

Balancing Coverage and Financial Sustainability in Pro-Poor Service Initiatives: A Case of a Uganda Project

Silver Mugisha¹ and Tatiana Borisova²

Abstract: *The pro-poor water service provision is a key to economic development in low-income countries. This paper focuses on the Affordable Basic Water Project implemented by Uganda's National Water and Sewerage Corporation (NWSC) in Kampala. A linear programming model is used to examine three alternative scenarios to the NWSC service provision using different mixes of three service provision technologies: yard taps, public water points, and public water points with pre-paid meters. The three proposed modeling scenarios allow better service coverage (an increase in customers by up to 280 percent) and/or improved financial sustainability (roughly a 1,000 times increase in the net present value), compared to the project that was designed by the NWSC using the trial-and-error approach. Social acceptability, managerial and operational feasibility, and payment collection criteria are used to examine the results of the three modeling scenarios. This study presents an approach that combines the qualitative data provided by the project stakeholders (stakeholder analysis and technology prioritization exercises) with a simple quantitative (linear programming) analysis. This approach can be used by managers in developing countries to design and evaluate pro-poor water provision projects.*

Key Words: pro-poor, water provision, linear programming, service coverage, financial feasibility, developing countries

1. Introduction

Improving access to drinking water and sanitation services is a key to economic development in low-income countries. Lack of water and sanitation services is linked to socio-economic challenges ranging from water-related diseases to time allocation for low-income households to cope with long-distanced communal water points. Related issues also include low

¹ Dr. Silver Mugisha is the Chief Manager, Institutional Development and External Services, National Water and Sewerage Corporation, P.O. Box 7053, PLOT 39 Jinja Road, Kampala, Uganda, Africa. He is a civil engineer specializing in institutional development and performance management (email: [Silver.Mugisha @ nWSC.co.ug](mailto:Silver.Mugisha@nWSC.co.ug); office telephone number: +256-414-315109; cell phone: +256-772-590178).

² Dr. Tatiana Borisova is Assistant Professor, Food and Resource Economics Department, PO Box 110240, University of Florida, Gainesville, FL 32611, USA. **Dr. Borisova is the contact author** (email: [tborisova @ ufl.edu](mailto:tborisova@ufl.edu); telephone: 1-352-392-1826, extension 317; and fax: 1-352-392-3646).

school attendance by girls, rampant poverty, gender inequality, and a high “under-five child mortality rate” (U5CMR). Furthermore, it is acknowledged that better access to water and sanitation services for the urban poor offers a profound positive impact on environmental awareness and sustainability. In contrast, lack of water and sanitation services for the urban poor can be linked to water contamination, reduced water availability, and higher water treatment costs.

While the global average for safe drinking water access is 83 percent of the world’s population, there is a tremendous variation among regions (Brown 2007). In Sub-Saharan Africa, about 42 percent of the population drinks untreated water. Rural-urban disparities are also significant. While in most developing regions, 70 percent of rural dwellers have access to improved drinking water sources and 31 percent to improved sanitation services, only 45 percent of rural dwellers in Sub-Saharan Africa have safe drinking water and 25 percent have improved sanitation services. Progress towards improved sanitation services has been very slow. An estimated 2.6 billion people are without improved sanitation facilities and services, and if the 1990-2002 trend holds true the sanitation millennium development target will not be achieved for 0.5 billion people worldwide.

Development in low-income countries and regions did not catalyze private sector investment in water and sanitation services, especially in Sub-Saharan Africa which received less than 0.2 percent of the total global private sector investments in water and sanitation services in 2002 (United Nations Millennium Project 2003). The involvement of multi-national water operating companies in developing countries is declining worldwide. Many multi-national water companies in Europe and South Africa see their role as operators and managers of water projects, and not as investors.³ These companies are reluctant to invest equity outside their home markets, and they are extremely careful about investing in perceivably risky markets where the return on investment (ROI) is uncertain. Some of the perceived investment risks in Sub-Saharan water and sanitation services include small markets, customers’ inability to pay, and regulatory requirements. In predominantly poor areas, returns on investment are further diminished by the high construction costs required to correct inadequate infrastructures, and high operation and maintenance costs.

³ The first author was part of the delegation from Uganda that visited two multi-national companies in France (ONDEO and Saur), one in Germany (MVV) and one in South Africa (Rand Water) in March 2005.

To balance the objective of service delivery for all with utility financial sustainability, some studies have suggested involving the community in service provisions and the maintenance of infrastructures (Kyessi 2005; Godfrey and Obika 2004). Community involvement entails examining the water tariffs and the willingness of the poor to pay for water services (Kayaga et al. 2003; Wittington et al. 1990; World Bank 1993). Kayaga and Franceys (2007) compare the incomes of poor households with the utility connection fees of the major water suppliers to emphasize the need for more affordable and customer-friendly water and sanitation services. Naidoo and Constantinides (2000) and Njiru et al. (2001) suggested that offering differentiated service options and flexible tariff structures could broaden the customer base while ensuring the utilities' financial strength. Akatch and Kasuku (2002) maintain that water and sanitation service provisions should be part of the housing policy for the poor and should be subsidized by taxing the rich. Mugabi et al. (2007) and Crook and Ayee (2006) address the advantages of focusing the utilities' management structures and performance evaluation procedures on improving customer relations.

While most empirical studies have used qualitative approaches and examined social marketing, affordability, and governance, this paper combines qualitative stakeholder analysis and technology evaluation with the quantitative linear programming approach to analyze different scenarios for the pro-poor service provision. Our objective is to use a specific case study, the Affordable Basic Water Project by the National Water and Sewage Corporation (NWSC) of Uganda (NWSC and Aqua Consult 2003a, b), to examine the mechanisms and measures that can be used to enhance financial sustainability in pro-poor project planning and development. Section 2 below presents the background for the Affordable Basic Water Project, Sections 3 and 4 present the methodology and empirical data used in the analysis, followed by the results and discussion.

2. Study Area and Project Background

The Affordable Basic Water Project was initiated in 2001. It focuses on the identification of the most effective strategies for water service provisions to the urban poor in Kampala, Uganda (Figure 1). According to the 2002 Census, the population of Uganda's capital and largest city, Kampala, is 1.2 million; however, taking into account the city's transient population, the

true population of Kampala is about 2.3 million (McGill University 2008). Many people from the villages migrate to cities in search of jobs, better economic prospects, and social opportunities. Thirty-nine percent of Kampala's population lives in absolute poverty and 43 percent are unemployed (Population and Housing Census 2002, cited by McGill University 2008). It is projected that the population of the poor urban residents in Kampala will more than double by 2015 (McGill University 2008, Humanitarian Care Uganda 2007). The majority of these will reside in informal settlements within the city.

INSERT FIGURE 1 HERE

As a part of the Affordable Basic Water Project, the NWSC sought extended stakeholder-input while developing the NWSC water service provision scenario. As a first step, the NWSC conducted an informal stakeholder analysis (Dani 2002; Kudat 2002; Brugha and Varvasovszky 2000), focusing on the barriers to water service provisions to the urban poor. Interviews with 24 key informants and 22 stakeholders in five focus group discussions, as well as two consultative workshops, were conducted. Information for the three stakeholder groups with the most significant influence on the project is summarized in the Stakeholder Analysis Matrix below (Table 1).

INSERT TABLE 1 HERE

The NWSC also collaborated with local stakeholders on evaluating alternative technologies for the water service provision. A semi-formal evaluation of four water service technologies was conducted: (1) rudimentary traditional systems (based on rainwater harvesting, protected springs and open wells), (2) public water points (with conventional mechanical meter or with pre-pay meter); (3) yard taps (with conventional mechanical or pre-pay meters), and (4) conventional house connection (with mechanical or pre-pay meter) (Table 2). Different water supply technologies were ranked based on the following five general criteria: (1) the level of service; (2) technical suitability, (3) social acceptability, (4) institutional suitability, and (5) environmental suitability. Prioritization showed that each of the service options presents tradeoffs among different criteria, and that none of the services can achieve all the priorities. The

social acceptability criterion dominated the discussion, and yard taps were identified as the most preferable service provision technology, followed by public water points. However, prioritization was conducted informally without any formal scoring of the technologies, which involves assigning a weight to each decision criterion according to its importance and then computing scores for each decision alternative considered (Anderson, Sweeney, and Williams 2008).

INSERT TABLE 2 HERE

Three pro-poor water service delivery technologies were selected for implementation: yard taps with conventional water meters (YTs), public water points (PWPs) with conventional meters, and PWP with prepaid water meters. Block maps of the target areas were prepared and the total numbers of standpipes, service points, and households were estimated. The targeted population (future customers) for the project was estimated to be 408 thousand people. Given that an average household size in Kampala is ten people (COWI⁴ 2007), it was estimated that a yard tap would serve on average 1.5 households, while a public water point (with or without a prepaid meter) would serve 15 households.

Finally, a specific service scenario (referred to as the *NWSC scenario*) was selected by the NWSC staff as follows: 19,067 YTs; 409 PWPs with conventional meters; and 409 PWPs with prepaid water meters. The NWSC scenario was selected using the trial-and-error process, based on the requirements of water provision to the target population and internal rate of return (IRR). The costs and returns of alternative service scenarios that could potentially achieve the same service provision coverage and IRR as the NWSC scenario were not examined. As opposed to selecting a scenario that merely satisfies the minimum requirements of the project, we propose using an optimization model that can maximize a specific project outcome (in this case, net present value) while satisfying other requirements (such as service coverage and maximum investments).

3. Model

⁴ COWI is the technical assistance consultant engaged by the NWSC/Development partner to carry out the project design.

We use letter i to index alternative water service delivery technologies, with $i=1$ referring to YTs, $i=2$ denoting PWP with conventional meters, and $i=3$ referring to PWP with prepaid meters. The decision variable, X_i , is the number of service points for each water service delivery technology. We consider a ten-year time period ($T=10$), and assume that the project is implemented in year one ($t=1$). Total capital costs for the project is the sum of capital costs for each service option:

$$CCost = \sum_{i=1}^3 c_i X_i \quad (1)$$

where c_i refers to capital costs per service point. Assuming that the operation and maintenance costs for each service point, w_i , NWCS's annual costs can be expressed as:

$$OMCost_t = \sum_{i=1}^3 w_i X_i \text{ for } t = 2, 3, \dots, 10. \quad (2)$$

Given the annual return from each service point, r_i , the NWCS's revenue can be expressed as a sum of returns from each service point and each service technology:

$$Revenue_t = \sum_{i=1}^3 r_i X_i \quad \text{for } t = 2, 3, \dots, 10. \quad (3)$$

The objective of NWSC is to maximize the net present value (NPV) of water service provision:

$$\text{Maximise NPV} = CCost + \sum_{t=2}^T (Revenue_t - OMCost_t) \frac{1}{(1+z)^t} \quad (4)$$

where z refers to a discount rate.

Net present value (4) is maximized subject to constraints on the total investment costs and population served by the project, as well as non-negativity constraints. Given the total funding available to the NWCS, \bar{C} , the total investment cost constraint can be expressed as (Equation 5):

$$\sum_{i=1}^3 c_i X_i \leq \bar{C}. \quad (5)$$

Denoting the targeted population for the project by \bar{P} and targeted population served by each service point as p , the total population constraint is expressed as follows (Equation 6):

$$\sum_{i=1}^3 p_i X_i \geq \bar{P}, \quad (6)$$

The non-negativity constraints are presented in Equation (7):

$$X_i \geq 0 \text{ for } i = 1, 2, \text{ and } 3. \quad (7)$$

4. Modeling Scenarios

The model (1)-(7) is used to examine the following three modeling scenarios. Scenario one, referred to as the *optimized service provision scenario*, is developed to meet all the financial and the targeted population requirements. That is, the financial investment constraint (5) and stipulated population constraint (6) are met as equality, while maximizing NPV from the project. Next, for scenario two, referred to as the *service-oriented scenario*, we relax the constraints (5) and (6) and allow the targeted population to exceed the baseline scenario target, while keeping investment costs less than the total funding available. Scenario three, referred to as the *cost-oriented scenario*, allows the investment cost to be less than or equal to the total funding available for the project, while requiring the population target (6) to be satisfied as equality. Finally, the results for the three modeling scenarios are compared with the NWSC scenario, and the effects on changes in the service technology mix on NPV, costs, and the targeted population served by the project are analyzed. The four scenarios were then examined using the Excel Solver add-in.

5. Empirical Data

Project costs and returns data (Table 3) show that there is a tradeoff associated with each water service provision technology. PWPs with pre-paid meters are the most capital-intensive technology, but they also provide the highest returns for the NWCS. In turn, YTs are the least costly technology for the NWCS, but they are the most costly service option for the customers. Finally, PSPs with conventional meters provide a compromise between the costs for the NWSC and customers' expenses, and the most opportunities for dealing with low collection efficiencies from urban poor settlements.

INSERT TABLE 3 HERE

The discount rate, z , is 4 percent, which is approximately equal to the NWCS's cost of capital and to the IRR calculated for the NWCS scenario. Total capital investment threshold is 6,600 million UGX (4.0 million 2008 US dollars).⁵ A more detailed analysis of the costs and returns for the project can be found in Berg and Mugisha (2009).

6. Results

The results of optimization for the three scenarios are summarized in Table 4 along with estimates for the NWSC scenario. For the optimized service provision scenario (scenario one), the maximum net present value (NPV) is 2.5 billion UGX (1.2 million 2008USD), which is a significant improvement in comparison with the NWSC scenario. The optimum solution does not include the construction of any PWP with conventional meters. Instead, the optimization process yields 9,542 YTs and 1,766 PWP with pre-paid meters. These results are in sharp contrast with the NWSC scenario, which proposes YTs supplemented by a small number of PWP with conventional and prepaid meters. A sensitivity analysis shows that the optimization result is robust with respect to the changes in revenues and costs per connection for each water service technology. Based on the reduced cost value, the introduction of every PWP with conventional meter into the solution would reduce the NPV of the project by 6 million UGX (2.8 thousand 2008 USD). The shadow price for the population constraint indicates that the NPV of the project would vary very slightly with the changes in the population target, as long as this target remains between about 345,000 and 453,000 people.

Optimization for the service-oriented scenario (scenario two) shows that the number of people served by the project can be increased significantly without violating the NWSC constraint on the total investment cost. In this scenario, the number of people served is almost four times larger than in the NWSC scenario, yielding an optimal net present value of 12,981 million UGX (7.9 million 2008 USD). The optimal solution includes only PWP with conventional meters, which is driven by low investment costs associated with this service technology and the capacity to serve a significant number of poor people. The sensitivity analysis shows that any deviation from the optimal service provision scenario by increasing the

⁵ This constraint does not cover the cost of infrastructure, which is common to all service technologies (4,893 million UGX)

number of yard taps or public water points with pre-paid meters will decrease NPV by one million UGX (0.6 million 2008 USD) for every yard tap and by three million UGX (1.8 million 2008 USD) for every public water point with pre-paid meter, respectively. In other words, the revenues collected from each service point for these service technologies would need to increase significantly before it would become beneficial to install them. Additional investment capital which would allow relaxing the capital cost constraint would increase the net present value of the project by 2.14 million UGX (1,301 2008 USD) for every additional million UGX (608 2008 USD).

Finally, the results for the cost-oriented scenario (scenario three) show that it is possible to provide water service to the targeted population by investing 5.9 billion UGX, which is 10 percent less than the capital cost target set by the NWCS. The optimal technological mix includes only PSPs with prepaid meters, which would reduce the total numbers of service points to only 2,720. High collection efficiency, which translates into higher returns associated with the PWP with prepaid meters is the main driver of optimality for this scenario. The optimal NPV is 4,708 million UGX. The sensitivity analysis shows that NPV would vary only slightly with the changes in the population served target. Changes in the optimal mix of service provision technologies (i.e., water provision through yard taps) would have a relatively minor effect on NPV, while the service provision through PWP with conventional meter would decrease NPS by 0.80 million UGX for every PWP.

Overall, results for these three scenarios show that NPV of the NWSC scenario can be significantly improved by changing the number of service points of the water provision technologies. Furthermore, the optimum selection of the technological mix would allow the NWSC to increase the number of poor customers served without violating the investment cost constraints. The optimal technology mix would allow the NWSC to combine the economic (revenue) and public service provision objectives. In all three optimization scenarios, NPV is positive, while the target for the total number of poor customers served is achieved or exceeded.

7. Discussion

The informal prioritization of service technologies conducted by the NWSC (Table 2) offers several criteria to examine the results for the three modeling scenarios. Service quality and social acceptability are the most important criteria for selecting a service technology mix (NWSC and Aqua Consult 2004b). For these criteria, PWPs are inferior to YTs (Table 5), since PWPs are seen by most communities as an interim solution and most communities aspire to higher levels of services. The PWP technology is also associated with a high risk of illegal water connections and a moderate to high level of vandalism. Hence, from the social acceptability standpoint, the optimized service provision scenario (scenario 1), which allows for almost 10,000 YTs, is the preferred scenario developed in this paper. The optimized service provision scenario also includes more PWPs with pre-paid meters as compared to the NWSC scenario, which partially addresses the non-payment problem associated with service provision through yard taps.

The NWSC offered a set of sub-categories to characterize the service technologies from both the management and operational perspectives (Table 6). Because the total number of employees working in the Kampala area is limited (NWSC and Aqua Consult 2004a), the scenario with the smallest total number of service points may be preferable. From this perspective, all the modeling scenarios proposed in this paper allow an improvement in water and sanitation services when compared to the NWSC scenario, since the total number of service points in these proposed scenarios is relatively small, but the cost-oriented scenario (scenario 3) is the most preferred scenario because it accounts for 86 percent fewer service points as compared to the NWSC scenario. But even this scenario implies installing about 3,000 new service points in the informal settlement. Hence, for any of the scenarios considered, the NWCS's "management approaches and operational routines have to improve tremendously in order to satisfy the additional management load" (NWSC and Aqua Consult 2004a).

The cost-oriented scenario (scenario 3) is also the most preferred from the payment collection perspective, which is an important target for utilities in developing countries (Berg and Mugisha 2009). Non-payment for services is a big problem because many households in the informal settlements earn income on a day-to-day basis and are often very transient, which makes it difficult for paying the monthly water bills or even the up-front costs for the yard tap connection (NWSC and Aqua Consult 2004a). The cost-oriented scenario relies solely on PWPs with pre-paid meters, and "where services are pre-paid the risk of consumers disappearing with water revenues is eliminated" (NWSC and Aqua Consult 2004b).

8. Conclusions

This paper examines three alternative water provision scenarios for the Affordable Basic Water Project for the urban poor in Kampala, Uganda. The methodology employed by the NWSC for the Affordable Basic Water Project integrates the main components of social research (Nichols 1991; Dani 2002; Kudat 2002), combines field investigations with stakeholder consultations, and prioritizes different water supply technologies. However, the NWSC did not formally examine how the changes in the number of service points for the water supply technologies would influence the socio-economic outcomes of the project. A certain combination of technologies was selected and tested against the rate of return criterion internal rate of return (IRR). In this study we found that the financial performance of the project (measured in NPV) can be improved by adjusting the mix of service provision technologies through a simple optimization technique.

We used a linear programming model to examine three alternative water service provision scenarios that meet the NWSC's criteria for the capital investment and population served by the project. These scenarios differ by the number of service points for the three water provision technologies considered: YTs, PWP with conventional meters, and PWPs with pre-paid meters. In addition, the scenarios maximize the net present value (NPV) of the project, while allowing for reduced capital investments and more customers in comparison with the NWSC scenario. Analysis shows that the targeted population served by the project can be significantly increased without affecting the financial characteristics of the project.

Next, the stakeholders' feedback received by the NWSC (NWSC and Aqua Consult 2003b) was used to examine the three alternative scenarios of water service delivery to the urban poor in Kampala, based on technical, managerial, and social acceptability criteria. From the social acceptability standpoint, the optimized service provision scenario (scenario 1), which allows for almost 10,000 YTs, is the most preferable among the three scenarios developed in this paper. In turn, the cost-oriented scenario (scenario 3), which relies solely on PWPs with pre-paid meters, is the most advantageous of all three modeling scenarios. From the managerial suitability perspective, it allows meeting the population served target with 86 percent fewer service points as compared to the NWSC scenario, and is the least expensive from the cash collection efficiency perspective.

The paper also highlights an important design issue for project managers designing pro-poor projects, which is to use simple optimization techniques, rather than the trial and error approach for obtaining the best solutions for water and sanitation services.

References

- Akatch, S.O., and Kasuku, S.O. (2002) Informal settlements and the role of infrastructure: The case of Kibera, Kenya. *Discovery and Innovation* 14(1-2), 32-37.
- Alence, R. (2002) Sources of successful cost recovery for water: Evidence from a national survey of South African municipalities. *Development Southern Africa* 19(9), 699-717.
- Anderson R., Sweeney, D.J., and Williams, T.A. (2008) *Introduction to Management Science: Quantitative Approaches to Decision Making*, 12th edition, p. 900. Thomson South-Western, Mason, OH.
- Berg S., and Mugisha, S. (2009) Pro-poor water service strategies in developing countries: Promoting justice in Uganda's urban project. *Water Policy* (forthcoming).
- Bordalo A.A., and Savva-Bordalo, J. (2007) The quest for safe drinking water: An example from Guinea-Bissau (West Africa). *Water Research* 41(13), 2978-2986.
- Bourguignon F., and Pereira da Silva, L.A. (2003). *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*. Oxford University Press, New York.
- Brown, A. (2007) *Successful Utility Reforms in Africa*. World Bank Working Paper, Country Office, Tanzania.
- Brugha, R., and Varvasovszky, Z. (2000) Stakeholder analysis: A review. *Health Policy and Planning* 15(3), 239-246.
- Cofie, O.O., Agbottah, S., Strauss, M., Esseku, H., Montangero, A., Awuah, E., and Kone, D. (2006) Solid-liquid separation of faecal sludge using drying beds in Ghana: Implications for nutrient recycling in urban agriculture. *Water Research* 40(1), 75-82.
- Coudouel, A., Dani, A.A., and Paternostro, S. (eds.). *Poverty and Social Impact Analysis of Reforms Lessons and Examples from Implementation*. The World Bank. Available at http://www.depeco.econo.unlp.edu.ar/cedlas/pdfs/poverty_and_social_impact_analysis_of_reforms.pdf . Accessed on April 24, 2009.

- Dani, A.A. (ed.). (2002) Social Analysis Sourcebook: Incorporating Social Dimensions into Bank-Supported Projects. Social Development Department, The World Bank, Washington, D.C. Available at <http://web.worldbank.org/>. Accessed on April 24, 2009.
- Godfrey, S., and Obika, A. (2004) Improved community participation: Lessons from water supply programmes in Angola. *Community Development Journal* 39(2), 156–165.
- Holland, J. (2007) Tools for Institutional, Political, and Social Analysis of Policy Reform: A Sourcebook for Development Practitioners. World Bank Publications, Washington, D.C.
- Humanitarian Care Uganda. (2007) Selected Kampala District Statistics. Available at http://www.hcareuganda.org/statistics.html#kampala_top . Last accessed on April 24, 2009.
- Kayaga, S., Calvert, J., and Sansom, K. (2003) Paying for water services: Effects of household characteristics. *Utilities Policy* 11(3), 123–132.
- Kayaga, S., and Franceys, R. (2007) Costs of urban utility water connections: Excessive burden to the poor. *Utilities Policy* 15(4), 270-277.
- Kudat, A. (2002). Social Analysis Guidelines for Water Supply and Sanitation Sector. Working Paper. Social Assessment Department, The World Bank, Washington, D.C. Available at <http://www.socialassessment.com/akdocs.html> . Accessed on April 24, 2009.
- Kyessi, A.G. (2005) Community-based urban water management in fringe neighborhoods: The case of Dares Salaam, Tanzania. *Habitat International* 29(1), 1–25.
- McGill University. (2008) City Information. Minimum Cost Housing Group, School of Architecture, McGill University, Montreal, Quebec. Available at <http://www.mcgill.ca/mchg/pastproject/edible-landscape/kampala/info/>. Accessed on April 24, 2009.
- Momba, M., and Kaleni, P. (2002) Regrowth and survival of indicator microorganisms on the surfaces of household containers used for the storage of drinking water in rural communities of South Africa. *Water Research* 36(12), 3023-3028.
- Mugabi, J., Kayaga, S., and Njiru, C. (2007) Strategic planning for water utilities in developing countries. *Utilities Policy*, 15(1), 1-8.

- National Water and Sewerage Corporation (NWSC) and AquaConsult. (2003a) *Identification of Management Options for Improved Water and Sanitation Services of Informal Settlements in Kampala. Draft Final Report. Volume Two: Implementation Framework and Guidelines*. National Water and Sewerage Corporation, Kampala, Uganda.
- National Water and Sewerage Corporation (NWSC) and AquaConsult. (2003b). *Identification of Management Options For Improved Water And Sanitation Services of Informal Settlements in Kampala. Draft Final Report. Volume Two: Management Principles and Options*. National Water and Sewerage Corporation, Kampala, Uganda.
- Naidoo, D., and Constantinides, G. (2000) Integrated approaches to efficient water use in South Africa. *Water Resources Development* 16(1), 155–164.
- Nichols, P. (1991) *Social Survey Methods – A Field Guide for Development Workers*. Oxfam GB, Oxford, UK.
- Njiru, C., Smout, I. K., and Sansom, K. (2001). Managing water services through service differentiation and pricing in an African city. *Journal of the Chartered Institution of Water and Environmental Management* 15(4), 277-281.
- Place F., and Otsuka, K. (2002) Land tenure systems and their impacts on agricultural investments and productivity in Uganda. *Journal of Development Studies* 38(6), 105-128.
- United Nations. (2000). Goal 7: Ensure Environmental Sustainability. United Nations, New York. Available at <http://www.un.org/millenniumgoals/enviro.html>. Accessed on April 24, 2009.
- United Nations Millennium Project (2003). *Achieving the Millennium Development Goals in Water and Sanitation, Background Issues Paper*, Task Force on Water and Sanitation, New York: United Nations Millennium Project.
- UNESCO. (2006). Case Study: Uganda. National Water Development Report UN-WATER/WWAP/2006/9. World Water Assessment Programme, UNESCO, Paris. Available at <http://unesdoc.unesco.org/images/0014/001467/146760E.pdf>. Accessed on March 30, 2009.
- Whittington, D., Okarafor, A., Okore, A., and McPhail, A. (1990). Strategy for cost recovery in the rural water sector: A case study of Nsukka district, Anambra state, Nigeria. *Water Resources Research* 26(9), 1899–1913.

Water and Sanitation Program, National Water and Sewerage Corporation, and AquaConsult. (2004a) Identification of Management Options for Improved Water and Sanitation Services of Informal Settlements in Kampala. Draft Final Report. Volume One: Management Principles & Options. NWSC, Kampala, Uganda, and AquaConsult, Baden Austria.

Water and Sanitation Program, National Water and Sewerage Corporation, and AquaConsult. (2004b) Identification of Management Options for Improved Water and Sanitation Services of Informal Settlements in Kampala. Draft Final Report. Volume Two: Implementation Framework and Guidelines. NWSC, Kampala, Uganda, and AquaConsult, Baden, Austria.

World Bank. (1993) The demand for water in rural areas: determinants and policy implications. The World Bank Research Observer 8(1), 47–70.

Yahoo! Finance. (2009) Currencies Center. Available at <http://finance.yahoo.com/currency-converter#from=USD;to=EUR;amt=1> . Accessed on June 24, 2009.

FIGURES AND TABLES

Figure 1. Uganda and Sub-Saharan Region



Source: UNESCO 2006.

Table 1. Stakeholder analysis matrix for affordable basic water project for urban poor.

Stakeholder Group	Interest in Project	Effect of Project on Stakeholders' Interest	Importance of Stakeholders for Success of Project	Degree of Influence of Stakeholders over Project
Water and sewage service providers: NWSC and Kampala City Council (KCC)	<ul style="list-style-type: none"> - Mandated to provide water and sewage services to urban poor - Concerned about the cost recovery of service provision to informal settlements - Regard informal settlements as temporarily; concerned about possible non-payments for services - Subject to contradictory state and local regulations 	<ul style="list-style-type: none"> - The project is a risky investment that can potentially result in losses for NWSC and KCC - NWSC has the flexibility to select the project design option that leads to positive expected profits. - If successful, service provision to poor has the potential to significantly increase NWSC's customer base, and hence, returns. - Successful provision of services to urban poor will earn country and regional recognition for NWSC and KCC, and will help collaboration with foreign donors 	Very important (NWSC and KCC are implementing the project)	Significant
Mailo landowners	<ul style="list-style-type: none"> - Legal owners of the land occupied by informal settlements - Unable to develop their lands occupied by the informal settlements - Lack formal means to regulate the extent of informal settlements or evict the settlers - Consider restriction of the water and sewer services as an informal instrument to influence the informal settlements 	<ul style="list-style-type: none"> - The project will improve living conditions of the residents of informal settlements, and hence, reduce the abilities of mailo landowner to vacate the settlers and develop their lands 	Stakeholders lack the legal means to influence the project result. However, the stakeholders can influence the project through informal relationships with influential city officials	Potentially significant

Stakeholder Group	Interest in Project	Effect of Project on Stakeholders' Interest	Importance of Stakeholders for Success of Project	Degree of Influence of Stakeholders over Project
Residents of the informal settlements	<ul style="list-style-type: none"> - Diverse group with diverse interests - Suffer health effects from the lack of access to safe drinking water and sanitation - Hold false believe that the alternative water source – spring – is safe - Lack legal standing to demand municipal services - Lack understanding of procedure to apply for municipal services - Concerned about the cost and reliability of municipal service 	The project will result in health benefits, improved access to safe drinking water and hygiene services. However, the stakeholders needs to be educated about expected benefits of the project	Success of the project depends on selection of the project design option acceptable to the residents of informal settlements.	Potentially significant

Source: Based on National Water and Sewerage Corporation (NWSC) and AquaConsult 2003a, b.

Table 2. Prioritization of service technologies.

Service Level / Prioritization Criteria	Service Quality	Technical Suitability	Social Acceptability	Managerial Suitability	Environmental Impact
Rudimentary traditional systems	Risk of contamination is high; water quantity available is relatively small; distance to the water source can be large.	Service reliability is mostly low. However, this option requires minimum operation and maintenance.	Generally viewed as inferior.	Can be administered by a community organization or water committee; no formal operator is needed	Direct environmental impact is low
Public water points (with conventional or pre-paid meters)	Water quality is moderate; water source located closer to the customers; water quantity varies.	Moderate service reliability; maintenance complexity varies with scheme size	Viewed as an interim solution; most communities aspire to higher level of services; willingness to pay is low; risk of illegal connections and vandalism is high.	Can be managed by a community organization or water committee; training in operation and maintenance is needed	Direct environmental impact is low;
Yard tap	Risk of water contamination at residents' houses is moderate or large. Water source located close to residences.	Reliable technology; moderate level of maintenance is required for high pressure pipes and shut-off valves	Yard tap is perceived inferior to house connection; overall acceptability is moderate or good with proper awareness of advantages; volume-based billing improves willingness to pay; risk of illegal connections is reduced; risk of vandalism is low	Can be administered by a community organization or a water committee; can be operated by customers; training of customers in water awareness is needed	Direct environmental impact is low
House connection	Water contamination is possible at the point of use; water source located close to residences;	Technical efficiency is moderate (higher leaks due to high pressure); reliability is moderate or low; maintenance is high	Social perception and acceptability are good; affordability is low; willingness to pay is moderate to low (poor control); risk of illegal connections is high; risk of vandalism is low	Billing system requires community support; requires significant training of staff; mentoring and water awareness is critical since there is no other control; cost recovery is moderate to low	Environmental impact is moderate to high (effluent management is needed)

Source: Based on National Water and Sewerage Corporation (NWSC) and AquaConsult 2004b.

Table 3. Expenditures and returns for various service options.*

	Yard Taps (YTs)	PWPs with Conventional Meters	PWPs with Prepaid Meters
Capital Cost, million UGX (2008 US\$)	0.287 (\$174)	0.632 (\$383)	2.186 (\$1,325)
Operating expenditure per connection per year, million UGX (2008 US\$)	0.103 (\$63)	0.103 (\$63)	0.103 (\$63)
NWSC consumption tariffs, UGX/cubic meter (2008 US\$)	1064 (\$0.6)	688 (\$0.4)	688 (\$0.4)
Collection ratios	85%	60%	100%
Return per connection per year, million UGX (2008 US\$)	0.119 (\$72)	0.466 (\$283)	0.777 (\$472)

* Exchange rate as of July 31, 2008 (Yahoo! Finance 2009)

Table 4. Service provision scenarios.

	NWCS-Scenario	Optimized Service Provision Scenario	Service-Oriented Scenario	Cost-Oriented Scenario
YTs	19,067	9,542	0	0
PWP with conventional meters	409	0	10,444	0
PWP with pre-paid meters	409	1,766	0	2,720
Total number of service points	19,885	11,308	10,444	2,720
Total capital investment cost, million UGX (million 2008 USD)	6,600 (\$4.0)	6,600 (\$4.0)	6,600 (\$4.0)	5,947 (\$3.6)
Population served	408,000	408,000	1,566,580	408,000
Net Present Value, million UGX (million 2008 USD)	8 (~\$0)	2,515 (\$1.5)	12,981 (\$7.9)	4,708 (\$2.9)

Table 5. Social acceptability of YT and PWP water provision technologies.

	Public Perception	Public Acceptability	Affordability	Willingness-to-Pay	Pay-in-Kind	Illegal Connections	Vandalism
YTs	Mixed (inferior to house connections)	Moderate to good (given proper awareness of advantages and upgrade options)	Moderate to good (most households can afford the service if investment costs are covered by a grant)	Good (especially for volume-based billing)	Good (suited for own excavation and laying of yard connection and servicing)	Low	Low
PWPs (with conventional or pre-paid meters)	Mixed (viewed as an interim solution)	Low (most communities aspire to higher level of service)	Moderate (most households can afford the service if investment costs are covered by a grant)	Low (since water should still be carried manually from a PWP to home)	Low	High	Moderate / high

Source: Based on National Water and Sewerage Corporation (NWSC) and AquaConsult 2003b.

Table 6. Technical and managerial suitability of YT and PWP water provision technologies.

	Administrative Capacity	Operating Skill	Training Needed	Payment Collection	Maintenance Needed	Technical Support Needed
YTs	Moderate (can be operated by a community organization)	Moderate	Training of customers in water awareness	Good (given no illegal connections and honest meter reading)	Moderate (maintenance of high pressure pipes and occasional servicing of shut-off valves in nodes)	Low
PWPs with conventional meters	Moderate (can be operated by a community organization)	Moderate	Training of customers in operation and maintenance	Very low due to limited control over water usage and payment	Moderate (varies with scheme size)	Moderate / low (varies with scheme size and density)
PWPs with pre-paid meters	Moderate / high (require frequent loading of cards or replenishing tokens, and deploying of many vendors)	Moderate, but frequent contacts with NWSC are needed; large schemes need dedicated operator	Training of customers in operation and maintenance	High, but can potentially be reduced with shrinking of water usage by customers	Moderate (varies with scheme size; special maintenance of pre-paid meters)	Moderate / high (special maintenance of pre-paid meters)

Source: Based on National Water and Sewerage Corporation (NWSC) and AquaConsult 2003b.