

## **LEGISLATION, VULNERABILITY AND DISASTER RISK MANAGEMENT OF WATERBORNE DISEASES IN ZIMBABWE**

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**Abstract:** The annual probabilities of droughts and floods in Zimbabwe averaged at 31.6 and 57.9 % between 1990 and 2014. Those disasters have accounted for 97.1 % of the disaster mortalities and for 99.7 % of the economic disaster losses in Zimbabwe. Occurrences of droughts and floods decrease the population's access to sufficient volumes of drinking water. In addition, provision of safe drinking water and access to improved sanitation facilities have been declining among the population in Zimbabwe in recent years, as a result of breakdown in public services. These factors have contributed to outbreaks of infectious diseases, such as cholera. Therefore, the water, sanitation and hygiene (WASH) will play a significant role in the disaster management in Zimbabwe. In the current article, the authors seek to analyse the legislation and the WASH vulnerability angle of the disaster management system in Zimbabwe. Results of the legislation analysis indicate that the disaster management system in Zimbabwe incorporates tools to deal with epidemics and WASH-related outcomes of disasters in general. The key parts of legislation include the Civil Protection Act no. 22 of 2001, the Emergency Powers Act no. 572/1979 and the Public Health Act no. 899 of 1978. Disaster management across the territory of Zimbabwe is overseen by the Directorate of Civil Protection at the national level. The coordination is also carried out by the National Civil Protection Committee. Data gathering could be facilitated by training of the NGO staff and volunteers, using the data-collection tool developed by the authors. The number of healthcare professionals who provide care to the Zimbabwean population is not the main reason for the WASH-related disaster risk. This type of disaster risk could be partially explained by the weak correlation between the socio-economic vulnerability of the Zimbabwean population and the risk from WASH-related health outcomes of disasters in the country. Further studies will have to be conducted to investigate these vulnerability results in more detail.

**Keywords:** cholera, civil protection, socio-economic vulnerability, expanded medical infrastructure vulnerability index, data collection.

## Introduction

All disaster management considerations are linked in the first instance to the quantification and understanding of disaster risk. Disaster risk is a function of the following variables in the disaster-prone/affected area:<sup>1,2</sup> type and extent of hazards, size of the population, value and physical location of lifelines and assets, resilience and exposure/vulnerability of the human population, lifelines and assets to disaster perturbations and preparedness of the disaster management systems to respond to a given disaster. Exposure, resilience and preparedness are often lumped into a consolidated term of capacity.<sup>3</sup> Hazards can be of natural and manmade origin; or can be complex if any interplay of the natural and manmade factors triggers a disaster. In Zimbabwe, disaster hazards include those leading to floods, droughts, the infectious disease epidemics and severe storms.<sup>4</sup>

Between 1990 and 2014, the annual probabilities of droughts and floods in Zimbabwe averaged 31.6 and 57.9 %, respectively (as summarised on the Prevention Web website).<sup>5</sup> For the same time period, flooding accounted for 97.1 % of the disaster mortalities, while impacts of droughts and floods together accounted for 99.7 % of the economic losses from disasters in the country (as summarised on the Prevention Web website).<sup>5</sup> Therefore dealing with droughts and floods must be a strong focus of the disaster management system in Zimbabwe. In this context, consideration must be given to the impacts of compounding factors such as the recent calendar shifts in the onset of rain.<sup>6</sup> This shift makes it more difficult to predict when the majority of precipitation will be recorded in a calendar year, i.e. complicating disaster risk planning and management of floods and droughts in Zimbabwe.

In 2015, Zimbabwe had the second highest INFORM risk index from among the countries of the South African Development Community (SADC; as summarised on the Prevention Web website).<sup>5</sup> The United Nations Human Development Index for Zimbabwe indicates that the country has achieved medium level of human development.<sup>7</sup> Therefore the country still faces developmental challenges which strongly influence disaster vulnerability. These include low levels of food security among the Zimbabwean population,<sup>8</sup> abysmal economic situation in the country and widespread cash shortages.<sup>9</sup> The HIV/AIDS epidemic and outward migration of the population has also played a crucial role in terms of disaster compounding/ vulnerability in Zimbabwe.<sup>10</sup> In the water, sanitation and hygiene (WASH) sector, the compounding originates from the lack of experience among the stakeholders' with implementation and operation of large scale projects,<sup>11</sup> and "new variant famine."<sup>12</sup>

Droughts result in the decrease in the available volumes of drinking water per capita per day among the affected population(s), e.g. due to the requirement to manage and often restrict the drinking water supply by local government.<sup>13</sup> On the other hand,

floods can result in faecal contamination of drinking water resources and compromised hygiene among the affected population.<sup>14</sup> One of the causes can be the flooding of sanitation infrastructure and the increased probability of human contact with sanitation wastes.<sup>14</sup> In addition, the drinking water provision has all but collapsed in major population centres around Zimbabwe in recent years.<sup>15</sup> The resulting decrease in the available volumes of safe drinking water per capita and the interlinked compromised hygiene increases the probability of the WASH-related disease outbreaks. Further information on the WASH challenges in Zimbabwe and their implications on disaster management and epidemics are described below.

The United Nations reported that the access to “safe drinking water” has dropped in the rural areas of Zimbabwe from 70 % in 1999 to 61 % in 2006.<sup>16</sup> Results of the “2004 National Water and Sanitation Inventory” indicated that 35 % of drinking water access points in Zimbabwe were out of order.<sup>16</sup> By 2009, the improved sanitation was available to only 43 % of the rural population in Zimbabwe.<sup>16</sup> Up to 33 % of the country’s population had to resort to open defecation on a regular basis.<sup>16</sup> These findings point compromised hygiene and to the increased vulnerability of Zimbabwean population to the WASH-related epidemics and infectious diseases in urban and rural areas.<sup>16</sup> One of the most significant hazards/risks in this regard originates from the perennial cholera outbreaks which regularly occur in Zimbabwe (see below). Mortality rates and geographical spread of two outbreaks which occurred in 2008-2009 and in 2010 are discussed in the next two paragraphs.

The average mortality rate during the 2008-2009 cholera epidemic was at 4.3 %.<sup>16</sup> In 2010, a smaller outbreak was reported with a mortality rate of 3.4 %.<sup>17</sup> During the 2008-2009 cholera epidemic the main disease burden was experienced by the urban population.<sup>16</sup> Up to 66 % of all cholera cases were reported in urban areas,<sup>16</sup> with almost 50 % occurring in the Budiro sub-urb of Harare.<sup>18</sup> At the same time, remote rural areas experienced a much higher mortality rates than the average mortality for the whole country, with the actual values ranging from 20 to 30 % of all cholera cases.<sup>18</sup> This is a significant disaster risk, as 82 % of all cholera cases from the 2010 outbreak were reported in rural areas.<sup>17</sup>

Using the 2008 World Health Organisation (WHO) data, the worldwide average mortality numbers during cholera outbreaks can be estimated to range from 2.0 to 4.0 % of all reported cases.<sup>19</sup> Based on the comparison of the data from Zimbabwe and the worldwide averages, the mean disaster mortality from cholera experienced by the Zimbabwean population is comparable for the worldwide averages. However, the mortality risk among the rural population is 5 to 15 times higher than the global levels. Therefore, access to treatment, and thus the country’s healthcare system, will be of critical importance to prevent disaster mortalities during a cholera outbreak and

other WASH-related epidemics in Zimbabwe, especially in rural areas of the country. Here access to the healthcare system in Zimbabwe by the country's population and the general status of the healthcare system must be evaluated.

Such an evaluation is possible through looking at the population's life expectancy at birth,<sup>20</sup> expenditure on healthcare as percentage of the country's gross domestic product (% GDP)<sup>21,22</sup> and mortality among children under 5 years of age.<sup>23</sup> The average life expectancy at birth of the Zimbabwean population was reported to be 61 years in 2016.<sup>24</sup> The neighbouring countries had the following expectancies at birth in 2016:<sup>24</sup> Angola – 62 years, Botswana – 67 years, Malawi – 63 years, Namibia – 64 years and South Africa – 63 years. The world average was equal to 72.035 years of age.<sup>24</sup> This data snapshot indicates that the life expectancy at birth in Zimbabwe was lower than the values from the neighbouring countries on the Southern African sub-continent and globally in 2016. As a result, Zimbabwean population is likely to receive a lower access to healthcare in comparison with the citizens in neighbouring countries and the worldwide population. Compared to these populations, Zimbabweans are likely to suffer from higher health vulnerability.

Public health expenditure in Zimbabwe was equal to 2.47 % of GDP in 2014, ranking the country 136<sup>th</sup> globally.<sup>17</sup> A more recent figure of the total health expenditure in the country was reported to be equal to 6.4 % GDP.<sup>18</sup> In 2014, the neighbouring countries had public health expenditure:<sup>19</sup> Angola – 2.12 % GDP (ranked 149<sup>th</sup> globally), Botswana – 3.19 % GDP (ranked 104<sup>th</sup> globally), Malawi – 6.00 % GDP (ranked 38<sup>th</sup> globally) and South Africa – 4.24 % GDP (ranked 69<sup>th</sup> globally). In recent years, the public health expenditure on healthcare in Zimbabwe was comparable to the neighbouring countries as percent of GDP. Therefore, the total investment of financial resources into the healthcare sector is not likely to be the main cause for the lower access to healthcare by the Zimbabwean population in comparison to neighbouring countries and the world. This conclusion is supported by the fact that the cost recovery in the healthcare facilities in rural Zimbabwe was shown to be comparable to the worldwide standards in the 1990's.<sup>25</sup>

Reasons for the lower population's access to healthcare are likely going to include the following causes in the Zimbabwe's healthcare sector: financial mismanagement,<sup>26</sup> staff shortages,<sup>27</sup> lack of medicines<sup>28</sup> and breakdown in essential laboratory health services in recent years.<sup>29</sup> Staff shortages are possibly the result of the outward migration of doctors and other educated personnel from Zimbabwe during the first decade of the 21<sup>st</sup> century.<sup>30</sup> All these factors, in combination with the compromised provision of safe drinking water and access to improved sanitation, are likely to increase the health and WASH vulnerability of the Zimbabwean population.<sup>31</sup> Further support to this argument is provided by the snapshot of the mortality rate of children

under 5 years of age (MCUFRY). If the country's population is risk in terms of WASH, then the diarrhoeal diseases are among the leading causes of the deaths among children under 5 years of age.<sup>32</sup>

In 2016, the MCUFRY stood at 56 deaths per 1000 live births in Zimbabwe.<sup>23</sup> For the same year, the neighbouring countries had the following MCUFRY values (number deaths per 1000 live births, designated as number per 1000 in Table 1): 83 for Angola, 41 for Botswana, 43 for South Africa and 55 for Malawi. The worldwide MCUFRY value was equal to 40.8 deaths per 1000 live births.<sup>23</sup> The MCUFRY value for Zimbabwe was comparable to Malawi and lower than the values for Angola in 2016. However, it was still 30.2 to 37.2 % higher than the values for Botswana, South Africa and the global average. This again indicates significant levels of the WASH and healthcare vulnerability for the population Zimbabwe.

Significance of the WASH angle and the health vulnerability in general is also supported by the HIV/AIDS rates in Zimbabwe (see the third paragraph of the Introduction). The rates of HIV/AIDS among the economically-active population, which includes Zimbabwean citizens aged 15 to 49, stood at 33.7 % in 2001 as summarised by Brummer, Table 1).<sup>33</sup> Rate of the HIV infections among this segment of the Zimbabwean population decreased to 13.5 % in 2016, but the HIV/AIDS disease burden was still significant as the rate was the sixth highest in the world.<sup>34</sup> Reviews of literature from Southern Africa also indicate that HIV/AIDS patients often suffer from chronic diarrhoea (as summarised by Luyt et al.).<sup>35</sup> Factors like these will complicate disaster response to the WASH-related disasters due to increased demand for drinking water and access to improved sanitation; and hygiene measures among the HIV/AIDS patients in the disaster zone.

Severity of the WASH-related diseases and their impact on the Zimbabwean population is obvious from the discussion above. As 32.2 % of the population resided in urban areas in 2017, it can deduced that up to 67.8 % of the Zimbabwean population lived in rural areas in the same year.<sup>36</sup> This places a large part of the population at increased risk from mortality from cholera and other WASH-related diseases. In addition, deteriorating WASH situation in the country, problems in the healthcare system and logistical problems with the sanitation project implementation are likely to increase the exposure and vulnerability to the WASH-related epidemics. Recently, legislation and policy analysis was conducted to identify disaster management tools which can be used to address WASH challenges in a country that has reached medium level of development.<sup>37</sup> Here a similar approach is used for Zimbabwe. The legislation and policy analysis is combined by examination of various aspects of the population's vulnerability in Zimbabwe. Where feasible, possible solutions are proposed.

## Methodology

Goals of this study were achieved as through a combination of literature review, policy analysis, calculation of vulnerability indices and correlation between vulnerability indices and the WASH risk measures. Zimbabwean government documents and legislation documents from the United Nations and scientific articles indexed in SCOPUS, [www.jamba.org.za](http://www.jamba.org.za), Google and Google Scholar were used as sources of information for the literature review and policy analysis part of the study. Solutions to the identified drawbacks in Zimbabwe's disaster management system are proposed using examples from the developing world and from SADC. The economic vulnerability index ( $EV$ ) and the social vulnerability index ( $SV$ ) of the Zimbabwean population were calculated for the 1990-2013 period.<sup>38</sup> For these calculations, data for gross domestic product per capita ( $GDP$ ; USD) were obtained from databases of the United Nations Development Programme<sup>39</sup> and the World Bank.<sup>40</sup> At the same time, data for the fraction of the total population living in urban areas of the country ( $FUP$ ; dimensionless) was obtained from databases of the United Nations Development Programme database.<sup>41</sup> The Index Mundi database was used as the source for the population growth rate ( $C_p$ ; dimensionless).<sup>42</sup> Dimensionless will be designated as dim in further text. Finally, the Human Development Index Values ( $HDI$ ; year<sup>0.667</sup>) were obtained from the United Nations Development Programme.<sup>42</sup>

Using the gathered data, values of  $EV$  and  $SV$  were calculated using Equations (1) and (2).<sup>38</sup>

$$EV = \frac{FUP \times \log(GDP)}{C_p \times HDI} \quad (1)$$

$$SV = \frac{FUP \times C_p}{HDI \times \log(GDP)} \quad (2)$$

Considering the information above, André's approach to vulnerability calculations yields the following units:  $EV$  (USD $\times$ year<sup>1.5</sup>) and  $SV$  (year<sup>1.5</sup> $\times$ USD<sup>-1</sup>).<sup>38</sup> Units for each indicator are the results of the units of the parameters used to calculate  $EV$  and  $SV$ . Both  $EV$  and  $SV$  are general indicators of the social and economic determinants of the vulnerability of the Zimbabwean population.

The expanded medical infrastructure vulnerability index ( $EMIVI$ ) was calculated using the definition of Kumpulainen<sup>44</sup> with the subsequent modification of Tandlich et al.<sup>45</sup> The definition of  $EMIVI$  is shown in Equation (3).

$$EMIVI = 1000 \times \frac{N(\text{healthcare staff})}{N(\text{population})} \quad (3)$$

In Equation (3), the numerator contains the term  $N(\text{healthcare staff})$  which represents the total number of healthcare staff participating in provision of healthcare to the Zimbabwean population.<sup>45</sup> The denominator of Equation (3) contains  $N(\text{population})$  which represents the total population of Zimbabwe in a given calendar year.<sup>45</sup> The  $EMIVI$  will be reported in  $N(\text{healthcare staff})$  per 1000 members of the Zimbabwean population and thus the coefficient of 1000 in Equation (3).<sup>45</sup> Raw data for the calculations of the  $EMIVI$  were obtained from the World Bank and the World Health Organisation for the following years: 1990, 1995, 2010 and 2011. For Zimbabwe, the World Bank did not contain any data on the number of community healthcare workers per 1000 citizens<sup>46</sup> and neither did the World Health Organisation databases.<sup>47</sup> Therefore the calculation of  $EMIVI$  were based on the numbers of medical doctors per 1000 citizens of Zimbabwe and the number of nurses and midwives for 1000 citizens of Zimbabwe.<sup>46-48</sup> The total population of Zimbabwe was extracted from the World Bank databases.<sup>49</sup> The calculation of  $EMIVI$  is necessary to establish whether there is enough healthcare professionals to treat any patients who are suffering from infectious diseases and/or WASH-related epidemics.

Data on the MCFURY for the time period from 2000 until 2013 was extracted from the World Bank databases.<sup>23</sup> The MCFURY values can be seen as a measure of disaster risk. More detailed analysis, not just the snapshot data used in the Introduction section, was done by correlating the MCFURY values with  $EMIVI$ ,  $EV$  and  $SV$ . The correlation or lack thereof were evaluated using Pearson correlation coefficient<sup>50</sup> and for the significance or a lack thereof by calculation of the respective  $p$ -values.<sup>51</sup> Doing this can provide an indication if correlation exists between the socio-economic vulnerability of the Zimbabwean population, the healthcare professional availability and the risk from WASH-related diseases.

## Results and Discussion

### *Legislative framework of Disaster Management and WASH in Zimbabwe*

Disaster management in Zimbabwe has been actively developed since before independence from Britain.<sup>52</sup> Original focus was on the civil defence, which included preparation for “natural disasters, hostile attacks or military action”.<sup>53</sup> It has been suggested by some researchers that the primary aim of civil defence in the territory of today’s Zimbabwe was aimed at the protection of the historically existing social and racial inequalities.<sup>52</sup> However, many efforts in the legislative domain have been ongoing to improve the disaster management system and make it inclusive of all Zim-

babwean citizens since independence. This is demonstrated by the Civil Protection Act no. 5/1989, no. 3/1992 and no. 22/2001.<sup>54</sup> The central organ of state responsible for disaster management has been established, i.e. the Directorate of Civil Protection.<sup>55</sup> The current legislation is the Civil Protection Act no. 22/2001 (Chapter 10:06, designated as Act in further text).<sup>54</sup> In the Act, disaster management is part of civil protection which is defined as “any service provided or measure taken for the purpose of preparing for, guarding against or dealing with any actual or potential disaster” (Part I section 2 of the Act).<sup>52</sup> The definition of a disaster includes “plague or epidemic of disease” (Part I section 2 of the Act).<sup>54</sup> As cholera epidemics are common in Zimbabwe, waterborne and WASH-related diseases are implicitly classified as disasters in Zimbabwean legislation.

Part II of the Act requires that government of Zimbabwe name a public official to serve as the Director of Civil Protection.<sup>54</sup> This is an official who oversees the disaster management activities in the entire territory of Zimbabwe. Results of the legislative analysis indicate that local government plays an important role in the disaster management system in Zimbabwe (see the analysis of the Public Health Act below). Therefore, housing disaster management in the National Ministry of Zimbabwe responsible for local government seems plausible.<sup>55</sup> However, placing disaster management under the Ministry of Local Government, Rural and Urban Development can lead to problems in the implementation of the disaster management policy framework in Zimbabwe. This is likely result of disaster management being removed from the centre of executive power, i.e. the Office of the President of Zimbabwe, similar to the example discussed for South Africa.<sup>55</sup>

Part III sections 4b and 4e of the Act indicate that the National Civil Protection Committee coordinates the disaster (risk) management at the national level of government in Zimbabwe.<sup>54</sup> Membership of this committee must include the National Secretary of Health and the Secretary-General of the Zimbabwean Red Cross Society.<sup>54</sup> This part of the Act again supports the interconnectivity between disaster management and public health. Public health in this context will cover WASH (see below the description of the Public Health Act). Health officials from the Zimbabwean government and non-governmental organisations have legislated roles to play on the National Civil Protection Committee. Specialised attention can be given to the epidemics and WASH-related disasters by establishing a sub-committee of the National Civil Protection Committee (Part III section 6 of the Act).<sup>54</sup> As such, this fact further supports the conclusion that legislative basis exists for using disaster management tools to deal with any (WASH-related) epidemic.

Furthermore civil protection plans can be developed by dedicated planning committees which are constituted for this purpose, e.g. response to gastro-intestinal diseases

(Part IV section 9 subsection 1 of the Act).<sup>54</sup> Specialised planning committees prepare civil protection plans for “civil protection areas and provinces” in the territory of Zimbabwe (Part IV section 9 subsection 2 of the Act).<sup>54</sup> Planning committees must include members from the jurisdictions for which the plan is prepared (Part IV section 9 subsection 2 of the Act).<sup>54</sup> Once finalised, the civil protection plan is communicated to the Director of the Civil Protection and the National Civil Protection Committee for approval (Part IV section 11 subsection 2 of the Act).<sup>54</sup> After the adoption by the National Civil Protection Committee, the Minister of Local Government, Rural and Urban Development ratifies the plan and it becomes operational (Part IV section 11 subsection 3 of the Act).<sup>54</sup> If disputes arise, the plan is sent back to the respective planning committee (Part IV section 11 subsection 4 of the Act).<sup>54</sup> Execution of the civil protection plans is carried out throughout the territory of Zimbabwe by provincial civil protection officers and district civil protection officers; and assistant civil protection officers.<sup>54</sup>

Besides the Act, connection between disaster management and public health; and implicitly WASH is supported by other legislation in Zimbabwe, e.g. the Emergency Powers Act no. 572/1979 Chapter 11:04.<sup>56</sup> In section 2 of this act, the essential services are listed as “any hospital service” (section 2a), “any service relating to the supply and distribution of water” (section 2d) and “sewage collection and sanitation” (section 2e).<sup>56</sup> Therefore emergency services include maintaining access to safe and improved water resources and improved sanitation facilities. Significance of accurate/baseline data about the nature, occurrence and other aspects of WASH-related disaster is implicitly stated in the classification of the emergency communication as one of the essential services (section 2i of the Emergency Powers Act).<sup>56</sup> Section 3 subsection 1i of the Emergency Powers Act gives the President of Zimbabwe the powers to issue orders to maintain the provision of any essential service, i.e. including the WASH services.<sup>56</sup> Expropriation of assets or means needed to carry out the government’s response to disasters is stipulated in section 3 subsection 2f and 2g.<sup>56</sup> Strong focus on the protection of human life is described by the legal obligation of the Zimbabwean government to assist people affected by disasters (section 3 subsection 2i).<sup>56</sup>

Implementing the provisions of the Emergency Powers Act lies with the Minister of Home Affairs or a Minister designated by the President (see section 2).<sup>56</sup> The effects of this act are short-term as any decisions made by the President under this act must be ratified by the Zimbabwean Parliament or they lapse (section 3 subsection 7 of the Emergency Powers Act).<sup>56</sup> The holistic approach to protection of property, assets and lifelines during disaster situations is clear from the text of the Emergency Powers Act. It appears that the text of the Emergency Powers Act at the time of its passing was intended to provide for good legislative framework for effective response to dis-

asters, including WASH-related disasters. This is mainly the case is considering the Emergency powers Act being implemented in conjunction with the Act and the Public Health Act (see below).

However, practical implications of the Emergency Powers Act will likely be complicated by the political and societal situation in Zimbabwe. An example is the ongoing lack of reform in the security sector which has often been abused by the Zimbabwean government to suppress dissent and maintain power of one political party.<sup>57</sup> Security forces are provided with wide-ranging powers in emergency situations.<sup>56</sup> They have been documented and widespread abuses of powers by the security forces in the past.<sup>58</sup> So the legislated roles that the security forces are to perform during disaster situations will not be accepted by the population, non-governmental organisations and other societal stakeholders.<sup>58</sup> These and other reasons can mean that some additional provisions of the Emergency Powers Act, e.g. the ability of the President of the Republic to issue legislation, the power of arrest for up to 14 days and the suspension of existing laws<sup>56</sup> will be problematic in practice and are also likely to be resisted by various stakeholders in the Zimbabwean society. Expropriation of also a sensitive subject in Zimbabwe and as was demonstrated by the varying opinions and attitudes among different societal stakeholders on land re-distribution.<sup>59</sup>

The Public Health Act no. 899 of 1978 – Chapter 15:09 (designated as Health Act in further text) establishes the focus of the Zimbabwean government on public health (Part I section 1).<sup>60</sup> It is indicated in the text of the Health Act that the primary responsibility for its execution rests with the Minister of Health and Child Welfare or with another Minister as designated by the President of Zimbabwe (Part I section 2).<sup>60</sup> The improved sanitation is termed “sanitary convenience” which represents the following types of mainly improved sanitation facilities “latrine, urinal, water-closet, aqua-privy, earth-closet, pit-closet, borehole-latrine or chemical-closet; or other device approved by a medical officer of health which is being, has been or is intended to be used for the disposal of human waste” (Part I section 2).<sup>60</sup> Part II section 3 clearly contains the responsibility of the Minister/Ministry of Health and Child Welfare as the authority which is responsible for the prevention, research and coordination, mitigation of the spread of infectious diseases.<sup>60</sup> Cooperation with local government is possible.<sup>60</sup> Thus the Ministry of Health and Child Welfare is the legislated authority that takes the lead to deal with disaster management and vulnerability of WASH-related diseases, such as cholera.

Part II section 4 of the Health Act vests the Minister of Health and Child Welfare with the authority to establish the “Advisory Board of Public Health” (designated as Board in further text).<sup>60</sup> The board’s membership must contain representatives from the professional boards of medical doctors, nurses and dentists, as well representa-

tives from paramedical organisations working in SADC such as St. John's ambulance (Part II section 4 subsection 1 of the Health Act).<sup>59</sup> Secretary of the Ministry of Health and Child Welfare is an ex-officio member of the Board (Part II section 4 subsection 2 of the Health Act).<sup>60</sup> The Board has the power to advise the Ministry of Health and Child Welfare on public health and may also conduct inquiries into, e.g. the WASH-related disease outbreaks (Part II section 4 subsection 6 of the Health Act).<sup>60</sup> It has been mentioned in the Introduction section of this article that the major threat to public health often exists in rural areas of Zimbabwe. This can be mitigated by the Minister of Health and Child Welfare establishing the "District Health Management Committee" in any "Rural District Council Area" (Part II section 4A of the Health Act).<sup>60</sup>

Part II sections 5-7 of the Health Act govern the appointment of medical officers at various levels of the government structure in Zimbabwe.<sup>60</sup> Part II section 8 of the Health Act mandates that the medical officers perform monitoring of the sanitary conditions/sanitation in their areas of jurisdiction.<sup>60</sup> Monitoring of WASH and other factors which control the spread of infectious diseases is implicitly mandated in sections 10-13 of Part II of the Health Act through, i.e. where the procedure for the appointment of the health inspectors is described.<sup>60</sup> Section 14 of Part II of the Health Act requires local government to prevent spread of infectious and communicable diseases, subject to specific instructions in terms of the Health Act and related regulations.<sup>60</sup> This function assigned to local government can be taken over by the Secretary of the Minister of the Health and Child Welfare (Part II section 16 of the Health Act).<sup>60</sup>

Clear legislative focus of the Health Act on WASH is apparent from section 17 which lists notifiable diseases, i.e. diseases where health authorities around Zimbabwe must be notified if any of the diseases of listed in section 17a-q) are diagnosed in human patients in any part of the territory of Zimbabwe.<sup>60</sup> These include several WASH-related infectious diseases such as "diphtheria" (section 17b), "typhus" (section 17f), "plague" (section 17g), "Asiatic cholera" (section 17h) and "typhoid or enteric fever" (section 17i). Section 18 of the Health Act provides for the reporting mechanism and a person, who is in charge of a school, hotel or other public gathering facilities, is responsible for the reporting.<sup>60</sup> This reporting section deals with morbidities, while section 19 deals with reporting of mortalities from notifiable diseases by medical practitioners to the Chief Medical Officer in the Ministry of Healthcare and Child Welfare.<sup>60</sup> Sections 20-35 deal with the disinfection, vector control and regulations pertaining to infectious diseases.<sup>60</sup>

Significant in terms of WASH are sections of the Health Act dealing with so-called "formidable diseases".<sup>60</sup> Section 36 contains the names of the formidable diseases,

i.e. “diseases with high virulence, high morbidity and mortality rates; and diseases which have the potential to spread quickly and affect a large part of Zimbabwean population.” They include “Asiatic cholera, plagues, and epidemic influenza” (section 36a).<sup>60</sup> Section 37 to 39 deal with disaster communication about the formidable diseases via detection authority, i.e. head of household, medical practitioner, chief, head of school, to district authority/local government and to the Chief Medical Officer.<sup>60</sup> Channel of communication should be “telegraph or any other suitable channel” (section 38 and 39).<sup>60</sup> Minister of Healthcare and Child Welfare can take over the management of infectious diseases if the local/district government fails or is perceived to fail at it (section 40).<sup>60</sup> Epidemic committees can be established in an outbreak area if necessary (section 44).<sup>60</sup>

### ***Implementation of the Legislative Framework and Practical of WASH Management in Zimbabwe***

In the implementation of the legislative framework and in addressing threats from WASH-related diseases, the government of Zimbabwe has taken various practical steps. To the best of the authors’ understanding, Director of Civil Protection has been appointed and the respective directorate is operational and centralised in the Ministry of Local Government, Rural and Urban Development at the time of the writing of this article.<sup>55</sup> Gonye listed the name of the Director of Civil Protection as of 2014 (see page 6 of the respective reference for the details).<sup>52</sup> The Directorate of Civil Protection also played a leading role in the response to the 2008-2009 cholera outbreak.<sup>61</sup> Zimbabwean government also prioritised disaster risks related to cholera outbreaks and its controlling variables in the 2012-2013 national contingency plan.<sup>61</sup> Cooperation with international organisations on contingency is of critical significance to disaster management in Zimbabwe, especially in the context outbreaks from diseases such as typhoid are prevalent and mostly concentrated in highly populated urban areas.<sup>61,62</sup> This is mainly due to the limited financial, human and technical resources allocated to disaster management and disaster risk reduction were provided by the international organisations during the 2008-2009 cholera outbreak.<sup>61</sup>

With respect to waterborne diseases, the Ministry of Health and Child Welfare established the “Emergency Operating Centre” to deal with cholera and other waterborne disease outbreaks (see section 3.5.3. in Government of Zimbabwe/United Nations).<sup>62</sup> The “Immediate Disease Notification system” has been established and is run by the same Ministry to monitor rates of waterborne disease in Zimbabwe (see section 3.5.3. in Government of Zimbabwe/United Nations).<sup>62</sup> The Ministry of Health and Child Welfare also runs dedicated WASH structures which allow it to deal with prevention and mitigation of waterborne diseases in the country (see section 3.5.3. in Government of Zimbabwe/United Nations).<sup>62</sup> Further steps should include the development

of additional policies with focus on children in disaster management as recommended by Sillah.<sup>63</sup>

Directorate of Civil Protection published periodical reports on the status of the river flow, dam levels and the general hydrological conditions in Zimbabwe, e.g. for January 2013.<sup>64</sup> Damage assessment has also been reported intermittently.<sup>65</sup> Floods and the severity of disaster damage have also been reported on sporadically.<sup>66</sup> However, the data available in the public domain and through the website of Directorate of Civil Defence are generally outdated. The government of Zimbabwe has participated in regional initiatives to improve resilience, e.g. in the Zambezi river basin.<sup>61</sup> Vulnerability data is collected regularly by the Zimbabwe Vulnerability Assessment Committee which falls under the Food and Nutrition Council.<sup>61</sup> However, respondents in a recent survey indicate that such data is not easily available in the public domain, or cannot be easily obtained by local and provincial authorities.<sup>61</sup>

Therefore, the access to disaster risk and vulnerability data is complicated in Zimbabwe. Under such circumstances, disaster planning for WASH events and the related health outcomes will be difficult and could make the public healthcare sector response unpredictable. Data availability could be improved and data could be collected on the local scale by the empowerment of local forums and NGOs/ volunteers/ community members. It can be based on tools such as the one which was developed by the authors and is shown in Appendix I. This tool is similar to various tools in literature, but has been developed by authors based on their experience and literature research in the WASH-related disasters in South Africa and in Zimbabwe. The second aspect of addressing the technical/skills gaps in the disaster management system include the use of volunteers and community members to carry out particular functions in individual phases of the disaster management cycle. Before practical use, the readability of the tool in Appendix I will have to be optimised using the relevant software packages.<sup>67-69</sup>

The Civil Protection Act no. 22 of 2001 was to be replaced by the drafts of the Emergency Preparedness and Disaster Management Act and the National Disaster Risk Management Policy.<sup>68</sup> However, those pieces of legislation have been stuck in the legislative process for more than a decade and have not yet been passed into law or implemented on the ground. The new legislation and policy disaster risk management in Zimbabwe was to incorporate the principles of disaster risk reduction, the Hyogo Framework for Action and to move away from the principles of civil protection to the holistic approach to disaster management and disaster risk reduction. The legislation should be updated as provincial and local disaster civil protection committee are often dysfunctional or lacking resources.<sup>61</sup> WASH remains a problem in spite of the contingency plans put in place in Zimbabwe.<sup>70</sup> Here the principle of participa-

tory approach to disaster (risk) management can be used, e.g. by the application of the multi-stakeholder-crisis-management platforms along the same lines as outlines in a recent study for South Africa.<sup>55</sup>

The stakeholder platforms and use of community members in disaster data collection can be a powerful tool for the collection of WASH-related data in Zimbabwe. This is supported by the fact that up to 62.2 % of all respondents were familiar with droughts and its impacts on the population and 4.4 % were familiar with human diseases in a recent survey about the disaster knowledge among the Zimbabwean population.<sup>71</sup> The data and communication about the actions to be taken could be disseminated efficiently using radio, TV and internet/cell phones which most of the Zimbabwean population uses for gaining information about impending disasters.<sup>71</sup> The literacy rate among the Zimbabwean population who are 15 years or older stood at 88.69 % in 2014.<sup>72</sup> In the same year, 58.76 % of the Zimbabwean population aged 25 or older completed at least lower secondary education.<sup>73</sup> Therefore the Zimbabwean population is able to collect the WASH-disaster-risk data and understand which data and how is needs to be collected.

The crisis-management platforms can play an important role in the disaster management in Zimbabwe, as recent research indicates that up to 50.5 % of the responses to disaster in the country are driven by local government and the NGOs/UN.<sup>71</sup> At the same time, 27 % of respondents indicated in a recent study that they got assistance from NGOs during the disaster-induced hardship.<sup>74</sup> Coordination between the resource-strapped local government and NGOs or international organisations will thus be important at the local level of disaster response. Efficient dissemination and collection of data can be stimulated by involving members of the population in the affected area(s) who have some background in disaster management and development.<sup>74</sup> A combination of the radio, TV, cell phone and early warning systems should be implemented here.<sup>74</sup> Focus on WASH-related issues could be supported by the perceived risk from drought being ranked to highest among the Zimbabwean population.<sup>71, 74</sup>

The widespread food insecurity in Zimbabwe<sup>75</sup> is compounded by unforeseeable conditions linked to structural and institutional factors made worse by the combination of structural violence effects, economic and political instability effects as well as the drastic change in climatic conditions which happened in the mid-2000s.<sup>76</sup> The rural areas of Zimbabwe such as Zambezi Valley has been noted to be one of the most vulnerable areas to floods in Zimbabwe. This region is frequently affected by seasonal floods and to a lesser extent by cyclones.<sup>77,78</sup> In 2000, Zimbabwe experienced floods due to the tropical Cyclone Elin, which caused a major economic loss of approximately 7.5 million USD, 120 fatalities, and more than 250 000 residents were

affected.<sup>79</sup> The floods damaged people's properties, crops, and infrastructure as well as food stocks exacerbating the food insecurity in the country.<sup>78</sup> Apart from the floods, Zimbabwe is also prone to food insecurity which is induced by drought. Maize, cotton, and tobacco, are some of the crops widely grown in Zimbabwe and are severely affected during these periods leading to low yields.

Balanced diet and the nutritional status of the Zimbabwean population will play an important role in its WASH vulnerability. To decrease this vulnerability and increase food security in response to the climate-related disasters, Zimbabwe traditional institutions initiated the development of safety nets for the enhancement of the population's resilience. These have included Zunde raMambo and Nhimbe schemes. Development and implementation of these initiatives have changed the initial perception of resilience which Cretney<sup>80</sup> and Tarhan et al.<sup>81</sup> defined as "being able to respond, cope and adapt to the change using the available resources/own resources". In the study by Mavhura,<sup>79</sup> community resilience was defined as "sharing resources in order to increase the production and cushioning one another against the disasters." Zunde raMambo and Nhimbe schemes employ collective work in building resilience towards food insecurity and community arrangement to access draught power to improve food security.

The developments in food security in the villages under the Zunde raMambo scheme from the year 2011-2014 can be summarized as follows:<sup>79-81</sup> for maize and sorghum production: maize yielded 11 tons in 2011 and 3 tons of sorghum, in 2012, a decrease was observed in the production of both products with 10 and 2.5 tons respectively. During the year of 2013 no change was observed with maize production, however, a 1.5 % increase was observed in sorghum production and finally, in 2014, maize production remained the same i.e. 10 tons while sorghum production had a downturn from 4 to 3.5 tons.<sup>79-81</sup> Thus literature point to the fact that traditional institution's plan of building resilience to food insecurity induced by climate-related disasters through initiating the schemes have restored the power of communities to cope with drought and flood-induced food insecurity in Zimbabwe.

NGOs will play a vital role in the disaster management, disaster preparedness and disaster risk reduction activities on the ground in Zimbabwe. Legislation and the procedures for their involvement must be clarified and any potential barriers must be removed.<sup>82</sup> Increased in interaction between NGOs and the Zimbabwean government authorities should be encouraged through strengthening existing platforms and the development of new ones. Knowledge of NGOs on the ground could provide increased monitoring of land use and thus provide a way to manage disaster hazards, e.g. in collaboration with the Environmental Management Authority and the enforcement of the statutory instrument 7.<sup>82</sup> Cholera outbreaks and floods can be both

rapid onset and slow-onset disasters, while drought will be a slow-onset disaster. Individual stages of the disaster management cycle in Zimbabwe will therefore be implemented through a combination of the disaster-continuum model and the expand-contract model.<sup>82</sup> Functioning of the crisis-management platforms and the civil protection plans will have to reflect this at the national, provincial and local government level in Zimbabwe.

The WASH front of disaster risk reduction and disaster management in Zimbabwe has been overseen and coordinated by various government platforms/committee (besides the ones already mentioned above). The “Advisory Board of Public Health” has been operational since the late 1990’s, but with some reservations from the Ngo stakeholders.<sup>84</sup> The organogram of the Ministry of Health and Child Welfare also contains a structure called “Department of Epidemiology and Disease Control” which is responsible for the overall management and disaster management of disease outbreaks.<sup>83</sup> National response plans have been developed for reportable diseases, i.e. typhoid fever, cholera, pandemic influenza.<sup>83</sup> Further improvement in the understanding of the disaster risk and the WASH-related health outcomes of disaster in Zimbabwe must be improved and the NGOs and strategies mentioned above can contribute to this. Further understanding of the disaster risk can be the examination of the population’s disaster vulnerability (types) and its controlling factors. This is done by the authors in the next few paragraphs and in Table 1.

Data in Table 1 indicate that the MCFURY values for Zimbabwe ranged from decreased from 70.0 deaths per 1000 live births in 2013 to a maximum of 99.7 deaths per 1000 live births in 2005. The *EV* values increased from 68.1 USD×year<sup>1.5</sup> in 1990 to 2743 USD × year<sup>1.5</sup> in 2005, before decreasing gradually to 77.1 USD × year<sup>1.5</sup> in

**Table 1. Vulnerability indices and the MCFURY values for the Zimbabwean population.**

<i>Year</i>	<i>HDI</i> (year <sup>0.667</sup> )	<i>GDP</i> (USD)	<i>FUP</i> (dim)	<i>C<sub>p</sub></i> (dim)	<i>EV</i> (USD× year <sup>1.5</sup> )	<i>SV</i> ×10 <sup>3</sup> (year <sup>1.5</sup> × USD <sup>-1</sup> )	<i>MCFURY</i> (number per 1000)
1990	0.488	2107	0.290	0.029	68.1	5.185	75.2
2000	0.428	2098	0.338	0.010	262	2.377	96.8
2005	0.412	1406	0.359	0.001	2743	0.277	99.7
2008	0.422	1070	0.372	0.003	890	0.873	98.0
2010	0.459	1216	0.381	0.014	183	3.767	89.9
2011	0.473	1316	0.386	0.021	121	5.494	83.8
2012	0.484	1337	0.391	0.027	93.5	6.977	76.0
2013	0.492	935	0.396	0.031	77.1	8.399	70.0

2013 (see Table 1 for details). The Pearson correlation coefficient between *EV* (independent variable) and *MCUFRY* (dependent variable) was equal to 0.6375. This correlation was not statistically significant at 5 % level of significance ( $p$ -value = 0.0891). The *SV* values decreased from  $5.183 \times 10^{-3} \text{ year}^{1.5} \times \text{USD}^{-1}$  in 1990 to  $0.287 \times 10^{-3} \text{ year}^{1.5} \times \text{USD}^{-1}$  in 2005. After this, there was a steady increase in the *SV* values to reached a minimum value of  $8.399 \times 10^{-3} \text{ year}^{1.5} \times \text{USD}^{-1}$  in 2013 (see Table 1 for details). There was a strong negative correlation between *MCUFRY* and *SV*, with the Pearson correlation coefficient equal to -0.957 and this correlation was statistically significant at 5 % level of significance ( $p$ -value = 0.0002).

These results point to the weak correlation between the socio-economic vulnerability of the Zimbabwean population and the risk from WASH-related health outcomes of disasters in the country. The values of *EV* and *SV* are comparable to or lower than the index values reported for the population of Algeria by Khaldi et al.<sup>85</sup> The correlation was repeated for the *EMIVI* and *MCUFRY* values. The source data and the results of the *EMIVI* calculation results are shown in Table 2.

The source data for the number of nurses, midwives and medical doctors were already converted to the necessary units and thus the *EMIVI* data were calculated as the sum of the number of nurses and midwives per 1000 citizens; and the number of physicians per 1000 citizens. The *EMIVI* values decreased from 1.573 in 1990 to 1,140 in 2012, and increased marginally to 1.332 in 2013. There was a weak negative correlation between *MCUFRY* (dependent variable) and *EMIVI* (independent variable), with the Pearson correlation coefficient equal to -0.2333 and this correlation was not statistically significant at 5 % level of significance ( $p$ -value = 0.7060). Thus, the number of healthcare professionals who provide care to the Zimbabwean population is not the main reason for the WASH-related disaster risk. Further studies will have to be conducted to investigate these vulnerability results in more detail.

**Table 2. Source data and calculated values of the *EMIVI* and the *MCUFRY* values for the Zimbabwean population.**

<i>Year</i>	<i>Nurses and Midwives (per 1000 citizens)</i>	<i>Medical doctors (per 1000 citizens)</i>	<i>EMIVI (dim)</i>	<i>MCUFRY (number per 1000)</i>
1990	1.447	0.126	1.573	75.2
2010	1.219	0.066	1.285	89.9
2011	1.194	0.074	1.268	83.8
2012	1.067	0.073	1.140	76.0
2013	1.257	0.075	1.332	70.0

## Conclusion

Results of the legislation analysis indicate that the disaster management system in Zimbabwe incorporates tools to deal with epidemics and WASH-related outcomes of disasters in general. The key parts of legislation include the Civil Protection Act no. 22 of 2001 (Chapter 10:06), the Emergency Powers Act no. 572/1979 (Chapter 11:04) and at the Public Health Act no. 899 of 1978 (Chapter 15:09). Disaster management across the territory of Zimbabwe is overseen by the Directorate of Civil Protection at the national level. The coordination is also carried out by the National Civil Protection Committee. These structures are mirrored at provincial and local level of government. However, the system needs improvements, mainly under the local conditions such as more disaster management resources must be allocated to provincial and local government structures. These action plans are the result of collaboration between the Government of Zimbabwe, the United Nations and local NGO-containing structures. The number of healthcare professionals who provide care to the Zimbabwean population are no the main reason for the WASH-related disaster risk. This type of disaster risk could be partially explained by the weak correlation between the socio-economic vulnerability of the Zimbabwean population and the risk from WASH-related health outcomes of disasters in the country. Further studies will have to be conducted to investigate these vulnerability results in more detail.

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## APPENDIX I. WASH and Public Health Information Gathering Tool

### Questionnaire-Water Quality identification

Area/ Location: \_\_\_\_\_

Questionnaire No.: \_\_\_\_\_

Date: \_\_\_\_\_

Interviewer: \_\_\_\_\_

Reservoir/Water Management Area: \_\_\_\_\_

**Please place an X on the appropriate line to indicate your answer. Write in the information required in the space provided.**

I have signed a consent form and I choose to answer this questionnaire of my own free will.

Yes\_\_\_No\_\_\_

The Purpose of the questionnaire is:

- to obtain background information on the daily quality of drinking water
- to localise causes for decreased drinking water quality
- to explore possible risk of waterborne disease (outbreaks)
- to evaluate the impact of the water sources on the communities health
- to evaluate perception of the water quality by the community
- to establish possible contaminants of drinking water and prevention strategies
- to establish which types of sanitation facilities and available to the population in the area where interviews were conducted

Unless prompted otherwise, please mark X to the option that applies or write the option out. Where necessary please provide an answer in the form of a number or a short work statement.

### 1. Demographics of the volunteer

1.1 Male\_\_\_ Female\_\_\_

1.2 Home language (please state if other which language)

English\_\_\_\_\_Shona\_\_\_\_\_Ndebele\_\_\_\_\_Venda\_\_\_\_\_ Karanga \_\_\_\_\_ Other\_\_\_\_\_

### 2. Education level completed

Primary\_\_\_\_\_High School\_\_\_\_\_University\_\_\_\_\_Technical College\_\_\_\_\_Other\_\_\_\_\_

### 3. Housing and water accessibility

3.1 What type of housing do you reside in?

Urban formal settlement\_\_\_\_\_Informal Urban settlement\_\_\_\_\_ Other\_\_\_\_\_

3.2 What the number of the permanent occupants of your house?

Adults: \_\_\_\_\_ Children: \_\_\_\_\_

3.3 Do some people come visit on weekends or during holidays? If yes, please provide an estimate/ range of number of guests on a single occasion.

\_\_\_\_\_

3.4 Do you have running/drinking water inside your house?

Yes\_\_\_ No\_\_\_

(if your answer is “No” then proceed to question 3.17)

3.5 Have you observed bursts in the water pipes in your area?

Yes\_\_\_ No\_\_\_

3.6 If you answered “Yes” in question 3.5, then choose one of the options below to indicate how often this occurs (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day):\_\_\_\_\_

3.7 Do you experience outages/interruptions in water supply?

Yes\_\_\_ No\_\_\_

3.8 If you answered “Yes” in question 3.7, then indicate how often there is an interruption in the supply of drinking water? (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day):\_\_\_\_\_

3.9 Do you have waterborne sewage, i.e. flushing toilet, in your house?

Yes\_\_\_ No\_\_\_

(if your answer is “No” then proceed to question 3.14)

3.10 If you answered “Yes” to question 3.8., which one of the following sanitation/sewage collection options applies to you?

Septic tank\_\_\_ Centralized sewage collection system\_\_\_

3.11 If you answered “Septic tank” in question 3.10, then please indicate how often your septic tank is emptied:\_\_\_\_\_

3.12 If you answered “Centralized sewage collection” system in question 3.10, have you observed pipe bursts in the sanitation infrastructure, i.e. did you observed raw sewage in the street(s) in your area?

Yes\_\_\_ No\_\_\_

3.13 If you answered “Yes” to question 3.12, then choose one of the option below to indicate how often does this occur (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day):\_\_\_\_\_

3.14 What type of non-waterborne sanitation is available to you?

Ventilated pit latrines\_\_\_ Other:\_\_\_\_\_

3.15 Is the sanitation infrastructure properly maintained?

Yes\_\_\_ No\_\_\_

3.16 If you answered “No” in question 3.15, then specify what problems are the result of the lack of maintenance:\_\_\_\_\_

3.17 If you answer “No” to question 3.4, do you collect water from a communal tap in the settlement you reside in?

Yes\_\_\_ No\_\_\_

(if you answered “No” is question 3.17, then please move to question 3.19)

3.18 If you answered “No” to question 3.4 and “Yes” in question 3.17, which member(s) of the household collects the water?

\_\_\_\_\_

3.19 If you answered “No” to questions 3.4 and 3.17., then which one of the following serves as your source of drinking water?

River water\_\_\_ Borehole water\_\_\_ Other\_\_\_\_\_

3.20 Who collects the water from the source you specified in question 3.19?

\_\_\_\_\_

3.21 Regardless of the drinking water source you use, what containers do you use to collect the water?\_\_\_\_\_

3.22 Based on question your answer in question 3.18, please specify any activities that take place in the vicinity of your drinking water collection point:\_\_\_\_\_

\_\_\_\_\_

3.23 Have you observed any cattle dung or human excrements in the vicinity of the water collection point you use as the source of drinking water?

Yes\_\_\_ No\_\_\_

3.24 If you answered “Yes” to question 3.23, then choose one of the option below to indicate how often does this occur (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day):\_\_\_\_\_

3.25 Do you boil your drinking water before consumption or domestic use?

Yes\_\_\_ No\_\_\_

3.26 Do you add bleach to your drinking water before consumption or domestic use?

Yes\_\_\_ No\_\_\_

3.27 If you answered “No” in questions describing the water cleanliness, could you describe if you clean your water in another way before consumption or domestic use?

\_\_\_\_\_

3.28 Do you purify your drinking water daily or only when you perceive a lowered drinking water quality?

\_\_\_\_\_

3.29 Overall, do you think your source of drinking water is clean and safe?

Yes\_\_\_ No\_\_\_

3.30 Has someone explained to you what makes drinking water safe?

Yes\_\_\_ No\_\_\_

3.31 If you answered yes to question 3.23., then who provided the explanation?

Clinic Sister\_\_\_ Pharmacist\_\_\_ Family\_\_\_ Friend\_\_\_ Other\_\_\_\_\_

3.32 Based on information available to you, what do you think is meant by “safe drinking water”?

\_\_\_\_\_

3.33 Do you know what waterborne diseases are?

Yes\_\_\_ No\_\_\_

3.34 Do you know how to prevent waterborne diseases?

\_\_\_\_\_

#### 4. Water Quality Parameters

4.1 What is the usual colour of your drinking water? Not in a coloured bottle.

Colourless\_\_\_Blue\_\_\_Green\_\_\_Brown\_\_\_Other\_\_\_\_\_

4.2 Is your water sometimes muddy or cloudy?

Yes\_\_\_ No\_\_\_

4.3 If you answered yes to question 4.2, then choose one of the options below to indicate how often does this occur (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day): \_\_\_\_\_

4.4 Does your drinking water have an odour, e. g., does it smell like rotten eggs?

Yes\_\_\_ No\_\_\_

4.5 If you answered yes to question 4.4, then choose one of the options below to indicate how often does this occur (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day): \_\_\_\_\_

4.6 What does your drinking water taste like?

\_\_\_\_\_

4.7 Have you observed any foam on the surface of your drinking water?

Yes\_\_\_ No\_\_\_

4.8 If you answered yes to question 4.7, then choose one of the options below to indicate how often does this occur (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day): \_\_\_\_\_

4.9 Have you observed scum or soap like particles on the surface of the water?  
Yes\_\_\_ No\_\_\_

4.10 If you answered yes to question 4.9, then choose one of the options below to indicate how often does this occur (1-once every two or three months, 2-once a month, 3-once a week, 4-two or three times a week, 5-every day): \_\_\_\_\_

## 5. Community Health

5.1 Have members of the community suffered from diarrhoea or stomach problems? (Definition of diarrhoea: Three or more watery/liquid/loose stools or stools containing blood in a 24 hour period and as evaluated in Sub-Saharan Africa before.<sup>86</sup>)

5.2 Which of the follow health problems are common in your community? Please circle the option(s) that applies/apply.

Bilharzia	Colds & flu	Stress	Worms
TB	Eye infections	High blood pressure	Diarrhoea
HIV/AIDS	Skin infections	Diabetes	Misuse of alcohol
Malnutrition	Drug Abuse	Cholera	Stomach problems

5.3 Have you or one of your family members ever suffered from the following symptoms? Please mark X to the option(s) that applies/apply.

Symptoms	Yes my family has	Yes I have	No
Stomach pain			
Bloody diarrhoea			
Blood in urine			
Eye infections			
Skin infections			
Itching body			

5.4 When approximately (week, month, or a couple of years ago) did you have diarrhoea?

5.5 What time of the year does your family suffer from diarrhoea?

Summer\_\_\_ Winter\_\_\_ Spring\_\_\_ After rains\_\_\_ After drought\_\_\_ Other\_\_\_\_\_

5.6 How do you treat diarrhoea?

## 6. Disease prevention

6.1 Which of the following things do you do to help prevent disease? Please circle the option(s) that applies/apply.

Wash hand before meals	Wash hands after defecation (use of toilet)	Clean eating utensils (knives, forks, etc.)
Boil water	Clean drinking water containers	Treat the water before use

regularly		
Clean food preparation surfaces before use	Put cooked food in a fridge between meals after cooling down	Wash vegetables and food before cooking
Wash clothes daily	Keeping waste outside the house	Keep food covered from flies
Dispose of nappies and then wash hands	Sterilise water before using for formula (baby milk) preparation	Heat previously cooked food (left-overs) thoroughly before eating

6.2. Where do you get water for the following processes? Please mark X to the option(s) that applies/apply.

	River	Tap	Borehole	Treated water	Other
Drinking					
Washing food					
Toilet flushing and cleaning					
Washing hands					
Preparing food					
Preparing formula					
Washing clothes					

6.3 What do you do with the water from these processes? Please mark X to the option(s) that applies / apply.

	Place on garden	Sewage drain	Nothing as use river	Treat and reuse	Use the bucket system or toilet
Washing food					
Toilets					
Washing hands					
Preparing food					
Preparing formula					
Washing clothes					

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