

# Assessing Urban Water Security in the City of Lubumbashi, Democratic Republic of Congo: a Quantitative Analysis

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## 1 ABSTRACT

Access to urban clean and potable water has been one of the major priorities, as cities pursue and seek to achieve sustainable development goals worldwide. Globally, urban water insecurity is a threat faced by the majority, however, residents of cities in the developing world; particularly low income households are the most affected and are in severe despair. Notwithstanding the abundance of surface and underground fresh water and also efforts by local governments to improve urban water provision, urban clean water accessibility remains a pipe dream for the majority of urban dwellers in the Democratic Republic of Congo (DRC). Currently, very little is documented and known about the levels of water service delivery and coverage in DRC cities. Consequently, this paper assesses water security, specifically focusing on the state of water supply and water management. A case study research design was adopted to investigate the level of water supply in Lubumbashi the second largest city in the DRC. The work also applied a quantitative research approach and questionnaires were administered to gather data on water availability, water accessibility and other variables. A Survey Monkey was applied to gather data from four hundred and eleven participants and the data was analysed using categorical aggregation and content analysis. Findings reveal that inadequate access to clean and potable water is mainly caused by shortages of the hydraulic networks within the population of the city and the inefficient water distribution by the local government. From the study it is also evident that low income households face severe water stress since they totally rely on the municipality water provision and cannot afford to have boreholes. Furthermore, it is clear that households with no pipes in their yards have to walk to their neighbouring houses to have access to clean water. The study also highlights that the city of Lubumbashi is under severe urban water distress and is far from achieving sustainable development goals related to access to clean water for all. In conclusion, it is recommended that an adequate inclusive planning and a methodological approach at the municipality level must be adopted and implemented as a matter of urgency in order to achieve efficient and adequate water provisions to its residents. There is also need to promote awareness in order to improve water security as efforts are made to provide viable suggestions which in turn improve water provision in the city and promote and achieve sustainable urban development in the DRC in the city of Lubumbashi. . The study identified and assessed the undesirable access conditions to clean water by the households.

Keywords: Water Security, Urban Water, Sustainable Development, Lubumbashi, Democratic Republic of Congo.

## 2 INTRODUCTION

Urban water provision and management has been a very immense and difficult task for governments, particularly local authorities in urban centres of developing countries with limited resources; since accessing safe drinking-water is not only indispensable for people's health but also a basic human right, every local government has to play a key role in the supply and management of drinking (World Health Organization, 2017). Water scarcity the world is experiencing is a serious threat that hinders the human-health development and socio-economic progress (world economic forum, 2019). Even though the matter about the quality, quantity and accessibility of water is now general as it has been argued that about 4 billion of the world population suffer from water shortage (Mekonnen & Hoekstra, 2016); (Kummu, et al., 2016), these issues are to become even tragic because of the rapid increase of urban population, climate change and the ageing and deterioration of the water equipment (Kummu, et al., 2016); (Gosling & Arnell, 2016); (High Level Panel on Water, 2018). Rapid urbanisation worldwide has significant impact on the service delivery as well as on water resources. In this paper the main objective was to examine and assess water security in the city of Lubumbashi, in order to find out whether the city is doing well in terms of water security that demonstrates an implication toward sustainable urban development. To come to this, we have selected a number of factors to assess water security such as water availability, running water frequency, water quality,

water accessibility. The study is structured in the following way: Firstly, a summarised background about the subject is presented and we introduce the city of Lubumbashi which is the area of study especially with concern on its availability of water within and its surrounding area at the provincial and national level. Secondly, we give a brief literature review on water insecurity. Thirdly, we present the method used to collect the data in Lubumbashi and the system we use to analyse the data. Fourth, the results of the survey of the 411 households collected in the study area on water accessibility, water quality, water frequency, water mode of collection are presented. Finally, we discuss the result obtained in the context of water consumption, water accessibility, and water quality and propose some recommendations.

### 3 CONCEPTUAL SYNOPSIS

Urban water insecurity may be defined as the incapacity to acquire but also to benefit from safe, clean, and sufficient water for a better life and good-health (Jepson, et al., 2017).

The surging concept of water security amplifies the significance of the urban water management narration (Baker, 2012). Water security may be defined as the easy access to good quality and acceptable quantity of drinkable water in order to increase and promote good health, healthy ecosystem and production (Grey & Sadoff, 2007). Water security as part of the Sustainable Development Goals, falls under three major aspects: social, economic and environmental (Giddings, et al., 2002). Each and every aspect of water security is needed to be assessed in order to achieve sustainability and security. For ages water security used to be one of the major rural area threats. However research has shown that it is also a serious issue for urban dwellers as the quality and availability of adequate water is threatened (Maiti & Agrawal, 2005); (Mohan, et al., 2011); (Cook & Bakker, 2012); (Mukherjee, et al., 2021). Hence, our study focuses on urban water security. According to the (United Nations Environment Programme, 2022) report, in Africa, Latin-America and the continent of Asia about one-third of their rivers experience extreme pollution from pathogens; near one-seventh of all their rivers suffer from drastic organic pollution; and salinity pollution ranging from moderate to severe is found in almost one-tenth of their rivers. Yet these are places around the world where people depend directly on rivers for their living and water source. Such polluted rivers put people's health at high risk and make water security in the Global South questionable. The same report argues that worldwide, a significant cause of death and disability is linked to waterborne diseases caused by the contamination of bacteria and viruses. On the other hand, the new and emerging pollutants which are not simple to eliminate from wastewater even when using new treatment technology are aggravating the situation. Worldwide, water demand is expected to escalate as a result of draught, anthropogenic climate change effects of global warming, change in rain fall pattern and intensification of storms (Bhaswati & Rajib, 2019). Despite the fact that many people are going to be affected by the water crisis, the worse affected group will be the marginal populations especially in the Global South because they depend on municipality water provision and also due to their little resources (Habeeb, et al., 2019).

The urban global population was only 30% in the 1950s, this number has increased to 50% by 2007 (UN, 2015). According to the United Nations Department of Economic and Social Affairs, 2019 report on world urbanisation about two third or 62% of the world population will be urbanised by 2050 and developing countries will experience the fastest urbanisation (UN-Habitat, 2020); (Cohen, 2006). Mostly, the rapid urbanisation rate does not correspond to the government's capacity to respond to issues related to inadequate water and sanitation (Narain, et al., 2013); (Varis, et al., 2007). On the other hand, climate change is increasing the already existing pressure on urban water supply, due to the way the rising sea level leads to flooding threat (Hallegatte, et al., 2013); (van Leeuwen, et al., 2012), but also by amplifying and prolonging the draught occurrence (Isler, et al., 2010). Finally one of the major contributions to the water calamity is the unequal distribution of resources and the inadequate water legislation (UNDP, 2006); (UNESCO; World Water Assessment Programme, 2006); (Porcher & Saussier, 2019). This has been predominant in most of the developing countries and the DRC is not spared.

## 4 RESEARCH METHODOLOGY

### 4.1 Case Study Research Design

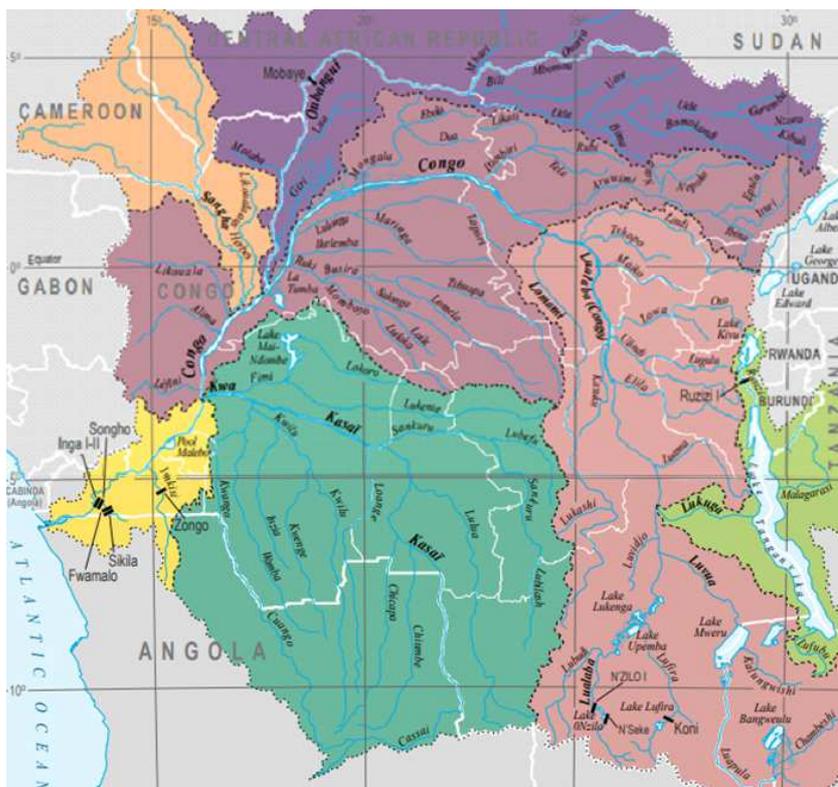
Our methodology is built on two main research strategies. On the one hand, there is the inductive-empirical method based on direct observations, and, on the other hand, there is the hypothetic-deductive method

guiding our survey and inquiry process, from preliminary questionings. As indicated above, our methodology is built around documentary research (consulting works and documents), internet research, quantitative and qualitative surveys; results of the surveys and gathered data processing.

## 4.2 Area of study

Lubumbashi is the capital of the rich province of High-Katanga, the second largest city in the Democratic Republic of the Congo with 1.7 million inhabitants; Lubumbashi is situated along the mining region of the copper belt. The mining industries have long been the backbones of the local economy.

In fact, the Democratic Republic of Congo is a large country which covers 40% over the 70% of fresh water of the continent of Africa and its 50% of forest in Africa contribute to a significant hydrologic cycle regulation. However, less than 50 % of the Congolese population have access to clean water. This is a paradox for a Congolese citizen who settles in a country with 11 lakes; rivers and sea but suffer from absence of clean water (Martial, 2015).



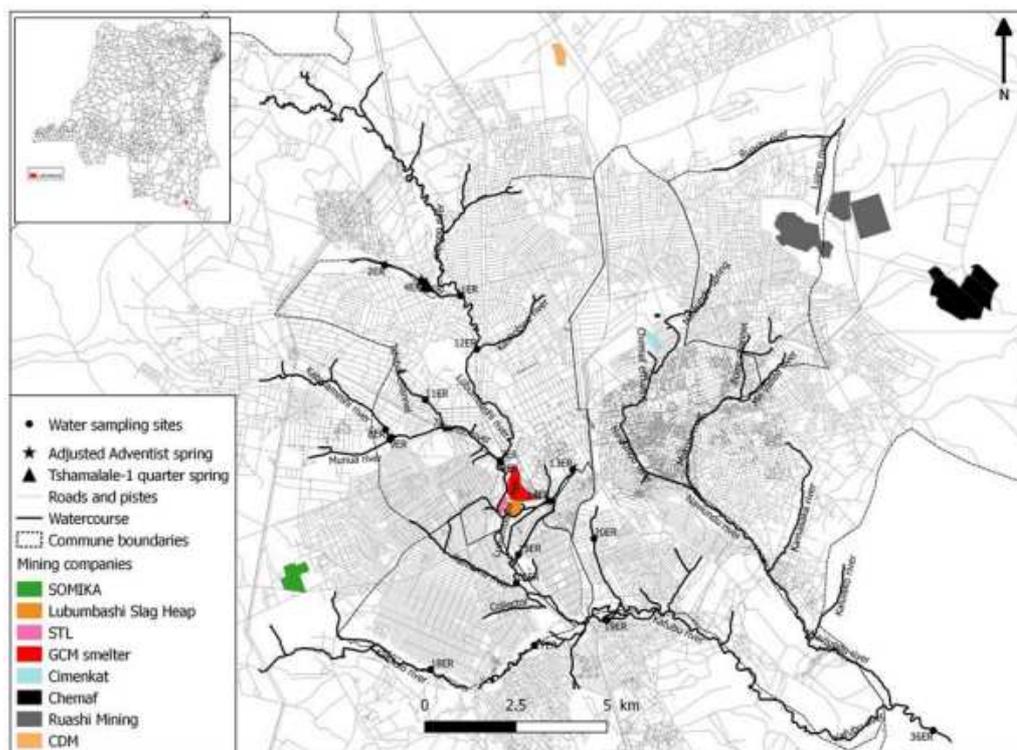
Map 1: Congo drainage Basin (UNEP, 2011)

The DRC in general, and the city of Lubumbashi in particular possess an adequate and sufficient hydrographic network that is very dense and well distributed over its territories. The 11 lakes cover about 86080 square Kilometre or 3, 5% of the country's total area. When it comes to its streams, the DRC possesses the longest, powerful Congo River from which its name "CONGO" derives. This river is the first in Africa and the second in the world after the Amazon in Brazil in term of its basin area. The Congo River discharges about 40 000 cubic metre per second ( $m^3/sec.$ ) and its basin occupies about 3 882 000-kilometre square (Martial, 2015). It is also the second in Africa after the Nile in terms of its length which is about 4700 kilometres. Besides the running from the streams, the DRC possesses an important amount of ground water that is used through boreholes. The country has an enormous water reserve; however, it presents a serious difficulty to provide clean and drinkable water to its citizens.

## 4.3 Field Survey

For this analysis, we have focused on the direct survey, enabling us to understand the city and the diversity in the population water consumptions better. This approach allowed us to discover aspects that were not covered by official investigations and were not found in statistics. These mainly include the spatial distribution of investigations, the relations between them, and the collective and specific water consumption, water distribution, and domestic water collection. Therefore, we resorted to direct observation, interviews

and surveys, in order to understand the problem of urban water security in Lubumbashi better, within a sustainable development context.



Map 2: Lubumbashi River Bassin (Muhaya, et al., 2017).

#### 4.4 Size and choice of the sample

The size of the referred sample was basically selected according to the representativeness of indicators and accuracy, while maintaining the investigation within reasonable time limits and our possibilities. Thus, the chosen sample was providing representative indicators for all the municipalities of the city.

In fact, given the real difficulties to proceed and to divide the city into homogeneous sectors, since they do not exist, a simple random method was applied, with a large sample with great dispersion, a method which allowed us to have good household estimators.

By this method, we have chosen a 411-household sample, a number that we could not restrict nor fix since the survey questionnaire was sent to different people which shared it with their relatives. We combed through more than 50 responses per municipality. The concerned households have not been pre-selected. More than this, no preliminary selection criterion has been imagined. We have simply relied on the goodwill and availability but also the internet possession of the respondents since this was an online questionnaire via a link. This has considered the reluctance, even hostility of certain people to respond to our questions. However, we have tried to respect the quota of households to be surveyed by municipality area.

#### 4.5 Data processing

We proceeded at the same time to conceptual as well as to quantitative treatment. The first consisted mainly of the description and location of observed facts and data gathered on the field. The description was built around keywords and previously defined concepts. We wanted this description to be precise and schematic, in order to reach a thorough and methodical explanation of the causes and the effects of phenomena revealed on the field. The latter allowed us to gather the 411-survey household. Thus, our processing concerned 411 surveys. It was carried out by means of a free version of the survey monkey software and the data were processed and analysed with Microsoft Excel.

### 5 RESULTS PRESENTATIONS AND DISCUSSIONS

The results of the survey are organised and presented next, with the following items: surveyed household distribution over municipalities; household residents analysis (number of people per household); type of

water source per household (tap water, well, boreholes); inside and outside tap water analysis; households serviced per outside tap; distance walked to water source, water consumption per household per day analysis; cost of water analysis, frequency of water and water quality analysis. The following are the findings and results of the 411 surveyed household's data.

Data were collected in all six municipalities of Lubumbashi. Out of the total number of 411 respondents, 21% were from the Lubumbashi Municipality, 19% from the Kamalondo Municipality, 14% from Kenya municipality, 15% from the Katuba Municipality, 13% from Rwashu municipality and 18% from Annexe Municipality. Thus, the data were selected from all around the city.

In terms of the number of people per household, it has been proved that 31% of household in Lubumbashi have 1 to 3 people, 22% have 3 to 5 people, 31% have 4 to 7 people and 13% have more than 7 people. This data helped to identify and assess the number of litres of water used per household, hence per person per day. It is not an easy endeavour to have adequate average number of people per household since the population is very nomad in the DRC and in Lubumbashi particularly but also due to lack or absent of demographic data (African development fund, 2017).

### 5.1 Types of water sources

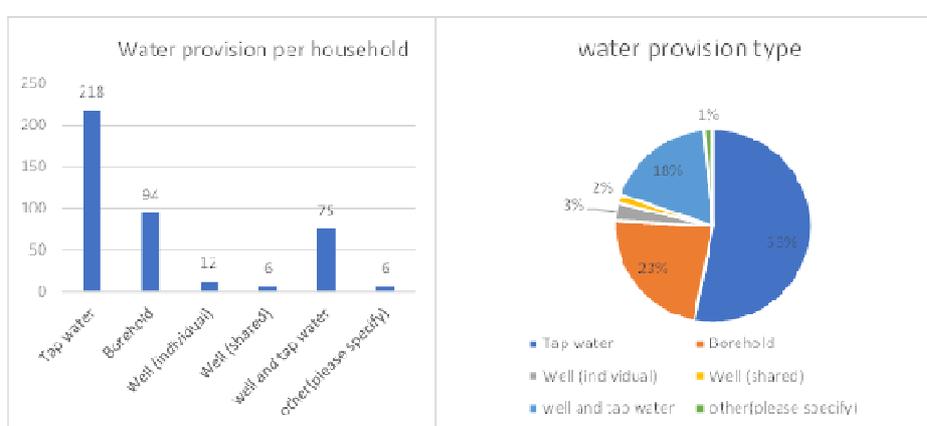


Figure 1. a. type of water source

Figure 1. b. water provision type as percentage

From Figure 1.a and 1.b, people in Lubumbashi get their water from different types of sources. 53% of households get their clean water from the Municipality through the only public company that provide water to the city (REGIDESO); 23% of households get their clean water from the boreholes that they have installed in their yards and use big tanks to keep enough water. 3% of households have individual wells in their yards that they use for domestic usage but then get tap water from their neighbours for drinking. 2% have wells in their yards that they share with others, 18% of households have both tap water and a well. This proves that people don't entirely rely on the water provision service from the municipality, so they must find another way of getting water. From all the above, the city doesn't have adequate and reliable water service provision as people have to have boreholes and wells in their yards so that they do not totally depend on the municipality.

### 5.2 Location of water sources

Figures 2.a and 2.b represent the number of households with water from a piped supply whether from the municipality or from the internal borehole but the tap is installed outside the house. 94% of all households having tap water don't have it necessarily in their houses but just outside and only 6% of households have taps inside their homes. This is to justify that adequate sanitation is jeopardised since water is not running in the house. The households with outside taps have it not just for themselves but also to help the community to get water from them, however, at a certain cost.

It is also found that 60% of households with outside taps provide water to 1 to 5 other households. 27% provide water to 6 to 10 households, while 5% provide water to 10 to 15 households, 2% provide water to 15 to 20 households, 1% provide water to 20 to 25 households, and 5% provide water to more than 25 households every day. This is the proof that many households, although claiming that they have tap water, they just have access to tap water from their neighbours.

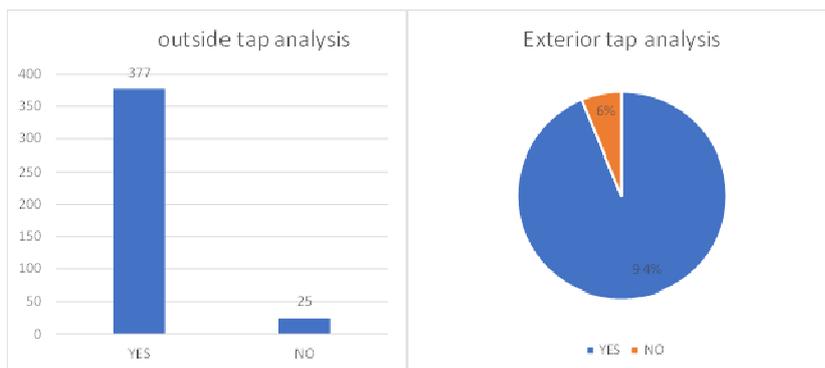


Figure 2.a. Outside-inside tap analysis

Figure 2.b. % of households with outside and inside tap

### 5.3 Distance of water sources

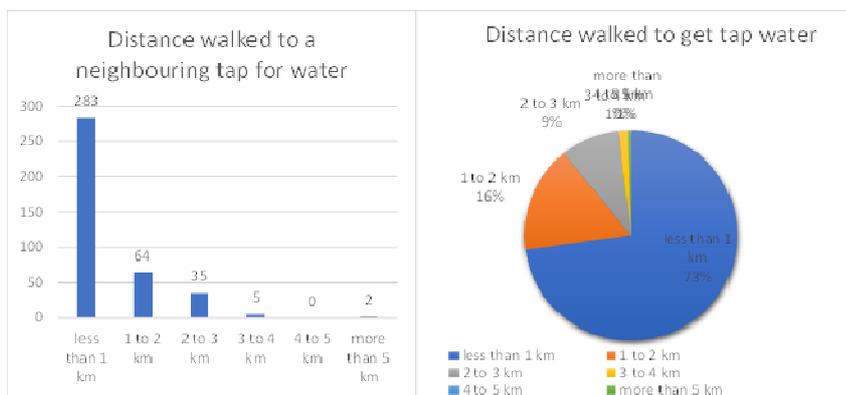


Figure 3. a. distance walked by household to a tap.

Figure 3. b. percentage of household walk to a tap.

From the above figure, it is shown that about 73% of households surveyed walk a distance less than 1km to get their water from a tap, about 17% walk from 1 to 2 km, 9% walk from 2 to 3 km, 5% walk from 3 to 5km and 0, 5% walk more than 5 km to get their tap water. It can be observed that most household residents are getting their drinking water from outside their yard; this is the proof that they don't have tap water in their yards.

### 5.4 Water consumption

The above figures show that 19% of the surveyed consume less than 20 liters a day, 36% consume 20 to 40 litres a day, 12% consume 40 to 60 litres, 11% consume 60 to 80 litres a day, 12 % consume 80 to 100 litre a day, 3% consume 100 to 140 litre a day, only 1% consume 140 to 180 litre a day, 4% consume 180 to 200 litre a day and 2% consume more than 200 litres a day. In 2010 the United Nations adopted a resolution to make drinking water, proper sanitation, and hygiene a human right (United Nations, 2010). In addition, the World Health Organisation suggested that adequate water consumption per capita per day should be 50 to 100 litres in order to make certain that fundamental needs will be met (World Health Organization, 2003). The WHO standard seems much higher compared to what is the current consumption in the city of Lubumbashi. By analysing the number of people per household of the respondents, although these results may possibly be carrying some errors. That can be because of the fact that many respondents could not estimate the amount of water they use since they get it outdoor, but it can also be due to the fact that they responded on only how much water they drink instead of how much they use for all their household activities. However, the reality remains true if people do not have water in their house or their plot, their daily consumption will obvious be reduced. Considering a household that the highest water consumption is 200 litres per household per day and that there are 6 people per household, that means the per capita per day usage is less than 50 litres, which is below the standard.

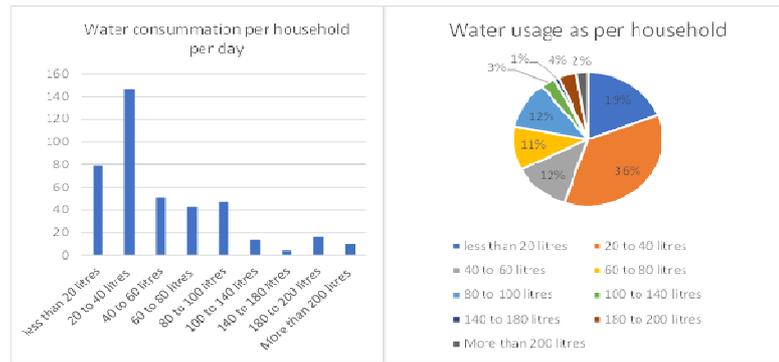


Figure 4. a. water consumption

Figure 4. b. percentage of water usage per household.

### 5.5 Water’s cost

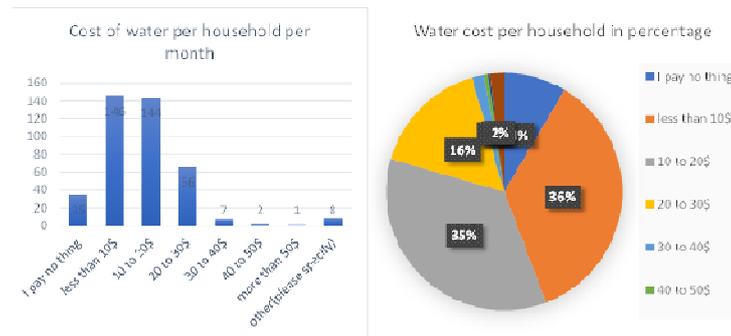


Figure 5. a. water cost per household per month

Figure 5. b. percentage of water cost per household

From these figures, it is clearly shown that 36% of the surveyed households pay less than \$10 per month for their water consumption, 35% pay 10 to \$20, 16% pay 20 to \$30, 9% pay nothing for their water consumption and only 4% of households pay more \$30. It is better to specify here that these payments are either from the consumer directly to the municipality or from the second consumer to the first consumer who is the client to the municipality; also, the 9% of the surveyed households are probably those with boreholes at their house, since they have disconnected from the municipality pipe connections. However, it can also be seen that the price of water for all the household is reasonable, the current reality may be due to the fact that households that do not have a tap inside their houses will not use so much water, since most of the factors that contribute to water consumption are disconnected from the water pipes (Domene & Sauri, 2016).

### 5.6 maintenance and reliability

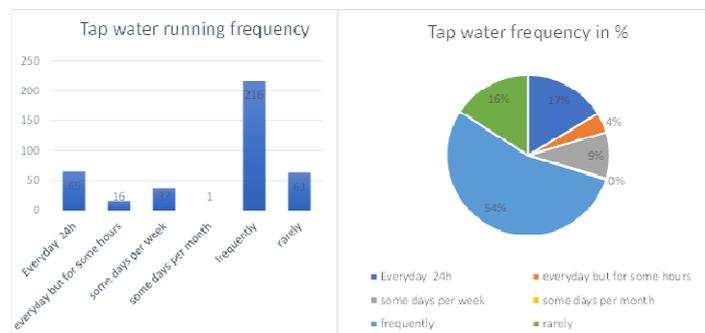


Figure 6. a. running water frequency

Figure 6. b. running water frequency in percentage

As it can be observed that 54% of the surveyed households in Lubumbashi have their water running frequently but that does not mean every day for 24 hours, 16% have tap running water rarely, only 17% have tap running water every day in their homes, 9% have water only some days a week, 4% have water everyday but at interrupted rate and for some hours in a day. This is a proof of poor water distribution and consumption but also the proof of water insecurity in the city. This is one of the reasons why the citizens of

the city of Lubumbashi do not rely on the municipality water distribution, so they find their ways of getting water from unprotected wells they make in their yards.

Further results from the assessment on the quality of water shows that: from the surveyed households, water quality in the city of Lubumbashi should be questionable since only 10% of households consider their water quality good, 36% find it satisfying, 27% use chemicals to have their water purified, it simply means the quality is not good for them, 24% boil their water to make it drinkable, also here they find their water not of good quality. and 4% clearly said the water quality is just bad. The quality of water should be good to satisfy population needs and improve health. According to the definition of water security by Subham, et al., (2022), it should be: the quantity of water that is available and enough, of good quality and always running for improved health, livelihoods, and ecosystem. In this regard, considering the frequency at which water is running in Lubumbashi and the quality of it, the concept of water security is far from being meaningful.

### **5.7 Issues that are threatening water security**

Although some meaningful advancement in several domains of sustainable development in the world are made, meeting the SGDs that relate to water and their targets is still not certain to be successful by 2030 nor to be a reality of long-term sustainability by 2050 (UN-Water, 2021). In order to be on track toward sustainable accomplishments and to reverse the negative tendency, high-priority actions and strong global cooperation are required (UNEP, 2017). About 51 million of the DRC population or almost three quarter has no access to clean, safe, and drinkable water, although over half of the water reserves of the African continent is hold by the DRC (UNEP, 2011).

The city of Lubumbashi (capital of the High-Katanga Province and mostly characterised by mining companies), just as other cities in the country is facing serious urban water poverty even though it is crossed by many rivers. People suffer a lot in terms of urban water availability. According to Martial, (2015) this situation is due to the fact that the company that deals with water in Lubumbashi (REGIESO) is not able to provide the water needs to the population that is growing due to rural-urban migration. This phenomenon is becoming worse due to the ageing of the water pipes and other hydraulic network equipment, and this has been exacerbated by the informal residential area growth and the decay of the urban water infrastructure. Without any doubt these situations have been the cause of the urban water problems in Lubumbashi.

Water usage in the DRC and in Lubumbashi particularly is characterised by domestic consumption which represent about 52% of the total distributed water. This is different if compared to other African countries where a huge quantity of water is first attributed to agriculture usage. In the DRC due to high rainfall and poor irrigation system, the agriculture sector uses only 32% while the industries utilise about 16% (UNEP, 2011).

Before the year 1990, the REGIDESO was considered as one of the most efficient and important public institutions of the country and also one of the best in Sub-Saharan Africa (UNEP, 2012). But nowadays most of these urban water infrastructures are in a very bad condition with no maintenance, not enough funds allocated for their replacement or maintenance, and most of the equipment from the colonial era ageing (UNEP, 2012).

In January 2016, the Congolese Government promulgated a new national law on water which was mainly focused on how best to manage the water resource in the country at the river basin level. This law had truly brought some light to the country reform on the management of water as resource. However, it has not demonstrated an adequate institutional consistency on how well urban water can be improved in order to improve good health and water security for the citizens of the country (UNEP, 2016).

## **6 MAIN CONTRIBUTIONS – IMPLICATIONS – LESSONS LEARNT**

The current study has used a quantity-based methodology of assessment to quantify urban water security in the city of Lubumbashi. The study identifies water-insecure areas in the distribution and consumption of urban water in Lubumbashi. This quantitative approach study will undoubtedly help policy makers from the local and national government to plan well and to take appropriate approaches to provide adequate water service to the citizens; but it would also help different stakeholders to set objectives and milestones to manage the local available water well, and any resources related to social life to achieve sustainable urban water security.

For any future work on water security in Lubumbashi, we would have to focus interest at an individual scale in the collection of data, but also on the difference of households in terms of their social standards and their area of residence.

From this study, we have learned that it is not easy to collect data from households especially when it is done remotely. Secondly, it is easy to have biased data if there is no proper explanation of the questions is given to the respondents. Also, the free versions of data collection and data analysis software are very limited and unable to provide adequate features that are capable to perform large and accurate analysis.

Water management and water usage have an implication on water supply, but it will also have an impact on economic and social activities necessary for people's well-being. In the city of Lubumbashi for example, the local water service provider (regideso) finds itself unable to provide enough water to all the residents of the city because of some unacceptable behaviours of some citizens who sometimes brake pipes in order to get illegal water for 24 hours. This practice affects not only the service provider but also some residents which will not receive water because a lot of water is being wasted somewhere else. Economically speaking, since we cannot separate water usage from economic activities, water scarcity in the city compromises the economic activities of the citizens at large, but the most vulnerable are the poor population. Big companies have lost confidence in the municipality water provision and hence, they have found a way of having water from the boreholds within their premises; however, the small businesses and the lowest income household whose lives depend on small commerce activities such as selling cool water find their businesses hindered due to lack of running water. Social implications are present and visible all over the city. More than 90 percent of residents don't have indoor taps; therefore, sanitation is seriously compromised. This phenomenon is the reason why people are not using their inside toilets but rather use toilets that are built outside their houses at the back of their backyard. These types of toilets don't use any water, they are called direct toilet or pit latrine with no toilet seat but with a hole directly leading to a pit that receives human faeces, which is considered unimproved sanitation. In some cases, people use a very limited quantity of water in a pit latrine with a slab, where they use a container to flush water. These outside pit latrines are all used by more than 3 households with more than 3 residents made up of males, females, and children. This practice is one of the main causes of infectious diseases, especially for females and children. The World Health Organization (2018) argued that inadequate water, sanitation, and hygiene is the cause of diarrhoea deaths which killed 842 000 people in 2012. Moreover, the same source argued that cholera which is another serious water, sanitation and hygiene related disease remains endemics in Africa. In the DRC, more precisely in the east of Katanga Province, about 84% of its population are affected by cholera and diarrhoea. Adequate water, sanitation and hygiene is crucial to prevent cholera, but its achievement remains very long term and expensive in Congo, hence the World Health Organisation (WHO) has introduced the Oral Cholera Vaccine (OCV) in Congo as a quick response to cholera. Since water source is at a certain distance for many residences, drinking water becomes a blue diamond for many households, hence water consumption per day per person is very low which can inevitably lead to many serious health issues; moreover, even the quantity and quality of water for other daily domestic activities such as laundry, dish washing, bathing is affected which can also lead to sanitation problems. To add to this, most of the people going out to look for drinking water are women and children, and this class of population becomes therefore vulnerable to many threats. For example, girls will have to wait until it is late and dark in the queue to get water, hence making them vulnerable for rape or other criminal attacks. In summary, water insecurity in the city of Lubumbashi is related to poverty, hence it is the cause of many sanitation problems and human health issues which deteriorate the well-being of many citizens and put pressure to other services such as the health care service.

## 7 CONCLUSIONS AND RECOMMENDATIONS

The main purpose of the current study was to conduct a quantitative-based study to assess the urban water security in the city of Lubumbashi. The following conclusion can be drawn from this study: firstly, water provision in the city of Lubumbashi is not secure and adequate, since many factors such as some people not having tap water in their houses and others having to walk far every day to collect water are very present in the city. Secondly, water frequency and water quality are a very serious issue in the city which brings us to conclude that the city of Lubumbashi is experiencing urban water insecurity and this phenomenon may exacerbate due to high urbanisation that the city is facing.

For this reason, the following are the recommendations we can provide:

- The city local government needs to consider all human aspects of good living and plan well for adequate provision of safe and healthy water.
- Rational policy, strong political dedication, adequate funds, and profound implication by all the stakeholders are fundamental obligations for successful delivery of drinking water to the citizens of Lubumbashi.
- There is need to improve water supply infrastructure that will help to boost the social well-being of the citizens of the city.
- Green energy from solar panels must be used to provide drinking water using solar water pump for boreholes especially in the area where water and electricity is not yet provided.
- The local government cannot safeguard water security alone, it also needs to work in partnership with the private sector to build a sustainable urban water system and provide adequate service to the citizens.
- There is a need to set up an assessment team of the urban water provision and capable to hold any stakeholder of the service accountable.
- Initiate an awareness campaign to promote water security for the local community is a must.

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