

AN ASSESSMENT INTO THE FACTORS AFFECTING THE EFFICIENCY OF WATER SERVICES PROVISION BY NAIROBI CITY WATER AND SEWERAGE COMPANY

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ABSTRACT

Nairobi City Water & Sewerage Company is the main service provider of water services in Nairobi. It is mandated to manage water resources and distribution of safe and clean water to all the residents of Nairobi. The major problem the Company faces is that despite the massive investments carried out in the sector in the last few years, and the many reforms, no tangible results have been felt. Water shortages and rationing are the order of the day for the city residents. Therefore, the main objective of this study was to assess the factors that hamper the efficiency of service provision by the Nairobi City Water and Sewerage Company. The study also sought to establish the influence of Information and communication Technology and infrastructural development on the efficiency of water services provision by the Nairobi City Water and Sewerage Company. The study adopted a descriptive research design. The target population of this study was 1096 individuals working at NCWSC. This study used stratified random sampling to select 10% of the target population and the sample size was 110 individuals. Primary data was collected by use of structured questionnaires. This study used Statistical package for social science (SPSS) analysis software, version 21 to analyze data. Quantitative data was analyzed by use of inferential statistics and descriptive statistics like measures of central tendencies (mean), measures of dispersion (standard deviation), percentages and frequencies were used to tabulate the information. Further, inferential statistics (correlation analysis) was used to establish the relationship between variables. On the other hand, content analysis was used to analyze qualitative data. Data was then presented in tables, pie charts and bar charts. This study established that infrastructural development was the most significant factor influencing water services provision, followed by public-private partnership and ICT while financial sustainability was the least significant factor. This study therefore recommends that the company as well as other water providing companies should adopt information communication and technology in opening and closing of water valves, meter reading and in the regulation of discharge and pressure.

Key Words: *Financial Sustainability, Public-private Partnership, Infrastructure Development, Efficiency*

Introduction

Improved access to water supply and appropriate sanitation is fundamental to the elimination of poverty and the achievement of millennium development Goals (MDGs) (Kinoti, 2010). Yet, access to water for most urban and rural poor groups remain very poor in developing countries (UNDP, 2007). The provision of adequate water supplies is essential in order to meet basic human needs and to address poverty, and promote economic development, health and hygiene. Water supply has a long history in this respect, and the rationale for its improvement has always been the need to protect public health, to reduce mortality and morbidity in the population, and to promote economic development, especially in the developing world.

During the last four to five decades, many cities in the developing world, particularly African cities, have experienced rapid population growth but, water and sanitation infrastructure has lagged behind. Despite considerable investments made in the development of water sector infrastructure, the progresses that have been registered in many of those places have been slow. Achieving the target set in the United Nations Millennium Declaration of halving the proportion of the population without access to potable water supplies by 2015 remains therefore a challenge. The Global Water Supply and Sanitation Assessment 2001 estimated, for instance, that in 2002, about 1.1 billion people worldwide lacked access to adequate water supplies, and that those lacking services were chiefly in Asia and Africa. In absolute terms, Asia has the highest number of underserved citizens, but proportionally this group is larger in African countries (WHO/UNICEFF, 2006) where, an estimated 27% of the population does not have access to potable water. Levels of service by world population, defined as access to piped water was estimated to be 47% while, in Africa, this figure was only 24% (Amnesty International, 2009).

Statement of the Problem

Water issues abound throughout the world with every region having its own distinct challenges (Tjandraatmadja & Burn, 2005). More than one billion people in the world today lack access to safe drinking water. The Millenium Development Goals' initiative aims to cut this figure in half by 2015. The development and operation of urban water supply (UWS) systems (and infrastructure in general) has largely been the responsibility of the public sector in both developing and developed countries alike. Nairobi has 3.14 million inhabitants at night, a number that swells to about 5 million during the day of which only about 50 per cent have direct access to piped water. The rest obtain water from kiosks, vendors, illegal connections or from wells. Only about 40 per cent of those with access to piped water receive water 24 hours per day (Nairobi Water Company, 2011). On average, residents of Nairobi received water for only 11 hours per day in 2009/10, a level deemed unacceptable by the Water Sector Regulatory Board (water service regulatory board, 2012).

Fraudulent billing remains a challenge. While some parts of the city are so dangerous that meter readers do not venture to enter them, in other cases men posing as employees of the

water company threaten to disconnect customers unless they pay them. According to the Water Sector Regulatory Board, collection efficiency - the share of bills that were paid - was not acceptable at only 75% in 2009/10. Despite the low collection efficiency NCWSC covered 126% of its operation and maintenance costs, which is within the range considered acceptable by the regulator. 87% of connections were metered, a ratio that was also judged not acceptable by the regulator (Water Service Regulatory Board, 2012).

The massive investments carried out by NCWSC in the water sector in the last few decades have not sufficiently served the residents with adequate water supply. Also with advance in technology the company has not met water requirement of the residents due to failure to monitor the water flow capacity. It is expected that the Company is able to monitor most of its operations accurately and come up with measures that would reduce the inaccuracies in meter readings, billings and close the gaps between the billings done and the collections made within a specified period of time. Many dams have been constructed and water and sewer lines have also been built but still complaints by their customers are increasing day by day on the poor service delivery they get from the Company.

This study therefore sought to find out why Nairobi City Water and Sewerage Company has not improved in its service delivery to its customers despite availability of modern technology to monitor their operations accurately and also development of infrastructure in the Company. The study further sought to find out the mechanisms the NCWSC has put in place in ensuring that they meet their mandate of adequate water provision to its customers despite many other factors that they may have no control of. Some of these factors include vandalism by the same residents who are meant to benefit from the Company's services.

Objectives of the Study

The general objective of this study was to assess the factors affecting the efficiency of water services provision by the Nairobi City water and Sewerage Company. The specific objectives for this study were; to find out the influence of Information and communication Technology on the efficiency of water services provision by the Nairobi City Water and Sewerage Company; and to determine the effects of infrastructural development on the efficiency of water services provision by the Nairobi City Water and Sewerage Company.

Limitations of the Study

Some respondent were not able to give all the relevant information because of fear of giving confidential information. In order to overcome this challenge the researcher got a letter from the university in order to assure them that information received would strictly be for academic purpose and would not be released without the consent of the university and the researcher.

In addition, the researcher used questionnaires only to collect data. Questionnaires collect data that is quantitative in nature and hence they deprive the respondents an opportunity to

express their attitude, behavior and feelings in relation to the objectives of the study. To counteract this challenge the researcher incorporated open ended questions so as to give the respondents an opportunity to express their attitude, feelings and behavior in relation to the objective of the study.

Literature Review

Theoretical Review

This study focused on two theories: Technology Acceptance Model and Frischmann's economic theory. One of the well-known models related to technology acceptance and use is the technology acceptance model (TAM), originally proposed by Davis in 1986. TAM provides a basis with which one traces how external variables influence belief, attitude, and intention to use. Two cognitive beliefs are posited by TAM: perceived usefulness and perceived ease of use. According to TAM, one's actual use of a technology system is influenced directly or indirectly by the user's behavioral intentions, attitude, perceived usefulness of the system, and perceived ease of the system. The study adopted this model to explain the role of information in enhancing efficiency in the provision of water services.

Brett Frischmann's Economic Theory of Infrastructure and Commons Management offer a comprehensive new proposal about managing certain types of resources by providing public access to them on an obligatory and nondiscriminatory basis. It critiques any systematic right to exclude as inappropriate—a right that would be an integral part of a typical resource management scheme based on private property. For many resources that are broadly shared and reusable, Frischmann argues, open access will be more conducive to maximizing the production of public and nonmarket goods on an ongoing basis. The beneficial processes of shared use and reuse, with their many positive spillover effects, would be impeded by granting a property right to an owner who then could exclude potential downstream users, based on inadequate signals about demand. Frischmann concludes that fundamental infrastructure should instead be shared. His theory is important and helpful in addressing current issues of resource management structure for information and the Internet.

Empirical Review

For those service delivery areas that were perceived by the communities to be poorly provided, the main reason for poor delivery was linked to limited capacity of service providers (Lynk, 2003). Malley et al., (2008) indicate that low satisfaction level by the communities was expressed for public offices, market facilities, access to energy and other infrastructures like water supply and protection of sources, and maintenance of the public infrastructure.

According to Renzetti & Dupont (2004), the diversity of the service sector makes it difficult to make useful generalization concerning the management of service organization. Water and sewerage services have certain special features not necessarily

typical of other infrastructure services. First, they are exceptionally capital-intensive compared with other public services (Marita & Musyoki, 2008). The capital costs (including interest and depreciation) are often 65-75 percent of annual operating costs. The greatest share of capital costs by far is related to pipe and sewer networks. Contrary to common belief, adequate and modern water and wastewater treatment accounts for only 10-15 percent of annual operating costs (Megginson & Netter, 2001). Yet, the treatment processes are of utmost importance for health and environmental reasons. The capital intensiveness is partly due to the low ratio of annual turnover to cost of assets.

A second special feature of water and sewerage services operations is that fixed costs i.e. those that do not vary with the volume of production, except within very wide limits are about 80 percent of operating expenses. Yet, the revenue of many utilities depends mainly on the volume of water sold (Pickford, 2001). This has a profound effect on the structure of rates and charges. Consumers have to pay for the services, commonly through consumption related charges, sometimes by other means like taxation (Panda, 2007). Lack of proper cost recovery policy has been one of the key problems in many countries.

The third, and maybe the most important, feature from the viewpoint of this study is that the Water and sewerage services infrastructure is a natural monopoly a concept first introduced by John Stuart Mill in 1848 (Perkins, 2008). In the case of services like water and sanitation it is feasible to construct only one system for one service area.

General services and efficiency standards are commonly benchmarked, and finance efficiency is also tracked extensively (Pickford 2001). In the NCWSC, specific indicators include water losses, energy cost, and revenue collection, areas in which the utility is striving to get good results.

Information Communication and Technology (ICT)

Automation and ICT were adopted in water supply facilities and networks since the early fifties. Most of modern water supply plants in the developed countries are nowadays fully automated, utilizing ICT for synchronization of water supply with demand, regulation of pumps operation for energy savings, coordination of withdrawal from different sources and reservoirs and control of purification processes in sewerage reclamation facilities (Davis, Bagozzi & Warshaw, 2001). The introduction of variable speed pumps, incorporating frequency adjustment drives, facilitates high-level regulation of discharge and pressure regime for savings of energy and water. The use of this advanced technology was boosted by the increase in oil price during the last decade. The anticipated oil price hike in the future increases the incentive for more extensive adoption of ICT in water supply facilities. Energy savings by installed appliances, amount to 20% - 30% by increasing the efficiency of pumping units, balancing withdrawals and eliminating pressure surges and fluctuations (Tjandraatmadja & Burn, 2005).

The municipal sector, particularly household water supply is lagging behind the agricultural and industrial sectors in controlling the water supply and consumption. Most household consumers in the world do not pay for water according to consumption. Many of them do not pay at all for the water consumed (Renzetti & Dupont, 2004). Only in limited number of countries, like Israel, each consumer's water outlet is equipped with a water meter. But, due to increasing worldwide water shortages, interest is growing in measuring household water consumption and invoicing the users according to the actual amount of water consumed.

Infrastructure Development

The role of infrastructure such as safe drinking water in societal welfare and development has long been recognized. Infrastructure is regarded as the systemic framework which underpins community's ability to fulfill its mission of providing a base for its citizens to be productive and to nurture social equity (Davis, 2005). It is a kind of public trust of commonwealth upon which every citizen relies and draws for prospect and day to day socio-economic opportunities. When it functions efficiently the whole society benefits and the resultant effect is manifested on the growth and development of the community, when it functions below expectation, everybody pays in kind and cash (Akinola, 2002).

Water supply like energy, capital and communications is a very important infrastructural prerequisite for sustainable development. Apart from its primary role in enhancing human health and wellbeing, it is equally important for industrialization and commercial developments (Pickford, 2001). Adequate water is absolutely necessary to support the population and economic life of a city. Critical shortages of water not only inhibit or stop economic development but also directly damage the health of the city's people. Pickford (2001) contends that without water, there is no life; he cautioned that bad water could be almost as harmful as no water at all. The recognition of the significant role of water resources to support life in a city and its use for urban development has instigated interest on it at the global level and its inclusion on the subject of sustainable development and environmental sustainability. According to UNEP (2008), the environmental resource systems which are important for sustainable urban development include water resources, among others.

Various commentators suggest that more dispersed and localized wastewater systems are required even in the major developed cities (Tjandraatmadja & Burn, 2005) along with nutrient recovery and better control of substances introduced into wastewater systems. Although there are arguments over the relative merits of localised (or "on-site") systems for wastewater management, serving individual or small groups of properties – compared with the "end-of-pipe" systems traditionally used – there is a growing usage of on-site sanitation in countries such as the United States. Such systems can recover nutrients and energy and also be linked to local water supply and reuse technologies. This potentially changes the approach to service provision in the future, with systems being smaller and requiring much less up-front capitalization for their implementation. Buller (2006) argues that decentralized systems are also better at coping with the need to expand services. In the area of storm water drainage, there is also a growing use of "source control" technologies that handle storm water near the

point of generation, *i.e.* locally, also providing opportunities for direct use for, e.g., toilet flushing.

Research Methodology

The study adopted a descriptive research design. The population of this study was all the employees of NCWSC. The sampling frame comprised Finance, Technical department (Technicians), Meter readers, ICT department and Human Resource departments. This study used stratified random sampling to select 10% of the target population. According to Mugenda and Mugenda (2003) a sample size of 10 to 30% is a good representation of the target population. The sample size of this study was 110 respondents.

This study used primary data which was collected by use of structured questionnaires. Questionnaires were distributed to the respondents and about 4 to 7 days were given to respondents to complete the questionnaires before collection. In addition, all the questionnaires were delivered to the respondents directly and picked later at an agreed date.

This study used Statistical package for social science (SPSS) analysis software, version 21. The study generated both qualitative and quantitative data. For this study, quantitative data was analyzed by use of inferential statistics and descriptive statistics like measures of central tendencies (mean), measures of dispersion (standard deviation), percentages and frequencies were used to tabulate the information. Further, inferential statistics (correlation analysis) were used to establish the relationship between variables. Quantitative data was presented in tables, pie charts and bar charts while qualitative data was presented in a prose form in a systematic manner in which many words of text were summarized into fewer content categories.

Research Findings and Discussion

Information, communication and Technology

This study sought to find out the influence of Information and communication Technology on the efficiency of water services provision by the Nairobi City water and Sewerage Company. The findings of this study revealed that Nairobi City Water and Sewerage Company had adopted information technology. The organization had adopted information technology in the finance, technical department (technicians), and human resource departments. The company was using ICT in issuing of invoices, in the control of purification processes, managing customer's records, managing water flow and water bill payment. Most of modern water supply plants in the developed countries are nowadays fully automated, utilizing ICT for synchronization of water supply with demand, regulation of pumps operation for energy savings, coordination of withdrawal from different sources and reservoirs and control of purification processes in sewerage reclamation facilities. However the company had not adopted ICT in the opening and closing of water valves, meter reading and in the regulation of discharge and pressure. The introduction of variable speed pumps, incorporating frequency adjustment drives, facilitates high-level regulation of discharge and pressure regime for

savings of energy and water. The respondents also indicated that ICT strategies budget in their organization should be increased. In addition, the organization should adopt technology in regulation of discharge and pressure, meter reading and in opening and closing of water valves.

Infrastructural Development

The study sought to determine the effects of infrastructural development on the efficiency of water services provision by the Nairobi City Water and Sewerage Company. The study established that the performance of water flow system in Nairobi City Water and Sewerage Company is moderate. The role of infrastructure such as safe drinking water in societal welfare and development has long been recognized. The study also found that infrastructure development affects water service provision in Nairobi City Water and Sewerage Company. However, the approximate annual financial budget allocated to water supply infrastructure development was between 5% and 20%. The study also established that the current infrastructure in place is inadequate to serve the residents of Nairobi with adequate and efficient water provision. Additionally, the study found that pipeline network, flow rate and ICT system connection influence water service provision to a great extent.

Correlation Analysis

A correlation is a number between -1 and +1 that measures the degree of association between two variables. A positive value for the correlation implies a positive association. A negative value for the correlation implies a negative or inverse association. The analysis of correlation results between the information communication and technology and water service provision show a positive coefficient 0.58, with p-value of 0.025. It indicates that the result is significant at $\alpha = 5\%$ and that if the scores of information communication and technology increase it will have a positive impact on the water services provision. The results also show that there is a positive association between infrastructural development and water services provision where the correlation coefficient is 0.92, with a p-value of 0.020

Table 1: Correlation coefficients

		Water services provision	ICT	Infrastructural development
Water services provision	Pearson Correlation	1		
	Sig. (2-tailed)	.		
ICT	Pearson Correlation	.58	1	
	Sig. (2-tailed)	.025	.	
Infrastructural development	Pearson Correlation	.92	.233	1
	Sig. (2-tailed)	.020	.012	.

Conclusions

This study concludes that there is a positive relationship between information communication and technology and water service provision in Nairobi City Water and Sewerage Company. The organization had adopted information technology in the finance, technical department (technicians), and human resource departments. The company was using ICT in issuing of invoices, in the control of purification processes, managing customer's records, managing water flow and water bill payment. However the company had not adopted ICT in the opening and closing of water valves, meter reading and in the regulation of discharge and pressure. The introduction of variable speed pumps, incorporating frequency adjustment drives, facilitates high-level regulation of discharge and pressure regime for savings of energy and water.

In addition, the study concludes that there is a positive association between infrastructural development and water services provision in Nairobi City Water and Sewerage Company. The study established that the performance of water flow system in Nairobi City Water and Sewerage Company is moderate. The role of infrastructure such as safe drinking water in societal welfare and development has long been recognized. However, the approximate annual financial budget allocated to water supply infrastructure development was between 5% and 20%. Additionally, the study found that pipeline network, flow rate and ICT system connection influence water service provision to a great extent.

Recommendations

This study established that Nairobi City Water and Sewerage Company had not adopted ICT in the opening and closing of water valves, meter reading and in the regulation of discharge and pressure. This study therefore recommends that the company as well as other water providing companies should adopt information communication and technology in opening and closing of water valves, meter reading and in the regulation of discharge and pressure. It was also revealed that the approximate annual financial budget allocated to water supply infrastructure development was between 5% and 20%. Most of the respondents indicated that this was not enough. This study therefore recommends that the company should allocate more finances in infrastructure development. This study was a case study and hence its findings cannot be generalized to other public water providing companies in Kenya. This study therefore recommends further studies on factors affecting the efficiency of water services provision in water providing companies in Kenya. The study also recommends further studies in the area of the role of information technology in enhancing efficiency of water provision in Kenya.

References

- Akinola S.R. (2002). *Urban Infrastructural Facilities*. Unpublished manuscripts. Development of Public Administration O.A.U. Ile-Ife.
- Amnesty International (June 2009). Kenya the Unseen Majority: Nairobi's two million slum-dwellers. Available at: www.amnesty.org.uk (Accessed on 11 July 2013)

- Buller, H., (2006). Privatization and Europeanization: The changing context of water supply in Britain and France. *Journal of Environmental Planning and Management*, 39, 461–483.
- Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (2001). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35(8), 982–1003.
- Davis, J. (2005). *Private-Sector Participation in the Water and Sanitation Sector*, Annual Review of Environment and Resources, 30, 83.
- Kinoti, M.K. (2010). *Factors affecting the performance of private water firms in delivery of water services a case of Imetha water and sanitation company-Buuri District*. Available at: <http://erepository.uonbi.ac.ke>: (Accessed on 11 July 2013)
- Lynk, E.L. (2003). Privatization, joint production and comparative efficiencies of private and public ownership: The UK water industry, *Fiscal Studies*, 14(2), 98-116.
- Malley, Z.J., Taeb, M., Matsumoto, T. & Takeya, H. (2009). Environmental sustainability and water availability: Analyses of the scarcity and improvement opportunities in the Usangu plain, *Tanzania Physics and Chemistry of the Earth, Parts A/B/C*, 34(1-2), 3-13
- Marita, F. & Musyoki, S. (2008). *Community-Led Total Sanitation (CLTS) leveraging on World Toilet Day celebrations in Kenya*. Nairobi, Kenya, Plan Kenya
- Megginson, W.L. & Netter, J.M. (2001). From state to market: a survey of empirical studies on privatization. *Journal of Economic Literature*, 39, 321–89
- Mugenda, O.M. & A.G. Mugenda (2003). *Research Methods. Qualitative and Quantitative Approach*. Nairobi: Acts Press.
- Panda, S.M. (2007). *Mainstreaming gender in water management: A critical view, Gender, technology and development*, Available at: <http://gtb.sagepub.com/cgi/content/refs/11/3/321> (Accessed on 11 July 2013)
- Perkins, A. (2008). *Katine it starts with a village. Water in Uganda*. Available at: <http://www.guardian.co.uk/katine> (Accessed on 11 July 2013)
- Pickford J. (2001). *Low-cost Sanitation, A survey of practical experience*. London: Intermediate Technology Publications Ltd.
- Renzetti, S. & Dupont, D. (2004). The Performance of Municipal Water Utilities: Evidence on the Role of Ownership. *Journal of Toxicology and Environmental Health*, 67, 1861-1878.
- Tjandraatmadja, G. F. & Burn, S. (2005). Rethinking Urban Water Systems- Revisiting Concepts in Urban Wastewater Collection and Treatment to Ensure Infrastructure Sustainability. *Water Science and Technology: Water Supply* 5(2), 145-154.
- UNDP, (2007). *Beyond scarcity: Power, poverty and the global water crisis*. Available at: <http://hdr.undp.org/en/media/HDR06-complete.pdf> (Accessed 11th July 2012)
- Water Services Regulatory Board, (2012). A performance Report of Kenya's Water Services Sub-Sector Impact Report. Available at: www.WASREB.co.ke (Accessed 11th July 2012)
- WHO & UNICEF, (2007), Joint Monitoring Programme for water supply and sanitation. Available at: www.wssinfo.org (Accessed on 11 July 2013)