Journal of Research and Rural Planning
Volume 13, No. 3, Summer 2024, Serial No. 44, Pp. 73-81
eISSN: 2783-2007 **ISSN: 2783-2791**
http://jrrp.um.ac.ir

Original Article

Non-Revenue Water Implications on Organisation Operation Cost and Customer Satisfaction: A Case of Musoma Urban Water Supply and Sanitation Authority (MUWASA)

Cyril Kalembana Komba[*1]

1- Senior Lecturer, Researcher and Consultant, Community Development and Gender, Moshi Co-operative University (MoCU), Tanzania

Abstract

Purpose- This study examined the effects of non-revenue water (NRW) on organisation running costs and customer satisfaction. The intention was to describe the NRW's effects on the MUWASA's performance as a case study. Specifically, it identified factors prompting non-revenue water; described the NRW effects on organisation running costs; and examined the level of customer satisfaction towards service provision.

Design/methodology/approach- A purposive sampling technique was used to pick respondents for the household survey and key informant interview. The study included 100 respondents (70 connected customers and 30 employees of the authority). MUWASA serves 5 zones of the municipality; therefore, the study obtained 70 connected customers from the five zones of the authority. The household survey and the key informant interviews (KII) were the main data collection methods, the survey technique was used to collect data from 100 respondents and seven were involved in key informant interviews. Descriptive and inferential statistics and content analysis were used in data analysis.

Findings- The findings have indicated that NRW affects the water utility revenue collection, and organisation running costs, which jeopardizes customer satisfaction with the organizational service delivery.

Originality/value- Based on the National Water Policy of 2002 which aims at achieving sustainable, effective, and efficient development and management of Water Supply and Sanitation one of its objectives is to create an enabling environment and appropriate incentives for the delivery of reliable, sustainable, and affordable water supply and sanitation services. Therefore, the findings of this study are a catalyst for the improvement of the set policy objectives and enhance interventions where necessary.

Keywords- Non-revenue water, Customer satisfaction, Operation costs, Connected customers, Water service, Water connection.

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How to cite this article:
Komba, C.K. (2024). Non-Revenue water implications on organisation operation cost and customer satisfaction: A case of Musoma Urban Water Supply and Sanitation Authority (MUWASA). Journal of Research & Rural Planning, 13(3), 73-81.
http://dx.doi.org/10.22067/jrrp.v13i3.2408-1107

Date:
Received: 20-08-2024
Revised: 27-10-2024
Accepted: 12-11- 2024
Available Online: 12-12-2024

[*]**. Corresponding Author:**
Kalembana Komba, Cyril, Ph.D.
Address: Department of Community Development and Gender, Moshi Co-operative University (MoCU), Sokoine Road, P.o.Box 474, Moshi, Kilimanjaro-Tanzania.
Tel: +255784462653
Email: cyrilkomba@gmail.com

1.Introduction

Water that is generated (or purchased) but not sold to consumers is referred to as non-revenue water, and it is expressed as a proportion of the total volume of water produced (EWURA, 2021). The feasible level of NRW measures is determined by the water utility company's performance level. A significant reduction in NRW is frequently challenging to achieve when the performance level is very low. For instance, a water supply utility with limited water availability cannot easily prevent underground leaking because there is no water flow in the pipes for an extended period, but they may still prevent visible leaks on the ground (Ndengwa, 2016).

The International Water Association (IWA) indicated that if the water losses in developing countries could have been halved, the saved water would have been enough to so supply around 90 million citizens (AWWA 2004). One of the major issues affecting water companies in developing countries is the substantial variance between the volume of water put into the distribution system and the amount of water billed to consumers (Non-Revenue Water [NRW]).

High NRW in a way infringes the rights of underserved and connected consumers as it limits cost recovery and sustainability leading to an unjustified burden for paying consumers. The global volume of non-revenue water (NRW) or water losses is staggering. It is reported that annually about 16 billion m^3 of water which are delivered to consumers (customers) are however, not invoiced due to theft, poor metering, or corruption (Frauendorfer and Liemberger, 2010).

The challenge of NRW may bring about such problems in providing satisfactory water supply to both rural and urban areas with growing populations, especially in developing countries. According to Martins (2014), the order of magnitude of NRW values that exist in many poorly managed utilities is certainly unacceptable due to the high level of NRW. The high levels of NRW normally jeopardise the levels of efficiency. When treated water is lost; water collection, treatment, and distribution costs are normally increasing, water sales tend to decrease, and substantial capital expenditure programs are often promoted to meet the unplanned ever-increasing demand (Frauendorfer and Liemberger, 2010).

Based on this conceptual gap it is observed that most water utilities are faced with the challenge of water losses in water utility management all over the world and it is even more challenging and serious in developing countries. Despite the efforts done by MUWASA towards the availability of clean and safe water sustainable 24 hours, the Authority is faced with the problem of water losses or non-revenue water. The situation of non-revenue water at MUWASA was 2,885,765 m^3 in 2019/20 which was about 49.7% and 2,520,197m^3(43.1%) in 2020/21 which shows a steady reduction of NRW in the authority but still high above the national benchmark average of 20% NRW. Therefore, this study determines the impacts of non-revenue water on water authority performance, effects on customer satisfaction on received services, and recommends efficient measures for the problem in the study area.

The NRW may tend to jeopardise authorities' performance towards achieving their objectives of meeting the provision of quality water service to its customers. How NRW affects the operation costs of MUWASA and meeting its customers' satisfaction was the central target of this study. This study, therefore, addresses the problem of NRW and its impacts on the water authority operation costs and its effects on customer satisfaction in accessing quality service. Based on the variation nature of the specific objectives of the study it was healthy and necessary for the study to adopt two different theories. These theories include the Expectation Confirmation Theory (ECT) by Oliver (1980) and the Servqual Model by Parasuraman *et al*., (1985).

The Expectation Confirmation Theory (ECT) by Oliver (1980) was used to guide this study. The theory explains a firm's expectations and perceived performance. This theory elaborates four main constructs expectation, performance, disconfirmation, and satisfaction. According to Oliver (1980), expectations-confirmation theory postulates that expectations, coupled with perceived performance, lead to post-purchase satisfaction. This effect is arbitrated through positive or negative disconfirmation between expectations and performance. If a product outperforms expectations (positive disconfirmation) post-purchase satisfaction will result; however, if a product falls short of expectations (negative disconfirmation) the consumer is likely to be dissatisfied (Oliver, 1980; Spreng *et al.* 1996). The four main constructs in the model are expectations, performance, disconfirmation, and satisfaction. A person's level of satisfaction with a water utility will be a function of the person's knowledge about water utility-related issues and how well their water utility performs relative to the expectations that a person has for the utility (American Water Works Association, 2004).

The service quality in the customer satisfaction model (Parasuraman *et al*., 1985 cited by Daniel and Berinyuy, 2010) was also used in this study. The service quality model is a composite of five dimensions (reliability, responsiveness, assurance, empathy, and tangibles to determine service quality). Four of the five dimensions, responsiveness, reliability, assurance, and empathy mainly focus on the human aspects of service delivery, and the fifth one focuses on the tangibles of service (Daniel and Berinyuy, 2010). The SERVIQUAL model deals with expectations and perceptions of individuals

about services offered, in this view the model has been used to measure the quality of services by MUWASA to the expected customers in the study area concerning NRW control of the authority. This model was relevant for the study because it has relieved the knowledge of how the challenge of non-water revenue in the study area may affect customer satisfaction on service delivery specifically on service reliability and responsiveness.

2. Research Methodology

The case study design was applied in this study. This design was selected because it allows quantitative and qualitative approaches (Bryman, 2007). This design enabled the study to obtain detailed information and to undergo an intensive analysis of a single case. The design enabled the study to undertake an intensive examination of MUWASA as a case under investigation.

This study was conducted at Musoma Urban Water Supply and Sanitation Authority (MUWASA). In the quarter of the 2021/2022 financial year MUWASA had a total of 20,949 connected customers. The MUWASA was selected because, in the Water Utilities Performance Review Report for the Financial Year 2020/21, it was reported to be the least performed in overall NRW management (EWURA, 2021).

The unit of analysis for the study was the Authority (MUWASA). The study population was categorised into two water users (customers) and employees of MUWASA from technical, finance, human resource, and commercial departments. The study used simple random and purposive sampling techniques to select the respondents. A simple random sampling technique was applied to customers while convenience sampling was applied to get respondents from the employees from the various sections of the Authority.

The study included 100 respondents (70 connected customers and 30 employees of the authority). MUWASA serves 5 zones of the municipality; therefore, the study obtained 70 connected customers from the five zones of the authority. The 30 (employees) respondents included 20 permanent employees and 10 casual labours (temporary employees). The Authority had 81 permanent employees and about 60 temporary employees (casual labour). There were four departments (Finance, Technical, and Commercial and Human resource and administration departments) of its organisation structure; hence, the study distributed 30 respondents from MUWASA employees for the questionnaire as follows: respondents from, the finance department, commercial department, technical department, and human resource and administration were also included.

The process of data collection among others involved a survey technique that included the connected customers and MUWASA employees. Two sets of questionnaires were presented for the two types of respondents, and they were the main tools for this study. Moreover, the MUWASA employees were also included in this technique. The prepared questionnaires were very useful in this technique in collecting primary data (both qualitative and quantitative). This technique was the best method available for the study as explained by Creswell (2015), that is best for social scientists interested in collecting original data and is an excellent vehicle for measuring the attitudes and orientations of a large population. Five key informants were involved in key informant interviews, these were proposed based on their professions, titles, age and experience or period of use of MUWASA services. The specific information collected included billing problems, revenue loss, NRW control redressing mechanisms and other relevant information to suit the study. The interview checklist was prepared as a guideline (George, 2022; Leavy, 2017). This technique was useful because it enabled the study to collect in-depth data from those obtained using a questionnaire.

The Quantitative and inferential statistics data were analysed using IBM Statistical Package for Social Sciences (SPSS) Statistics, Version 23, and Microsoft Excel 2010 programs. The coded data were transferred into computer code sheets and were then processed to determine descriptive statistics such as frequencies and percentages to analyse the quantitative information. Moreover, descriptive and inferential statistics were the principal components in quantitative data analysis whereas percentages and frequencies were obtained.

Quantitatively, the extent of customer satisfaction with MUWASA water service and dealing with NRW challenges were determined through the gap score and unweighted average serviqual score model. The calculations were performed in five steps: Step 1: Using the tailored serviqual questionnaire the score for each of the 5 expectation statements and each of the 5 perception statements were obtained from each respondent. Step 2: Is the computation of the Gap Score (GS) = Perception (P) – Expectation (E). Step 3: The average GS for each dimension of service quality was obtained through assessment of the gap scores for each statement that constituted the dimension and dividing the sum by the number of statements making up the dimension. Step 4: The calculated average for each of the five dimensions was then summed up, and the result was divided by five (total number of the dimensions) to obtain the average serviqual score, which represents the unweighted measure of service quality for the MUWASA water services in the study area.

Qualitative data analysis was performed to assess the extent to which customers were satisfied with the services they received from MUWASA, five statements of service quality concerning the water service provision as they are affected by the NRW incidences were tested.

The origin of the statements was basically from five dimensions as suggested by Parasuraman *et al*. (1991). To respond to the statements, the respondents had to choose one service quality scale option (1 = not satisfied at all, 2 = satisfied little and 3 = satisfied very much) for each statement to indicate their perceptions and expectations of water service from MUWASA and dealing with NRW occasions. The dissimilarity between perceptions and expectations is called a quality gap. If (Perceptions - Expectations) < 0, the quality is unacceptable; if the answer is 0, the quality is satisfactory; and if the answer > 0, the quality is acceptable (Parasuraman *et al*., 1991). This statistical conclusion by Parasuraman *et al*. (1991) was used to generate an empirical conclusion for this study.

3. Research Findings

3.1 Non-revenue Water Problem

The purpose of the study specifically intended to deal with the problem of NRW and how it affects the operation costs as well as how it jeopardizes customer satisfaction. Hence two specific considerations were involved in this study. However, the study began by analysing the NRW challenges in the organisation operation costs. These findings would have to play a part in the strengthening of the management of NRW among the water utilities. The findings in Table 1 indicate how the respondents considered the various expenses that the authority concurs with because of the NRW prevalence.

Table 1- Non-revenue Water Problem on Organisation Operation Cost

NRW Problems on operation cost	Frequency	Percent (%)
High operating and distribution expenses	27	90.0
Extra energy expenses	28	93.3
Inability to meet proper maintenance program	23	76.7
Insufficient revenue to meet general operation costs	24	80.0
Workers' incentives are delayed to be paid on time	26	86.7
Delay in new water supply infrastructure investments	25	83.3
Repeated repairing of the water infrastructure and networks	22	73.3

It was furthermore, reported that the non-revenue water problem increases operation costs significantly, for a lot of money is spent in purchasing fittings, valves, and pipes for attending leakages and replacement of worn-out pipes and water meters. Besides the money spent on those items, much money is also spent on the provision of incentives to people from local communities who cooperate with the water utility in the reduction of NRW by notifying the water utility about illegal connections. Moreover, it was also ascertained that too much money is also spent on the payment of labourers for the excavation of trenches for the replacement of worn-out pipes through extra duty hours of which the money would have been spent to strengthen the water distribution networks. One of the key informants said that:

"*…… hheee are svvaad probssss , especially on operation costs which are associated with NRW nnuudng.. produooon costs becoming higher sometimes than the revenue that is collected and sometimes water rationing to zones and creating chaos to the community whereas water service is stopped in certain lines for a time while the other is getting wa.....* ".

Similar findings have also been reported that the NRW always and merely puts pressure on the financial management of the operation, making it difficult to provide the services. Efforts must be there to minimise NRW as much as possible, this is because the water produced and distributed with costs should not be wasted (JICA, 2020). Moreover, it was reported that too much time and resources are spent in the processes of repairing the destructed systems rather than investing in new connections.

Plate 1- MUWASA Workers Replacing Burst Water Pipes in a Distribution Line

Another interviewee appealed that:

…….. NRW warrr attttt t opaaaoonaal oosss bccause we are producing more water but selling less. Percentage wise, we are currently selling only 60% of the water that we are monthly producing. If we reduce NRW, there is a possibility of reducing the operational oosss sggnaaaaaa…….”

The study was also informed that the problem of NRW in the study area has many effects on the operation costs. For example, it was described that some other impacts of the non-revenue water incidences on the operation cost include the cost of treating water to an acceptable standard (purchasing of water purifying chemicals), transporting water to the reservoir tanks and customers (power charges as used to operate water pumps) as well as maintenance of the equipment/machinery at the treatment plant. The report in the Manager's NRW Handbook for Africa (2010) nails this by indicating that customer metering is not universally applied, tariff systems and revenue collection policies often do not reflect the true value of water supplied, and this limits the utility cost recovery.

Water that is lost on its way to the customer without generating revenue for the authority has serious financial impacts on the authority. This is because pipe bursts and leakages require expensive repair works which also increases operation and maintenance costs for the authority. It was described that revisiting the MUWASA case around 40% of the produced water, which has gone through costly treatment processes and subsequent transportation to various points, does not generate revenue but leads to a huge operation costs burden. Hence reducing NRW is an important step towards the commercial viability of the Authority whereby the saved money would have been used for expansion and establishment of new water services into other areas hence leading to increased water network connections of the authority.

3.2 Non-Revenue Water Effects on Customer Satisfaction

The study was also interested in measuring if MUWASA customers are satisfied with the services received from the utility. The intention was to assess customers' satisfaction with the quality of the service received from MUWASA given the NRW incidences. The extent of customer satisfaction with the MUWASA water service provision and dealing with NRW challenges was determined by the service quality using the following steps:

Step 1: Using the tailored serviqual questionnaire the score for each of the 5 expectation statements and each of the 5 perception statements were obtained from each respondent. Step 2: Is the computation of the Gap Score = Perception – Expectation. Step 3: The average gap score for each service quality dimension was obtained by assessing the gap scores for each statement that constituted the dimension and dividing the sum by the number of statements making up the dimension. Step 4: The calculated average for each of the five dimensions was summed up, and the result was divided by five (total number of the serviqual dimensions) to obtain the average serviqual score, which represents the unweighted measure of service quality for the MUWASA water services in the study area.

The findings in Table 2 indicate that customers were only satisfied with the service of the water connection (with mean dimension = 0) despite the challenges of NRW incidences in the study area. The authority is in a good position to satisfy its customers in terms of water connection service. The NRW incidences are likely to reduce the speed or influence the capacity of the authority to supply water to new customers as it may make the authority not establish new connections but deal with the problem of leakages. Pipe bursting as well as other NRW incidences hence leading to no new or new connected customers. However, this was not the

case with MUWASA. For the customers they must support that are satisfied with the speed and water connection service from the authority. This is also well supported by Frauendorfer & Liemberger (2010) who ascertained that in Asia the volume of water that is lost has immediate effects on the supply of water for the volume of water is reduced and hence limiting water connection and supply.

Table 2- Calculation of Gap Score and Unweighted Average Servqual Score

Sn.	Service Dimension	Perceptions score (P)	Expectations score (E)	Quality gap (P-E)	Mean for dimension
Dealing with the NRW problem		65	70	-5	-1
Customer care during NRW reporting (Employees respond to customers' complaints reported timely)		60	67	-7	-1.4
Water connection service		70	70	0	0
Water service availability 24hrs/7days		59	65	-6	-1.2
MUWASA response to reported water leakage, pipe break		70	68	2	0.4
Unweighted average Servqual Score					-0.64

Another satisfaction point was on how MUWASA technical staff responds to reported water leakage, pipe break which had a mean dimension of 0.4. While for the other remaining three service dimensions had negative mean dimensions indicating that their service responses were not unacceptable. This is due to the descriptions given by (Parasuraman *et al*., 1991) where it was described that if (Perceptions - Expectations) < 0, the service quality is unacceptable; while if it is 0, the service quality is satisfactory; and if it happens to be > 0, the service quality is acceptable.

In this case therefore no service was at an acceptable point indicating that there are several complaints on the service that is provided by the authority on service provision which need to be redressed seriously by the authority's management without forgetting being in collaboration with other relevant stakeholders like the customers, private sectors like material service providers (contractors) as well as area leaders. Moreover, of the three dimensions with negative scores, there was no service dimension which was the most deficient for their mean dimension scores were closely ranging from -1 to -1.4 (Table 2).

Furthermore, the findings in Table 3 indicate that 75.7% of the customers' respondents were satisfied very much with how the authority deals with their problems, while on the other side on services like; Customer care during NRW reporting (Employees respond to customers' complaints reported timely), Water connection service, Quality of water (MUWASA provide quality water service 24hrs to their customers) and MUWASA response to reported water leakage, pipe break respondents were little satisfied at an average of 45.7%, 81.4%, 60%, and 54.3% respectively. However, the level of not satisfied at all was higher at 32.9% for customer care during NRW reporting while very minimum in the not satisfied at all with 2.9% for the water connection service and the same service minimum of 15.7% at the level of satisfied very much.

These findings implicate that the level of customer satisfaction is at an average level because of the variations of the responses for the reported events and customer challenges on water service delivery as far as NRW prevalence is concerned in the study area. The findings are in line with assumptions of the Expectation Confirmation Theory (ECT) by Oliver (1980). According to Oliver (1980), expectations-confirmation theory posits that expectations, coupled with perceived performance, lead to post-purchase satisfaction. This effect is mediated through positive or negative disconfirmation between expectations and performance.

Table 3- MUWASA Customer Satisfaction Status on Service Delivery (n=70)

Type of Service Dimension	Levels of Satisfaction					
	Satisfied very much		Satisfied a little		Not Satisfied at all	
	Freq.	%	Freq.	%	Freq	%
Dealing with the NRW problem	53	75.7	12	17.1	5	7.1
Customer care during NRW reporting (Employees respond to customers' complaints reported timely)	15	21.4	32	45.7	23	32.9
Water connection service	11	15.7	57	81.4	2	2.9

Type of Service Dimension	Levels of Satisfaction					
	Satisfied very much		Satisfied a little		Not Satisfied at all	
	Freq.	%	Freq.	%	Freq	%
Quality of water (MUWASA provides quality water service 24hrs to their customers)	15	21.4	42	60.0	6	8.6
MUWASA response to reported water leakage, pipe break	23	32.9	38	54.3	9	12.9

The discussion with one of the ward executive officers (WEOs) in the study area on MUWASA services and responses on breakdowns of its service lines, it was indicated that there variations in the opinions of the levels of satisfaction because the responding rate and level among MUWASA staff have also variations because at a time they receive complaints on a certain issue they might have been into another duty this may lead either a delay or fastening of the response to a reported challenge. But this can also be considered on the characteristics homogeneity and heterogeneity of the customer respondents described earlier that this can be one of the factors of the variations of the responses from MUWASA service and NRW response rate satisfaction among customers.

"*……hhe eeeess oa aaisaaooon on SSSSS S seeeeeeend response to NRW incidences will not and will never be equally among the respondents due to various reasons including technical, human and financial on.... basnng on hhe aapayyyy ynd posoooo of hhe authority at that particular time the incidence is being rpporddd……*".

Studies emphasise that to improve the efficiency and quality of water services and develop customer loyalty and improved satisfaction, service providers (water utilities), regulators, and decision-makers must introduce appropriate management tools for measuring and monitoring their performance. The managers of water utilities need to understand the importance of data collection, verification, storage, and processing to the utilities' success. This is supported by the author who pointed out that the operator (water utility) should be convinced that the task goes far beyond fulfilling the requirement of a financial statement where numbers are placed in columns, but also about how the data is useful for water service management among the utilities (Shushu et al., 2021).

3.3. Contributions and Practical Implications

Water resources and water service distribution have much potential for domestic and industrial use. Non-revenue water (NRW) is the water that is generated (or purchased) but not sold to consumers. The NRW evaluation is based on water loss as a percentage of production, the volume of water loss per kilometer of pipe network per day, and the volume of water loss per water connected per day. The studies recognize the importance of improving the amount and volume of NRW for the performance of water utilities. This study was conducted at MUWASA to contribute knowledge and enlighten the communities and water utilities stakeholders on the effects of NRW prevalence and its importance to effective control. The findings of this study have also provided new insights into the body of literature concerning customer satisfaction with water service delivery as far as NRW is concerned and effective measures to be undertaken in case of such incidences.

In terms of methodological approach, the study provided an alternative way of determining the levels and causes of community (water utility customers) satisfaction and the outcomes of their dissatisfaction with the services provided by the water utility. The study constructed five tailored statements based on the services by the water utility (MUWASA) and connected with the statements originating from the serviqual model's five dimensions (reliability, responsiveness, tangibles, assurance, and empathy) as suggested by Parasuraman *et al*. (1991).

The theoretical contribution of the findings of the study has proved that the Serviqual model and the Expectation Confirmation Theory (ECT) are relevant approaches to enlighten and examine the organization's performance with the services provided and the expectations and satisfaction of those who receive the services (customers). Therefore, the findings from this study have increased awareness and provided new knowledge about the adverse effects of NRW and how properly they can be handled. The findings have a specific critical influence on MUWASA as a case under investigation and other organizations with similar characteristics as water utilities.

4. Discussion and Conclusion

The study utilised a total of 100 respondents (70 MUWASA connected customers and 30 MUWASA employed staff) for the survey techniques. In a survey 55.7% of customer respondents were males and 44.3% were females while 80% of MUWASA employed staff were male and the remaining 20% were females, this also indicates that 63% of all respondents were males and 37% were females.

Moreover, a total of seven other MUWASA employed staff were used in this study as key informants in key

informant interviews. Furthermore, 21.4% of the connected customer respondents have a bachelor's degree education while 40% of the MUWASA employees had the same level of education. These variations justify the idea that the study had captured a range and diversity of information from the heterogeneous composition of respondents. This enriched the study with abundant of information as required for analysis and generalisation.

The findings of the study indicate that there are various effects of the NRW incidences that affect the organisation's performance in terms of revenue collection, organisation running costs, and improved water service provision to its customers hence delaying meeting the customers' expectations.

The study has found that the performance of the organisation has been jeopardized in relation to the prevalence of NRW hence leading to the problem of limited customer satisfaction based on the services that are expected to be received from the authority. This is because, from the study findings, it was argued that the level of customer satisfaction was very limited as expected.

The study calls upon the responsible authorities (MUWASA) to take proper measures to make sure that all the incidences of NRW are reduced and their related or associated effects are well addressed through various techniques. This will enable the authority to retain its standards as per organisation vision and mission and hence reduce customer complaints.

The authority should make sure that there is a proper maintenance programme of water distribution systems to the entire existing network including all customer service lines. Deprived maintenance has the problem of encouraging pipe leakages and bursts as well as shortening of pipes' life span. This study hence calls for the scheduled water system maintenance programme in place to manage this problem of NRW in the study area. Moreover, the study recommends that the Authority make sure that the existing relationship with the community members especially in the areas of water network security is well maintained and strengthened.

The study recommends to the authority (MUWASA) that during customer awareness programs and campaigns all customers should be emphasised and encouraged to report all observed and found illegal connections but there would be reporters of such incidences should be duly provided with monetary awards by the authority to motivate more people to come out and give information on illegal connections and deliberate vandalism of water infrastructures. Finally, the study recommends that the Authority make sure that all the water service provision related grievances are well redressed, and the solutions are in place on time, and they are effective.

Acknowledgments

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

The authors equally contributed to the preparation of this article.

Conflict of interest

The authors declare no conflict of interest.

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