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Assessing Water Supply in Urban Zambia: Case study of areas formerly serviced by Local Authority in Chingola

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ABSTRACT

The importance of water supply was recognized centuries ago by several ancient civilizations. Archeological excavations in Asia and the Middle East have revealed highly developed communities with piped water supplies (T.H.Y TEBUTT, 1971).

It is amazing to think that the Romans had piped water and system of drainage as long ago as the fourth century and that after their departure, these amenities ceased to exist until the middle of nineteenth century. Water was drawn from wells or fountains and had to be carried to the house, as it still is in many parts of the world today, while drinking water was brought round and sold by water carriers. Drinking and cooking had to be provided for, but washing and bathing would be far too difficult (Edward Gibbon 1776).

Management of potable water and of services drawing upon water for functions central to human life, is of critical importance to health, social, economic, and political well-being. Changing consumption patterns, lack of environmental controls have pushed water concerns high on the international agenda.

During the conference, 1992 United Nations held on Environmental and Development (UNCED) Earth summit in Rio, Agenda 21 stated that "By the year 2000 all states should have national action programmes for water management based on catchment basins or sub basins, and efficient water use programme".

According to NWASCO report (2012) in 2011 the Republic of Zambia enacted the Water Resource Management Act No. 21 of 2011 where the Department of Water Affairs delegated its water resources Management functions to the Water Resources Management Authority (WARMA), it became necessary to restructure the water functions in the ministry. The water development function includes among others undertaking surveys, actual construction, maintenance and data management as well as research in the development of water resources. In addition, it involves providing support in technical planning, budgeting and mobilization of resources.

Chingola Town is located on the copper belt Province of Zambia. The development of the town is highly pivoted by mining activities. Copper is the most common mineral that is mined in the area and produces 60% of Zambia's Copper mines.

Chingola Town is located on the Copperbelt Province of Zambia. It has an elevation of 1300m above mean sea level. It lies on latitude of 12 degrees 50 minutes east. It is bordered to the South by Kalulushi District, Mufulira District to the East, Solwezi District to the West and Chililabombwe District to the North. It has a population of 217, 589 people at 3.1% growth rate and is expanding at a high rate due to the mining activities in the area. Copper is the most common mineral that is mined in the area and produces 60% of Zambia's Copper mines. It has an area of 167 square kilometres and is the home of Konkola Copper Mines plc. Potable water supply and sanitation services in Chingola town are provided by Mulonga Water and Sewerage Company (MWSC) Limited.

INTRODUCTION

Mulonga Water and Sewerage Company (MWSC) Limited was incorporated in September 1998, following the Water Sector Reforms in Zambia which were implemented with the aim of improving water and sanitation service delivery on a commercial basis. The National Water Supply and Sanitation Council (NWASCO) was established in 1997.

MWSC was one of the three commercial water utilities on the Copperbelt formed in the year 2000 under the Water Supply and Sanitation Act No. 28 of 1997. The other commercial utilities formed on the Copperbelt under this act were Nkana and Kafubu. This Act gives mandate to Local Authorities to manage water and sewerage services through these utilities.

Prior to October 2007 MWSC covered areas formerly serviced by Municipal Councils of Chililabombwe, Chililabombwe, and Chi. On 28th August 2007, Mulonga Water and Sewerage Company (MWSC) was mandated to provide water and sanitation services to Chingola, Chililabombwe and Mufulira in entirety effective 1st October 2007.

A. Problem Statement

Most townships in areas formerly serviced by Chingola Municipal Council receive quantities of water below the recommended service level guaranteed by the regulator (NWASCO). In some places, water is supplied at low pressure and for short times in some cases less than three (3) hours, some sections do not even receive water.

B. Main Objective

The main objective of this study was to investigate the constraints that have led to areas formerly serviced by Chingola Municipal council not to have adequate potable water.

C. Specific Study Objectives

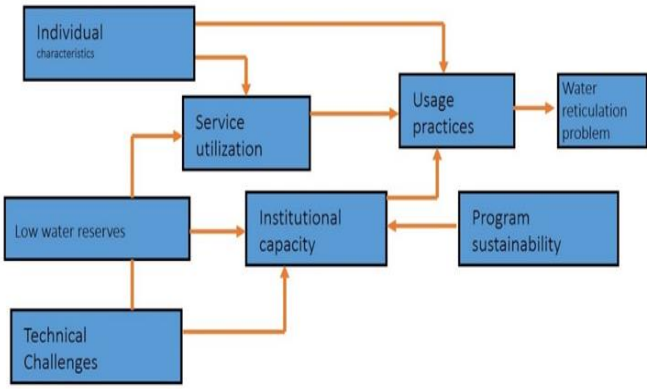
- To assess the water supply and demand in Chingola.
- To evaluate the unaccounted-for water in the system through metering ratio
- To establish home water usage
- To identify technical constraints

D. Research Questions

- What are the levels of water supply and demand in Chingola?
- What is the level of unaccounted for water in the system through metering ratio?
- What is the degree of home water usage?
- What are technical constraints faced by Mulonga water?

1.7 Conceptual Framework

The conceptual framework adopted for this study is one that looks at the various factors that affect the problem being in this paper. The conceptual framework connects all the factors that might relate the problem of water reticulation. It further shows the casual pathways linking to water reticulation.



From the above framework, it is evident that there are a variety of factors perpetuating constraints to adequate supply of potable water. Constraints to adequate supply of potable water are manifested in water shortages (having running water only for a few hours in a day and/or no water at all) and low pressure. As argued by Chambers (2001), causes of such constraints are found with both the service provider and the service user. Service providers have technical challenges which undermine the capacity to supply water efficiently and effectively. On the part of the service users, individual user characteristics and attitudes such as bad usage practices affect water supply and undermine the overall process thereby making things unsustainable. Bad usage practices such as using wrong sizes of water taps and pipes at a household level affect

pressure and leads to water reticulation problems in neighborhoods.

The interaction between factors such as water supply institutional capacity, technical challenges, individual user usage practices all affect water supply. Meanwhile, these factors are proliferated by other factors such as funding systems to the water suppliers as well as financial status of water users as it determines quick payment of water user fees. All these factors influence the efficiency and effectiveness to which water is supplied sustainably (Nkhuwa, 2002).

1.8 Definition of Variables

In this study the following variables are used and defined;

Water Reticulation: This is the network of pipes for irrigation and water supply. In this study water reticulation will be used to measure the amount of water that is unaccounted for in the water system.

Water Supply: This is the provision of water by public utilities commercial organizations, community endeavors or by individuals, usually via a system of pumps and pipes. In this study the variable of water supply will simply be the volumes of water that utility providers are able to provide.

Unaccounted-for Water (UfW): represents the difference between the volume of water delivered into a network and the volume of water that can be accounted for by legitimate consumption, whether metered or not (Sharma, 2008). In this study the UFW will consider metered water only.

Water demand: the volume of water needed to be consumed by commercial organisations, community endeavors and individuals via a system of pumps and pipes.

Potable water: this is pumped water which is delivered to consumers through pipes.

Technical constraints: institutional challenges faced by water service providers.

1.9 Rationale of the Study

This research is significant because the benefits of identifying technical constraints faced by Mulonga water can start a chain of reaction of positive effects that can be passed on to other companies involved in water supply services in the country, local government, non-governmental organizations, public institutions, the Community of Chingola and the nation at large. This study will reveal areas of weakness, incompetency of water suppliers and attitudes of water consumers.

1.10 Organization of the Study

This research will have six chapters. Chapter One contains the background to the study, statement of the problem, objectives of the study, research questions, conceptual framework, significance of the study and structure of the dissertation. Chapter Two reviews the relevant literature on the possible constraints that have led to areas formerly serviced by Chingola Municipal council not to have adequate potable water.

Chapter Three focuses on the methodology of the study. It describes the study design, the target population, the sampling procedure, sample size, the research instruments used, data and sources, data processing and analysis, the ethical issues considerations and the challenges from the fieldwork. Chapter four will contains the presentation of findings. Chapter five will discuss the findings while chapter six will give conclusions and recommendations.

Chapter Two

Literature Review

E. Introduction

This chapter reviews on inadequate water supply problems experienced by other societies, urban, peri-urban and rural. Furthermore, it gives information on National Water policy for the Government of Republic of Zambia regarding service level guarantee and indeed adequate water supply to different communities.

According to Water Aid International (2008) services standards in water delivery worldwide are measured by the following “water use and satisfaction of level of services” criteria:

Accessibility and Reliability which are measured in terms of amount water available to a person at any time called the specific or per capita consumption, no. of persons per direct connection, no. of hours in day or no. of days in the week of uninterrupted flow.

Technical Performance of Piped System measured in terms of water quality, adequacy of flow velocities and pressures, availability of firefighting requirements, level of physical losses, frequency of pipe bursts.

Affordability has to do with water tariff levels and assessment of affordability by willingness and ability to pay, willingness and ability to pay by income levels and frequency of payments/default in payment and promptness of payments, if you like number of times a particular house/household has been disconnected for nonpayment.

Level of community involvement this is crucial for project sustainability and **Duty of Care** by Institutions in respect of consumers as individuals and as members of their local communities.

F. Zambia

UN-Water (2012) explained that although Zambia may have sufficient water during the rainy season, the high meteorological variability coupled with inadequate infrastructure storage, delivery and management, are resulting in water scarcity in certain instances. The main water issues affecting the country are, among others: i) lack of decentralized and sustainable structures that are accessible and consider the participation of stakeholders/communities; ii) poor resource management, regulation and enforcement of legislation mechanisms; iii) lack of an integrated approach to water resource management; iv) inadequate investment in water infrastructure and v) recurring droughts and floods.

According to Urban and peri- urban water supply and sanitation sector report (2003) service provision by local authorities to service areas continue to deteriorate in the Eastern, Luapula and Lusaka provinces towns. In Eastern Province at that time, Nyimba had no supply and Katete reported very poor service with two (2) hours supply per day

G. National Water Policy

National Water Policy expresses the following on vision and strategies for water supply and sanitation in urban and peri-urban areas:

- Provision of adequate, safe and cost-effective water supply and sanitation services with due regard to environmental protection.
- Commercialization private sector participation and independent regulation.
- Support to the National UWSS development that focuses on enhancing institutional capacities, policy, legal frame works, information Management for planning and development at national and provincial, and district levels.
- Support to investment programmes that aim at increasing access to safe, adequate water supply to 80 percent of the population by 2010.
- Involvement of service providers in the achievement of investment programme.
- To recognize water as an economic good to ensure that a reasonable tariff is paid by all users.
- Promote the generation of revenue by realistic pricing on the concept of cost recovery for the effective management, development and use of the water resources.
- Control the demand for water through realistic pricing.
- Promote the concept of polluter pays principle in water pricing strategies.
- Introduce penalties that will encourage the timely payment of the tariffs.
- Prevent and control pollution of the water resources.

The Water Supply and Sanitation Act No. 28 of 1997 requires providers to ensure efficient, affordable and sustainable water supply and sanitation services within the service areas. This implies that the provider must guarantee a certain and defined level of service to the customer for a specified price ensuring therefore “value for money”.

It is in the very interest of the provider to offer adequate services to the consumers because it increases the willingness of consumers to pay for the services (The Water and Sanitation Act, 1997).

H. Personal Critique and Established Gap

The literature presented clearly indicates the need for water in society and the role of water providers at creating a sustainable water service system.

However, a gap exists in the information about the water reticulation problem from the consumers' perspective it is not clear as to whether bad consumer practices are the causes of the research problem at hand. On the other hand, it could be a matter of inadequate optimal performance among the service providers. In other ways are the water utility companies operating at full capacity? Based on these set of questions the study takes first step of identifying the causes of inadequacy in the provision water.

CHAPTER THREE

Research Methodology

- **Overview**

This chapter covers the research design broken down into the time horizon, sources of data and population of the study. Further, looks at the sampling techniques, sample size and data collection tools. The research mainly used secondary data. Primary sources included administered questionnaires.

- **Study Area**

This research was done in the town of Chingola of the Copperbelt Province in Zambia.

- **Location**

The areas formerly serviced by Chingola Municipal Council, many of these townships are located on the eastern part of Chingola. This area lies on latitude of 12º 50" East. It is bordered to the south by south township which was former serviced by Zambia Consolidated Copper Mines (ZCCM), *Kabundi* townships to the East, industrial area to the west and Nchanga north to the North respectively. It has an area of 839 square kilometers.

- **RESEARCH DESIGN**

This research adopted a case study as a research design. Case studies are in-depth investigations of a single person, group, event or community. Typically, data is gathered from a variety of sources and by using several different methods (e.g. observations and interviews). The case study method often involves simply observing what happens to, or reconstructing 'the case history' of a single participant or group of individuals (such as a school class or a specific social group), i.e. the idiographic approach. Case studies allow a researcher to investigate a topic in far more detail than might be possible if they were trying to deal with a large number of research participants (nomothetic approach) with the aim of 'averaging' (Stake, 1995).

The case study is not itself a research method, but researchers select methods of data collection and analysis that will generate material suitable for case studies such as qualitative techniques (semi-structured interviews, participant observation, diaries), personal notes (e.g. letters, photographs, notes) or official document (e.g. case notes, appraisal reports) (Yin, 2003).

The data collected was analyzed using different theories (e.g. grounded theory, interpretative phenomenological analysis, text interpretation (e.g. thematic coding) etc. All the approaches mentioned here use preconceived categories in the analysis and they are ideographic in their approach, i.e. they focus on the individual case without reference to a comparison group. Case studies are often conducted on roads and involve collecting and reporting descriptive information about a particular person or specific environment, such as a school.

I. Data Collection Tools

The data from the field was collected using a questionnaire which covered all of the areas of interest. Further the researcher would give the questionnaires to the respondents who filled the questionnaire. In most instances, the researcher had to administer the questions to the respondents. The attached Appendix is a sample of the questionnaire used for collection of data from the selected respondents. The method of data collection that was adopted in this research is one that ensures accuracy in order to capture quality evidence that then translates to rich data analysis and allows the building of convincing and credible answers to questions (Johnson and Turner, 2003). The research used both primary and secondary data.

J. Data Analysis and Processing

The data collected using the structured questionnaire were checked for uniformity, consistency and accuracy. Thereafter, the raw data collected from the field was then subjected to a coding process and then it was entered into a computer program. For quantitative data, SPSS (v20.0) and Excel spread sheets were used to

generate charts and graphs while qualitative data was analysed manually using themes to give proper interpretation and meaning. SPSS (v20.0) and Excel spread usage made the entire process of analysis relatively easier and faster.

Analytical framework is the collection and organization of analysis patterns, tools, skills, organization techniques, examples and expertise of analytical methods. In qualitative analysis, a narrative analysis approach has been used. In-depth interviews were re-read to get a deeper insight and subcategories have been formed with the aim of obtaining the final themes (Tashakkori, and Teddlie, 1998).

The nature of this research being qualitative prompts us to employ a thematic analytical framework analysis. 'Themes' refers to topics that come up in discussions and this form of analysis groups' related topics. In using this form of analysis, themes are identified. We are using this analysis for the reasons being that it is flexible. The thematic analysis has been used as a way of getting close to our data and develop deeper appreciation of the context. Additionally, the use of thematic analysis is as a result of it not being tied to any particular epistemology or discipline.

The research has identified information that is relevant to the research questions and objectives. The research also developed a coding system based on samples of collected data. The research developed a summary report identifying major themes and the association between them, use graphics and direct quotations to present the findings. The frequency with which an idea or word or description appears is used to interpret the importance, attention or emphasis (Patton; 2002).

Chapter five

Discussion of findings

The discussion of findings is presented in this chapter coupled with the objective analysis

Objective one

The first objective of this study was to assess the water demand and supply in Chingola. To tackle this objective, the researcher interviewed some personnel from the institution of Mulonga Water. The following responses where obtained;

```
. summarize supply
```

Variable	Obs	Mean	Std. Dev.	Min	Max
supply	5	60111.8	15351.26	46543	83000

```
. summarize volumessold
```

Variable	Obs	Mean	Std. Dev.	Min	Max
volumessold	4	39481.5	13325.49	27926	52000

```
. summarize waterloss
```

Variable	Obs	Mean	Std. Dev.	Min	Max
waterloss	4	15904.25	3733.275	11000	19000

Table** Error! No text of specified style in document.**-1 Water Supply, Volume sold, Water Loss (m^3)

The ***Table** Error! No text of specified style in document.**-1 Water Supply, Volume sold, Water Loss***; shows the various the data that was obtained from the Water supply institution.

Water Supply.

The findings about water supply show the mean daily water supply in Mulonga is 60,111.8 cubic meters. The minimum water supplied in a day was 46,543 cubic meters. The maximum amount of the water supplied was 83,000 cubic meters.

Water Volumes.

The findings show that mean daily water volumes effectively sold is 39,481.5 cubic meters. the minimum water volume sold was 27,926 cubic meters while the maximum volumes water sold was 52,000 cubic meters.

Water Loss

The water lost through reticulation was calculated at an average of 15,904 cubic meters.

Daily Output and Water Demand

```
. summarize dailyoutput
```

Variable	Obs	Mean	Std. Dev.	Min	Max
dailyoutput	4	46250	8301.606	35000	55000

```
.
```

Table** Error! No text of specified style in document.**-2 Daily Output

```
. summarize demand

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
      demand |          3    70328.33    12706.05       62971      85000

.
```

Table** Error! No text of specified style in document.**-3 Water Demand

Table** Error! No text of specified style in document.**-2, and ***Table** Error! No text of specified style in document.**-3***, show the daily output by Mulonga Water in Chingola and the estimated demand. The findings show that the expected demand is about 70,328 cubic meters while the mean daily output is 46,250 cubic meters. this shows that there is a huge deficit of about 24,078 cubic meters of water.

Objective two

Evaluating the Unaccounted-for Water (UFW) in the system

The second objective is then tackled by calculating the water loss through reticulation. The findings as shown in ***Table** Error! No text of specified style in document.**-1*** indicate the water that is lost through the metering is about, on average, 15,904 cubic meters, the total water supplied is 46,543 cubic meters. To calculate the loss of water, the following formula is used;

UFW = net production – legitimate consumption

The Net production in our case is amount of water supplied. While the legitimate consumption is the amount of water that is effectively sold.

$$UFW = 60{,}111m^3/day - 39{,}841m^3/day$$

$$UFW = 20{,}630m^3/day$$

The percentage loss is then calculated as fraction of net production,

$$\%loss = \frac{UFW}{Water\ Supplied} x\ 100\%$$

$$\%loss = \frac{20{,}630m^3}{60{,}111m^3} x100\%$$

$$\%loss = 34.17\%$$

The estimated daily loss of water is at 34.17% of the output.

Objective three

The fourth objective was to establish home water usage. Home water usage is important as it affects effectiveness to which water is supplied. Household water usage is key factor in this study and the following table given an overall summary of how the water supplied is used in households.

Water Usage

Statement	Definitely Agree	Mostly Agree	Neither Agree or disagree	Mostly disagree	Definitely disagree	No Response
1. The water is always available for use	11%	13%	2%	23%	41%	11%
1. 2. Water is used for households needs (cooking, washing, cleaning, gardening)	62%	20%	1%	4%	3%	11%
3. Water is used for business purposes	5%	1%	6%	9%	31%	50%
4. Broken pipes are easily attended to	11%	2%	5%	17%	49%	16%
5. Water is used for gardening	28%	31%	3%	6%	18%	14%
6. Taps are usually closed	60%	21%	3%	0%	7%	10%
7. I think about the amount of water I use daily	40%	22%	5%	7%	12%	15%
8. Water is always sufficient for all the household needs	24%	11%	7%	21%	27%	11%
9. Water is usually insufficient for all the household needs	21%	27%	10%	8%	22%	13%
10. Water cuts unexpected	60%	16%	2%	3%	10%	10%
11. There's a schedule for water cuts	13%	0%	3%	3%	55%	26%

From the table above, it is clear that 64% of respondents said that water is not always readily available for use in households. This was evident as officials at Mulonga waters and Sewerage Company mentioned low supply of water, inconsistency in water supply, and sometimes the supply of poor quality as the end user consequences of the institutional technical challenges faced by Mulonga. This means that Mulonga water and Sewerage Company does not meet the demand in terms of supplying water for household usage.

Furthermore, it can be said that households try to be cautious in their usage of water. As seen in the table above, more than 80% of respondents agreed that they usually keep their taps closed and think about the amount of water they use daily. Despite being economical in water usage at households, the water supplied is usually insufficient for household usage. Households experience unexpected water cuts as there is no schedule for water cuts. This causes a lot of unnecessary and unplanned costs as well as panic as people try to access water.

Objective four

1) **Technical Challenges Faced by Water Suppliers**

1. Dilapidated Water Infrastructure

In identifying the technical challenges faced by institutions of water supply in their operations in Chingola, officials at Mulonga water and sewerage company and other people from institutions such as schools, banks, hospitals and hotels where interviewed. Their opinions provided rich data on the technical challenges involved in water supply in Chingola. Dilapidated water infrastructure is one big technical challenge being faced by water supplying institutions. Officials at Mulonga water and sewerage company explained that water pipes from Kafue river to the reservoirs and within the communities are worn out and develop a lot of leakages.

Figure** Error! No text of specified style in document.**-1 Source: Field work pictures

Also, it was reviewed that the institution does not have enough water pumping machines. It was found out that Mulonga water and sewerage company supplies an estimate of more than 17, 525, 900m^3 in a year, and out of this amount, about 19 000m^3 of water is lost through water reticulation system every day. This means that Mulonga water and sewerage company loses almost 40% of water in the supply network.

Apart from having worn out pipes, it was found out that Mulonga water and sewerage company does not have enough water reservoirs and treatment plants to adequately supply to the ever-expanding demand. This is a big technical challenge that results in supplying water for only a few hours in the day in most of the communities studied because the capacity of the present reservoirs is inadequate compare to the demand.

2. Lack of Financial Resources

It was also found out that lack of financial resources is another big technical challenge faced by the water supplying institution. This problem of having limited resources acts as a barrier to carrying out higher frequencies of inspections and repair of water facilities such as changing old water pipes replacing them with new ones and employing enough workers to carry out routine checks efficiently.

3. Illegal Connections

Figure** Error! No text of specified style in document.**-2 Source: Field Survey

Official at Mulonga water and sewerage company further reviewed that they face challenges as some households in communities make illegal water connections. That results losing water intended for the clients willing to pay for it. As illustrated in the picture in ***Figure** Error! No text of specified style in document.**-2 Source: Field Survey***. This problem is massive in that it results into weakening the pipelines thereby causing leakages and unnecessary panic on the part of water suppliers.

4. Non-Payment of Water Bills by Households

Another technical challenge water supplying institutions face in supplying water is non-payment of water bills by households in the community. It was found out that a significant amount of water is supplied to households that in turn do not pay on time. This leads to those household accumulating debts which is usually not cleared until the water supplier disconnects them from supply.

5. Uncoordinated Issuance of Plots Between Local Authorities and Water Suppliers

Another big challenge being face in water supply is as a result of lack of coordination between local authorities who issue and allocated plots to the

general public and the water suppliers who are supposed to provide water to those new locations. This problem is further exacerbated by the increase in population which is leading to expansion of communities thereby expanding the area to be supplied with water. It was found out that the massive population and community expansions taking place are the result of low water pressure in households.

Figure** Error! No text of specified style in document.**-3 source: field work pictures

6. Poor Work Culture by Employees

Furthermore, it was found out from interviews that employs at Mulonga water and sewerage company do not have a good work attitude. They lack dedication and do not respond and attend to water problems faced by clients on time. They do not carry out frequent inspections of their water supply network to see and mend or replace leaking pipes to reduce loss of significant amounts of water.

5.19.2 Consequences on End Users of Water

As a result of the above discussed technical challenges faced by Mulonga water and sewerage company, consequences on the end user of water include;

- Inconsistent in water supply (less hours of water supply)
- Low water pressure in areas of low levels in reservoirs
- Supply of poor quality water (dirty water)
- No water supply in some areas because of no water in the reservoirs

Chapter Six

Conclusion and Recommendations

The main objective of this study was to investigate the nature and extent of the inadequacy of water delivery and access in the high-density areas of Chingola. Management of potable water and of services drawing upon water for functions central to human life, is of critical importance to health, social, economic, and political well-being. Changing consumption patterns, lack of environmental controls have pushed water concerns high on the international agenda.

The study's objectives were to assess the water supply and demand in Chingola, evaluate the unaccounted-for water in the system through metering ratio, establish home water usage, and to identify technical constraints. The findings show that there is huge deficit in the supply of water, the demand is not yet met with supply of water. Statistics from Mulonga showed that about 40% of the water supplied is lost through reticulation. Furthermore, the findings review that water is used for home purposes mostly. However, many challenges include dilapidated infrastructure, low water reserves, and general maintenance.

Given the findings the following recommendations are outlined:

1 **MONITORING OF CONTINOUS NIGHT FLOWS**

The utility should put in place a system of continuous night flow monitoring two levels for reporting purposes, operational monitoring that is used for leakage management on a day to day basis. High level monitoring should be derived from reservoir outlet, supply zone and /or bulk meters. The size of these areas tends to be large but district water meters require to be installed to calculate the area minimum night flow to determine leakage rates. These meters are supposed to be installed at the entry points of the system where it is viable to take flow measurement. High flow should be set to alert staff when flows into an area increases above a preset level. Leak location staff can be rapidly deployed.

2 LEAKAGE LOCATION

There is need for the service provider to consider installing district water meters (DMA) as they provide the following information: -

- Night flows data from DMA's provides information on which areas to direct the leak location effort. This effort is divided into two separate activities, leak localizing and leak pin pointing. Leak localizing is an activity that priorities pin pointing of leaks and can be undertaken in two ways:
- Step testing: This is an activity whereby a DMA is subdivided by the systematic closing of valves during the minimum night flows. The flow data is then analyzed to determine the area of suspected leakage.
- Acoustic Logging: These devices measure changes in volume of sound being emitted from pipe fittings installed at distances of several hundreds of meters apart. They are programmed to log for period of one hour during the night.
- The loggers will be moved to different locations in a DMA over the course of several nights, data is then analyzed to determine the location of potential leaks.

There is need to raise metering ratio from the current percentage to 100% in high cost and Medium cost. This will drastically reduce the wastage of water and increase responsiveness to leaking fittings. To achieve this, the service provider requires to adopt meter installation philosophy and meter installation practicalities as listed hereunder: -

1. METER INSTALLATION PHILOSOPHY

-Installation arrangement that minimize vandalism and tempering of the meters

- Strategy to bring about immediate high positive impact on cost reduction
- Reduction of Unaccounted for Water
- Reduction of Wastage
- Water Demand Management initiatives by reducing consumption
- Continued functioning and use of meters by putting in place an effective meter management system.
- Consumer sensitization plan
- Coding system which immediately indicates location of installed meter

2. METER INSTALLATION

The programme of meter installation is recommended to start with major consumers i.e. Non-Domestic Customers; high cost Customers and then medium cost customers. Low cost customers can only be metered after all the properties in commercial, high cost and Medium cost are metered. Below are the recommended installation details: -

- All meters require to be installed inside customers' property
- All meters require to be installed above ground within a lockable meter box.
- Provision for disconnection shall be inside the lockable meter box.
- Once meter is installed, customer shall be responsible for looking after the meter in their property.
- Once the water meter installed in customers' property is damaged the customer will be responsible for the damage.
- Everyone that uses piped water provided by the Water Utility should be well informed that all repairs after the water meter are purely a responsibility of the customer whilst before the water meter; it is the responsibility of the water utility.
- Customers will be required to pay a fee whenever they require their meters to be tested.
- All defective meters shall be worked on by the company.
- Metering cannot stand out as the optimal measure on its own, therefore, it should be practically supported by commercial department by making sure that the metered properties are encoded immediately and billing commences basing on meter readings.

- Meters installed should also be regularly checked and ensures that they are not being tempered with, by traitorous clients.
- Skilled labor should be embraced and highly promoted to avoid unnecessary leakages. It should be noted that casual laborers and temporal workers should not be used on the day to day duties except in excavations.
- Whilst we acknowledge all the information on water conservation, there is need for extra effort by the service provider to put up campaign programmes which must be conducted to raise awareness through T.V programmes, posters, and booklets.

Conclusively, the utility should adopt a policy for the speed of leak repairs as follows: -

- 90% of reported leaks are repaired within 4 working days.
- 100% repaired within 5 working days.

In addition to the leakages reported by customers via the customer services should be repaired by the end of every shift.

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