs necessary to maintain financial viability within a chosen subsidy framework (including the possible use of internal cross-subsidies between users) and the affordability of monthly charges for users;

Identifying the key policy and/or budget options by evaluating the sensitivity of the model outcomes to the different input variables and developing a more limited set of scenarios based on these key choices.

Informing policy and budget decisions through the modeling process by developing a sector investment framework and plan based on the key options identified in the model.

The South African experience

Investment models have supported important policymaking and budgeting processes in South Africa including the implementation of a needs-oriented policy agenda, the shift of responsibilities to local government, and an assessment of institutional options for the regional provision of water services.

Scenario-based models to support investment planning have been used extensively in South Africa since the early 1990s, coinciding with a shift in policy leading up to and after the first democratic election in 1994. The early models estimated the costs of providing universal access to basic water supply and sanitation services within a five-year timeframe. These relatively simple national models informed the development of the Reconstruction and Development Program adopted by the new democratic government as a key part of its policy manifesto. National government budgets were based on the modeled results, which showed, for example, that provision of waterborne sanitation to the whole population was not affordable within the five-year planning period. Consequently, the government adopted the minimum standard of a ventilated-improved latrine in its water policy.

By 2000, the primary responsibility for water supply and sanitation was shifted to local government, and the early models were extended and refined to model investment needs and financial viability at the city level. Municipalities were categorized according to their settlement type and the scale of their economy (metropolitan areas, secondary cities, large towns, small towns and traditional rural areas). Models were developed for each category and then weighted and aggregated to create a national perspective. These
scenario-based models were used to develop a Municipal Infrastructure Investment Framework to guide the allocation and transfer of funds by national and local governments and to shape municipal tariff policies. By ‘turning off’ certain sectors, the models could isolate others (for example, water and electricity) and could then be used to inform sector allocations and sector policies, particularly for water.

At the city level, the models were able to show the service levels that were affordable for a particular city. For example, it is possible to provide a much higher proportion of the population with waterborne sanitation in Johannesburg than in Durban (eThekwini).

The models were then adapted to estimate investment requirements for the entire water sector in South Africa and to test the results of different configurations of regional water institutions in managing bulk and/or retail water supply. This analysis also estimated the size of the investment gap at the national level providing the necessary data to support a motivation for budget increases. An added benefit of the modeling process was to understand the value and distribution of water assets across the whole sector for the first time.

The Zambian experience

Investment models can help identify contexts where it is reasonable to expect utilities to be financially viable with specified levels of external assistance. This analysis can be important to create national service standards and subsidy policies, as well as to regulate tariffs for individual water utilities.

In Zambia, the commercial water utilities were modeled as a group to understand the impact of service-level policies, changing incomes, and income distribution on the viability of these utilities. The modeling process benefitted from relatively good data collected over a number of years by the national water regulator—the National Water Supply and Sanitation Council (NWASCO). Costs and the financial viability of the utility are affected by the choice of service level; low-income households typically cannot afford the full cost of high levels of service. However, the model allows for cross-subsidies between households and between businesses and households, so that the distribution of income and economic activity—within a utility service area and across the country—can reduce service disparities between income groups.

**Total Water Sector Assets in South Africa, 2011**

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>2011 (R billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water resources</td>
<td>206</td>
</tr>
<tr>
<td>Water: Bulk</td>
<td>220</td>
</tr>
<tr>
<td>Water: Connector - non-potable</td>
<td>187</td>
</tr>
<tr>
<td>Water: Connector - potable</td>
<td>136</td>
</tr>
<tr>
<td>Water: Internal</td>
<td>110</td>
</tr>
<tr>
<td>Sanitation (ex MIIF)</td>
<td>106</td>
</tr>
</tbody>
</table>

**Relationship of cost of service to income**

- Cost of providing service
- Bill to customer
- Deficit on providing services to low-income customers
- Surplus on providing services to high-income and non-domestic customers

Whether bill for low income is less than or equal to cost depends on level of service provided

Low income | High income | Non-domestic
**Key success factors**

It is important for a client to be specific about the questions being asked of a model and to be involved in the modeling process. Creating a useful model is largely the art of finding the balance between enough detail to adequately represent the real world and the simplicity necessary to identify clear outcomes.

The investment modeling experiences in South Africa and Zambia over the past 20 years have shown that the outcomes are more useful if:

- **The modeling process is strongly owned by the client**, who is involved in identifying the key policy questions (for example, in the planning for the Reconstruction and Development Programme in South Africa);
- **There is good data, typically supported by a strong regulatory process** (for example, NWASCO in Zambia and strong financial reporting requirements by the National Treasury in South Africa);
- **The model is able to successfully identify and highlight the most significant variables** for the policy issues in question (for example, the affordability of providing waterborne sanitation to everybody in South Africa);
- **Model outcomes are regularly validated** to check for consistency and their correspondence with real world outcomes;
- **Models are transparent and simple** enough for clients to understand and have confidence in their process and outcomes;
- **The client institution is stable** and has the institutional memory necessary for the considerable investment in time and resources required for modeling to be maintained over time.

**Possible applications in Zimbabwe**

Scenario-based modeling for investment planning could be used effectively in three essential ways in Zimbabwe:

1. A model (or set of models) could create a more systematic and comprehensive analysis of the investment needs for the water sector in Zimbabwe as a whole. This would involve modeling the main sub-sectors: national water resources (major dams and related infrastructure), irrigation, urban areas (with separate models for the major urban centers such as Harare and Bulawayo) and rural areas. This modeling could provide data for a fair allocation of the national budget to the water sector and also assist with a rational allocation of resources between sub-sectors within the water sector.

2. A model for the Greater Harare area for water supply and sanitation could help policymakers choose technological options, support the development of service agreements between Harare Water and the other urban settlements it serves, and identify the most suitable institutional arrangements.

3. A model of municipal finances as a whole—and water and sanitation finances as a subset—for cities and towns in Zimbabwe could enable an evidence-based dialogue between national and local governments on appropriate levels of financial support and the reform of local revenue raising policies for local government.

Similarly, scenario-based models could be used effectively in other developing countries to better inform policy and budgeting processes in the water sector.