

Chapter 4

Challenges for Water Supply and Sanitation in Developing Countries: Case Studies from Zimbabwe

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1 Introduction

Many developing countries are not on course to meet the Millennium Development Goals for water supply and sanitation (WHO/UNICEF 2012). There continues to be disparities in urban and rural services and also between water supply and sanitation (WSS). Water supply has continued to receive preferred attention compared to sanitation. WHO/UNICEF (2012) figures show that access to safe water supply in developing countries stands at about 86 % compared to 99 % in developed countries. Poor water quality has resulted in many waterborne disease outbreaks in developing countries, such as cholera, dysentery, and typhoid. For sanitation, the situation is critical, with coverage figures at 56 % for developing countries versus 95 % in developed countries (WHO/UNICEF 2012). Poor sanitation, unsafe water supplies, and unhygienic practices can cause the transmission of a wide range of diseases (especially diarrheal diseases, skin and eye diseases, and worm infestations). Poor water and sanitation also worsen malnutrition, which in turns leads to stunting, lower school and work productivity, and impaired cognitive function and learning capacity.

Using UNDP (2013) figures, the world population has increased by an average 1.3 % per annum since 1990 and currently stands at about 7 billion. The Sub-Saharan Africa (SSA) population has also increased by an average annual rate of

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2.6 % since 1990 and currently stands at about 860 million. Global urbanisation has increased from 43 % in 1990 to 51 % in 2010 and the rising trend is expected to continue as poor countries industrialise and floods and droughts affect rural communities. The SSA region is urbanising at a rate of 4.0 % per annum. This urbanisation, which is highest in developing countries, has led to the mushrooming of informal settlements where water supply and sanitation services are almost non-existent. It has also placed serious pressures on ageing water and sanitation infrastructure in existing high density and low income areas.

This chapter looks at the broader challenges in water supply and sanitation in developing countries, focusing particularly on the SSA experience and using Zimbabwe as a case study. The reason for choosing SSA instead of the whole of Africa is that the other North African countries (Egypt, Libya, Morocco, Tunisia, Algeria) generally show a substantially different picture of development indicators (WHO/UNICEF 2013; UNDP 2013). Including these countries would distort the indicators used in this chapter. The distinction also enables regional comparisons, as most UN and other multilateral reports always distinguish between North Africa and SSA. The chapter starts by outlining the general water supply and sanitation issues, covering both domestic and productive water, and how this relates to environmental and health issues in SSA. It then uses Zimbabwe as a case study for going into further details and introducing the institutional responses. It also looks at the urban and rural aspects of water supply and sanitation services. This work is based on a review of the literature, practical experience, and personal knowledge of the water and sanitation sector in Zimbabwe.

Figure 4.1 shows a map of the Southern Africa Development Community (SADC) countries. The SADC is a Regional Economic Community in Africa comprising 15 member states: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. Established in 1992, SADC focuses on regional integration and poverty eradication within Southern Africa through economic development and ensuring peace and security. Zimbabwe was once a success story in SADC in terms of water supply and sanitation, with almost complete coverage in urban areas and above 60 % coverage in rural areas (WHO/UNICEF 2013). This scenario changed at the turn of the century when a political crisis affected the economy resulting in annual inflation soaring to billion percentage levels and economic collapse. A great cholera outbreak in 2008/09 attracted the attention of international donors, leading to a current recovery. This chapter discusses the water and sanitation sector in Zimbabwe in more detail, including a background to the cholera outbreak, water supply and sanitation challenges in rural and urban areas, institutional responses, and financial issues.

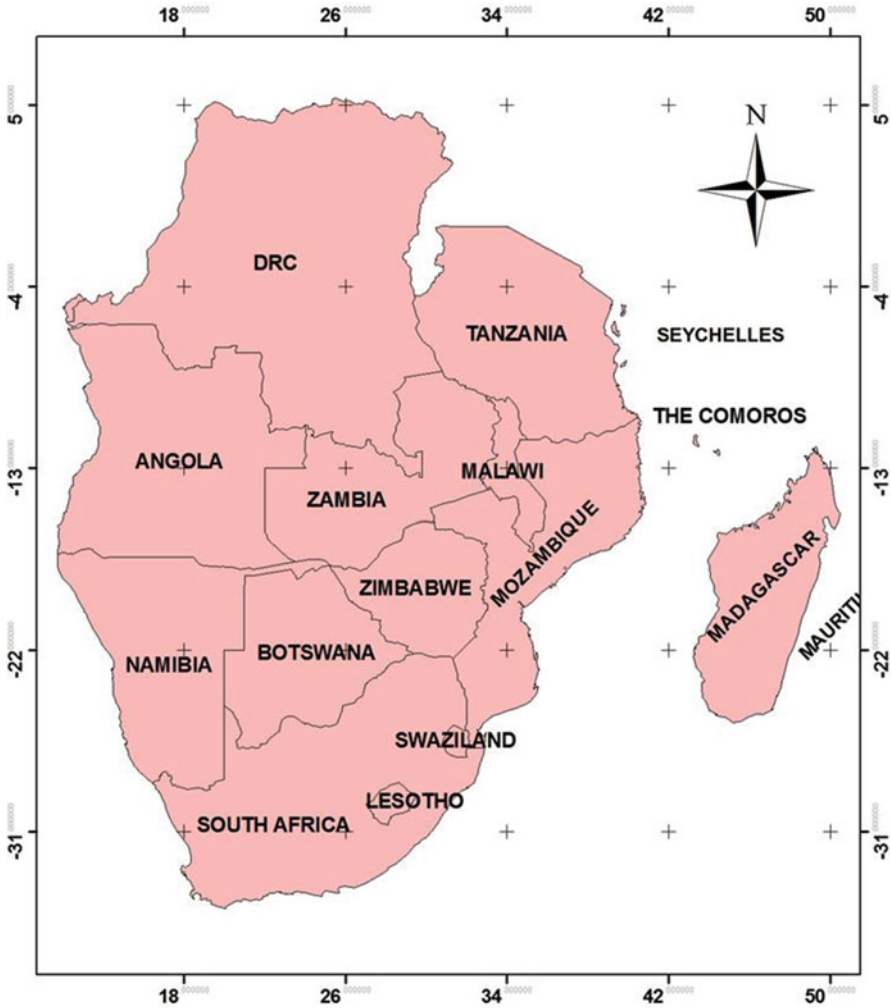


Fig. 4.1 Location of Zimbabwe within the Southern Africa Development Community (Map by W. Gumindoga)

2 Challenges to Water Supply and Sanitation in Sub-Saharan Africa

2.1 The Challenge of Urbanisation and Slum Developments

Like other developing countries, African countries are urbanising very quickly. Some 49 % of the world’s population is estimated to be living in rural areas; in SSA, it is estimated that about 37 % of the population live in cities and these cities are

Table 4.1 Percentage of slum dwellers in urban population by region, 1990–2012

Major region or area	1990	1995	2000	2005	2007	2010	2012
Developing regions	46.2	42.9	39.4	35.6	34.3	32.6	32.7
Northern Africa	34.4	28.3	20.3	13.4	13.4	13.3	13.3
Sub-Saharan Africa	70	67.6	65	63	62.4	61.7	61.7
Latin America and the Caribbean	33.7	31.5	29.2	25.5	24.7	23.5	23.5
Eastern Asia	43.7	40.6	37.4	33	31.1	28.2	28.2
Southern Asia	57.2	51.6	45.8	40	38	35	35
South-eastern Asia	49.5	44.8	39.6	34.2	31.9	31	31
Western Asia	22.5	21.6	20.6	25.8	25.2	24.6	24.6
Oceania	24.1	24.1	24.1	24.1	24.1	24.1	24.1

Source: UN-HABITAT (2012)

growing at an average rate of 2.6 % per year, as calculated by UNPD (2013) and WHO/UNICEF (2013). Globally, less developed regions will hit the half-way point later, but likely before 2020. The 3.3 billion global urban population is expected to grow to 4.9 billion by 2030. Urbanised areas in SSA are forecast to grow most rapidly, doubling in population between 2000 and 2030.

Sub-Saharan Africa is headed for a population emergency, as the population has been growing at an annual rate of 2.6 % since 1990. In 1960, there was only one SSA city (Johannesburg) which had 1 million or more residents, and now there are over 30 megacities, straining urban services. Only six nations in Africa had economic growth rates above 7 % in 2010 (Chuhan-Pole et al. 2011) – the minimum rate believed necessary to support population growth of this magnitude.

The rapid growth of African cities has failed dismally to keep pace with required urban shelter. This has given rise to the development of so-called ‘peri-urban housing’ or slums. From Table 4.1, it can be seen that urbanisation in SSA has become virtually synonymous with slum growth, and there is a similar trend in most developing countries. Common examples of slum settlements are found in Kenya, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe (UN-HABITAT 2012). The battle to achieve the MDGs will therefore have to be waged in urban slums. This is due mainly to the failure of governments to cater for the influx of people from rural areas, amid growing poverty levels in many SSA countries. In other cases, wars and the HIV/Aids pandemic have displaced many people who have been forced to seek shelter and better opportunities in urban areas. The majority of slum dwellers in African cities are between the ages of 15 to 24 (Zulu et al. 2002). Table 4.1 shows a positive trend in the reduction of urban slum dwellers from 70 % in 1990 to about 62 % in 2012. However, the figures for SSA remain the highest compared to other regions and the downward trend could be reversed due to recent droughts and an economic recession mainly affecting rural communities.

2.2 *Water Resources Challenge*

There are basically two main challenges related to water resources management for urban areas. The first one is how to supply enough water of adequate quality to all, at all places, at all times, and at an affordable cost. The second and emerging challenge is related to adaptation and sufficient resilience against the extreme climatic conditions of floods and droughts. These challenges are compounded by rapid urbanisation and massive land use changes. Often, the floods that kill people in urban areas are strongly concentrated in areas with high population growth. The global energy crisis has resulted in many urban areas resorting to firewood for fuel, a situation that has resulted in massive deforestation in urban areas and surroundings. The increase in the use of firewood has resulted in some cities experiencing problems with sand and silt in sewers since households resort to sand for removing soot from their pots. Harare in Zimbabwe is typical of such a problem (see Fig. 4.2). Global warming and climate change are also altering temperatures, affecting evaporation and rainfall, and ultimately increasing the frequency and severity of floods and droughts.

The quest for better opportunities and jobs in towns and cities has, no doubt, exacerbated rural-to-urban migration, but global warming and climate change might also have been a factor. A lack of developed water supply infrastructure, such as dams and boreholes, in rural areas could motivate people to migrate from drought-prone areas into cities.

2.3 *Water and Health*

Water is responsible for spreading 80 % of diseases in Africa. The main causes of death in children under five are diarrhoea, malaria, and measles (Lopez and Mathers 2006). Malnutrition accounts for about one-third of the disease burden in low- and middle-income countries. The most effective management intervention is providing



Fig. 4.2 High levels of sand in sewers (*left*) can cause downstream problems at sewage treatment plants (*right*) (Photographs: City of Harare)

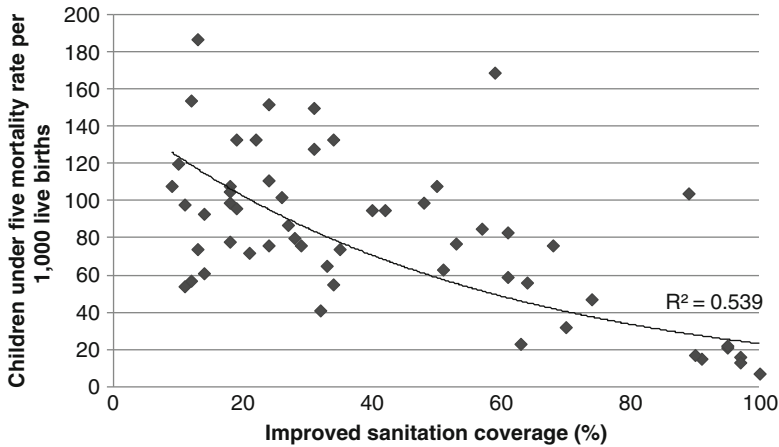


Fig. 4.3 Under-5 child mortality versus sanitation coverage for African countries. Each *dot* represents data from one country (Data source: WHO/UNICEF 2013)

safe drinking water and proper disposal of human waste (UNEP 2010). Figure 4.3 shows that there is a relationship between child mortality and access to improved sanitation ($R^2=0.54$). Although the graph does not show other factors that affect child mortality, such as general nutritional standards, access to health care and medical treatment, and so on, it is clear that there is a causal connection between access to sanitation and health. Additionally, improved sanitation will provide multiple other benefits: reducing the incidence of diarrhoeal diseases is important, especially for young children.

Poor sanitation, unsafe water supplies, and unhygienic practices lead to the transmission of a wide range of diseases, especially diarrheal diseases, skin and eye diseases, and worm infestations. Poor water and sanitation also leads to malnutrition, resulting in stunted growth, lower school and work productivity, and impaired cognitive function and learning capacity. The cost of not investing in water and sanitation also affects education, water resources, the environment, poverty reduction, tourism, and economic development. The impact of water and sanitation is often underestimated: the cost of not investing can be a cost to society of 2–5 % of GDP (Rees et al. 2012). Sanitation has therefore been described as “the greatest medical milestone since 1840” (British Medical Journal 2007).

3 Water Management and Challenges in Zimbabwe

3.1 Cholera Outbreaks in Zimbabwe

Zimbabwe has been sporadically affected by cholera outbreaks on an annual basis since 1998 (Red Cross 2010). The protracted 2008/09 cholera crisis was attributed to weakened public health and municipal services, with local authorities unable to

provide adequate access to safe water, waste disposal, and sanitation. By the end of June 2009, 98,702 cases of cholera had been reported, with 4,282 deaths and a cumulative case fatality rate (CFR) of 4.3 %. According to WHO (2004), a CFR of <1 % from cholera is acceptable. Harare alone reported a total of 15,773 cases and 485 deaths, giving a CFR of 3.1 % (UNICEF 2010). Actually, it is possible that many more people might have died but were not recorded, especially in peri-urban and rural areas. The incidence of cholera in Zimbabwe during 2008/09 is shown in Fig. 4.4.

Partners in the Water, Sanitation and Hygiene (WASH) cluster estimated that, just before the cholera outbreak, 6 million people in Zimbabwe had limited or no access to safe water (UNICEF 2010). This was largely due to the unavailability of water treatment chemicals, irregular refuse collection, and inadequate sanitation facilities, as well as a lack of resources to repair damaged infrastructure. Leaking sewers in some urban residential areas and insufficient number of latrines in many rural areas resulted in unhygienic conditions and practices which led to the contamination of water sources, contributing significantly to the outbreak (Gwinji 2010). The situation was further exacerbated by the deteriorating socio-economic condi-

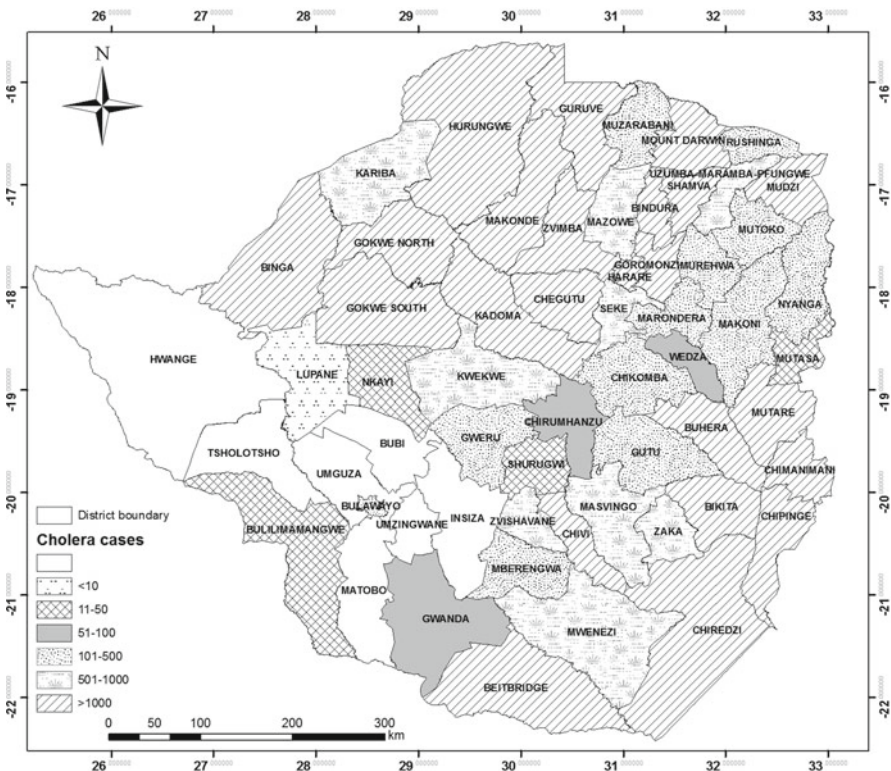


Fig. 4.4 Overview of the cholera outbreak in Zimbabwe, August 2008 to June 2009 (Map by W. Gumindoga based on data from UNICEF Zimbabwe)



Fig. 4.5 Use of unprotected shallow wells (*left*) and protracted sewer overflows (*right*) became very common, especially in high density suburbs, during the 2008 cholera outbreak in Zimbabwe (Photographs: I. Nhapi)

tions and food security in the country, a dire situation which called for major humanitarian intervention. The cholera outbreak in 2008 coincided with a period of breakdown of many systems, including the national financial system, hyperinflation, and little or no municipal service delivery (Red Cross 2010). Most residential areas in urban areas had to survive for many days or even months without water supply, and most sewerage systems were choked by reduced water inflows (UNICEF 2010). The blocked or collapsed sewers resulted in sewage flowing all over residential areas and the sewage flows found their way to shallow wells and boreholes (Fig. 4.5). Most people were forced to resort to the use of river water or shallow unprotected wells. With less household water available, personal hygiene greatly suffered and most public toilets were unusable. Open-air defecation became common, increasing the opportunity for disease transmission since even the basic practice of handwashing with soap after visiting the toilet was not possible.

A study by Kumwenda (2012) identified two phases of the 2008/09 cholera outbreak in Zimbabwe (Fig. 4.6). Period A was before the cholera was declared a national disaster and the start of donor interventions to control the disease in terms of preventative actions and treatment. Period B shows the response and containment period. However, this study makes clear that cholera outbreaks are likely to recur unless concerted efforts are made to ensure safe water supplies and access to good sanitation into the future. The analysis also showed that the cholera outbreak period coincided with a period during which water production seriously went down (Fig. 4.7). Although the circumstances have not been fully documented, the study noted that apparently after the supply of water treatment chemicals was withdrawn by donors in March 2012, water production by City of Harare went down.

There are a number of WASH-related disease outbreaks that have been recorded in Harare from 2000 to 2011, the main ones being cholera, dysentery, diarrhoea, and typhoid (Mokitimi 2012). These are waterborne diseases that are caused by

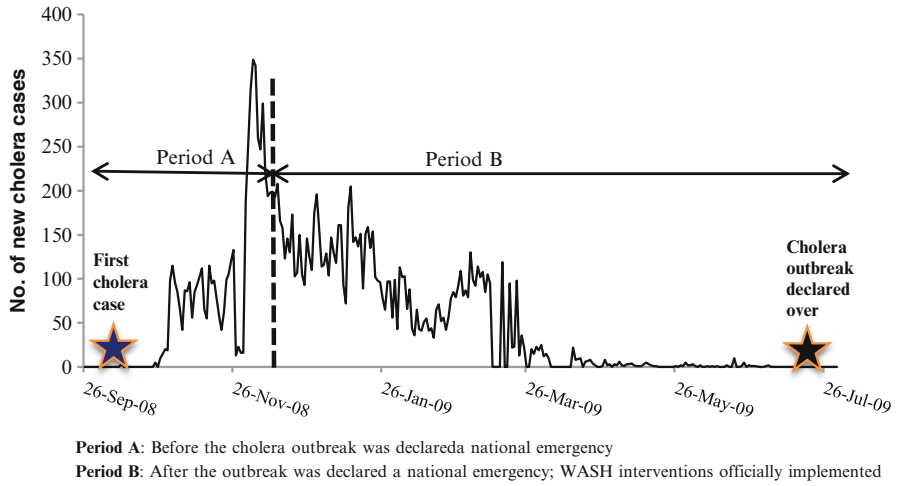


Fig. 4.6 Cholera cases from October 2008 to July 2009 (Source: Adapted from Kumwenda 2012)

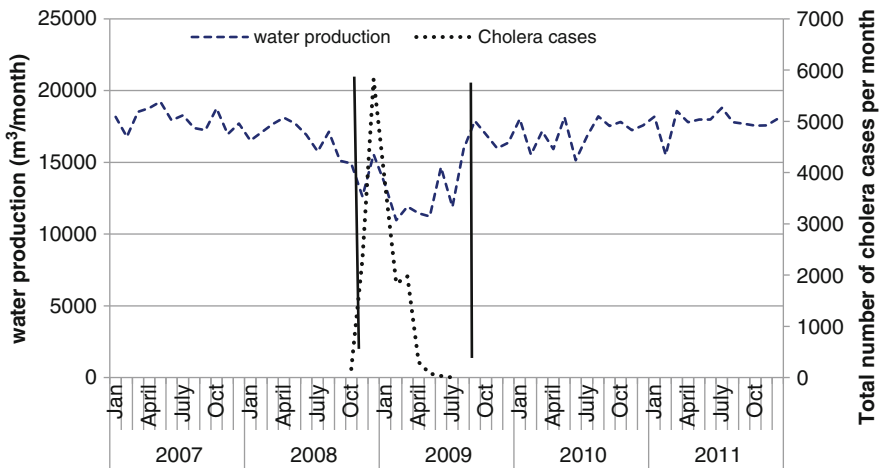


Fig. 4.7 Monthly water production (2007–11) and monthly cholera cases (2008–09) (Source: Adapted from Kumwenda 2012)

pathogenic microbes that can be directly spread through contaminated water. Dysentery rates appear to have been fairly consistent over the years, resulting in a number of fatalities since 2000 (Fig. 4.8). However, the cholera outbreak of 2008/09, discussed earlier, stands out as the most severe and well-known outbreak of waterborne disease in the country.

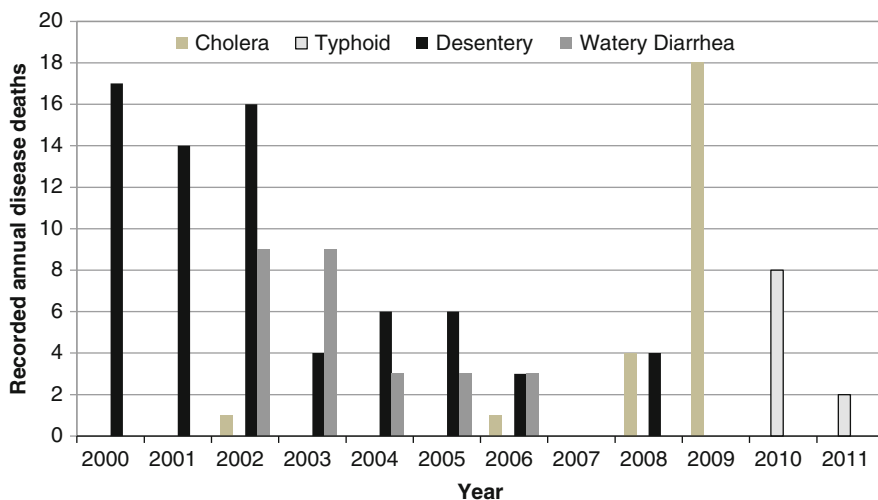


Fig. 4.8 WASH diseases annual total cases in Harare from 2000–11 (Source: Own elaboration based on data from Mokitimi 2012)

3.2 *Historical Development of WASH in Zimbabwe*

The development of WASH in Zimbabwe can be classified into four phases according to the World Bank Zimbabwe Country Status Overview Report of 2010. The phases are elaborated below.

Phase I: Rhodesian Legacy (Until 1979) Rhodesia, as Zimbabwe was known before independence in 1980, began developing its urban infrastructure from the 1890s. Urban and commercial farming infrastructure development in the first half of the twentieth century was heavily skewed towards the interests of the white settlers, though water and sewerage services were also extended to African high density townships (Masst 1996). The city and town water, sewerage, stormwater drainage, and waste disposal services were built to a high standard. Decentralised management was in place from an early date, and urban and town services were managed through water and sewerage departments in local authorities (AMCOW 2010). Zimbabwe’s urban infrastructure during the latter part of the twentieth century was built on the revenue from urban consumers. Water supply and sanitation services in rural areas, where the majority of the indigenous population lived, were typically neglected (AMCOW 2010).

Phase II: Independence (1980–1999) At independence in 1980, an international conference on reconstruction and development (ZIMCORD) sought to rebuild the country’s infrastructure after the devastating effects of the war of liberation. The main water supply and sanitation challenge was to extend services to rural areas. The 20 years ending at the millennium saw a near doubling of coverage (WHO/

UNICEF 2013). During the early years of independence, the government developed an Integrated Rural Water Supply and Sanitation Program (IRWSSP), based on government-subsidised, low-cost, locally developed technologies (Bush pumps, VIP latrines) (AMCOW 2010). The IRWSSP was built on external development assistance grants to the Government of Zimbabwe (GoZ). By contrast, the growing urban population continued to be served by decentralised municipal authorities and coverage levels of nearly 100 % were maintained for urban water supply and sewerage services. Milestones in sector development were: adoption of a National Master Water Plan for Rural Water Supply and Sanitation (NMWP) in the mid 1980s; the establishment of a National Action Committee (NAC) and its secretariat (the National Coordination Unit, NCU) to coordinate the IRWSSP; revision of the Water Act in 1998 to establish catchment management councils; and the creation of a central parastatal, the Zimbabwe National Water Authority (ZINWA) for commercial management of the country's water resources (AMCOW 2010).

Phase III: Collapse (2000–2008) The decline of the economy (due to donor confrontation over the land reform program), the collapse of government funding, and the pull-out of donors from 2000 saw reduced investments in service delivery for nearly a decade, characterised by failure to repair or maintain an already aging infrastructure. The collapse in public sector salaries led to a significant exodus of skilled manpower. Capacity shortages developed in the public and private sector along the entire value chain: local manufacturing and supply of essential equipment, spares, chemicals and commodities, management of water treatment and wastewater plants, engineering supervision, finance, administration, project design, contract management, policy guidance, and necessary skills at provincial, district and village levels (AMCOW 2010). A nationwide cholera epidemic started in August 2008 and spread to 60 out of 62 districts, as well as into neighbouring countries. The outbreak was an indicator of the state of national neglect of the water and sanitation sector.

Phase IV: Emerging Recovery (2009 Onwards) The cholera epidemic generated a considerable humanitarian response from all parties. This, together with the introduction of a multi-currency system and the establishment of a Government of National Unity (GNU), led to important sector developments. The cholera emergency generated a strong response from donors and NGOs with UNICEF playing a leading role in coordinating the humanitarian response (IWSD 2009). A WASH cluster mobilised and coordinated the rural sector and an Urban Emergency Rehabilitation Program focused on supplying chemicals to urban local authorities, drilling boreholes and implementing cholera educational programs (GoZ and WHO 2011). The definition of humanitarian assistance was expanded to include “quick win” repairs to essential components of the water infrastructure. An analytical Multi-Donor Trust Fund (MDTF) was established to support critical studies and capacity building. A programmatic MDTF was also set up by the World Bank. In February 2010 the Ministers from the four leading water-related ministries met and agreed on plans to restructure the water and sanitation sector leadership, building momentum for a new era in sector development (see Sect. 14.3.7).

3.3 Zimbabwe WSS Sector Challenges Versus MDG Targets

3.3.1 Zimbabwe MDG Targets

The aftermath of the cholera outbreak saw a lot of investment in the supply of water treatment chemicals and the rehabilitation of critical water and sanitation infrastructure. Other areas targeted included the improvement of solid waste management and improved health and hygiene awareness. It was later realised that all these investments were going to count for nothing if they were only supported by donors, with councils collecting very little in terms of revenue (GoZ and WHO 2011). A World Bank scoping report in April 2009 estimated that less than 20 % of urban water and wastewater expenses were being recovered from revenue collections. A lot of effort thus began to be focused on tariff setting, management, and revenue collection. High water losses, up to 50 %, also meant reduced revenues for councils, so funding was therefore directed at further rehabilitation.

The Zimbabwe water and sanitation MDG targets are shown in Table 4.2. However, Zimbabwe also developed a draft water policy in 2004, a policy that was never implemented, and this had ambitious targets of almost universal coverage by 2015. The target was set despite the fact that in 2004 the Zimbabwean economy was already on an uncontrolled decline. The country's inflation environment, shown in Fig. 4.9, derailed all investment efforts to meet the MDG targets.

Table 4.2 Zimbabwe MDG targets and achievements (Source: AMCOW 2010; WHO/UNICEF 2013)

	MDG targets (2015)	2004 Draft policy targets (2015)	Latest JMP figures (2011)
Water coverage	90 %	100 %	80 %
Rural	85 %	100 %	69 %
Urban	99 %	100 %	97 %
Sanitation coverage	79 %	85 %	40 %
Rural	68 %	80 %	33 %
Urban	100 %	100 %	52 %

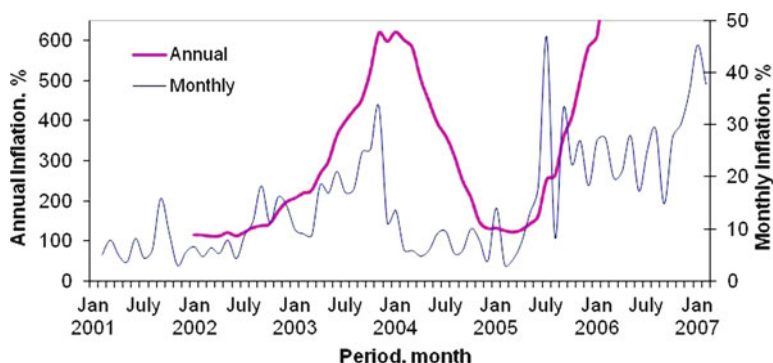


Fig. 4.9 Inflation in Zimbabwe from Jan 2001 to Jan 2007 before it spiralled to billions in 2008, signalling the collapse of the water and sanitation sector, among other calamities (Own elaboration using data from www.rbz.co.zw)

Zimbabwe has numerous national water supply and sanitation targets. Estimates of coverage and investment requirements also vary considerably. Two scenarios of the current status can be developed which represent the range of sector status:

Scenario 1 – an optimistic scenario is presented which uses the lower targets, is based on WHO/UNICEF Joint Monitoring Programme (JMP) figures, and assumes sufficient and sustained budget allocations from 2010 onwards with supplementary funding from the Multi-Donor Trust Fund. In 2008, JMP suggested that 82 % of Zimbabweans had access to improved drinking water and only 68 % had reasonable access to an improved toilet.

Scenario 2 – a more pessimistic scenario which uses the higher targets, Zimbabwean sector agencies' own figures, and assumes a scenario where, without a political settlement, external resources are more limited and budget allocations cannot be sustained. This scenario uses the lower estimates that in 2008, 46 % of Zimbabweans had access to improved drinking water and 30 % to improved sanitation facilities.

3.3.2 JMP Drinking Water and Sanitation Coverage Trends in Zimbabwe, 1990–2010

The water supply coverage in urban areas of Zimbabwe shows very high coverage of piped water (Fig. 4.10) but this coverage has been declining over recent years. This is attributed to a number of new housing plots under development by cooperatives where plot owners have moved onto their plots without first finishing the house to an acceptable state. Performance issues include high unaccounted-for water, sub-economic tariffs, and reluctance to pay for water due to erratic and poor service delivery (Manzungu and Chioreso 2012; Ndebele 2012).

Rural water supply coverage is, surprisingly, showing limited movement (71–69 %) despite huge investments into the rural water sector at the end of the last millennium. The land reform of 2000 also resulted in people moving from communal areas to formerly commercial farming areas (Scoones et al. 2011). Although no scientific studies have been conducted to ascertain the water and sanitation situation in resettled areas, it is most likely that very few resettled farmers have reasonable toilet facilities, and heavy soils in resettled areas have poor well water yields. With a declining economy, very few households can afford to drill and equip boreholes which cost from USD4,000 upwards.

Compared to drinking water coverage, national improved sanitation coverage is virtually stagnant at 40 %, despite large investment programs in rural sanitation. This situation (Table 4.3) suggests there is still a large number of people who must use open-air defecation in Zimbabwe and points to a significant failure of the rural sanitation policy in the country. Although urban sanitation shows extremely high coverage, it is now declining. The general conclusion is that either new investment or a new policy addressing current urban sanitation challenges is required. The current high standards of urban sanitation (sewerage provision) might be difficult to sustain and justify in the long-term.

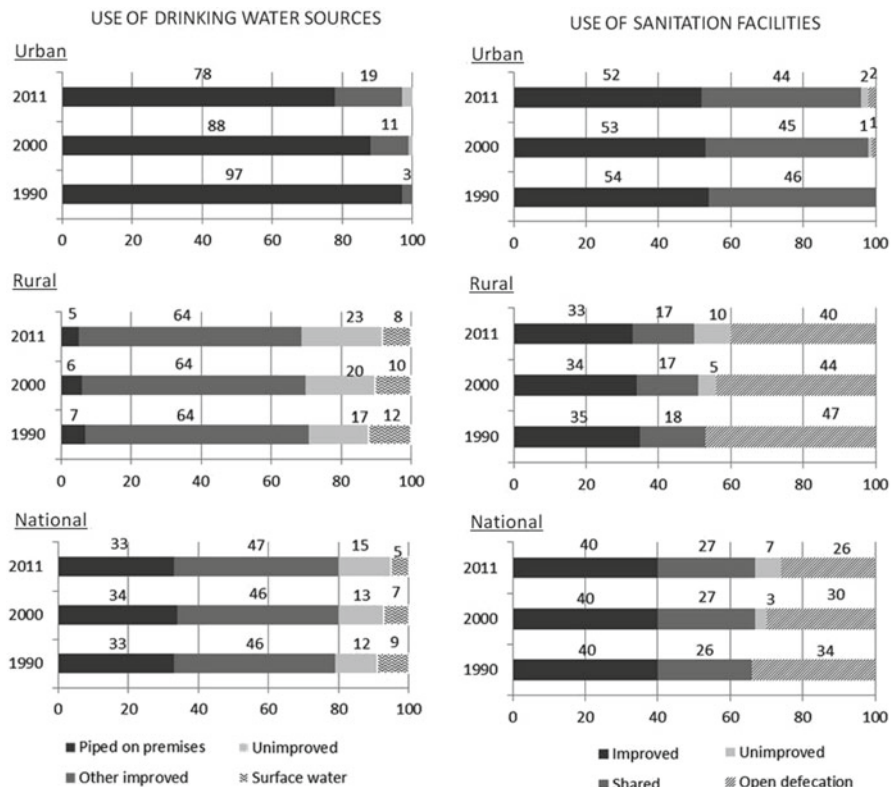


Fig. 4.10 JMP-estimated trends of drinking water and sanitation coverage in Zimbabwe to 2011 (Source: WHO/UNICEF 2013)

3.4 Key Rural WASH Challenges in Zimbabwe

Zimbabwe’s rural water and sanitation services, once a source of national pride, have suffered a major collapse in the past decade due to, among other reasons, the flight of external support agencies in 2000, persistent droughts that have resulted in severe stress in both surface and underground water, general economic decline, eroded institutional and community capacity, and the effects of the HIV/Aids pandemic. In the new resettlement areas there are very few water and sanitation facilities and people rely on unsafe sources of water and use bushes for disposal of excreta. From a ministerial meeting on water sector coordination held in Nyanga in February 2010, key challenges in the rural WASH sector were identified. For ease of discussion here, they are grouped into the following broad categories: inadequate organisation/coordination of water and sanitation utilities at all levels; the economic situation (an external factor); and deficiencies in public action at the national level.

Table 4.3 Modified wastewater production scheme for medium- and low-density residential areas of Harare

Wastewater source	Medium-density areas	Low-density areas	Actions required to reduce wastewater production
	L/cap/d	L/cap/d	
Bath	50	50	Reduce larger water heater sizes to 50 L
WC	50	50	Replace larger size cisterns with 5/10 cisterns: 5 L for flushing urine and 10 L for flushing faeces (or smaller)
Laundry	8	11	Laundry once a week. 25 L for washing and 25 L for rinsing
Kitchen	9	13	Based on three washings (dishes or hands) and cooking routines using a double-bowl sink of 15 L/bowl. Seven and 10 people per household for low- and medium-density respectively
Other	12	12	10 % contingencies to cater for leakages and incidental washings
Total	129	137	
Target figure	135	150	Amount to be targeted in wastewater reduction efforts
Current figures	210	315	Source: JICA (1997)
% reduction in consumption that can be reached with the actions described	36	52	
Cost savings, USD/household/year	162	227	

- *Inadequate organisation/coordination of water and sanitation utilities at all levels* – There has been a lack of clarity about overall leadership in rural water supply and sanitation (RWSS). Coordination structures for the water and sanitation sector at all levels are currently weak and thus require urgent rescue and rejuvenation. The District Development Fund (DDF), under the Ministry of Transport, Communications and Infrastructural Development (MoTCID), has been leading the drilling of boreholes and a piped water scheme, while the development of toilets and shallow wells is being managed by the Ministry of Health and Child Welfare (MoHCW). The Ministry of Local Government, Public Works and National Housing (MoLGPW&NH), through the district councils, is responsible for rural development. This has led to confusion on who is in charge, with the Ministry of Environment, Water and Climate (MoEnvWC) largely left out of local initiatives. In addition, responsibilities for rural sanitation and hygiene have not been clear because several ministries are involved.

Borehole drilling has not been the sole responsibility of any agency and no government department claims sole authority over it. The DDF and the Zimbabwe

National Water Authority (ZINWA), for example, have always drilled boreholes on a service provider basis. However, the sector recognises the current limited capacity within government departments to provide drilling services, and thus encourages the participation of the private sector. Responsibilities for financing, coordinating, drilling, and maintenance therefore need review and clarification.

- *Economic situation* – Over the last decade the public sector budgetary allocation to the rural WASH sector has been on the decline, largely due to the economic challenges facing the country after the debilitating economic sanctions imposed by mainly western donors since 2002. In particular, budgets for rural WASH since 2002 have declined to negligible amounts, with several NGOs largely taking up the responsibilities. The Ministry of Health’s budget for environmental health development has largely been inadequate for its responsibilities. The Rural Capital Development Fund (RCDF), established under MoTCID’s Department of Infrastructure Development, was the main instrument through which the National Rural Water Supply and Sanitation Programme was financed from Treasury. These allocations have never been adequate given the increased demand and nationwide need for water and sanitation services. The RCDF does not fund MoHCW for key promotion, control, and hygiene education functions. A national financing strategy for the RWSS sector, which takes into account the current financial resource base and implementation capacities at all levels, is essential to mobilise resources.

It is estimated that more than 65 % of water points in rural areas are non-functional at any given time, owing to the many challenges bedeviling the existing DDF-led three-tier maintenance system (Gwinji 2010). In response to this challenge, NAC adopted (though with some challenges) the Community Based Management System (CBM), aimed at empowering communities to operate and maintain their water facilities with limited outside support. The main impact of the economic situation, however, is that government agencies are massively under-resourced to undertake needed functions in the RWSS sector. To compound the situation there is high staff turnover and shortages of vehicles, equipment, and communication material to support operational activities. Conditions of service have declined, staff loss and rates of turnover have been high, together with inadequate budgets for specialised expertise, training, and operational activities. It will take time for Zimbabwe to recover economically using its own resources. Therefore the reengagement of the donor community to complement government efforts to rebuild the sector has become a priority.

- *Deficiencies in public action at the national level* – There was no national policy in place until March 2013 when a new National Water Policy was launched. A national Sanitation and Hygiene Strategy was also developed and launched in 2011, but the official document was only released and circulated in early 2013. To better coordinate government and donors, a national investment framework is required for specific sectors. In 2012 the government, with assistance from the World Bank, has been developing a national water sector investment framework and, as it is not sector-specific, it is likely to reduce the focus on specific sectors like rural WASH.

From the foregoing, there is the major issue of resilience that should be addressed: due to unfavorable economic conditions the system has collapsed and it is failing to recover from the shock. There is therefore a need to increase resilience (or decrease vulnerability), such as increasing revenues from water users (to become more independent from donors) and use of appropriate technologies. Technologies implemented should be screened for appropriateness and those who use them should be trained as necessary. Water and sanitation coverage continues to decline, rendering the meeting of MDG targets a challenge to the sector (WHO/UNICEF 2013). Under the current situation, the Zimbabwe Government provides rural water supply services with limited community participation and ownership. A sustainable option that encourages community-managed rural water services development, with user communities contributing to capital development and operation and maintenance costs, could be adopted. Of priority in the sector is the rehabilitation of all non-functional infrastructure, establishing a sustainable community-managed operation and maintenance system and implementing community participatory approaches to hygiene and sanitation improvement. A tremendous and immediate turn-around in sector investment and performance is a priority if sector MDGs targets of 100 % for water supply and 80 % for safe sanitation are to be achieved. The government needs to create a favourable environment for private sector participation and direct foreign investment. This, among others, involves fostering confidence and certainty on tariffs, ownership, and profit remittances.

Following the cholera outbreak, NGOs and the donor community (e.g., EU, DFID, USAID, AusAid, SIDA, CIDA, ECHO, GIZ) have played a crucial role in the recovery of rural water supply and sanitation in Zimbabwe. These have continued to provide infrastructure, and have also enabled communities to manage their own water infrastructure under the Community Based Management Programme. Organisations such as World Vision, Practical Action, and PumpAid have done a lot of work in this area. For example, PumpAid (<http://pumpaid.org>) introduced a simple water abstraction technology called the elephant pump. The technology is not as complicated as the bush pump which needs a specially trained person to maintain and repair. The majority of villagers can be trained in its maintenance, although there are questions on its life span. Also notable is the financial assistance provided by organisations such as the EU and DfID under the Protracted Relief Programme.

3.5 Urban Domestic Water Supply and Sanitation Challenges in Zimbabwe

One of the major challenges in urban water supply in Zimbabwe is the current high levels of water consumption for domestic purposes. Current life styles can result in an enormous thirst for both energy and water, with the high usage directly related to the type of water installation in the home. The use of large water heaters (or geysers), jacuzzis, and large cisterns needs revisiting. In Zimbabwe water use varies from 80 to about 600 L/cap/d for poor to affluent residents, respectively (JICA

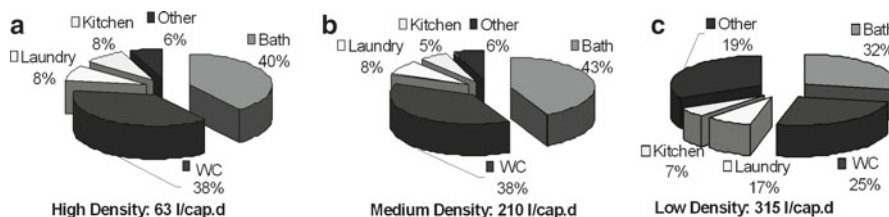


Fig. 4.11 Household water use and wastewater production in Harare (Source: Nhapi et al. 2002). Figures below each pie chart relate to wastewater production, not water consumption

1997, Nhapi and Gijzen 2004). However, under the post-2008 water rationing regime, demand has generally been reduced to about 20 to 100 L/cap/d (Chisango 2012). A high water demand results in the generation of large volumes of wastewater which requires treatment, and the capital and running costs for wastewater treatment plants are directly related to the volume treated. Thus the generation of huge volumes of wastewater has a direct bearing on the cost of treatment. High volumes of dilute wastewater also reduce options for wastewater treatment, making technologies such as anaerobic treatment unattractive.

A combination of end-use efficiency, system efficiency, stormwater harvesting, storage innovations, and reuse strategies would greatly reduce current municipal water demand. The estimated proportion of household water demand required for potable uses (drinking and cooking) is only 5–8 %, whereas 25–38 % is used for toilet flushing in Harare (Fig. 4.11). Greywater constitutes about 56 % of water used in all housing categories. The high water consumption for bathing and toilet flushing can be explained by the sort of water systems installed in homes. A large reduction in consumption is possible if water saving measures and devices were to be used. Education and community awareness campaigns could greatly reduce water consumption as reported in Bulawayo, Zimbabwe's second largest city, where reductions of more than 50 % were reported (BCC 2002). Water-saving devices are useful for water conservation in Zimbabwe and these include specific types of showerheads (3–5 L/min), smaller or dual-flush cisterns (6 or 3 L/flush), specialised toilet pans, and low water-usage faucets (2 L/min) (Chaplin 1998). In low-density areas, bore water could be used for supplementing municipal supplies. However, this alternative needs further investigation because extracting ground water can have negative ecological or other effects. More efficient methods and devices for watering gardens can also be used, e.g. drip irrigation, depending on cost. The possible methods and their wastewater volume reduction potentials are given in Table 4.3.

Table 4.3 shows that a reduction in wastewater production is feasible without greatly compromising present comfort, convenience, dignity, or quality of life. The high wastewater volumes produced in medium and low-density areas are a direct result of installed systems in homes. For example, water heaters (geysers) in most affluent homes are as large as 200 L and there is a tendency to empty the geyser each time a person takes a bath (Nhapi 2004). A 50-litre geyser will still be adequate. Most of the toilet cisterns being sold in Zimbabwe have capacities of around 15 L

with no provision for separately controlling flushing volumes for urine or faeces, although the flushing of each requires different water volumes. A '3/6' cistern is used in Australia and other countries (Chaplin 1998), with the 3 L button used for flushing urine and the 6 L for flushing faeces. Because of different development densities, a '5/10' cistern will still do for Zimbabwe and would realise substantial savings. There is a tendency for housemaids to do laundry more frequently, and washing could be reduced to once per week without inconvenience so that water usage could be reduced. In kitchens, double-bowl sinks of 15 L each could replace washing under a running tap.

Applying the above-mentioned changes and adding a 10 % contingency level for leaks and other incidental washings show that it would be feasible to reduce wastewater production from the current 210 L/cap/d to about 135 L/cap/d (a 36 % reduction) for medium-density residential areas. For low-density, the reduction would be from 315 L/cap/d to 150 L/cap/d, implying a 52 % reduction in wastewater production. It is therefore concluded that reduction of wastewater production is technically feasible in Harare. The cost savings per household per year based on the average cost of treated water of USD0.5/m³ are USD162 for medium and USD227 for low density areas. Some of the measures described here for households could also be applied for commerce and industry.

The reuse of wastewater, especially greywater from laundry, kitchen, and bathing, and the harvesting of rainwater could potentially reduce water consumption by more than 50 % (Chaplin 1998). Rainwater harvesting is a possible substitute to a treated water supply. With an annual rainfall of 830 mm/annum in Harare (ZINWA records), and assuming 50 % losses, about 0.4 m³/m²/year could be collected. For an average built housing area of 120–300 m², this means 4–17 m³/cap/year (depending on the housing category, water consumption is 30–230 m³/cap/year). In certain parts of Hawaii, the Virgin Islands, Australia, and Texas, rainwater collection systems provide the entire water supply for many homes (Chaplin 1998). Progressively high water tariffs could also be used as a demand management tool since almost all properties in Zimbabwean towns have water meters. An increasing block tariff structure applies punitively high charges for high water consumption.

3.6 Water Tariffs and Funding of Urban WSS in Zimbabwe

3.6.1 Water and Sewerage Tariffs

In 2011, the Government of Zimbabwe, with assistance from the World Bank, commissioned a study on water and sewerage tariffs. The study, among others, aimed at developing a methodology for establishing cost recovery tariff levels and an appropriate tariff and subsidy structure to simultaneously meet a number of national objectives and to develop financial tariff models for each of the selected seven municipalities (Harare, Bulawayo, Chitungwiza, Mutare, Kwekwe, Masvingo, and Chegutu). The study also looked at options for an institutional regulatory

framework to manage the tariff review process, monitor and benchmark performance, and provide incentives for continuous performance improvement. Only two of the seven municipalities, Mutare and Kwekwe, were more-or-less meeting the demand for potable water. The main problems faced by water and sewerage (W&S) departments were high population growth, high losses (technical and commercial), a high fraction of non-functioning meters, and low recovery ratios on billed water (World Bank 2011). People without adequate municipal supplies of water were surviving through access to boreholes (using hand pumps in the high density areas), shallow wells, surface water, and water purchased from unlicensed vendors.

The state of the infrastructure in each town varies, but one of the common problems is lack of functioning meters. People getting water are using more than the volume they are metered and charged for. People not getting water are unwilling to pay monthly fixed charges (Ndebele 2012). On the sewerage side, nearly all of the biological nutrient removal (BNR) plants are not working. The ponds are still working, but overall there is a high degree of pollution of streams due to spillage from sewers, failure of sewage pumping stations, discharge of raw/partially treated sewage from treatment works, and failure of effluent pumps (Dlamini 2012). Pollution has had the most impact in Harare and Chitungwiza, where the sewage discharge is upstream of water intakes (Kibena et al. 2013).

The financial position of W&S departments is generally precarious due to the following factors (World Bank 2011; Ndebele 2012):

- Collection efficiency is low at about 30–60 % (customers are unwilling to pay when service is poor).
- Non-revenue water (NRW) is extremely high at about 40–60 % (leaking old pipes and lack of working meters, as already noted, contribute in a big way).
- Spending on essential fixed costs is low (salaries, repairs and maintenance, capital).
- Transfer of funds from the water account to other municipal uses, such as social services (schools, clinics, amenities), is significant (Harare is an exception).

The municipalities expect to make significant improvements in service delivery and revenue generation in the next couple of years. Cumulative benefits are expected as non-revenue water declines, access to water improves, and willingness to pay increases. The resulting downward pressure on tariffs is offset by the need to increase infrastructure spending (maintenance, rehabilitation, and investment). Zimbabwe's urban areas have some of the lowest cost of treated water in the region (the lowest being USD0.05/m³ in Mutare). Tariffs are also very low by regional standards (van den Berg and Danilenko, 2011).

3.6.2 Setting of Water Tariffs in Zimbabwe

Setting of urban water tariffs in Zimbabwe is premised on a number of legal instruments, Acts of Parliament, subsidiary legislation or regulations in place, and directives from respective Ministers for Water and Local Government. Section 8 of

the ZINWA Act (Chapter 20:25) allocates the function of water pricing to the Authority (GoZ 1998a). It also allocates the particular function of encouraging and assisting local authorities to discharge their obligations with regard to the development and management of water resources in areas under their jurisdiction – in particular, the provision of potable water and the disposal of wastewater. Section 30 of the ZINWA Act sets water and other charges. ZINWA is empowered to fix charges for the sale of raw or treated water from waterworks operated or controlled by the Authority. The charges by ZINWA must be approved by the Minister of Water after considering various factors. There is no reference to consultations with users of water, or setting water costs according to full cost recovery for the dams from which the water is extracted. There is no consideration at this level as to the ultimate cost of water for the users, especially the urban vulnerable groups.

The Water Act (Chapter 20:24), Section 6, under the General Functions of the Minister, states that it “shall be the duty of the Minister of Water Resources to secure the provision of affordable water to consumers in under-privileged communities” (GoZ 1998b). Under the Urban Councils Act (as amended 2008), (Chapter 29:15, Part XIII), the powers of the council in relation to water include entering into agreements for the purchase and sale of water (GoZ 2008). It is not clear whether there is any agreement between the urban councils and ZINWA on the pricing of raw water and the method of calculating the price of water to consumers in order to satisfy the legal requirements of the Minister of Water Resources to meet the provision of affordable water to consumers in under-privileged communities (World Bank 2011).

The post-independence Urban Councils Act has progressively been altered, in part to deal with challenges from inefficient and increasingly ineffective urban councils, as well as with their reduced accountability/transparency. In short, councils have over time been perceived as not representing the interests of their electors. The Minister has increased his oversight powers to intervene. These changes have usually been promulgated as regulations and not amendments to the Act, using especially Part XXI of the Act under “General” (World Bank 2011). There are provisions that could inadvertently undermine the powers and duties of councils through many open powers being delegated to the Minister of Local Government. The Minister, for political or other reasons, may scale down justifiable tariffs through cost recovery objectives, thereby undermining service delivery, maintenance, and water production capacity.

The Urban Councils Act does not mention systems for fixing water tariffs. Municipal councils are required to balance their budgets with the general consent of their residents. However, since independence a number of regulations and directives by successive Ministers of Local Government have defined priority areas for high density areas on issues of affordability, especially the minimum charge (World Bank 2011). For example, in April 2011 the Minister of Local Government, with the concurrence of the Minister of Water Resources, slashed the price of water for Harare (World Bank 2011). Harare’s high-density fixed charge was reduced by the Minister’s directive from USD7 to USD5 and for low density from USD13 to USD11. This was done after the City budget had been approved and 3 months into

the financial year. There is presently no independent regulator to whom both the municipal council and the Minister can refer any contentious issues.

3.6.3 Affordability

In recent years, there have been few studies on household income and expenditure. One exception is the Zimbabwe Vulnerability Assessment Committee (ZimVAC) report of April 2011, the Urban Livelihoods Assessment Report. This is based on studies of vulnerable households in a sample of urban areas which is shown in Table 4.4, which also gives the expenditure on water as a proportion of income. The average household expenditure on water and sanitation is 5.2 % of monthly household income. If the reference point is that expenditure on water by vulnerable households should be less than 5 % of their income (Franceys et al. 1992) then there were, in 2011, four towns in which this affordability threshold is breached (Harare, Bulawayo, Chitungwiza, and Mutare). When expenditure is higher than affordability, payment for services becomes an issue.

Reasons for the high cost of water and sanitation can be attributed to inefficiencies and losses in the treatment and distribution systems, as summarised in Table 4.5. Consumers are in a way compelled to cover the costs of water which does not reach them or is not metered. In Table 4.5, the first panel has estimated demographic information. The results of the 2012 Zimbabwe national census were released as preliminary results in December 2012 but these have been disputed by almost all councils according to media reports. The next panel records the number of connections, the number of staff, current water treatment works (WTW) capacity, and current production. Only in Mutare is WTW capacity fully utilised at present (in fact over-utilised, 70 ML/d being produced from a plant with nameplate capacity of 64 ML/d). The amount of water that Chitungwiza purchases from Harare is uncertain because it is not metered. The city is charged for 27 ML/d, but the indications are that the volume is larger.

Table 4.4 Affordability of water and sanitation in selected towns of Zimbabwe. (Source: World Bank 2011)

Town	Average household income, USD/month	Household expenditure on water and sanitation, USD/month	Household expenditure on water and sanitation, % of monthly income
Harare	457	26.10	5.5
Bulawayo	311	19.86	6.4
Chitungwiza	475	26.10	5.5
Mutare	293	17.35	5.9
KweKwe	359	17.53	4.9
Masvingo	331	12.08	3.6
Chegutu	308	13.37	4.3
Average	362	18.91	5.2

Water losses are high in all the towns covered, ranging from 30 % in Chitungwiza to 57 % in Harare, but there seems to be considerable uncertainty about the accuracy of the figures kept by councils (World Bank 2011; Ndebele 2012). The cost of losses reported in Table 4.5 represents the revenue lost when supplying treated water that never gets sold, compared to benchmark losses of 20 % – the figure for Harare is USD35 million per year. The costs are incurred whether the water is sold or not – the opportunity cost that is involved in non-revenue water is the effective tariff, which takes the collection ratio into account (actual collected revenue divided by billed volume), multiplied by the excess losses (difference between actual losses and the benchmark level of 20 %).

The next panel deals with present levels of supply of piped water and of consumption of water (piped plus self-supply water). Only Mutare and Kwekwe supply between two-thirds and three-quarters of unconstrained demand with piped water (Table 4.5). The lowest performer is Chitungwiza, which only supplies 15 % of unconstrained demand, which is itself based on a lower assumed consumption per capita than other councils. Self-supply is thought to be important in Harare, Bulawayo, Chitungwiza, and Chegutu, with the actual values on a ML/d basis being as shown in the table. The relative contribution of self-supply is highest in Chegutu (12 %) and Chitungwiza (9 %). Total consumption of water is closest to unconstrained demand in Mutare (80 %) and Kwekwe (66 %). The unconstrained figure for Harare is high because it includes provision for bulk sales to Norton and Chitungwiza as well as a large industrial demand.

3.7 Institutional Structure and Coordination Mechanisms

The cholera outbreak of 2008/09 exposed the bottlenecks in the institutional system in Zimbabwe, and both donors and the government realised the need for better coordination and accountability in the sector. A ministerial meeting was therefore organised. The Nyanga Ministerial Retreat held in February 2010 was attended by ministers and senior government officials from the key ministries involved in the WASH sector. The following are the major outcomes from the Nyanga Retreat:

- Development of a common understanding of issues affecting the WASH sector in Zimbabwe
- Development of a comprehensive framework clearly showing leadership, sub-sectoral roles and responsibilities, and key coordination and financing mechanisms for the sector
- Identification of interventions for sector recovery, including development of policy, legislation, institutional development, and capacity building, and
- Agreement on important follow-up steps, including relevant interventions, timeframes, and responsibilities.

The institutional structure for the water sector in Zimbabwe, after extensive discussions, was subsequently changed – see Fig. 4.12. The Government of

Table 4.5 Basic information on water supply, demand, and wastewater management in selected towns of Zimbabwe, based on available 2011 data (Source: World Bank 2011)

Demand and supply	Units	Harare	Bulawayo	Chitungwiza	Mutare	KweKwe	Masvingo	Chegutu
Stands	#	177,000	160,000	67,000	34,000	17,500	14,300	12,100
Population	#	2,500,000	985,000	400,000	200,000	155,000	120,000	100,000
of which HDA	#	2,200,000	757,000	395,000	281,000	143,000	115,000	90,000
prop. of total	%	88 %	77 %	99 %	141 %	92 %	96 %	90 %
Unconstrained water demand	ML/d	1,200	221	136	45	54	50	21
Water connections	#	177,000	160,000	67,000	34,000	17,500	14,300	12,100
Staff involved in water services	#	2,480	530	365	155	112	77	42
Water treatment works capacity	ML/d	704	260	0	64	90	30	12
Current water production	ML/d	570	140	30	70	60	24	8
Daily water losses	ML/d	325	49	9	36	24	10	3
Losses as % of daily production	%	57 %	35 %	30 %	52 %	40 %	41 %	40 %
Opportunity cost of losses	\$M p.a.	35.3	2.8	0.3	0.6	0.8	0.6	0.1
Net current piped supply	ML/d	244	91	21	34	36	14	5
Prop. unconstrained demand	%	20 %	41 %	15 %	75 %	66 %	28 %	22 %

Self supply	ML/d	53	11	12	2	0	0	3
Prop. unconstrained demand	%	4 %	5 %	9 %	5 %	0 %	0 %	12 %
Total consumption	ML/d	298	102	33	36	36	14	7
Prop. unconstrained demand	%	25 %	46 %	24 %	80 %	66 %	29 %	34 %
Sewage treatment works operational capacity	ML/d	220	89	56	34	35	23	12
Current volumes treated	ML/d	275	91	29	43	23	14	7
Capacity utilisation	%	125 %	103 %	52 %	128 %	66 %	60 %	59 %

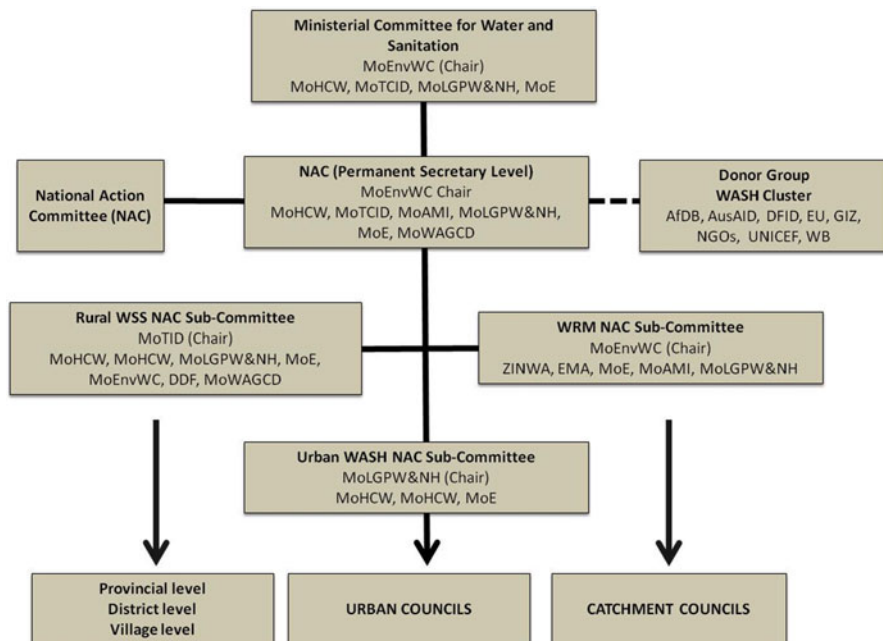


Fig. 4.12 Zimbabwe water sector institutional structure as established in June 2010 (Updated from AMCOW 2010)

Zimbabwe agreed to consolidate the water sector from June 2010 through a National Action Committee on water, looking at all aspects of water in both rural and urban areas as well as water resources management issues. The Government decided to transform and enhance the old National Action Committee on rural water supply and sanitation which had hitherto focused on rural areas only. The new NAC has three sub-committees, each looking at specific issues:

- I. Rural Water Supply and Sanitation Sub-Committee,
- II. Urban Water Supply and Sanitation Sub-Committee, and
- III. Water Resources Management Sub-Committee.

The outcomes of the Nyanga retreat have far-reaching implications for the recovery of the WASH sector. Sector steering will now be the responsibility of the Cabinet Steering Committee for Water and Sanitation chaired by the Minister of Environment, Water and Climate (MoEnvWC). Included in this Cabinet Steering Committee are Ministers for Agriculture, Health and Child Welfare, Transport Communications and Infrastructure Development, Energy, and Local Government. The national coordination and management of the sector will now be through a National Action Committee for water and sanitation chaired by the Permanent Secretary for the ministry responsible for water. Members of this committee are Permanent Secretaries for the Ministries of: Health and Child Welfare, Transport Communication and

Infrastructure Development; Agriculture, Local Government; Women Affairs Gender and Community Development; Energy; and Finance. Each Permanent Secretary can nominate an alternate whose level shall not be below that of a Director. The new NAC is required to work closely with the Donor Coordination Group and the WASH cluster.

4 Conclusions

Rapid population growth and urbanisation are key drivers in water supply and sanitation in developing countries. These have resulted in pressures in the provision of key rural and urban infrastructure such as housing, safe water supplies, and adequate sanitation. In some cases, these pressures have resulted in the mushrooming of slum settlements and the prevalence of waterborne diseases such as cholera, dysentery, typhoid, and diarrhoea, among others. The impact of poor water supply and sanitation services could potentially affect other key development indicators since many lives and livelihoods are affected. The problem in most developing countries is that they lack the financial muscle to deal with a myriad of problems facing them, meaning they cannot reach the targets of the Millennium Development Goals. In this context, urban water supply and sanitation should aim for reduced water usage to cut conveyancing and treatment costs and to widen management choices. Rural sanitation is not being given the attention it deserves, and particular attention needs to be paid to coordination, appropriate technology, and financing mechanisms.

In this analysis, Zimbabwe has been used as a case study to show the key challenges in water supply and sanitation in developing countries. The challenges include lack of investment in the water and sanitation sector, inappropriate technologies, ill-defined institutional frameworks, capacity limitations, and neglect of rural infrastructure. These challenges should be factored in at the planning and organisation of the sector to ensure a win-win situation under various environmental and economic situations. This calls for innovative thinking, judicious choice of technologies, robust institutional structures, a responsive legal framework, and political will. Poor water supply and sanitation in Zimbabwe is typified by the cholera outbreak of 2008/09 which killed nearly 4,300 out of the 99,000 that were affected. The cholera epidemic caught the attention of the international community and attracted donor funding. Responses included a review of the policy environment, appropriateness of the institutional structure, accountability, and choices of technologies. The emphasis now is shifting to appropriate technologies centred on waterless toilets and natural sewage treatment systems. For water supply, the focus is now on demand management, reduction of unaccounted-for water, and innovative methods for enhancing revenue collection. Two important lessons for other developing countries are that the water sector must be streamlined to give efficient service delivery at all times, and that the technologies chosen should be robust, resilient, and appropriate for the situation.

References

- AMCOW. (2010). *Water supply and sanitation in Zimbabwe: Turning finance into services for 2015 and beyond*. Nairobi: World Bank.
- BCC (Bulawayo City Council). (2002). *Study on water use, water conservation and affordability, May 2002*. Bulawayo: Department of Works.
- British Medical Journal. (2007). Sanitation is greatest medical milestone since 1840. Press release, 18 January 2007. <http://group.bmj.com/group/media/press-release-archive-files/BMJ/bmj-2007/BMJ-18Jan-2007.pdf>. Accessed 23 Feb 2014.
- Chaplin, S. (1998). *Water efficiency: The next generation*. Draft report 5–9, Rocky Mountain Institute, Colorado. http://www.rmi.org/Knowledge-Center/Library/W98-07_WaterEfficiencyNextGeneration. Accessed 23 Feb 2014.
- Chisango, H. (2012). *Investigating opportunities for improving service through water demand management in Harare*. MSc Thesis, University of Zimbabwe, Harare.
- Chuhan-Pole, P., Korman, V., Angwafo, M., & Buitano, M. (2011). *Africa's pulse: An analysis of issues shaping Africa's economic future* (Vol. 3). Nairobi: World Bank.
- Dlamini, S. (2012). *Evaluation of the water quality status in Lake Chivero, Zimbabwe*. MSc Thesis, University of Zimbabwe, Harare.
- Franceys, R., Pickford, J., & Reed, R. (1992). *A guide to the development of on-site sanitation*. Geneva: WHO.
- GoZ (Government of Zimbabwe). (1998a). *ZINWA Act (Chapter 20:25)*. Harare: Government Printers.
- GoZ (Government of Zimbabwe). (1998b). *Water Act (Chapter 20:24)*. Harare: Government Printers.
- GoZ (Government of Zimbabwe). (2008). *Urban Councils Act (Chapter 29:15, amended)*. Harare: Government Printers.
- GoZ (Government of Zimbabwe) & World Health Organization. (2011). *Intersectoral actions in response to cholera in Zimbabwe: From emergency response to institution building*. Paper presented at the World Conference on Social Determinants of Health, 19–21 Oct 2011, Rio de Janeiro.
- Gwinji, G. (2010). *The key rural water, sanitation and hygiene issues in Zimbabwe*. Paper presented at the Inter-ministerial Conference on Water, Nyanga, 10–11 Feb 2010.
- IWSD (Institute for Water and Sanitation Development). (2009). *Evaluation of the WASH response to the 2008–2009 Zimbabwe cholera epidemic and preparedness planning for future outbreaks. Zimbabwe WASH Cluster Report*. Harare: Institute for Water and Sanitation Development.
- JICA. (1997). *The study of water pollution control in Upper Manyame river basin in the Republic of Zimbabwe*. Ministry of Local Government, Public Works and National Housing, Harare, Zimbabwe.
- Kibena, J., Nhapi, I., & Gumindoga, W. (2013). Assessing the relationship between water quality parameters and changes in landuse patterns in the Upper Manyame River, Zimbabwe. *Physics and Chemistry of the Earth, Parts A/B/C* (in press). doi:10.1016/j.pce.2013.09.017.
- Kumwenda, V. (2012). *Evaluating the impacts of WASH interventions on the 2008–09 cholera outbreak in Harare, Zimbabwe*. MSc Thesis, University of Zimbabwe, Harare.
- Lopez, A. D., & Mathers, C. D. (2006). Measuring the global burden of disease and epidemiological transitions: 2002–2030. *Annals of Tropical Medicine & Parasitology*, 100(5/6), 481–499.
- Manzungu, E., & Chioreso, R. (2012). Internalising a crisis? Household level resistance to water scarcity in the city of Harare, Zimbabwe. *Journal of Social Development*, 17(1), 111–136.
- Masst, M. (1996). *The harvest of independence: Commodity boom and socio-economic differentiation among peasants in Zimbabwe*. PhD Dissertation, Roskilde University, Roskilde.
- Mokitimi, L. (2012). *Linking institutional and legal framework with accountability and possible implications on urban water sub-sector performance in Zimbabwe*. MSc Thesis, University of Zimbabwe, Harare.

- Ndebele, P. (2012). *Assessment of water revenue collection strategies in selected urban local authorities in Zimbabwe*. MSc Thesis, University of Zimbabwe, Harare.
- Nhapi, I. (2004). *Options for wastewater management in Harare, Zimbabwe*. PhD Thesis, Wageningen University, The Netherlands. Taylor and Francis, London, UK (ISBN 9058096971). <http://edepot.wur.nl/193572>. Accessed 23 Feb 2014.
- Nhapi, I., & Gijzen, H. J. (2004). Wastewater management in Zimbabwe in the context of sustainability. *IWA Water Policy Journal*, 6(6), 115–120.
- Nhapi, I., Siebel, M., & Gijzen, H. J. (2002). *Options for the decentralised management of wastewater in Harare Zimbabwe*. IWA Water and Environmental Management Series, Dec. 2002, pp. 955–964.
- Red Cross. (2010). Final report, MDRZW004 – Zimbabwe cholera. Harare, Zimbabwe: International federation of red cross and red crescent societies.
- Rees, N., Chai, J., & Anthony, D. (2012). *Right in principle and in practice: A review of the social and economic returns to investing in children*. New York: United Nations Children’s Fund (UNICEF).
- Scoones, I., Marongwe, N., Mavedzenge, B., Murimbarimba, F., Mahenehene, J., & Sukume, C. (2011). *Zimbabwe’s land reform: A summary of findings*. Brighton: Institute of Development Studies, University of Sussex.
- UNDP. (2013). *Human development report 2013. The rise of the south: Human progress in a diverse world*. New York: United Nations Development Programme. http://hdr.undp.org/sites/default/files/reports/14/hdr2013_en_complete.pdf. Accessed 23 Feb 2014.
- UNEP. (2010). *Assessing the environmental impacts of consumption and production: Priority products and materials*. Report of the Working Group on the Environmental Impacts of Products and Materials to the International Panel for Sustainable Resource Management. http://www.unep.fr/shared/publications/pdf/DTIx1262xPA-PriorityProductsAndMaterials_Report.pdf. Accessed 31 Dec 2012.
- UN-HABITAT. (2012). *State of the world’s cities 2010/2011: Bridging the urban divide*. Nairobi: United Nations Human Settlements Programme (UN-HABITAT).
- UNICEF. (2010). The 2008–2009 cholera epidemic in Zimbabwe. United Nations Children’s Emergency Fund, unpublished report, Harare.
- UNPD (United Nations Department of Economic and Social Affairs, Population Division). (2013). *World population prospects: The 2012 revision, key findings and advance tables*. Working paper No. ESA/P/WP.227, New York.
- van den Berg, C., & Danilenko, A. (2011). *IBNET water supply and sanitation performance Blue Book: The international benchmarking network for water and sanitation utilities data book* (p. 176). Washington DC: World Bank.
- WHO. (2004). *Assessing the outbreak response and improving preparedness*. Geneva: World Health Organization.
- WHO/UNICEF. (2012). *Progress on drinking water and sanitation: 2012 update*. New York: UNICEF/World Health Organization.
- WHO/UNICEF. (2013). *Progress on sanitation and drinking-water, 2013 update*. Geneva: WHO.
- World Bank. (2011). *Zimbabwe urban water tariff study: Final report*. Report prepared for the Zulu, World Bank and the Government of Zimbabwe. Harare: World Bank.
- Zulu, E. M., Dodoo, F. N., & Chika-Ezee, A. (2002). Sexual risk-taking in the slums of Nairobi, Kenya, 1993–8. *Population Studies*, 56, 311–323.