Management function and water quality service concerns: Emerging management issues in selected town councils in Uganda

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Abstract

A study has been conducted to illustrate examples of water quality problems to vulnerable communities in Uganda's small town councils. Many urban communities in sub-Saharan Africa still lack clean water for basic needs such as drinking and washing. Even where water points have been constructed, many breakdown prematurely or provide inadequate, seasonal or poor-quality water supplies. While techno-managerial factors are relevant in explaining these problems, attention is needed to the institutional and political-economic dynamics shaping policy outcomes on the ground. Structural Equation Modelling (SEM) as a manifestation of multivariate analysis was used as an instrument for decision making in factor analysis of water quality service. Variance based SEM helped with variables of water pollution which consisted of qualitative and quantitative variables. Linear structural equation model obtained as a result of the study showed the contribution level among pollution factors. T-statistic values obtained by doing bootstrap model resample showed the significances of the management function. It was concluded that effective planning of water projects in small towns will reduce on the management challenges. There is need to ensure installation of hand pumps, and look after their repair and maintenance with the coordination of urban dwellers. There is need to create health awareness about diseases caused by unsafe water by providing safe drinking water, thereby reducing water borne diseases.

Key words: *Water quality, Water service quality*

Introduction

Water is an indispensable natural resource for the survival and wellbeing of humankind. It is also essential for the production of food, energy that contributes to the economic and industrial development of a society (Naiga and Penker, 2014). Safe and reliable supply of water is therefore essential for individual welfare and for community development (Ovrawah, and Hymore, 2001). The first and foremost consequence of lack of safe water for community consumption is diseases (Mpaata, 2018). World Health Organization (WHO) estimates that as much as 80% of all diseases in the world is associated with water (Hirsch, 2006). Available evidences indicate that most of the health benefits from safe water are attainable at service levels of 30–40 liters per capita per day. Mpaata (2018) notes that with good water structures and systems, the role of organized water supply in the prevention of water-borne diseases and in the promotion of public health can be well appreciated (Hall, Lobina, and De la Motte, 2005).

For most developing countries, clean water access is still unattainable (Gautam, and Shivakoti, 2005). According to the Human Development Report of United Nations Development Programme (UNDP), as of 1996, more than 31% of the population in developing countries is yet to have access to safe water and more than three-fourths of this population lives in the rural areas. In Uganda, the responsibility for providing drinking water supply in small town councils vests with the central government, through the Ministry of Water and Environment (Kintale, 2017). However, Uganda's drinking water crisis has become severe over the past decade. Increasing demands on available water resources for intensive agricultural practices and industrial use, together with deteriorating water quality, constrain drinking water availability despite massive outlays for drinking water and sanitation infrastructure (Kintale, 2018). The water crisis seems to be worse in the study towns of Lwengo in Western Uganda, Kayabwe in Central Uganda, Ishaka in Western Uganda, Omoro in Northern Uganda, Buwenge and Bugembe in Eastern Uganda.

More than half of these small town council households depend upon tap water, hand pumps as their main source of drinking water. This increased between 2007 and 2015 to make this source the preferred source of drinking water. However, there has been an increase of 3% of town dwellers using these sources putting pressure on the government to provide more tap water(Water Resources Department, 2019). Although most of the water supply and sanitation schemes by Uganda's government have penetrated into small towns and covered many households (about 54% of householders are fully covered), many households (about 46%) have no drinking water facilities (Water Resources Department, 2019). Moreover, there are growing concerns about the sustainable use of groundwater and surface water with respect to emerging issues of inequity of water distribution and access (Water Resources Department Uganda, 2019). Although the government assures that drinking water is available in most towns, the quality of that water supply is a problem. Currently, a large proportion of Uganda's communities is consuming water that does not meet the WHO drinking water quality standards (WHO Report, 2017). Furthermore, in most of the towns, users are unaware of the quality of the water being supplied to them for drinking(MoWE Report, 2018). Under drought conditions, the quality of water tends to be overlooked, and priority is given to quantity. Hence, it is essential to examine the management function and quality of the drinking water use in the small town communities that lack proper water supply infrastructure.

Problem statement

In spite of continuous efforts to provide drinking water in small town councils in Uganda, the government of Uganda has been able to solve the problem in only 46.9 per cent of the towns (Water Resources Department, 2019). About 53.1 per cent towns are still without safe drinking water supply (MoWE, 2018). Through a recent report it has been made clear that in small urban centres, 15 per cent persons are suffering from problems related to quality of water (MoWE, 2018). Among these problems, the main problem is of fluoride, arsenic, iron element, and pollution due to nitrate and salinity (WHO Report, 2017). In spite of so many efforts for providing drinking water, water supply system is disturbed on account of the fact that the common man has developed the presumption that water is a social asset and responsibility for providing it vests completely with the government.

Water policy practices

Solving water quality problems requires strategies to prevent, treat, and remediate water quality concerns. Water resource management, including water quality management, is an exclusive national competency. As such, water quality management is the responsibility of the Minister of Water and Environment.

The Ugandan Constitution as amended 1995 National Objectives and Directive Principles of State Policy XXI states that every citizen has the right to access adequate water that is not harmful to health. The constitution says "it is every person's right to have access to clean water". This places an obligation on those charged with the provision of water to communities.

The Uganda Water Act Chapter 152 gives substance to constitutional requirements with respect to access, national norms and standards and institutional framework for provision of water services. It states that drinking water quality should comply with prescribed National Drinking Water Standards. The Water Act, therefore, makes it mandatory that consumers be involved in water quality monitoring and management. S. 50 provides that a set of individuals or households may form a water user group and collectively plan and manage the point source water supply system in their area. At the local government level, the primary responsibility for ensuring the provision of safe drinking water rests with Ministry of Water and Environment in that, it will monitor the quality of drinking water provided to consumers, compare the results to national drinking water standards and communicate any health risks to consumers and appropriate authorities. The Ministry promotes an understanding of the entire water supply system, the events that can compromise drinking water quality and the operational control necessary for optimizing drinking water quality and water pollution. Delivery of drinking water supply has taken different shapes, primarily due to the choice of technology by the respective governments. While some have emphasized hand pumps, others have taken measures to set-up piped water supplies. Under the common national program for ensuring safe drinking water in the vicinity of households, providing services by piped water supply is a better option than hand pumps (Naiga, and Penker, 2014). This is because piped water supply can more effectively improve drinking water security when coupled with safety norms to reduce water contamination, than other technologies, like hand pumps. Water quality in this study has been examined on the basis of contamination by fluoride, arsenic, iron, salinity, and nitrate. A number of towns studied are vulnerable to water quality problems. High levels of calcium, magnesium and nitrate in water taps and private boreholes, attributed to the agricultural practices and washing of clothes in the neighborhood of the boreholes, have been found in groundwater. High levels of calcium and magnesium increases the hardness of water as the Ministry of Water and Environment Report (2016) emphasizes. Nitrates commonly generated from waste water, agricultural effluent from fertilizers and livestock feed-lots, waste disposal sites, urban sanitation, and cemeteries is the single most important reason for groundwater resources to be deemed unfit for human consumption. High nitrate concentrations in groundwater occur mainly in a wide band. Nitrates contamination of groundwater is a serious threat to public health and high levels can lead to methamoglobinemia (blue baby syndrome), a disease found especially in infants less than six months but also can affect the adults. Calcium hypochlorite (chlorine powder or bleach powder) is used to treat the drinking water at public water supply areas but the question remains whether this powder is used to treat water from different sources in small towns in Uganda in order to have the water safe for drinking?

Methodology

The study was carried out in six selected town councils of Lwengo in Western Uganda, Kayabwe in Central Uganda, Ishaka in Western Uganda, Omoro in Northern Uganda, Buwenge and Bugembe in Eastern Uganda. An initial sample of 1013 respondents from the six selected towns of Lwengo, Kayabwe, Bugembe, Buwenge, Omoro, Ishaka was drawn. Later smaller samples were calculated using the random selection of cases from the six towns, namely samples with 25, 50, 100, 250, 400, and 500 units. This was performed in order to check the possible impact of sample size on relationships between latent variables using the CB-SEM and the PLS-SEM method. The methodological approach to this study was qualitative and quantitative in nature where structured questionnaire and unstructured interview guides were adopted. A descriptive cross sectional survey design was adopted. In line with the research purpose and the unit of analysis in this study, the study population comprised of water officers, Sub county Chiefs, Ministry of Water and Environment Officials, Town Engineers and the residents of the six selected towns. This study was multi-dimensional hence multiple sampling techniques was used for specific groups of informants. Simple random sampling, purposive and convenience sampling was adopted. The structural equation modeling (SEM), including multi-group analysis, was performed using AMOS version 24. The goodness of fit (GOF) of the model with the data was examined using several GOF statistics, such as Chi-square (minimum discrepancy/degree of freedom: CMIN/DF), goodness-of-fit index (GFI), root mean square error of approximation (RMSEA), comparative fit index (CFI) and Akaike information criteria (AIC).

Table 1. Validity and reliability of variables in model

Latent variable	Indicator	Convergent validity		Reliability		R^2
		loading	average variance extracted	composite reliability	Cronbach's alpha	
AA	A1	0.842	0.6923	0.8999	0.8514	0.000
	A2	0.782				
	A3	0.863				
	A4	0.839				
LRP	B1	0.769	0.5802	0.8463	0.7567	0.781
	B2	0.809				
	B3	0.684				
	B4	0.779				
LWE	C1	0.849	0.5845	0.8485	0.7639	0.735
	C2	0.729				
	C3	0.758				
	C4	0.714				
LS	D1	0.593	0.5398	0.8224	0.7165	0.769
	D2	0.739				
	D3	0.777				
	D4	0.811				
RWP	E1	0.787	0.6587	0.8852	0.8277	0.748
	E2	0.843				
	E3	0.801				
	E4	0.814				
S	F1	0.857	0.7379	0.9184	0.8815	0.812
	F2	0.888				
	F3	0.811				
	F4	0.877				

Explanations: AA = anthropogenic activities; LRP = law, regulation and policy; LWE = land and water ecosystem; MR = Lake source; RWP = river water pollution; S = sustainability; A1 = industrial, A2 = residential, A3 = commercial, A4 = agricultural; B1 = green technology program, B2 = no plastic program, B3 = recycle program, B4 = education program; C1 = habitat, C2 = shelter, C3 = food supply, C4 = freshwater; D1 = soil structure, D2 = erosion and sedimentation, D3 = floods, D4 = landslide; E1 = poisoning, E2 = disease spread, E3 = toxic, E4 = physico-chemical and biological pollution; F1 = responsibility, F2 = respective, F3 = attitude, F4 = adaption of religious education.
Source: own study.

The validity and reliability of variables (which refer to indicators) in the domains were required for examination to determine the existence of relationship within the variables. This is because the six domains generated in the model had to be valid and reliable, which were important to represent the indicators or instrument items. In other words, the SEM analysis explains that the six domains referred to as latent variables were represented by their indicators in the particular model that was produced.

Table 2. Validity & Reliability References For Outer Model

Category	Parameter	References Value
Convergent validity	Loading Factor	>0.70 for confirmatory research >0.60 for exploratory research >0.50 for startup research
	Average variance Extracted(AVE)	>0.50 for confirmatory and exploratory research
Discriminant validity	Cross loading	> 0.70 for every variable
	√AVE and correlation among latent construct	√AVE > correlation between latent construct
Reliability	Cronbach's Alpha	> 0.70 for confirmatory research > 0.60 for exploratory research
	Weight Significances	t-value > 1.65 - α = 0.1 • t-value > 1.96 - α =0.05 • t-value > 2.58 -α = 0.01

The authors postulated two possible models related to the ideas that management function affects water quality service (Model 1) or that management factors affects water service quality in small towns in Uganda (Model 2). The path diagrams of Model 1 and Model 2 are shown in figure 1 and figure 2 with results of SEM analysis. The left and right parts of these figures depict management function and water quality service respectively.

The R^2 value of endogenous *water pollution level* variable is 0.2996. It can be referred that the structural model of this case study is rather weak. Based on Table 4, the only significance variable is *upstream condition* (confidence interval of 95%), because it was the only variable which has t-statistic value more than 1.96.

Table 3. Ave Compared With Latent Variables Correlation

	√AVE			ALD	HULU	PM	TP
PM	0.8735	compared	**PM**	0.0156	-0.1924	1.0000	-
TP	0.8766		**TP**	0.2739	0.4955	-0.2389	1.0000

Table 3: is giving the path coefficients of the structural equation model (sample mean). Thus, the structural equation of the model is

Table 4: Path Coefficients

	Original sample 0	Sample mean M	Standard Error STERR	T-Statistics STERR
DOM-WPL	0.185	0.215	0.169	1.099
UPS-WPL	0.425	0.466	0.190	2.243
CP-WPL	0.016	-0.078	0.286	0.055
CP-WPL	0.160	-0.129	0.173	0.924

Source: Primary data (2020)

Table 5. Ave Composite Reliability, Cronbachs Alpha, R^2

	AVE	Composite Reliability	Cronbachs Alpha		R^2
HULU	-	-	-		-
ALD	-	-	-	0.0002	
PM	0.7630	0.8642	0.7269		-
TP	0.7685	0.8688	0.7076	0.2996	

Source: Primary data (2020)

The prediction strength of structural model shown by value of R^2 each of endogenous latent variable. R^2 value of 0.75, 0.50 and 0.25 explain the model. The variance-based SEM can be used well-enough for helping the water quality service factor analysis. It can mix qualitative and quantitative variables with good perseverance. The case study resulted in a weak structural model with significance value identified for one variable. In order to strengthen the model, it need more variable and indicators to put up. It is recommended to have many observed indicators when make the model concept in first place. It is also recommended to add latent variable of regulation or policy that leads into pollution rising. Despite the national policy and programmatic efforts to provide basic water services, many small towns in Uganda remain characterized by a disjuncture between water for livelihood needs and their actual access to the available water supply. Effective and efficient management of water supply systems in small town councils in Uganda remains a challenge. This is due to the long distances between consumers and town centres, the low income of most residents and the government policy on water management.

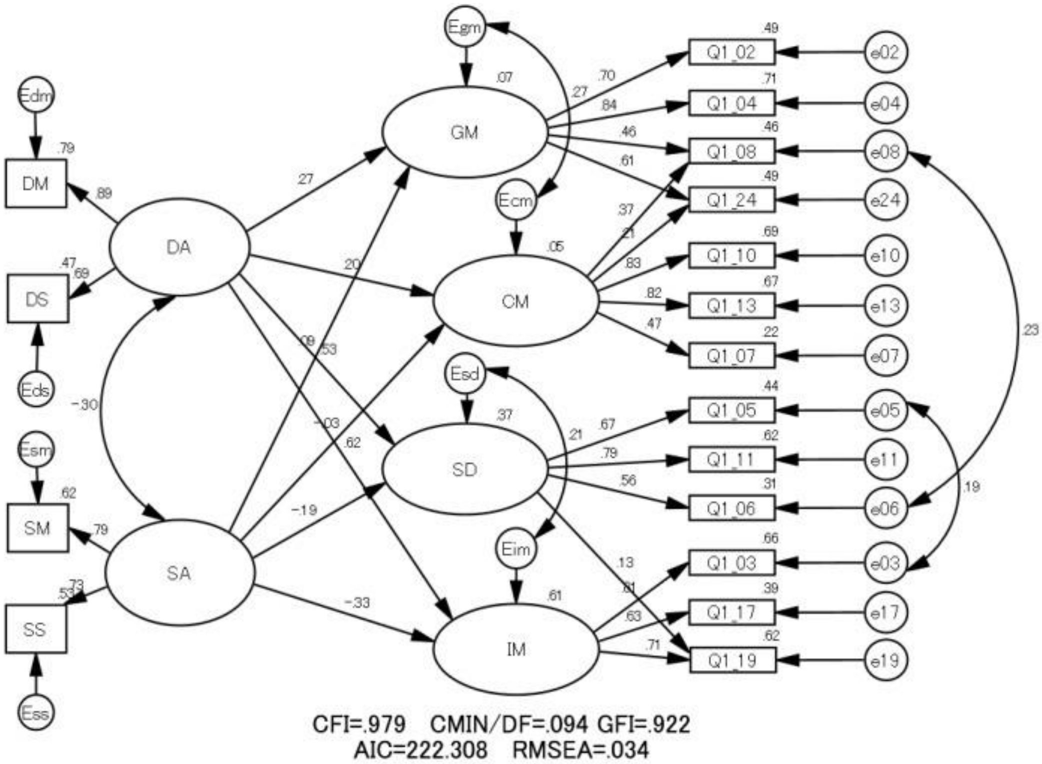


Figure 1:
The structure of Model 1 with standardized estimators among variables and goodness-of-fit (GOF) statistics. In this figure, DA: deep approach, SA: surface approach, DM: deep motive; DS: deep strategy, SM: surface motive, SS: surface strategy, GM: grade movement, CM: clean movement of water, SD: service-drivers and IM: internal water movement

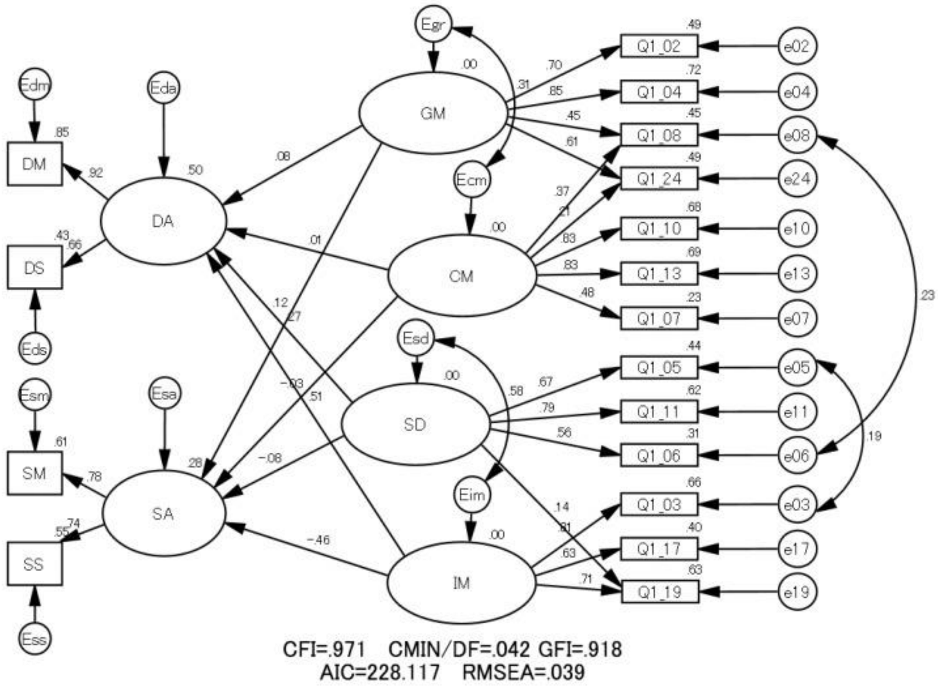


Figure 2: The structure of Model 2 with standardized estimators among variables and GOF statistics. In this figure, DA: deep approach, SA: surface approach, DM: deep motive; DS: deep strategy, SM: surface motive, SS: surface strategy, GM: grade movement, CM: clean movement of water, SD: service-drivers and IM: internal water movement.

In Figure 1 and Figure 2, the single-headed and double-headed arrows indicate causal relationships and correlations between variables, respectively. In Figure 1, the arrows were drawn from the latent variables of learning process (DA and SA) to those of management function profile (GM, CM, SD and IM). On the other hand, in Figure 2, the arrows were drawn from the latent variables of water service concerns profile to those of management function. Figure 1 and 2 are founded on the ideas that management function affects water quality service and that management concerns affects water quality, respectively. To establish a model with a better fit, some correlations were added to the original models. Both Figure 1 and Figure 2 satisfied most GOF statistics in terms of the conventional criteria (p-values of the Chi-square test, CMIN/DF: >0.05; CFI: >0.90; GOF index: (GFI): >0.90; RMSEA: <0.05). Comparing the GOF statistics, Figure 1 was found to be a better fit for the data than Model 2 because CFI and GFI were larger and RMSEA and AIC were smaller in comparison with Figure 2. Thus, the authors adopted Figure 1 as the structure illustrating the causal relationship between management function and water quality service. Table 6 shows the estimated regression weights from the management function to the water quality service profile in Figure 1. All estimated regression weights of the paths from DA to management factors were all positive and statistically significant (less than 0.05). In contrast, the regression weights from SA to the components of management factors were not significant or negative. These results indicate that DA helped to increase management factors, while SA had little influence or a slightly negative influence on water quality service.

Table 6: Standardized estimated regression weights from the management function (DA and SA) to water quality service (GM, CM, SD and IM) in Model 1

Path	Standardized Estimate	Estimate	Standard Error	*p*-Value
DA to GM	0.270	0.078	0.030	0.009
DA to CM	0.204	0.062	0.031	0.045
DA to SD	0.530	0.148	0.031	<0.001
DA to IM	0.618	0.168	0.028	<0.001
SA to GM	0.090	0.028	0.033	0.397
SA to CM	–0.035	–0.012	0.035	0.742
SA to SD	–0.188	–0.057	0.031	0.069
SA to IM	–0.326	–0.096	0.029	<0.001

p-values were obtained from estimates and their standard errors by the z-test. In this table, DA: deep approach, SA: surface approach, GM: grade movement, CM: clean movement of water, SD: self-drivers and IM Internal water movement.

Based on Figure 1, the authors assessed the change in relationship between management factors and water quality service profile by month using the multi-group analysis. In multi-group analysis, several constrained models can be established. The smallest AIC was found in the constrained model, which had equalized measurement weights, measurement intercepts and structural weights. Therefore, this figure was selected to be the final model. The influence of management factors on water quality service was evaluated from the change in estimated means of DA and SA.

It is known that the management function and water quality concerns are related to each other. The DA has been reported to correlate with water quality and the ability to maximize meaning. Although DA was known to be associated with water quality, a causal relation between these two variables would be usually unclear. In this study, I reveal that management function influences water quality service.

Results based on two SEM Techniques on Different Samples Sizes from the six study towns.

In my study, the relationship between management function factors and water quality service was investigated using two different approaches (CB-SEM and PLS-SEM) and different sample sizes were investigated.

Research was implemented on an initial sample of 1013 respondents. In the next step, six smaller samples were calculated using the random selection of cases, namely samples with 25, 50, 100, 250, 400, and 500 units, because I want to check the possible impact of sample size on relationships between the latent variables using the CB-SEM and the PLS-SEM methods. Therefore, the following hypothesis is proposed:

Hypothesis 1 (H1). Planning has a negative impact on water quality service.

Hypothesis 2 (H2). Coordination has a negative impact water quality service.

Hypothesis 3 (H3). Control has a positive impact on water quality service.

Hypothesis 4 (H4). Staffing has a positive impact on water quality service.

Hypothesis 5 (H5). Direction has a positive impact on water quality service.

An initial sample of 1013 respondents from the six selected towns of Lwengo, Kayabwe, Bugembe, Buwenge, Omoro, Ishaka is drawn. Later smaller samples are calculated using the random selection of cases from the six towns, namely samples with 25, 50, 100, 250, 400, and 500 units. This is performed in order to check the possible impact of sample size on relationships between latent variables using the CB-SEM and the PLS-SEM method.

Dimensionality, Validity, and Reliability

The reliability of measurement scales for all samples was assessed within the scope of inner consistency with Cronbach's alpha coefficient.

The alpha coefficient of $\alpha \geq 0.80$ is marked as exemplary; the coefficient in the interval $0.70 \leq \alpha < 0.80$ as very good; the interval $0.60 \leq \alpha < 0.70$ as moderate; and smaller than 0.60 as barely acceptable. Cronbach's alphas in Table 7 show that the scales were reliable for all measurement scales across all samples.

Table 7: Cronbach's alphas for different samples

Construct	Alpha Sample 25	Alpha Sample 50	Alpha Sample 100	Alpha Sample 250	Alpha Sample 400	Alpha Sample 500	Alpha Sample 1013
Planning	0.859	0.868	0.924	0.920	0.927	0.929	0.929
Coordination	0.928	0.973	0.956	0.948	0.950	0.954	0.951
Control	0.899	0.903	0.908	0.909	0.905	0.898	0.896
Staffing	0.943	0.945	0.941	0.938	0.933	0.928	0.930

In order to assess the proper dimensionality, reliability, and validity, CFA was performed using the CB-SEM on the whole database. Some of the items with low loadings on their latent variables or with high cross-loadings were excluded from the model. The final CB-SEM measurement model consisted of four indicators for management function. An overall fit assessment of the structural model yielded a significant chi-square value x^2 (645.79; $p < 0.001$), which indicated a non-perfect fit. However, according to, other fit indices should be used, since x^2 may be an inappropriate standard when researchers are dealing with a complex model and with a large sample size. The following fit indices were calculated for the measurement model: RMSEA = 0.073, GFI = 0.924, NFI = 0.964, TLI = 0.962, and CFI = 0.969. All indices were within the accepted boundaries as proposed by representative authors in the field. The same variables were also used for constructing the PLS-SEM model.

All indicator loadings in the CB-SEM model were higher than 0.7 and statistically significant. In addition, the average variances extracted (AVE) were all higher than 0.7, indicating the appropriate convergent validity. The composite reliability (CR) measures exceeded the suggested level of 0.6, suggesting a high reliability of the scales. Criterion was used to test for discriminant validity.

Table 8: Square roots of the AVE and correlations among the latent variables for the CB-SEM and PLS-SEM models.

	Planning	Control	Coordination	Staffing	Planning	Control	Coordination	Staffing
Planning	0.932*				0.955*			
Control	−0.708	0.855 *			−0.684	0.883 *		
Coordination	0.905	−0.741	0.863 *		0.854	−0.702	0.891 *	
Staffing	0.874	−0.707	0.944	0.863 *	0.812	−0.659	0.869	0.910 *

* Square root of AVE

According to the proposed hypotheses, structural models were tested with CB-SEM and PLS-SEM on seven samples with 25, 50, 100, 250, 400, 500, and 1013 respondents.

CB-SEM and PLS-SEM Results

The CB-SEM and PLS-SEM results are presented in Tables 8 and 9. For CB-SEM analysis, the model fit was assessed with x^2 (df), RMSEA, GFI, NFI, TLI, and CFI fit indices. x^2 was statistically significant for all samples, but, as already mentioned, this is not always the most appropriate fit index. As can be seen from Table 8, the GFI and NFI for the 25 and 50 employee samples were lower than 0.9, indicating a bad fit for the model. The GFI fit indices were lower than 0.9 for the 100 and 250 employee samples. However, other fit indices were within the suggested intervals meeting the suggested thresholds.

Table 9. Fit indices for CB-SEM and PLS-SEM.

Method		**CB-SEM**				**PLS-**	
Sample Size	**GFI**	**NFI**	**TLI**	**CFI**	**RMSEA**	**NFI**	**SRMR**
25	0.612	0.832	0.902	0.920	0.155	0.685	0.081
50	0.727	0.832	0.902	0.920	0.122	0.797	0.075
100	0.839	0.914	0.954	0.962	0.085	0.879	0.055
250	0.870	0.938	0.949	0.958	0.088	0.901	0.058
400	0.895	0.952	0.961	0.968	0.076	0.912	0.056
500	0.897	0.952	0.955	0.963	0.082	0.910	0.055
1013	0.919	0.963	0.961	0.968	0.076	0.921	0.054

Abbreviations: GFI—goodness of fit index, NFI—normed fit index, TLI—Tucker–Lewis index, CFI—comparative fit index, RMSEA—root mean square error of approximation, and SRMR—standardized root mean square residual index.

Table 10. Standardized regression paths for CB-SEM and PLS-SEM

Hypoth	H		H		H		H		H	
Metho	CB-SEM		CB-SEM		CB-SEM		CB-SEM		CB-SEM	
Sample Size	Planning -> Water quality service		Coordination-> water quality service		Control-> water quality service		Staffing-> water quality service		Direction-> water quality service	
25	−0.809 (p < 0.01)	-0.677 (p < 0.01)	Non-significant	Non-significant	0.757 (p < 0.01)	0.611 (p < 0.01)	0.688 (p < 0.01)	0.564 (p < 0.01)	0.344 (p < 0.01)	0.447 (p < 0.01)
50	−0.655 (p < 0.01)	-0.610 (p < 0.01)	Non-significant	Non-significant	0.835 (p < 0.01)	0.714 (p < 0.01)	0.562 (p < 0.01)	0.478 (p < 0.01)	0.429 (p < 0.01)	0.508 (p < 0.01)
100	− 0.-790 (p < 0.01)	-0.760 (p < 0.01)	Non-significant	Non-significant	0.807 (p < 0.01)	0.738 (p < 0.01)	0.464 (p < 0.01)	0.525 (p < 0.01)	0.521 (p < 0.01)	0.426 (p < 0.01)
250	−0.726 (p < 0.01)	−0.691 (p < 0.01)	−0.158 (p < 0.01)	−0.156 (p < 0.01)	0.778 (p < 0.01)	0.725 (p < 0.01)	0.355 (p < 0.01)	0.443 (p < 0.01)	0.638 (p < 0.01)	0.518 (p < 0.01)
400	− 0.-713 (p < 0.01)	−0.680 (p < 0.01)	−0.174 (p < 0.01)	−0.172 (p < 0.01)	0.763 (p < 0.01)	0.709 (p < 0.01)	0.331 (p < 0.01)	0.427 (p < 0.01)	0.661 (p < 0.01)	0.531 (p < 0.01
500	− 0.718 (p < 0.01)	−0.696 (p < 0.01)	−0.179 (p < 0.01)	−0.201 (p < 0.01)	0.754 (p < 0.01)	0.676 (p < 0.01)	0.371 (p < 0.01)	0.471 (p < 0.01)	0.613 (p < 0.01)	0.474 (p < 0.01)
1013	−0.713 (p < 0.01)	−0.684 (p < 0.01)	−0.192 (p < 0.01)	−0.195 (p < 0.01)	0.738 (p < 0.01)	.678 (p < 0.01)	0.329 (p < 0.01)	0.436 (p < 0.01)	0.659 (p < 0.01)	0.515 (p < 0.01)

Since it is not common to calculate as many fit indices in PLS-SEM as in CB-SEM, only NFI and the SRMR index were used in this case (Table 9). For samples larger than 250, NFI reached the suggested threshold of 0.9, while for the smaller samples (25, 50, 100) it was lower. SRMR for all cases was close or lower than 0.08. R^2 values for all endogenous variables (planning, control, coordination and staffing) for all samples were larger than 0.4.

As can be observed from Table 10, the results acquired with both methods showed that planning had a negative impact on water quality service. The relationship was strong, negative, and statistically significant. The impact of planning on water quality service was negative. This relationship was much weaker and statistically significant for larger samples, but not for the samples of 25, 50, and 100. In these cases, the relationships were non-significant. Control had a strong and statistically significant impact on water quality service and a moderately significant impact of staffing on water quality service. The impact of direction on water quality service in small towns in Uganda was strong and statistically significant.

Final Results and Hypotheses Testing

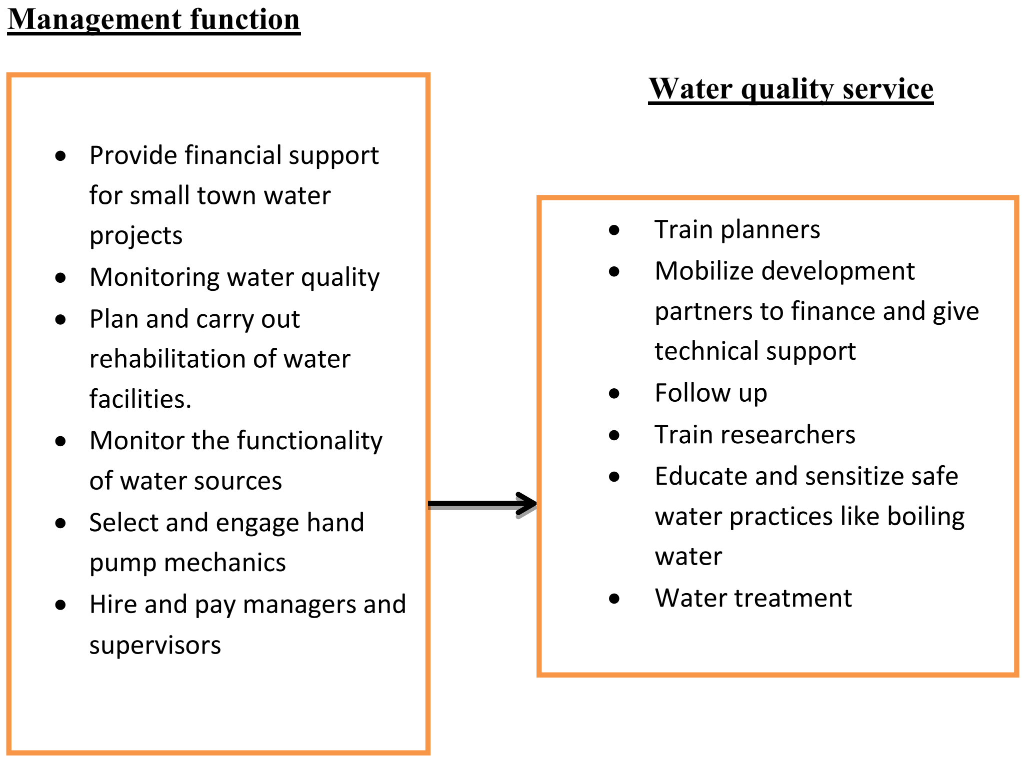
Concerning the hypotheses, the results were identical for the CB-SEM and the PLS-SEM models. Planning had a strong negative impact on water quality service, meaning that hypothesis H1 was confirmed for all samples. This is consistent with the findings of Bartram & Cairncross(2010) in which the author found that a higher planning causes a lower level of water quality service. Bartram & Cairncross(2010) revealed that if not well planned, groundwater quality can be affected on a local scale for example in Lwengo where the residents who could not afford buying tap water sold at 200 Uganda shillings had to walk long distances in search for water from springs and boreholes. This is a time-consuming, cumbersome activity. Low availability, untimely and irregular deliveries, degraded quality, inequity in distribution, and so on were the major problems reported.

The relationship between planning and water quality service was weak and statistically insignificant for smaller samples (sample sizes of 25, 50, and 100), but significant for larger samples. The hypothesis H2, therefore, could only be confirmed for larger samples. However, since planning decreases documentation, goal setting and target setting, it can also potentially directly influence water quality service. Hypothesis H3 was confirmed since the impact of control on water quality service was strong and statistically significant. It must be stressed that this relationship was one of the strongest in the model. Similar evidence is also provided in studies by Asingwire (2008) in his study on water pollution. He notes that to operate the pumping station, the community employs a water worker. However, the inadequate public funding in Lwengo, Buwenge and Bugembe hampers the maintenance of the communal water supply facilities. Current budgetary constraints make it impossible to actually invest in the maintenance and development of the drinking water supply system. Because of the lack of maintenance and the poor state of repair, the reliability and safety of the services is becoming an important concern and source of discontent of the local population in the six study towns.

Staffing had a positive and significant impact on water quality service. Therefore, the hypothesis H4 was also confirmed for all samples. Staffing seemed to be specifically important in achieving water quality service and could also have a mediating influence of planning on water quality service.

This is in accordance with previous studies by Kintale (2017) who noted that many towns in Uganda have few water technicians who can help when the water system breaks down. Service interruptions have become the norm rather than the exception. Like in many rural towns, the sanitation and sewerage system in Lwengo and Kayabwe is insufficient. Nearly all buildings in the towns are not connected to a sewerage system. Most of the visited households had no in-house water tap and none of them has a hot water tap. Most building owners have to install privately financed underground water pipes between their own properties and the subsurface pipeline. They usually have a water tap on their properties, whereas the other users have to walk a certain distance to the next public standpipe or other freshwater sources to fetch their water in jerry cans, bottles, etc. The water pressure within the private pipelines is very low, since the water in the pipeline only follows the natural slope gradient. However, it is suggested that in future, the Kayabwe and Lwengo Town council management will ensure they install pipelines to properties. With an increasing number of such privately installed pipelines, the water pressure will subside in the system. In addition, the number of people using water from the public standpipes in the streets will decrease. During the survey, the households were asked about their daily amount of freshwater consumption for cooking, drinking, laundry and sanitation. Most of them (50%) estimated their water consumption between 50 and 100 litres per day.

Figure 3: Analytical framework for best practices to enhance water quality



Source: Adopted based on the Study Findings

Reccomendations

There is need to train of water supply personnels, the training for personnel concerned with water-supplies may be divided into : (a) professional academic training, (b) observation visits, (c) short special courses (usually in-service type), and (d) supervised experience. Professional academic training is almost exclusively for the engineers and may be obtained in several countries.

There is need to ensure installation of hand pumps, and look after their repair and maintenance with the coordination of urban dwellers. There is need to create health awareness about diseases caused by unsafe water by providing safe drinking water, thereby reducing water borne diseases.

If nothing solves the problem, then water should be brought to town councils by water tanker trucks. And finally, the local administration and community should ensure the equitable distribution of water with drinkable quality to all.

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