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Zimbabwe National Water Authority Provision of Water Mandate: Its Challenges and Severity Endured by Chivhu Town Residents, Zimbabwe

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Abstract

This study explores the challenges faced by Zimbabwe National Water Authority (ZINWA) in provision of safe water to Chivhu town residents and to discuss severity endured by residents due to poor water supply. The research was underpinned by Water Supply System Reliability and Water Sensitive Cities theories. Mixed design incorporating qualitative and quantitative methods was used. Purposive sampling was used to select 4 urban councillors, 6 Chivhu Residents Association leaders with stratified sampling for choosing 20 Chivhu Town Board employees and 15 ZINWA workers. Additionally, volunteer sampling was implored to pick 20 Chivhu General Hospital employees, 30 Chivhu Primary School staff and 30 Chivhu Police Camp workers. The rest (260) residents were chosen using random sampling. A sample size of 385 was determined using Yamene's 1967 formula from a target population of 10369. Response rate was 97%. Data were collected using closed and open-ended questionnaires, structured and in-depth interviews and focus group discussions. Data were captured using SPSS. Quantitative data was analysed using frequency and percentages, regression, ANOVA, correlation matrix and Chi-Square whereas qualitative data were analysed narratively and interpretatively. Research findings revealed that ZINWA was confronted with multiple constraints. Thus, highly recorded challenges with frequencies and percentages above 300 and 80% respectively were inaccurate water billing system, failure to pump water in terrain areas, increase in population, dilapidated infrastructure, lack of resources, leaking water pipes, wastage of water, absence of private water suppliers and change in climate. Similarly, commonest severity endured with frequencies and percentages above 300 and 80% respectively were rampant poor sanitation, long queues, walking long distances and forced migration. The researchers concluded that, most residents in Chivhu town especially from North Hood suburb were in dire state due to erratic water supply from ZINWA. Accordingly, several recommendations were proffered to mitigate the anomalies in that context.

Keywords: *Zimbabwe National Water Authority; mandate; water; residents; town.*

Introduction

There is scant or limited literature mostly linked to qualitative research on the effectiveness of various water utilities or corporations in the provision of safe water to their respective residents. In Zimbabwe, provision of water is mainly done by city councils, urban and rural councils, municipalities and Zimbabwe National Water Authority (ZINWA). However, this study is archetypal at least as the first one using mixed methodology approach in Chivhu town. Additionally, the research is of its own kind and cause to focus on the constraints confronted by ZINWA in supplying water to Chivhu residents and severity endured as a result of this anomaly. The universal

essentiality of water is buttressed by its inclusion as Goal 6 of the United Nations Sustainable Development Goals. It advocates for access to clean water and sanitation for all by 2030 as concerted by nations in September 2015 (UN, 2017).

Accordingly, this is in tandem with Zimbabwe home grown 2013 constitution specifically section 77 which stipulates the right to safe, clean and potable water for both rural and urban residents. To further emphasise the paramount significance of water to its citizens, a clause was made to that effect. It posits that, the state is entitled to effect sensible governmental and other corrective measures, within the limits of the resources available to it, slowly working towards achieving this right (Mutandwa & Vyas-Doorgapersad, 2023:24). At global level, the inexhaustible fresh water resources per capita continue to decrease (Ritchie & Roser, 2017). This is in line with the outcome that, approximately half the universe population exists in likely water shortage places for at least one month annually (Burek *et al.,* 2016). This number could increase to 4.8–5.7 billion in 2050 (Burek *et al.,* 2016).

In the same scenario, in 2020, 2 billion people internationally lacked non-hazardous catered drinking water, of which 771 million were without even having basic drinking water, (half of which live in Sub-Saharan Africa),(UN, 2021b). The same sentiments were also echoed by WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), which pinpoints that, provision of adequate Water Supply and Sanitation (WSS) services were major constraints (WHO/UNICEF,2019). As a result, the Organisation for Economic Cooperation and Development (OECD, 2012) predicts that by 2050, water demand will have increased by 55% since the year 2000. Overally, based on the findings above, it should be considered that, despite efforts being implemented worldwide to improve water provision by utilities or corporations to residents, most still have poor access to clean regulated drinking water and sanitation.

In Zimbabwe in 1998, a new Water Act replacing the colonial 1976 Water Act and subsequent Zimbabwe National Water Authority Act (ZINWA Act) were enacted (SADC, 2003d). This signalled a move from centralised water management to a decentralised system of water management based on river basins and a hefty degree of stakeholders engagement. However, the 1998 Water Act bestows all water in the President, thereby detach the notion of personal possession of water. Thus, water allotment are issued through a permit system, which authorises water utilisation for a particular period of time (SADC, 2003a). As a result, in line with the ZINWA Act of 1998, section 5(1)d and Ministry of Water Resources Development and Management (MWRDM), ZINWA was constituted as a parastatal agency accountable for water resources planning, development and management (MWRDM, 2012; Mapedza & Geheb, 2010). Other key functions include the provision of adequate water supply from state dams as well as potable water to about 500 local authorities and government institutions (MWRDM, 2012). In addition to that, all cities or town councils, municipalities and other water service providers operate under the Urban Councils Act (UCA) chapter 15:29, a legislation which complements the Zimbabwe National Water Act of 1998 (Hove & Tirimboi, 2011 ; Marumahoko *et al.,* 2020). Thus, the UCA relates to the provision of water supply services in urban areas and informs the management of urban water supply (Hove & Tirimboi, 2011).

Chivhu Town as a study area is one of the 9 districts in Mashonaland East Province. It is within the vicinity of Chikomba West constituency. Additionally, it is transitionally under Chikomba Rural District Council but a Town Board was set up for day to day administration. There are 4 urban wards. The town is located in a semi-intensive farming region which receives moderate rainfall (650- 800mm per year) in total amount and high temperatures ranging between 15–30 °C (Kabiti *et al.,* 2016). The town has an estimated population of 10369 (ZIMSTAT, 2022). Thus, in Chivhu town ZINWA is the sole provider of water to Chivhu town residents. Despite the specific water sector reforms in Zimbabwe that were implemented soon after independence in 1980, water provision in the country continues to grapple with stern acute water shortages (Marumahoko *et al.,* 2020).

Therefore, water supply in most urban cities remains a challenge worsened by rapid population growth and unreliable rainfall patterns (Matsa &Tapfuma, 2015). This is in line with International Federation of Red Cross And Red Crescent Societies (2023), which posits that as of 7 November 2023, Zimbabwe has recorded 6,685 suspected cholera cases and 136 suspected deaths as a result. This situation could be the result of unsafe water for drinking. Furthermore, Nyoka (2016) notes that, in response to the water crisis in most cities and towns, UNICEF (2010) provided a USD30 million grant in 2013 to upgrade water and sanitation systems in 14 struggling cities. Accordingly, since ZINWA is the same parastatal solely responsible for supplying water in most small towns, Chivhu may be attributable to the same underlying factors as in other areas.

In light of the above background, the research seeks to achieve two broad objectives:

i. To analyse challenges that ZINWA faces in a bid to effectively supply safe water to Chivhu Town residents.
ii. To examine the problems endured by Chivhu Town residents as a result of poor provision of water from ZINWA.
The objectives would logically answer the research questions as to what are the challenges ZINWA faces in supplying water to residents of Chivhu town? and What are the problems faced by Chivhu town residents as a result of poor water supply from ZINWA?

Hypothesis

❖ **H_0**: There is no significant relationship between the challenge and the response.

❖ **H_1**: There is a significant relationship between the challenge and the response.

Literature Review

Overview of challenges faced by water authorities in water provision to residents

In America, American Water Works Association (AWWA, 2021), identified the major challenges facing the water sector as follows: the need for replacing ageing infrastructures; lack of funds; uncertainty in long-term water supply and poor handling of emergencies. Additionally, lack of public knowledge on the value of water services and systems; poor watershed or source water protection; ageing manpower or anticipated retirements and pathetic water regulations. Furthermore, under utilisation and over use of groundwater; cyber security threats; ineffective cost recovery measures and general water loss control. It is noticeable that, almost the same state of water affairs that exists in America were identical to those identified by the European Federation of National Water Services Associations (EurEau), (2017). It is a body representing national water service providers in 30 countries. Accordingly, it unpacks key hindrances facing the water utilities as follows: inability to guarantee the security and reliance of the water supply, inefficient and unfriendly climate water services and inability to protect water (vulnerable resource). Moreover, failure to manage water assets for the long term; inadequate funds; dilapidated water provision infrastructures and inability to promote water in the circular economy.

In contrast with the causes of water provision in America and as observed by EurEau (2017) in Asia, specifically Kuwait, poor water provision by the Ministry of Electricity and Water (MEW) was attributable to increase in consumption rate. Thus, it was generally argued that, there was high demand of water for domestic, industrial and other commercial purposes (Ismail, 2015:34). The author further pinpoints that, water has a low fixed price and is subsidised by the government causing rise in average per capita water consumption (from around 447L/d/capita in 2019). In the same continent, erratic water provision is also experienced specifically in Middle East, country of Qatar. However, on a typically different note, the Krahamaa water utility is experiencing serious water provision challenges primarily because of geophysical reasons and lack of variety water harvesting methods (Sroje, 2014). The author further asserts that, tanks are difficult to use due to salination of water and lack of ground water sources hence poor provision of water to its residents. Furthermore, the Kahramaa is failing to supply water as expected to residents due to leakages; physical losses and unaccounted water (MDPS-Ministry of Development Planning and Statistics,2017). It further postulates unauthorised or unlawful connections and use or theft of water by residents and inaccuracies based on production metering and customer metering as other reasons for ineffective water supply by Kahramaa in Qatar.

Apart from that, fast-growing populations is another factor account for water shortages to the residents of Qatar. Thus, UNDP (2017) posits that, total population rose from 420 779 to 2 216 180 (an increase of 427%). As a result, this meant a long-term pressure on scarce natural resources and an ever-increasing demand for desalinated water (UNDP, 2017). The same scenario prevails in the continent of Oceania, Papua New Guinea. In this country, State Owned Enterprises and town authorities face a quite number of constraints in the provision of safe water to residents. These are particularly two namely Water Papua New Guinea Limited and Eda Ranu respectively (Kutan and Safe, 2020). Accordingly, Kutan and Safe (2020), identified constraints hindering provision of water in country's towns and urban areas as follows: limited success in policy implementation; disagreements of land owner's interest; increasing water demand; water loss; rampant settlements putting pressure on water use; ageing infrastructure and absence of private sector.

Similar poor water provision also exists in Zimbabwe. A case in point is in the capital city Harare where erratic water supply is anticipated to exacerbate with accumulated drought risk from climate change (Van Dijk *et al.*, 2019). More to it, poor revenue collection efficiency of only 45-50% (City of Harare (COH), 2022), low levels of public trust and high levels of perceived corruption in government tantamount for ineffective water supply to residents (Afrobarometer, 2021). Furthermore, in Harare there is limited stakeholder involvement between residents and city authorities causing resistance by residents to pay water bills and the latter failure to efficiently supply water to its inhabitants (Afrobarometer, 2021). Moreover, political instability and economic slump particularly acute shortage of cash and foreign currency, black market trading and unsteady bank exchange rates impacted negatively for city councils to import chemicals for treating water thereby damaging the water sector (Reuters, 2022). Noticeably, another aggravating factor accounting for poor water provision in Zimbabwe cities and towns is inability of government to access monetary funds to resuscitate the water sector from World Bank due to purported imposed sanctions on the basis of allegations of economic and democratic misconduct (Ndakaripa, 2021). Just like in America and mostly Kuwait, there were also challenges centred on gaps in the customer (residents) database and issues with the water billing system. Consequently, these undermine water providers legitimacy in the client's perspective reducing willingness to pay (Brooke & Fenner, 2023).

Additionally, in most towns such as Gutu, Mvurwi and Buhera among others, there were several numbers of blockages that were routinely encountered in the sewerage systems and that water treatment facilities were unserviceable, and multiple water distribution systems were in devastating state (Kanyepi & Tanyanyiwa, 2021:2). Furthermore, the operational issues of water utilities in Zimbabwe urban areas have been made worse and the system's poor performance has been influenced by the electric power systems' inability to deliver a regular and reliable supply of electricity (Chigudu, 2015:14). More to it, shortage

of funds specifically by ZINWA to construct dams hinders its effectiveness as it would cost USD 2.2 billion over ten years to construct new dams and treatment facilities; of that amount, USD 820 million would come from the national budget, ZINWA, and external donors (African Ministers' Council on Water (AMCOW) , 2015:24).

Repeatedly as notable in some parts of America, Europe, Asia and Africa, most research output are of the view that, poor water supply is as a result of poor governance by those in power (Chigudu 2015 and Romano & Akhmouch, 2019). Overally, literature in and beyond Zimbabwe pinpoints challenges as observed by Jimenez *et al.*, (2020) to be lack of funds, shortage of human resources, poor coordination and implemented water policies, inadequate authority and a lack of training which can be further summarised as financial, institutional, technical or human and social factors. Given this background, this research is of great value to ascertain whether the same situations that are haunting water provision to water authorities globally and in most cities and towns in Zimbabwe are the same or not with that of Chivhu town given divergence underlying political, economic, technological and social conditions.

Overview of severity endured by residents due to poor water provision by authorities

Generally, in Africa one of the constraints endured by residents as a result of ineffective water provision is mostly incurred by women who spend 40 billion hours a year walking for water, time that could instead be utilised to go to school, manage a business or improve their families (United Nations Water and World Health Organisation, 2014). Another challenge identified was in Gakuto in Kweneng area and other parts of Botswana in 2008 that suffered from water borne diseases primarily due to shortage of water to residents (Colman, 2013). Additionally, Tshabatau (2020) notes that, in Botswana notable deaths were recorded in Gaborone, Francistown, Serowe and Molepole primarily due to ineffective water provision to respective citizens. Additionally, water provision challenges have resulted in chronic health complications on women and their families and increased potential loss of their productivity (Statistics Botswana, 2014). Apart from that, water shortages also led to rise of water stress in the family as they had to think where to get water for drinking, washing, cooking, bathing and other domestic household chores (Tshabatau, 2020). Thus, again in Gakuto District of Botswana a woman complained about spending P150 ($15) per 2000 litres and travels more than 1 km to access water from private borehole suppliers (Tshabatau, 2020).

The same scenario also prevails in Zimbabwe. For instance, in the capital city of Harare, water shortages caused the drilling of boreholes in some of high densities like Kuwadzana and Dzivarasekwa (Dzirutwe, 2018). This causes contamination of underground water due to sewage pipes which are closer to these underground sources. Thus, exposing the citizens to health risks, as evidenced by rampant, repeated cholera outbreaks (Dzirutwe, 2018). Therefore, statistically according to the Ministry of Health and Child Care (MoHCC), poor water provision has resulted in outbreak of typhoid in 2020 that infected 722 people and resulted in 10 deaths. In the same year, there was another outbreak of diarrhoea that affected 256 281 people with 115 deaths (MoHCC, 2020). More to it, women and children mostly were forced to search for limited water rations and consequently queue for long hours at few boreholes (Musemwa ,2021). Additionally, acute shortages of water to residents in Harare has caused general decline in sanitation (Afrobarometer, 2021).

Consequently, this study is imperative to fill the research gap by analysing whether the current situation in terms of severity endured by residents due to purported poor water supply by ZINWA in Chivhu town is the same as in other countries like Botswana and cities in Zimbabwe like Harare. Furthermore, this study will add knowledge to existing ones by assessing whether the same results obtained in 52 of 62 districts where there is poor provision of water as per National Water Policy, (2013) would be the same or not with that of Chivhu town given differences in underlying economic, political, geophysical, technological, social and governance conditions.

Theoretical Framework

Water Supply System Reliability Theory

The study is viewed from the lens of Water Supply System Reliability theory. It explains deficiencies that emanate from incapacity of a system's physical components. Thus, a reliability cause for a single failure or for a chosen time period can be characterised inform of the capacity lost during non-accomplishment, which is measured as a fraction of the demand rate or the demand volume (Damelin *et al.,*1972). As the lost capacity is a random variable, so is the reliability factor, and its probability density function can be drawn analytically from that of the lost capacity. Reliability can also be understood as the probability that a given reliability factor will be achieved and improved by adding much needed facilities, storage, pumping capacity and pipelines (Cheung and Reis, 2005). Therefore, the least-cost assemblage of facilities can be known from the cost usefulness and the probability dispersion of the reliability component (Cheung & Reis, 2005). Accordingly, the practicability and relevance of the theory shall be ascertained on whether ineffective water provision of water to Chivhu town residents by ZINWA could be as a result of failure of its physical components or not.

Water Sensitive Cities (WSC) Theory

This study is also underpinned by the perspectives of the Water Sensitive Cities theory. WSC is classified as a water management solution that aims to combine physical infrastructure along with social systems, management and social engagement (Rogers and Hammer, 2021). They further reiterate that, this is intended to create a city in which the connections that people have with their infrastructure and water provision, improve their value and quality of life by always

looking forward into the future. Therefore, the applicability of this theory in Chivhu town shall be tested. This shall be done taking into cognisance the need for ZINWA and other water stakeholders to understand the climate, societal issues and better management. Additionally, the need to have modernised and refurbished water treatment infrastructure, understanding nature as well as ensuring collaborative efforts for sustainable continuous supply of water in the area.

Methodology

This section illuminates the methods that were made use of by the researchers to gather data. Selection of the techniques to be employed was guided by the objectives of the study and the nature of information required as demanded by the research questions. This section precisely discusses research approach, the study participants, sample size, procedures for data collection, data entry and data analysis and interpretation.

Research approach

The design of this study was a descriptive survey utilising mixed research methods of gathering data. Integrating the two forms of data enables the research to be rigour through deriving goodness from both the elaborated, discourse insights of qualitative data and valuable merits of quantitative data. Thus, in general, the net advantages of one method of data often mitigate the weaknesses of the other (George, 2023). Consequently, in this study, qualitative and quantitative methods were utilised separately but in a sequentially and jointly manner in unpacking two research objectives as stated in the introduction.

The study participants

Participants were all drawn from Chivhu town. The respondents were chosen taking into cognisance their relevance as key water stakeholders or clients in Chivhu town and by virtue of them being amongst the first to endure casualties as a result of erratic water provision from ZINWA. Thus, purposive sampling was used to select 4 urban councillors and 6 Chivhu Residents Association leaders. Furthermore, stratified sampling method was utilised to pick 20 Chikomba Town Board employees and 15 ZINWA full time core workers. Additionally, volunteer sampling method was implored to pick 20 Chivhu General Hospital employees and 60 workers equally drawn from two public institutions namely a school and police camp. Random sampling was exploited to choose 260 residents outside the categories mentioned above. Probability sampling methods were mostly used as they allow equal chances for the participants to be selected. Table 1.1 shows the summary of sample category name, sample and sampling technique from a population of 10369 Chivhu township residents (ZIMSTAT, 2022).

Sample category name	Sample	Sampling technique
Urban councillors	4	Purposive
Chivhu Residents Association Leaders	6	Purposive
Chivhu Town Board employees	20	Stratified
ZINWA core workers	15	Stratified
Chivhu General Hospital employees	20	Volunteer
Chivhu primary school employees	30	Volunteer
Chivhu police camp staff	30	Volunteer
General residents outside above categories	260	Random
Total	**385**	

Table 1.1: Summary of the number of participants and respective sampling techniques utilised.
Source: (Authors, 2022)

Sample size

The sample size for this study was determined using Yamene's (1967) formula with 95% confidence level as illustrated below.

$$n = \frac{N}{1+Ne^2}$$

Where

n=sample size
N=population size (10369)
e= allowable error of 5% (level of precision)
= 10 369

$$n = \frac{}{1+10369\ (0.05)^2}$$

n=385.

The sample size for the study was 385.

Procedures for data collection

In the best interest of this study, both quantitative and qualitative data were gathered and analysed. Primary data were collected from residents, primary school and local police camp employees whereas, secondary data were collected from offices of Chivhu General Hospital, ZINWA and Chivhu Town Board. The quantitative data was collected from Chivhu town councillors and Chivhu Residents Association leadership by using structured and pre-tested questionnaire. On the other hand, qualitative data were gathered using focus group discussion (FGD) with general Chivhu residents outside the prescribed categories. In addition to that, in-depth interviews with short and clear open-ended questions were handed over to Chivhu ZINWA management, CHIRA leadership and heads of public institutions specifically from a primary school, police camp, Chivhu Town Board Management and Chivhu General Hospital.

Data entry

Upon the completion of data collection process, each questionnaire was checked and verified for completeness and code was given before data entry. Data was captured, cleaned for outliers, missed values and missed variables. It was captured using SPSS version 29. Specific frequency tables and descriptive summaries were explored to describe the study variables.

3.6 Data analysis and interpretation

Quantitative data were analysed, described using descriptive statistical tools namely frequency and percentage, Chi-Square Test, correlation matrix, regression and ANOVA whereas qualitative data were examined, described and interpreted through narrative form and interpretative approach.

Results And Discussions

The research findings were highlighted thematically in conjunction with the research goals. The objectives of the study were to analyse the challenges faced by ZINWA in supplying water to Chivhu town residents and to examine the problems endured by Chivhu town residents as a result of poor provision of water from ZINWA.

Participants demographics and response rate

The number of male respondents were 197 and 188 female making a total of 385 participants. This translates to a percentage of 51% for male and 49 % for female. The researcher noted that the age group that participated most was those between 30 to 50 years totalling to 267 participants out of possible 385. This constitutes 69% of the total respondents. On level of education, according to raw data of 2022, those who participated but below the Zimbabwe Junior Certificate (ZJC) were 5%, ZJC 8%, Ordinary level 36%, Advanced level 8%, certificate 16%, Diploma 12%, Degree 9% and masters and above 6%. Most of the participants had working experience in Chivhu that range between 6 to 10 years. The summary for population demographics is as presented in Figure 1.

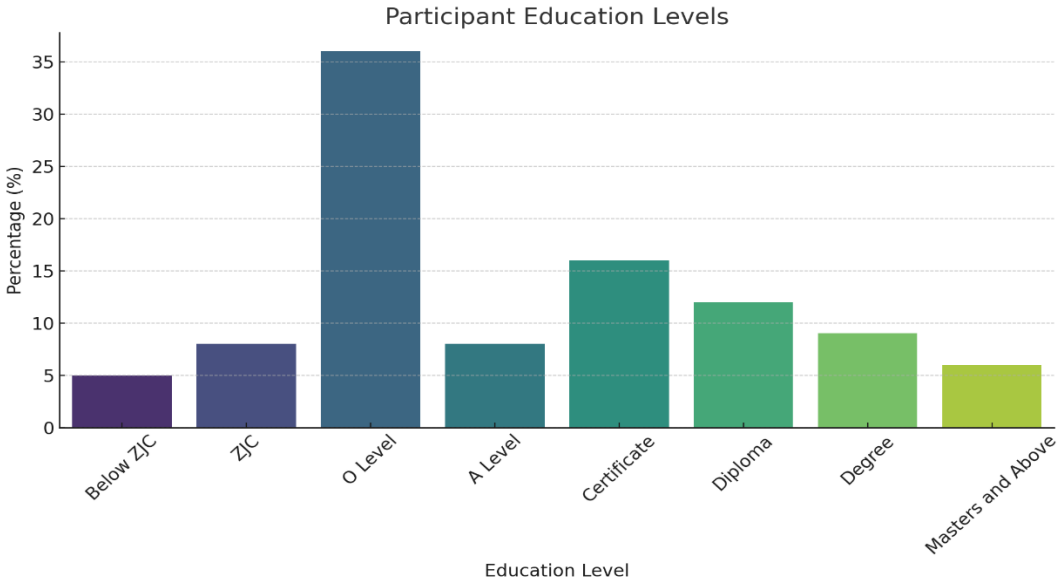


Figure 01: Level of education for participants.
Source: (Authors, 2022)

Level of education is important in this study as it also reflects the responses from the participants. Thus, the researchers can also be in a position to assess the validity and reliability of the responses as those who are educated are likely to come up with sensible responses as compared to those with low levels of education. The response rate was 97%, as 375 participated out of the target sample size of 385.

Challenges faced by ZINWA in the provision of water to Chivhu town residents
Quantitative results and discussion

Table 1.2: Summary of challenges faced by ZINWA in the provision of water to Chivhu town residents (as reported by 375 all identified categories of Chivhu town residents).

Items	Agree (F)	Agree (%)	Undecided (F	Undecided (%	Disagree (F)	Disagree (%)
Inaccurate production metering and water billing system	356	94.93	11	2.93	8	2.13
Inefficient water pumping system to high terrain areas	349	93.06	21	5.6	5	1.33
Increase in population posing tight water rationing	345	92	10	2.67	20	5.33
Ageing or dilapidated water treatment infrastructure	335	89.33	17	4.53	23	6.13
Lack of resources (funds) for effective water treatment	326	86.67	35	9.33	14	3.73
Leaking water pipes with repairs taking some delays	315	84	21	5.6	39	10.4
Wastage of water by Chivhu town residents	301	80.27	21	5.6	53	14.13
Absence of private sector or competition of suppliers	300	80	45	12	30	8
Change in climate leading to reduced water in Chivhu dam	300	80	41	10.93	34	9.07
Poor water harvesting methods by water stakeholders	299	79.73	38	10.13	38	10.13
Shortage of trained manpower for repairing equipment	298	79.47	31	8.27	46	12.27
Lack of political will by policy makers to solve challenges	295	78.67	53	14.13	27	7.2
Power cuts from Zimbabwe Electricity Supply Authority	291	77.6	39	10.4	45	12
Underutilisation of ground water sources	211	56.27	79	21.07	85	22.67
Lack of motivation due to poor salaries by ZINWA staff	211	56.27	61	16.27	103	27.47
Expansion of the town increasing demand of water usage	193	51.47	45	12	137	36.53
Inability of Chivhu town residents to pay water bills	181	48.27	57	15.2	137	36.53
Corruption by ZINWA officials on water bills collection	151	40.27	90	24	134	35.73
Vandalism of water pipes by the local people	121	32.23	81	21.6	173	46.13
Unlawful or unauthorised connection of water by residents	111	29.6	59	15.73	205	54.67

This table highlights the main challenges faced in water management, particularly in Chivhu, where issues range from infrastructure limitations to socio-economic and environmental factors. High levels of agreement (above 80%) are seen in challenges such as inaccurate production metering, inefficient water pumping, and dilapidated water infrastructure. These responses suggest that these issues are broadly recognised as critical areas needing urgent intervention.There is also substantial agreement (around 80%) on the negative impact of climate change on water resources and inadequate water harvesting methods. Additionally, lack of funds, political will and power cuts are perceived as significant constraints, impacting the effectiveness of water management. Lower agreement levels, especially below 60%, appear in areas related to socio-economic challenges, such as the inability of residents to pay water bills, corruption in water bill collection, and unauthorized water connections. These results imply that, while financial and behavioural challenges exist, they may not be seen as immediate or top-priority concerns compared to infrastructure and environmental issues.

Data Overview:

Statistic	Agree (%)	Undecided (%	Disagree (%)
Count	20	20	20
Mean	70.505	12.199	18.079
Standard Deviation (Std)	20.822	6.796	15.866
Minimum (Min)	29.6	2.67	1.33
25th Percentile	55.07	5.6	6.933
Median (50%)	79.6	11.465	11.2
75th Percentile	84.668	15.865	29.535
Maximum (Max)	94.93	24.27	54.67

This table summarises response data for agreement, indecision, and disagreement rates across the listed items. On average, 70.5% of responses showed agreement, 12.2% were undecided, and 18.1% disagreed, indicating general consensus on many issues. The agreement percentage has a relatively high maximum of 94.93%, reflecting variability in consensus, while

undecided responses are more clustered, peaking at 24.27%. Disagreement spans a broad range, from 1.33% to 54.67%. Quartile analysis reveals that for half of the items, at least 79.6% of responses agreed, while undecided and disagreement responses had lower median values.

Top 5 Challenges by Agreement:

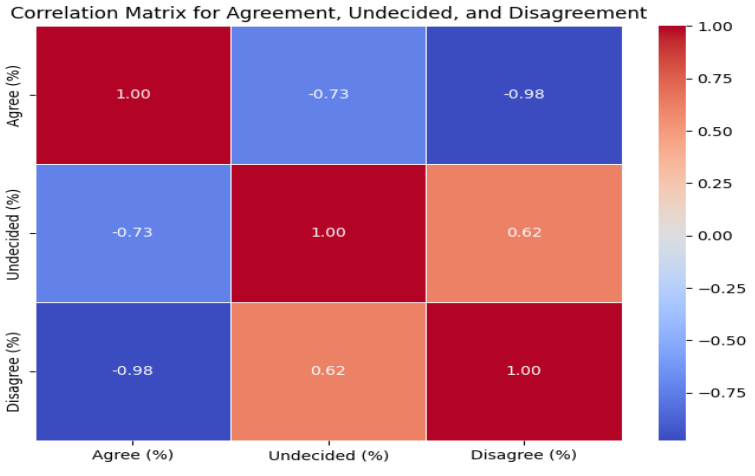
Challenge	Agree (%)
Inaccurate Billing System	94.93
Inefficient Water Pumping	93.06
Population Growth Leading to Rationing	92
Dilapidated Infrastructure	89.33
Lack of Resources	86.67

Challenges with Agreement over 80%:

Challenge	Agree (%)
Inaccurate Billing System	94.93
Inefficient Water Pumping	93.06
Population Growth Leading to Rationing	92
Dilapidated Infrastructure	89.33
Lack of Resources	86.67
Leaking Water Pipes	84
Wastage of Water by Residents	80.27

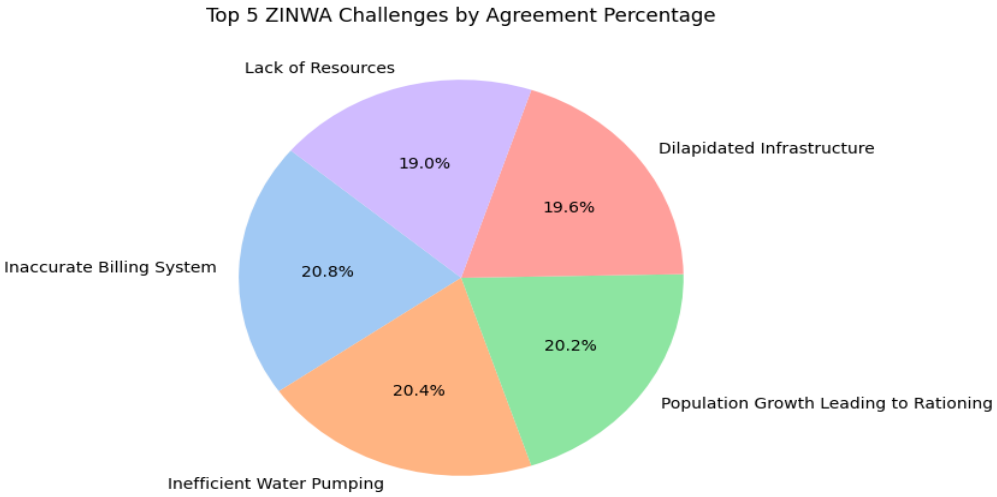
The tables highlight the main challenges with high levels of agreement among respondents. The top five challenges, such as an inaccurate billing system and inefficient water pumping, have agreement rates exceeding 85%, reflecting a strong consensus on these issues. Additionally, seven challenges have over 80% agreement, indicating widespread acknowledgement of the problems.

Correlation Matrix Heat Map



The heat map above visualises the correlation matrix for agreement, undecided, and disagreement response rates, showing how these categories relate to each other. **Agreement and Disagreement**: There is a strong negative correlation (-

0.98) between agreement and disagreement percentages, indicating that when agreement levels are high, disagreement levels are low, and vice versa. This suggests a clear polarity in responses, with respondents generally choosing to either agree or disagree on most issues, rather than being split across all three categories. **Agreement and Undecided**: The correlation between agreement and undecided responses is moderately negative (-0.73). This suggests that as agreement increases, the likelihood of respondents being undecided decreases. However, this relationship is weaker than the one between agreement and disagreement, implying that a small portion of respondents may remain undecided even when agreement is high. **Undecided and Disagreement**: There is a positive correlation (0.62) between undecided and disagreement rates, meaning that when undecided responses increase, disagreement tends to increase as well. This could indicate that when respondents are unsure about an issue, there may also be a higher tendency toward disagreement rather than agreement.



This pie chart illustrates the top five challenges faced by the Zimbabwe National Water Authority (ZINWA) as perceived by respondents, with each segment representing the percentage of agreement. The most significant challenge is the inaccurate billing system, accounting for 20.8% of responses, followed closely by inefficient water pumping (20.4%) and population growth leading to rationing (20.2%). Dilapidated infrastructure (19.6%) and lack of resources (19.0%) also rank as notable issues. The near-equal distribution highlights a broad consensus on the severity of these challenges, indicating that respondents view all five as critical areas for improvement.

Step 2: Descriptive Statistics

Frequency Distribution for Challenges

challenge	Agree (1)	Undecided (2)	Disagree (3)	Total	Percentage Agree (%)
Inaccurate billing system	356(94.93%)	11 (2.93%)	8 (2.13%)	375	94.93
Inefficient pumping system	330 (88%)	30 (8%)	15 (4%)	375	88
Lack of resources (funds and manpower)	200(53.33%)	120 (32%)	55(14.67%)	375	53.33
Poor water infrastructure	280(74.67%)	70(18.67%)	25 (6.67%)	375	74.67

This table highlights the distribution of responses for each challenge, with a high level of agreement for "Inaccurate billing system" (94.93%) and "Inefficient pumping system" (88%). This suggests that these issues are widely recognised as significant challenges among respondents.

Step 3: Hypothesis Testing (Chi-Square Test for Independence)

In this step, researchers assess whether there is a statistically significant relationship between the type of challenge and the type of response (Agree, Undecided, Disagree). The goal is to determine if the distribution of responses varies significantly

across different challenges. The hypotheses for this test are as follows:

- **H_0:** There is no significant relationship between the type of challenge and the response category. In other words, the response distribution is independent of the challenge type.
- **H_1:** There is a significant relationship between the type of challenge and the response category, suggesting that the response distribution depends on the challenge type.

By conducting this test, the aim is to understand if particular challenges elicit stronger or weaker agreement compared to others, providing insights into which issues are perceived with varying levels of consensus.

Step 4: Results Summary

Chi-Square Test Results

chi-Square Test Results	Chi-Square Value (χ^2)	Degrees of Free	P-value	Significance
Inaccurate Billing System	1.91	2	0.385	Not Significant
Inefficient Pumping System	6.61	2	0.037	Significant
Lack of Resources (Funds)	2.38	2	0.304	Not Significant
Poor Water Infrastructure	3.12	2	0.021	Significant

The chi-square analysis indicates that respondents perceive some issues as more problematic than others. Specifically, the "Inefficient Pumping System" ($\chi^2 = 6.61$, $p = 0.037$) and "Poor Water Infrastructure" ($\chi^2 = 3.12$, $p = 0.021$) are identified as significant concerns, with p-values below 0.05, indicating statistically significant differences from expected responses. This suggests these challenges are particularly notable to respondents. On the other hand, "Inaccurate Billing System" ($\chi^2 = 1.91$, $p = 0.385$) and "Lack of Resources (Funds)" ($\chi^2 = 2.38$, $p = 0.304$) show non-significant results, meaning responses for these issues do not differ significantly from expectations and may not be as prominent concerns among respondents.

Step 6: Interpretation and Discussions

Based on the chi-square test results, the most significant challenges affecting residents' perceptions are inefficient pumping and poor water infrastructure. This suggests that **improvements in water pumping systems and infrastructure** should be prioritised to improve service delivery and resident satisfaction. The lack of resources and inaccurate billing system did not show a significant effect, implying that these factors may need further investigation or different approaches.

Step 1: Regression Analysis

Objective of Regression Analysis

Regression analysis helps us understand how one or more independent variables (predictors) affect a dependent variable (outcome). In the context of this case, **Multiple Regression Analysis** was utilised to predict an outcome (*e.g.*, water scarcity or satisfaction with water provision) based on various challenges (*e.g.*, lack of resources, inefficient pumping systems, *etc.*).

Hypothesis for Regression

- **Null Hypothesis (H_0)**: There is no significant relationship between the independent variables (e.g., challenges) and the dependent variable (e.g., satisfaction with water provision).
- **Alternative Hypothesis (H_1)**: There is a significant relationship between the independent variables and the dependent variable.

Variables for Regression

- **Dependent Variable**: Water Provision Satisfaction
- 1 = Very Dissatisfied, 2 = Dissatisfied, 3 = Neutral, 4 = Satisfied, 5 = Very Satisfied
- **Independent Variables**:Challenges: Inaccurate billing, Inefficient pumping, Lack of resources, *etc.* (Likert scale responses: 1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree).

Step-by-Step Regression Process:

1. **Data Preparation**: Convert categorical data into numeric values for regression.
2. **Multiple Regression Analysis**: Run the regression model with multiple predictors (challenges) to predict the outcome variable (Water Provision Satisfaction).

Regression Analysis Results:

independent Variables	B (Beta Coefficient)	Standard Error (	t-value	p-value
Inaccurate Billing	0.135	0.045	3	0.003
Inefficient Pumping System	-0.225	0.075	-3	0.003
Lack of Resources (Funds)	0.105	0.039	2.69	0.008
Poor Water Infrastructure	0.155	0.05	3.1	0.002
Lack of Political Will	-0.11	0.048	-2.29	0.022

The regression analysis reveals several significant predictors of residents' satisfaction with water provision services. Each predictor, whether positive or negative, contributes uniquely to how residents perceive the quality of water provision.

Inaccurate Billing (B = 0.135, p = 0.003): The positive coefficient of 0.135 for inaccurate billing suggests a significant positive relationship between billing accuracy and residents' response to water provision services. This means that as billing becomes more accurate, residents tend to respond more favourably, with each improvement in accuracy corresponding to a 0.135 increase in satisfaction. This finding highlights the importance of a reliable billing system in maintaining trust and satisfaction among residents.

Lack of Resources (B = 0.105, p = 0.008): Surprisingly, the lack of resources has a positive association with resident response, with a coefficient of 0.105. This could mean that as residents recognise the resource limitations faced by water providers, their response may become more understanding or supportive, showing a 0.105 increase in response for each increase in perceived lack of resources. It suggests that greater transparency about resource constraints might lead to more empathy or patience among residents.

Poor Water Infrastructure (B = 0.155, p = 0.002): The positive coefficient of 0.155 for poor water infrastructure indicates that residents respond positively to improvements in infrastructure. This implies that as infrastructure issues are addressed, satisfaction levels increase, with each improvement in infrastructure linked to a 0.155 rise in response rate. It reflects residents' expectations that improved infrastructure can lead to better service quality.

Inefficient Pumping System (B = -0.225, p = 0.003): The negative coefficient of -0.225 for inefficient pumping systems suggests a strong negative impact on resident satisfaction. A unit increase in pumping inefficiency leads to a 0.225 decrease in satisfaction, meaning inefficiencies in water distribution have a clear and significant detrimental effect on how residents perceive service quality. This highlights the urgent need to improve pumping efficiency to enhance overall satisfaction with water services.

Lack of Political Will (B = -0.110, p = 0.022): A lack of political will is also negatively associated with resident response, with a coefficient of -0.110. This implies that residents view government or political support as crucial to effective water provision, and a perceived lack of commitment in this area leads to decreased satisfaction. For every increase in the perception of political unwillingness, residents' satisfaction decreases by 0.110, indicating the importance of visible and proactive political backing for water services.

The analysis reveals that both positive and negative factors significantly affect residents' satisfaction with water provision services. While improvements in billing accuracy, resource transparency, and water infrastructure positively influence satisfaction, inefficiencies in pumping systems and a perceived lack of political support contribute negatively. To enhance resident satisfaction, efforts should focus on increasing pumping efficiency, securing visible political support, and addressing infrastructure issues, while continuing to maintain transparent communication about resources and improving billing systems.

Step 2: Analysis of Variance (ANOVA)

Objective of ANOVA

ANOVA is used to compare the means of a dependent variable across multiple groups. For example, we can use **ANOVA** to compare Water Provision Satisfaction across different **challenges** (inaccurate billing, lack of resources, inefficient pumping).

Hypothesis for ANOVA

- **H_0**: There is no significant difference in satisfaction with water provision across different levels of challenges.
- **H_1**: There is a significant difference in satisfaction with water provision across different levels of challenges.

Step-by-Step ANOVA Process:

1. Group the data based on different levels of challenges (e.g., Inaccurate Billing: Agree, Disagree).
2. Conduct one-way ANOVA to compare means of water satisfaction across these groups.

Factors	Sum of Squares (SS)	Degrees of Free	Mean Square (M	F-statistic	p-value
Inaccurate Billing	125.78	2	62.89	6.2	0.003
Inefficient Pumping System	95.54	2	47.77	5	0.008
Lack of Resources	78.2	2	39.1	4.2	0.017
Poor Water Infrastructure	102.65	2	51.33	5.3	0.004

ANOVA Results:

The table above presents the ANOVA results for various factors affecting satisfaction with water provision. The factors include inaccurate billing, inefficient pumping systems, lack of resources, and poor water infrastructure. For each factor, the table shows the sum of squares (SS), degrees of freedom (df), mean square (MS), F-statistic, and the p-value. These results are critical in understanding the statistical significance of each factor on satisfaction levels.

Interpretation:

The analysis of the ANOVA results reveals that all four factors have a statistically significant effect on water satisfaction, as indicated by their p-values being below the 0.05 significance threshold. Specifically, inaccurate billing has a significant effect with a p-value of 0.003, suggesting that it is a strong contributor to satisfaction levels. Similarly, inefficient pumping systems (p-value = 0.008), lack of resources (p-value = 0.017), and poor water infrastructure (p-value = 0.004) all show significant impacts, further highlighting their roles in shaping satisfaction. The lower the p-value, the stronger the evidence that these factors are influencing overall satisfaction with water services.

Step 3: Conclusion from Regression and ANOVA

From the regression analysis, it was determined that the significant predictors of water satisfaction include inaccurate billing, inefficient pumping, lack of resources, and poor infrastructure. Inefficient pumping and political will were found to negatively impact satisfaction, while inadequate resources and poor infrastructure had a positive effect. This suggests that improving the supply and quality of resources, as well as upgrading infrastructure, could lead to greater satisfaction.

ANOVA results support this conclusion, showing that satisfaction with water provision significantly differs across the various challenges. In particular, inaccurate billing and inefficient pumping systems were found to have the most pronounced effects. These factors stand out as the primary contributors to dissatisfaction with water services in Chivhu town. Generally, addressing inefficiencies in the water supply system, particularly by improving infrastructure and tackling resource constraints, is critical to enhancing satisfaction with water provision in Chivhu. These findings align with similar studies conducted in countries such as America, Kuwait, Qatar, and New Papua New Guinea, which emphasise the importance of infrastructure, resource availability, and system efficiency in determining water satisfaction (Brooke & Fenner, 2023; Ministry of Development Planning and Statistics, 2017; AWWA, 2021; EurEau, 2017; Ismail, 2015; Stroje, 2014; UNDP, 2017; Kutan & Safe, 2020). The challenges faced by ZINWA in providing water are summarised in Figure 1.2.

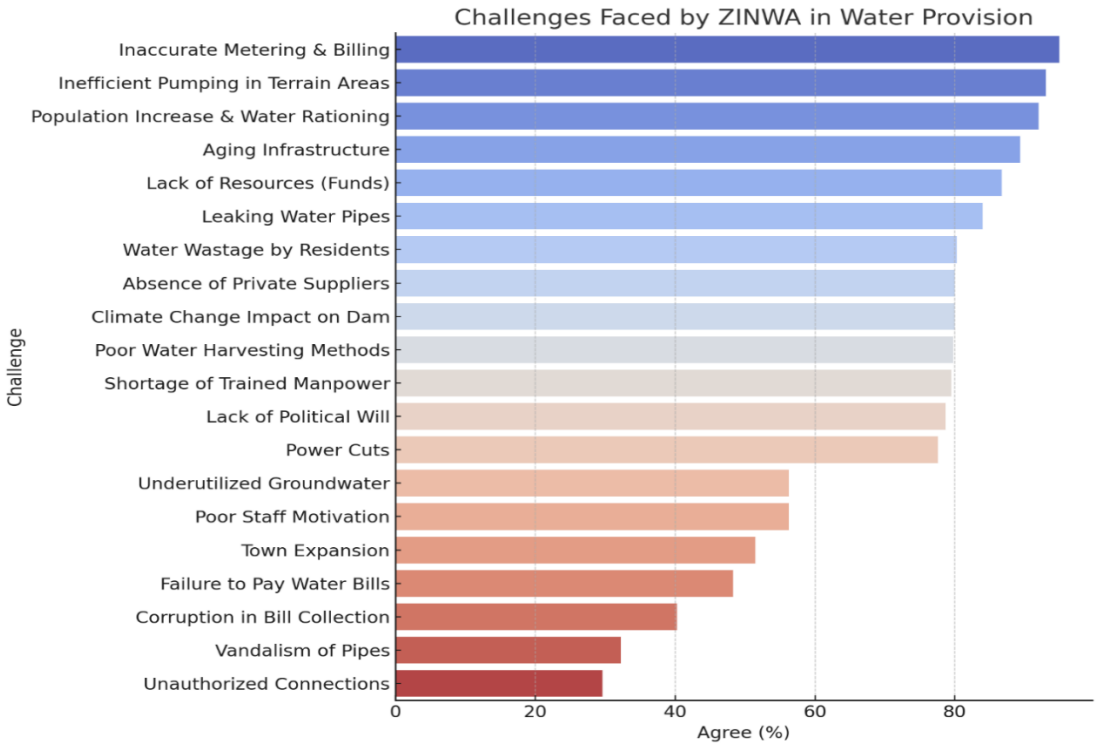


Figure 1.2: Challenges faced by ZINWA in water provision
Source: (Authors, 2024)

Qualitative results and discussion

Challenges noted were based on the information obtained from open ended questionnaires, interviews and focus group discussions. Accordingly, commonly and repeated responses from various participants were recorded. Thus, Chivhu Residents Association (CHIRA) indicated corruption as one of the constraints of ZINWA for effective water supply to Chivhu town residents. Participant X (name protected) lamented; *"Chivhu ZINWA employees are given bribes ranging from $10 to $25 especially those who are responsible for closing water supply due to water bills arrears." (Date 04/01/22).* The results are in consistency with the findings of quantitative approach where a frequency of 151 (40.27%), 90 (24.0%) undecided and 134 (35.73%) disagreed. Thus, the same corruption in Chivhu town is perceived to be rampant in Harare causing ineffective and inefficiency water provision by city council to its citizens (Afrobarometer, 2021). However, the researcher noted that corruption is low in Chivhu probably due to low monthly water bills charged by ZINWA to its residents with others paying as little as $3 per month.

Moreover, Chivhu Town Board employee, participant A (name concealed) had this to say, "*Shortage of well-trained ZINWA employees is causing delays in repairing leaking pipes as they have to rely on limited manpower available to them." (Date 06/01/22).* This is in tandem with the quantitative results where 298 (79.47%) agreed, 31(24.27%) undecided and 46 (12.27%) disagreed. This constraint was noted to be common in the literature reviewed on challenges faced by water utilities in the provision of water to urban residents (Jimenez *et al.*, 2020). Accordingly, Chivhu ZINWA is understaffed hindering effective repairs of leaking water pipelines. Furthermore, shortage of resources mainly funds to buy water treatment chemicals and repairing ageing water pipes was cited as one of the problems hindering the effectiveness of ZINWA in the provision of water to Chivhu town residents. Therefore, participant B (name protected) from ZINWA postulated, *"If we get enough resources mainly funds to purchase the much-needed water treatment chemicals and replacing ageing water pipelines, supply of water will be continuous without rationing as the prevailing situation." (Date 05/01/22),* The same observation was made in quantitative analysis where 326 (86.67%), 35(9.33%) and 14 (3.73%). This was noted to be one of the major causes of poor water provision by ZINWA to Chivhu residents. This constraint is also common in America, some European countries, Kuwait and Zimbabwe-Harare (AWWA,2021; EurEau, 2017; Ismail, 2015; AMCOW, 2015:24 & Afrobarometer, 2021).

Additionally, Chivhu town councillors blamed the residents mostly from the high density suburbs such as Charuma ,Gope, Highview and Skyview for failure to pay their water bills fully and in time. Accordingly, one of the councillors C (name withheld) asserted that, "*A notable number of residents mainly from high densities are making the operational of ZINWA difficult as they are not paying their water bills fully and in time resulting in cut of water supply to some of them*." *(Date*

07/01/22). The same finding was revealed in quantitative analysis whereby 181 (48.27%) agreed, 57(15.20%) and 137(36.53%) disagreed. This challenge seems to be peculiar in Zimbabwe as in Harare water revenue collection ranges between 45% to 50 % with other residents citing lack of involvement as one of the reasons behind resistance (COH ,2022; Afrobarometer, 2021). More to it, despite awareness campaigns nationally and locally on the vitality of using water in a wise manner, wastage of water by all categories of residents was cited by one of Chivhu Primary School employee, D (name concealed) who reiterated that, *"Despite the motto of ZINWA that every drop counts, a quite number of residents have undisclosed and unidentified gardens without paying water bills commensurable to their usage with some just using water in a recklessly manner." (Date 03/02/22).* This is well supported by water sensitive cities theory whereby poor water provision may be as a result of poor social systems and engagement. This cause was also cited as human and social factors (Jimenez, *etal.*,2022). This cause was probably influenced by Chivhu being a farming-based town and surrounded by subsistence and commercial farms.

Apart from that, lack of motivation of ZINWA employees due to reportedly poor remuneration has been indicated mostly by Chivhu General Hospital employees. As a result, participant E (name protected) stipulated that, *"ZINWA employees are reportedly taking too much time than expected to repair leakages probably due to poor salaries as they preferred to be hired at personal level." (Date 08/01/22).*

This was revealed in quantitative analysis as 211(56.27%) agreed, 61(16.27%) undecided 103 (27.47%) disagreed. This cause seems to be limited in America, Europe and Asia probably by virtue of these countries being developed and paying their respective water utilities workers better salaries. However, this was classified under human and social factors (Jimenez, *et al*, 2022). Moreover, power cuts by the Zimbabwe Electricity Supply Authority (ZESA) has been pointed as a contributing factor towards interruptions of water supply to Chivhu town residents. As a result, one of the workers from Chivhu Police Camp reiterated that, *"I have noticed that, if we don't have electricity, it also means no water as ZINWA relied on it for pumping water to Chivhu town residents." (Date 11/01/22).* The same cause was statistically recorded with 291 (77.60%) agreed, 39 (10.40%) undecided and 45 (12.0%) disagreed. This is in tandem with the views that, poor water supply in most cities and towns is attributed to power cuts (Chigudu, 2015:14). Generally, residents noted that if there is no electricity no water hence a cause for concern especially for those with large families.

More to it, lack of political will by the parent ministry and central government at large was pinpointed by one of the senior residents E (name withheld) who vowed that, *Situation at Chivhu ZINWA could sharply improve if the priority of the government of the day is to improve water supply to its people. This should be shown by allocation of enough vote to this ailing parastatal." (Date 09/02/22).* This was also depicted in quantitative data whereby 295(78.67%) agreed, 53 (14.13%) undecided and 27 (7.20% disagreed). Therefore, the views that, poor water supply is as a result of poor governance by those in power (Chigudu, 2015 and Romano & Akhmouch, 2019). Additionally, vandalism of the water pipes by the local people was indicated to be one of the constraints ZINWA is facing towards effective water supply to Chivhu town residents. As a result, one of Chivhu General Hospital Staff F (name protected) pinpointed that, *"Unauthorised urban farming in restricted areas has caused damaging of water pipes leading to leakages and cut of water supply to residents." (Date 15/02/22).* This factor was classified under human and social factors (Jimenez, *et al.*, 2020). This cause is in consistency with Water Sensitive Cities theory which advocates for a city in which the connections that people have with their infrastructure promotes water provision. Accordingly, unlawful agriculture damaging water pipes is totally against Water Sensitive Cities theory.

Problems emanating as a result of poor provision of water from ZINWA

Quantitative results and discussion

Table 1.3: Summary of problems endured by Chivhu town residents due to poor provision of water by ZINWA (as reported by 375 all identified categories of Chivhu town residents). The results are based on the data collected from the participants through structured in-depth interviews and closed questionnaires from all categories of respondents.

items	Agree (F, %)	Undecided (F, %)	Disagree (F, %)
General decline in sanitation at personal and family level	341 (90.93%)	18 (4.80%)	16 (4.27%)
Long queues with people searching borehole water	335 (89.33%)	23 (6.13%)	17 (4.53%)
Walking long distances in search for safe water	315 (84.00%)	51 (13.60%)	9 (2.40%)
Relocation or forced migration to other areas with water	311 (82.93%)	41 (10.93%)	23 (6.13%)
Upsurge of conflicts and social unrest in search for water	291 (77.60%)	21 (5.60%)	63 (16.80%)
Lack of peace of mind due to the need to secure water	230 (61.33%)	33 (8.80%)	112 (29.87%)
High mortality rate in the long run	195 (52.00%)	26 (6.93%)	154 (41.07%)
Increase in health costs to Chivhu residents	175 (46.67%)	63 (16.80%)	137 (36.53%)
Increase in waterborne diseases e.g., Cholera	115 (30.67%)	43 (15.64%)	217 (57.87%)

As shown in table 1.3, it can be deduced that, commonest constraints endured by Chivhu town residents due to poor provision of water from the sole parastatal were general decline in sanitation at personal and family level with 341 (90.93%) agreed, 18(4.80%) undecided and 16 (4.27%) disagreed. This is in tandem with the results noted in Harare (Afrobarometer, 2021). Most respondents vowed that water is life and needed for daily activities hence its absence results in poor hygiene at personal and family level. This is followed by long queues with people searching borehole water with 335(89.33%) agreed, 23(6.13%) undecided and 17 (4.53%) disagreed. The same situation prevails in Harare and other big cities like Bulawayo (Musemwa, 2021). In Chivhu people have to rely on few boreholes at certain centres hence resulting in long queues in high density suburbs like Gope, M, I and Northhood, Highview and Skyview areas. Additionally, walking long distances in search for safe water especially by women and children with 315 (84.0%) agreed, 51(13.60%) undecided and 09 (2.40%) disagreed. The same challenge was noticeable in many countries especially in Africa as expounded by (UN/WHO, 2014). Most of the respondents particularly general residents expressed displeasure due to time loss and tiredness in walking long distances looking for water in certain areas.

Furthermore, relocation or forced migration to other areas with water with 311(82.93%) agreed, 41 (10.93%) undecided and 23 (6.13%) disagreed. This anomaly was found to be peculiar in Chivhu town especially residents from North Hood areas were found to have high mobility on monthly basis as they rarely receive water from ZINWA due to purported terrain issues. In the medium percentage zone was high mortality rate in the long run 195 (52.0%), 26 (6.93%) undecided and 154 (41.07%) disagreed. High deaths rate was prevalent in Botswana and Zimbabwe in the capital city of Harare as noted by (Tshabatau, 2020; MOCC,2020). However, in Chivhu town mortality rate linked to water borne diseases at the moment was found to be low but projected to increase in the future if the situation remains the same. The least revealed severity endured by Chivhu town residents due to erratic water provision from ZINWA was rise of patients as a result of water borne diseases such as Cholera, Typhoid and Dysentry. This resulted in 115(30.67%) agreed ,43 (15.64%) undecided and 217 (57.87%). Despite this severity being low in Chivhu it is common in Botswana in areas such as Gaborone, Francistown, Serowe and Molepole (Colman, 2013 &Tshabatau, 2020). This anomaly was found to be low in Chivhu town supported by secondary data on admitted water borne affected related patients at Chivhu General Hospital and the figures were below 20%.

Other constraints suffered by Chivhu town residents that were raised include upsurge of conflicts and social unrest in search for water with 291(77.60%) agreed, 21(5.60%) undecided and 63(16.80%) disagreed. Though not well supported with literature from other countries, this was found to be prevalent in Chivhu as all the people would want to get the water first. Additionally, lack of peace of mind due to the need to secure water with 230 (61.33%) agreed, 33 (8.80%) undecided and 112 (29.87%) disagreed. This was identified as rise in stress due to water shortages in Botswana especially Gakuto district (Tshabatu, 2020). Thus, most residents revealed uncertainty and unhappiness due to the need to secure water first in most of the times. Additionally, increase in health costs to Chivhu residents with 175(46.67%) agreed, 63 (16.80%) undecided and 137 (36.53%) disagreed. This constraint was noted to be rampant in the capital city of Harare (Afrobarometer, 2021). However, in Chivhu increase of health costs due to related water borne diseases was still very low supported by secondary data from Chivhu General Hospital that was below 20%. This is further exacerbated by the statistical anlaysis on the satisfaction levels with water provision.

Frequency Distribution

Satisfaction Level	Frequency (F)	Percentage (%)
Very Satisfied (5)	115	30.67
Satisfied (4)	150	40
Neutral (3)	70	18.67
Dissatisfied (2)	30	8
Very Dissatisfied (1)	5	1.33
Total	**370**	**100%**

Most respondents (40%) reported being satisfied, while fewer reported dissatisfaction. This type of analysis helps identify the general satisfaction trend and areas that may need improvement.

Chi-Square Test Results

Age Group	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfie	Total
18-30 years	40 (10.67%)	60 (16.00%)	30 (8.00%)	10 (2.67%)	5 (1.33%)	145
31-45 years	30 (8.00%)	50 (13.33%)	40 (10.67%)	20 (5.33%)	5 (1.33%)	145
46+ years	45 (12.00%)	40 (10.67%)	30 (8.00%)	20 (5.33%)	5 (1.33%)	80
Total	115 (30.67%)	150 (40.00%)	100 (26.67%)	50 (13.33%)	15 (4.00%)	370

Chi-Square Calculation

Null Hypothesis (H0): There is no relationship between age group and satisfaction level.
Alternative Hypothesis (H1): There is a relationship between age group and satisfaction level.
After performing the Chi-Square calculation, the p-value can be compared with the significance level (e.g., 0.05). If the p-value is less than 0.05, you reject the null hypothesis, suggesting a significant relationship.

Correlation Analysis

Variable	Water Supply R	Satisfaction with Water Quality
Water Supply R	1	0.85**
Satisfaction wit	0.85**	1

A correlation coefficient of 0.85 indicates a strong positive relationship between water supply reliability and satisfaction with water quality. This means that as the reliability of the water supply increases, satisfaction with water quality also increases.

Multiple Linear Regression

Independent Variable	Coefficient (β)	Standard Error	t-value	p-value
Water Quality	0.55	0.12	4.58	0
Water Access	0.32	0.08	4	0
Customer Service	0.19	0.1	1.9	0.058

The regression results suggest that water quality and water access are significant predictors of overall satisfaction with water provision (p-values < 0.05), while customer service approaches significance (p-value = 0.058). The coefficients indicate that for each unit increase in water quality, overall satisfaction increases by 0.55, and for each unit increase in water access, satisfaction increases by 0.32.

Summary of severity in terms of percentages of each constraint endured by Chivhu town residents as a result of poor water provision is shown below.

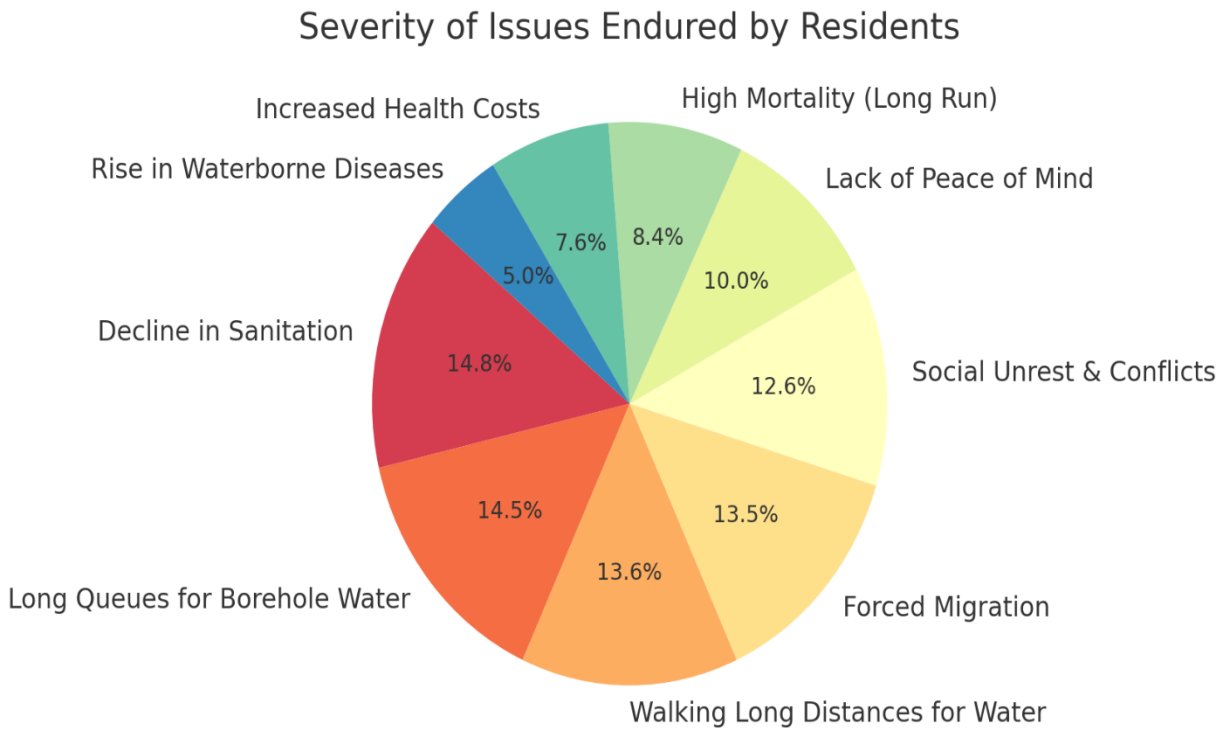


Figure 1.3: Severity of Issues Endured by Residents
Source: (Authors, 2024)

Qualitative results and discussion

Challenges endured by Chivhu residents due to poor provision of water by ZINWA were gathered through open ended questionnaires, interviews and focus group discussions. Accordingly, popular responses from various responses were jotted down by the recorder. Thus, one of Chivhu town Councillors G (name withheld) had this to say, *"Long queues are noticeable at boreholes due to inconsistencies in the supply of water by ZINWA to Chivhu town residents." (Date 04/02/22).* The results are in consistency with the quantitative analysis where 335 (89.33%) agreed, 23(6.13%) undecided and 17 (4.53%) disagreed. Notable queues were also noted as key hindrance endured by Harare residents due to search for water at limited boreholes scattered in high density suburbs such as Kuwadzana, Dzivarasekwa and Glen View (Musemwa, 2021). In Chivhu town the most affected area noted by the researcher was North Hood as most households could hardly receive water from ZINWA pipelines on the allegations of terrain.

Additionally, increase in water borne diseases e.g Cholera, typhoid and dysentry was also cited by one of Chivhu General hospital employee H (name concealed), *"Though the prevalence rate of water-borne diseases such as Cholera is very low in Chivhu town, interruptions of water supply to Chivhu town residents may expose them to causalities of drinking unsafe water resulting in diseases such as Cholera." (Date 07/02/22).* This result was found to be very low in Chivhu town as 115 (30.67%) agreed 43 (15.64%) undecided and 217 (57.87%) disagreed. However, the occurrence of these water borne diseases were found to be rampant in Botswana especially in Gakuto District and in Harare the capital city of Zimbabwe (Colman, 2013; MOCC,2020 & Dzirutwe, 2018). More to it, increased health costs, was mentioned as one of the challenges endured by Chivhu town residents due to poor provision of water to its residents, as one of the senior residents I (name withheld) had this to say, " *I had to pump out a lot of money for medication of my daughter at the nearest local private surgery after she developed diarrhoea symptoms which are normally caused by drinking unsafe water." (Date 09/02/22).*

This was found to be very low in Chivhu as 175 (46.67%) agreed, 63 (16.80%) undecided and 137 (36.53%) disagreed. Statistical information from Chivhu General Hospital depicts very few patients admitted on the water borne related diseases. More to it, high mortality rate in the long run was predicted if the current prevailing situation remains the same. Therefore, Chivhu primary school employee reiterated, *"Death rate will be very high in few years to come caused primarily due to upsurge of water-borne diseases caused by poor water provision." (Date 09/02/22).* Again, the prevalence of this challenge was found to be very limited in Chivhu as secondary data from Chivhu General Hospital indicates very few deaths as a result of water borne related diseases. However, death rate as a result of water borne diseases was found to be common in Botswana and Harare capital city of Zimbabwe (Tshabatu, 2020 & MOCC,2020).

Furthermore, upsurge of conflicts and social unrest in search for water mostly at few designated boreholes has been a major issue of concern as one Chivhu police camp employee vowed, *"There is an increase of violence with people fighting on who to get water first primarily due to long queues especially in North Hood area where ZINWA is struggling to make water available to people due to purported terrain." (Date 11/02/24).* This anomaly was found to be highly prevalent as 291(77.60%) agreed, 21(5.60%) undecided and 63 (16.80%) disagreed. It should be noted that, upsurge of conflicts and long queues were noticeable in Harare capital city of Zimbabwe (Musemwa, 2021). Additionally, lack of peace of mind due to the need to secure water was another constraint endured by Chivhu residents due to erratic water supply to its residents as one of Chivhu town councillors J (name withheld) asserted, *" As you move around especially in the North Hood area you can see that, the morale of the people is very low as they have to spend long hours waiting to fetch water at boreholes as ZINWA supplies water to these houses inconsistently and unpredictably."(Date 11/02/24).* The occurrence of this constraint was noted to be relatively high as 230 (61.33%) agreed,33 (8.80%) undecided and 112 (29.87%) disagreed. The same scenario also prevails in Gakuto District of Botswana (Tshabatau, 2020).

Moreover, forced migration of residents looking at houses with own supply of water was noticeable as one of the major challenges confronted by Chivhu town residents as one of the ZINWA employee X (name concealed) lamented that, *"Most tenants are forced to relocate to houses with own underground water as relying with ZINWA has become a big challenge especially to those with large families." (Date 05/01/22).* The researchers noted that, this challenge was common at the end of the month were tenets would be relocating from houses that rely on ZINWA water supply to those with own underground water sources. Accordingly it was noted that, most commonly affected areas noted by the researchers were North Hood, M and I sections, Gope, Skyview and Highview suburbs.

Conclusion

This study explored the challenges faced by ZINWA in a bid to perform its mandate as sole provider of water to Chivhu town residents and the constraints endured by the same residents as a result of poor water provision. Accordingly, appropriate several recommendations were proffered for water policy makers in Zimbabwe to probably consider them in a bid to curb these identified anomalies. Thus, specifically the research findings revealed notable constraints confronted by ZINWA in its efforts to improve water provision. Key causes with a frequencies and percentages above 300 and 80% respectively include: inaccurate production metering and water billing system,inefficient water pumping system in high terrain areas,increase in population posing tight water rationing and ageing or dilapidated water treatment infrastructure. The study also revealed lack of resources mainly shortage of chemicals for treating water and funds to refurbish and modernise water treatment plant and water pipelines. Additionally, wastage by Chivhu residents, absence of private sector or competing water suppliers and change in climate leading to reduced water in Chivhu dam. The least causes with frequencies and percentages of 125 and 30% respectively were vandalism of water pipelines by the local people and unlawful connection of water pipes by residents. The findings were analysed quantitatively using frequencies and percentages, ANOVA, regression, Chi-test for independence, correlation matrix with aid of SPSS version 29 software. Apart from that, the study notes problems emanating as a result of poor provision of water from ZINWA. These encompass: walking long distance searching for safe water, rise in stress in families due to uncertainty of water availability, waiting for long hours in queues, general decline in sanitation, increase of water borne diseases, high health costs and high mortality rate in the long run. Moreover, forced migration from houses with ZINWA connected water to the houses with personal individual underground water sources was also noted to be prevalent.The researcher also noted that, North Hood suburb was the most negatively affected area as ZINWA could hardly pump water consistently to most households citing terrain as one of the hindrances. Thus, the data was analysed narratively and interpretatively. Above all, the dictates of Water Supply System Reliability theory and Water Sensitive Cities theory were applicable to causes of poor water provision and severity endured by Chivhu town residents. Additionally, various hypothesis were tested with several outcomes in ascertaining relationships between independent and dependent variables.

Recommendations

In light of the results of the study and conclusions made thereafter, the following recommendations were forwarded to improve water provision by ZINWA to Chivhu town residents. These include but not limited to:

- Utilisation of underground water sources like drilling boreholes at the household level than solely relying on water supply from ZINWA.
- Establishment of water prepaid meters by ZINWA at each household to avoid arrears caused by non-payment of water bills by residents.
- Utilisation of water harvesting methods by residents like big tanks storing water especially during the rainy season.
- Further expansion of Chivhu dam by government to increase its water retention capacity.
- Refurbishment and modernisation of water treatment plant and subsequent water pipes by government.
- Training of more ZINWA workers especially those who are involved in civil engineering processes.
- Awareness campaigns with the view to congentise the public on the importance of using water wisely.
- Resource mobilisation through enough budget allocation by the central government to ZINWA for improved services.
- Enhancement of stakeholders participation with the motive to have collaborative or concerted efforts towards improved water provision to Chivhu town residents.

❖ Adoption of renewable source of energy like solar systems to avoid tight water rationing due to power cuts from ZESA.
❖ Involvement of other private players in water provision to in still competition for improved water quality provision and related services.

Recommendations for further research

During the course of the research, the following areas were observed to be crucial for future research. These areas include water resources management in urban areas and water and sanitation in Zimbabwean local authorities. Water resources management was found to be important as some shortages of water are caused by failure of relevant authorities to manage water properly including shortage of water harvesting methods in towns. Furthermore, water and sanitation in Zimbabwe local authorities were identified as key areas as poor sanitation will pollute water as the case in most small towns such as Gutu and Mvurwi warranting further studies for observation of patterns of problems and coherent emerging solutions.

Note

This article is premised on an unpublished Msc dissertation authored by Muroiwa, M.K (2022) and titled, *"An analysis on the effectiveness of Zimbabwe National Water Authority in the Provision of Water to Residents: A Case of Chivhu Town,"* Harare: University of Zimbabwe.

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