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Conjunctive use of Urban Water Sources for Domestic Purposes in Harare,Zimbabwe. Systematic Review

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I. Introduction/Background

The deterioration of water quality and quantity in Harare has been attributed to the rapid growth in population, inadequate rehabilitation- maintenance of water and waste treatment plants, poor institutional framework and socio-economic political situation as stated byJICA (1996); Moyo, (1997); Manjonjo, (1999); Kamudyariwa, (2000); Mawere, (2001); Nhapi, (2009). Numerous studies have been conducted on the water quality and quantity. These studies have revealed continuous deterioration in water quality from the rivers feeding into Lake Chivero as stated by Nhapi, (2009). The above mentioned factors have led to the erratic water supply to residential areas in Harare. This in certain cases has led to outbreaks of water borne diseases such as cholera, diarrhoea, typhoid as evidenced by the statistics from the City Health Department. According to Devillez (2011),problems associated with using unsafe water in Harare, and poor sanitation facilities pose a major threat to the public health of the residents.

In most Low–Middle Income Countries (LMIC), acute water related diseases remain the leading cause of mortality as evidenced by Liu, Hope, etal (2012). While tremendous gains have been made in providing access to safe water throughout developing countries, there are still roughly 800 million people who do not have access to improved water and 2.5 billion are without access to proper sanitation UNICEF/WHO, (2013). The effects of unclean water and lack of access to adequate sanitation has had devastating effects on the health and wellbeing of vulnerable groups such as children and women as stated by Metwally, Ibrahim, Saad and El-Ela, (2007). Diarrhoea kills 4000 children every day around the world, making it the second leading cause of death among children under five globally and the fifth leading cause of death among all age groups, WHO, (2008). This concurs with the fact that diarrhoea (88 per cent of which is due to poor water and sanitation, WHO, 2014) kills more children than HIV and AIDS, malaria and measles combined, UNICEF/WHO, (2009). Improved water supply is adjudged the single most cost effective means of reducing water related diseases and deaths globally (UNEP, 2012). About 1.1 billion people globally lack access to safe drinking water and approximately 2.4 million deaths a year are attributed to unsafe water (Pal, 2012).

Despite the presence of policy and legal frameworks, rapid urbanisation and growth in population reflects that the population of Harare now exceeds the carrying capacity of water supply resources. Harare produces 650 mega litres of water against a demand of 1400 mega litres a day as alluded by Kativhu, (2013). This has put a lot of pressure on water and sanitation resources in Hararеas the erratic andlimited supply of water by the City of Harare has led to residents seeking alternative sources of water such as shallow wells, streams and boreholes whose waterquality is questionable. The assumption being made by manyis that these alternative water sources could be the source of water borne diseases in the city.

Despite water supply challenges, Zimbabwe has comprehensive and extensive policy,legal and institutional frameworks that govern the provision of water in the country. The following are some of the provisions that govern the provision of water in Zimbabwe: National Constitution (2013) Water Act (1998), Urban Councils Act (1996), andPublic Health Act (1996). The Constitution of Zimbabwe states that every person has the right to clean,safe andpotable water.The state must take reasonable legislative and other measures within the limits of the resources available to it to achieve the progressive realization of this water right. The importance of water to human health and wellbeing is encapsulated in the Human Right and Sanitation, which entitles everyone to ‘sufficient, safe, acceptable physically accessible and affordable water for personal and domestic uses’, Committee on Economic Social Rights, (2002). It is therefore, necessary for Harare to embrace

the conjunctive approach to addressing the problems of water shortage in its residential areas.Currently high density areas such as Glenview, Glen Norah and Budiriro have recorded more than 5000 cholera cases in the 2018 outbreak.

Objective

The objective of this paper is to use a systematic review approach to identify and analyse the conjunctive use of different water sources which complement municipal reticulated water supply in Harare.

The Purpose of the Systematic Review

The overarching purpose of this systematic review was to gather credible literature, evidence and synthesise all the available research reports and grey literature including other documents on the conjunctive use of water sources to fully support the topic. The systematic review process was aligned to the objective, theoretical and conceptual frameworks within global and regional water governancesystems.

The synthesised literature sources and evidence included articles from: peer reviewed journals, primary research papers, United Nations portals, World Health Organisationamong many otherrelevant sources. A search strategy was designed using the PICO framework, that is, *Population, Intervention, Context and Outcome.*

Regulatory framework on Water in Zimbabwe

The provision of water in Zimbabwe is subject to policy and legal frameworks. Zimbabwe has extensive and comprehensive policy, legal, technical and institutional frameworks to support water quality monitoring and management. These include,

The National Constitution (2013) Water Act (1998) Urban Councils Act (1996)

The Public Health Act (1996)

The constitution of Zimbabwe states that every person has the right to safe water, clean and potable water and the state must take reasonable legislative and other measures within the limits of the resources available to it to achieve the progressive realization of this right.

Global Perspectives Water Issues

The past years have witnessed many countries making significant progress towards meeting their water and sanitation access goals as noted by WHO/UNICEF (2015). Despite global efforts, 660 million people still lack access to clean water, and 2.4 billion lack access to sanitation. Coupled with the growing challenges of the 21st century rapid urbanization, climate change, pollution, and higher demand for water resources the challenge of bringing water supply and sanitation (WSS) to all remains immense, UN (2015). In a bid to meet the global water challenges, the global community responded by endorsing Sustainable Development Goal Number 6 (so called Water SDG), which calls for universal access to water and sanitation services by 2030 that are safe, affordable, and available when needed. Improving water quality and restoring water related ecosystems are some of the targets for increasing efficiency of water use across all sectors.

Within the global perspectives, the quest for solutions has also brought about a shift in water resources management thinking from a supply to a demand-oriented focus as stated by Bashir, (2012). Despite the presence of global frameworks such as Sustainable Development Goals, (SDG number 6), the historical levels of funding for extending access to water supply, sanitation, and hygiene (WASH) services during the MDG era were estimated at $16 billion in 140 countries, whereas what's needed to ensure universal access to safely managed services by 2030 is around $112 billion per year as Ibrahim (2017) cited (World Bank 2016).The status quo financing model in global water sector in many low- and middle-income countries (LMICS) relies on public funds that are insufficient, poorly targeted, and often crowd out, rather than crowd in, new sources of financing as evidence by the International Monetary Fund and World Bank, (2017). This scenario has presented a lot of challenges in the provision of water supply in most LMICS.

Globally, evidence has shown that in order to ensure equitable access to water a new paradigm is needed whichinvolves public-private partnership in "crowding in" commercial finance to supplement existing sources of finance. This will include increasing the level of commercial finance for the water sector which would allow service providers to borrow and invest in expanding and improving the quality of water sanitation services to borrow and invest in expanding and improving the quality of water sanitation services, without having to wait for scarce public resources to be made available. This is further supported by Wilson, (2013), Adam, (2014), WHO/UNICEF (2015), who assert that the overall objective will be for those currently without water and sanitation services, who are predominantly poor, to have the same access that wealthier citizens already receive—and at a price that is affordable to them.

International conference on Water and the Environment (ICWE) built consensus in advocating and creating awareness of the need to identify innovative strategies for the assessment, development and management of water resources as cited by Chikozho (2002) and World Bank Report. The ICWE set out

recommendations for action at the local, national and international levels based on four guiding principles. First, the effective management of water resources demands a holistic approach linking social and economic development processes with the protection of natural ecosystems. Secondly, water development and management should be based on a participatory approach involving users, planners, and policy-makers at all levels. Third, women play a central role in providing, managing and safeguarding water. Fourth, water has an economic value as a global common property resource. However, despite the presence of these noble recommendations funding and weak institutional frameworks and policies have been some of impediments affecting their implementation.

The evidence review also revealed that a number of African countries have been battling with water sector reforms as part of global water resources management paradigm. This has been attributed to rapid urbanisation, policy inconsistency and water revenue leakages. A number of initiatives have highlighted the need to ensure self-sustainability, equitable allocation and distribution of the resource, decentralized and participatory management; and integrated water resources management. Most of these noble initiatives are policy-based with paucity implementation strategies and plans, Ibid (World Bank Report)

In the midst of comprehensive global water frameworks, national and regional frameworks there is need to understand the different social, political and economic factors that must be addressed at the local levels as well as the institutional development processes for water reforms to materialize socio-economic benefits to communities in LMICs.

Studies on urban water service delivery in Harare

Water service delivery studies have been conducted in Harare by (Hove and Tirimboi (2011), Matsa (2012), Ncube (2014, Godebo (2015) Most of these studies revealed that water service delivery was unreliable due to unexpected water cuts which could last for one to six days. In response to the unexpected water cuts communities were storing water. The study samples revealed that residents had different perceptions on the quality of water, with the majority of respondents in the samples revealing that the quality of water in Harare was not good. The evidence synthesized in the studies also revealed that due to erratic supply of municipal water, residents resort to use alternative sources as their main water source for domestic purposes. The quality of alternative water sources has become a major concern to many, because most people depend on these sources for their livelihood. In all the study samples, 85% of boreholes and 96% of wells sampled did not meet the World Health Organisation total and faecal coliform standards of zero per 100ml.

II. Methodology

The increasing global consensus on the importance of water governance and its supply and demand has led to growth of literature around this topic. It was therefore imperative to undertake a rigorous systematic review of literature given the quantity and quality of the different types of literature. According to Oxford Lib Guides, (2015), a systematic review is an appraisal and synthesis of research papers, articles, reports and other literature sources using a rigorous and clearly documented methodology in both the search strategy and the inclusion and exclusion criteria of literature. Systematic review are also defined as a type of literature review that uses systematic methods to collect secondary data, critically appraise research studies, and synthesize studies.This minimises bias in the results as alluded by the LibQ Guides (2015), and synthesize studies. They are designed to provide a complete, exhaustive summary of current evidence relevant to a research question.

The main review question was as follows:

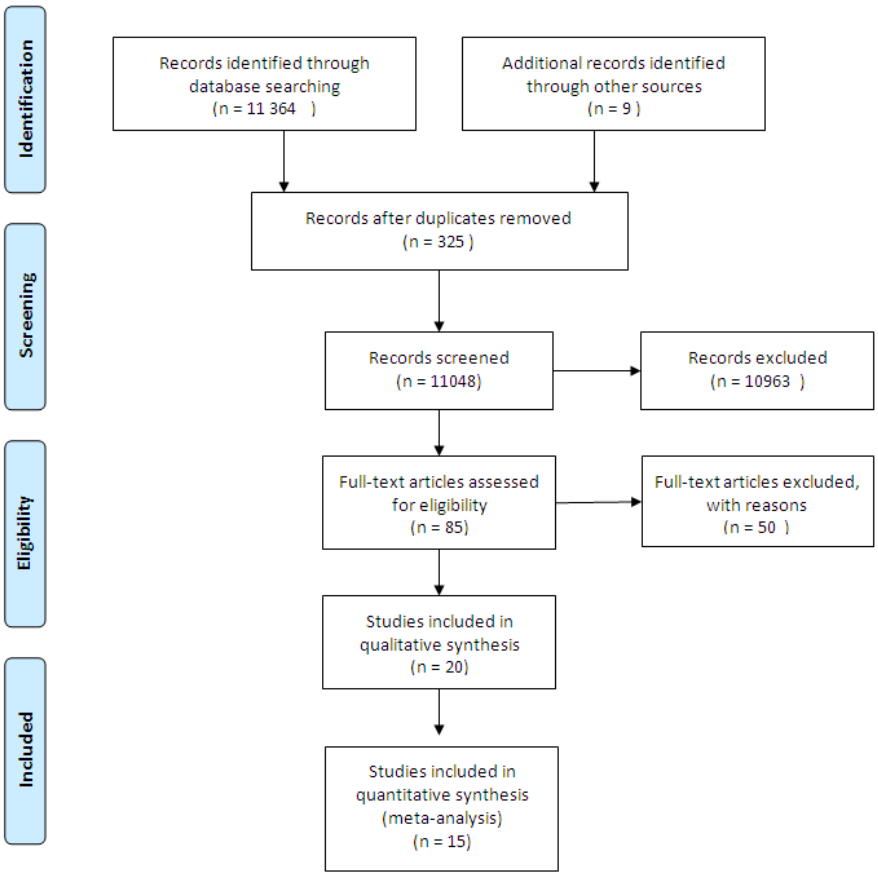
What are the conjunctive water sources in use for domestic purposes available and their implications? What sources are under use and how are they being used?

The search strategy was as follows:

Population – *Africa, Low Middle Income Countries (LMIC)* Developing countries
Specificity –Zimbabwe, Harare urban areas
Intervention –*Water supply, Water safety mechanisms*,
Comparator - Outcome – Water safety and quality of life,
Time: 2000 – 2018 publications were searched.
Boolean operators'/Search strategy
Water Safety AND Africa, developing countries OR least developed countries. Alternative sources of water AND LIMICS OR Africa
Water Safety and Zimbabwe OR Harare or least developed countries
Water quality and Africa, developing countries OR least developed
Water Safety and Africa, developing countries or least developed countries. Alternative sources of water and LIMICS, Africa

Find below prisma table for the number of literature sources and databases which were searched.

Systematic Review Prisma Table



Systematic search and quality grading

A total of 11 364 records were identified through database searches and a further 9 records were identified through other sources such as newspaper, grey literature sources. 325 duplicate records were identified. Grey literature such as UN country reports play a critical role in the formulation of national policies as such they were included in the appraisal of relevant studies. A total of 11048 records were screened for eligibility and context specificity, 10963 records were excluded as they did not meet the criteria of water safety in low-middle income countries. 85 records were included for meta-analysis into results. Information communication technology tools were used for screening studies and coding as being potentially relevant.

III. Findings

A qualitative and quantitative synthesisof global, regional and localresearch evidence has shown that alternative water sources such as wells, boreholes and water harvesters are now the key sources of water in the of City of Harare. The evidence reviewed also noted that alternative sources of water such as wells from five high density areas (Glen View, Mbare, Budiriro, Kuwadzana Mabvuku) tested positive to total coliform, E. coli, Salmonella and Shigella. The presence of faecal coliform and E. coli suggests that there is faecal contamination of wells and boreholes. According to the guideline for drinking water quality (WHO, 2008) this makes them unsuitable for human consumption. The physiochemical parameters which included pH, turbidity and colour were found to be acceptable and suitable for human consumption as per WHO guidelines. However, conductivity, hardness, sulphate and nitrate, exceeded the maximum permissible limit hence the water needed treatment before use in each of the high density areas affected.

Implications

According to chemical and microbiological analysis, the quality of alternative water sources is unsuitable for human consumption as there was viable microorganism in water samples collected. Studies

review also noted that the contamination of alternative sources of water predisposes the residents of Harare to waterborne and diarrhoeal diseases. The systematic review evidence recommended that water quality must be conducted at least once in three months on alternative sources of water in both high and low density suburbs of Harare. This can act as an early warning system in ensuring that incidences of contamination are noticed earlier for remedial action.

The studies reviewed also evidenced the need for awareness and education of residents on treatment of water from alternative sources such as wells, boreholes. The evidence synthesis revealed the need to protect wells and boreholes by the installation of hand pumps in ensuring water safety. Alternative sources of water such as wells, boreholes should be raised well above the ground level to divert runoff water when constructing wells to avoid seepage and contamination. There is need to develop national strategies and plans towards the Water Safety Plan (WSP) approach which was introduced by the World Health Organisation in 2004 as it is still under development in Zimbabwe. The Water Safety Plan is a critical tool in developing national mechanisms and strategies that ensures the safety of drinking water supply through the use of a comprehensive risk assessment and risk management approach as postulated by WHO, 2008. There isalso urgent need for the enactment of bylaw which permit the construction, use of alternative water sources to alleviate water shortages.

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Evidence Review 2

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