

**AN ASSESSMENT OF IMPACTS OF WATER SHORTAGES IN MALAWI PRISONS  
ON HUMAN HEALTH OF INMATES IN RELATION TO SANITATION: A CASE  
STUDY OF BLANTYRE AND BVUMBWE PRISONS**

**MASTER OF SCIENCE IN SUSTAINABLE ENGINEERING MANAGEMENT  
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14<sup>th</sup> October, 2020

## **DECLARATION**

I, Owen Isaac Gwerere-Kapudzama, hereby declare that this thesis is my own original work which has not been submitted to any other institution for similar academic purposes. All other sources of information have been acknowledged accordingly.

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**Date**

## CERTIFICATION OF APPROVAL

We, the undersigned, certify that we have read and hereby recommend for acceptance by the University of Malawi a thesis entitled “*An Assessment of Impacts of Water Shortages in Malawi Prisons on Human Health of Inmates in Relation to Sanitation: A Case Study of Blantyre and Bvumbwe Prisons*”.

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## **DEDICATION**

I dedicate this thesis to my loving Mom and Dad, Mr. and Mrs Gwerere Kapudzama, who have played a critical role in inspiring me to pursue my academic career, starting from my early childhood days to where I am today. If it were not for their valuable support and parental guidance, I would not have undertaken this study.

To my daughter Matamando, my son Akuzike and my lovely wife Chisomo, I say a big thank you for standing by me during difficult times when I was pursuing my graduate studies at the University of Malawi – The Polytechnic. Your valuable support and word of encouragement have not been vain.

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## ABSTRACT

This study evaluated impacts of water shortages at Chichiri and Bvumbwe Prisons on human health of inmates in relation to sanitation and hygiene at Chichiri and Bvumbwe Prisons in Blantyre and in Thyolo Districts, respectively. Sources of water supply at the prison site were assessed in terms of the quality of water. Water drawn from taps at the two prisons is good for domestic consumption. However, the same is not true of water collected from the borehole and the shallow well at Chichiri Prison. Water samples collected from the two water points contained Escherichia Coli (E. coli) way above the 0/100ml limit, rendering the water unacceptable for domestic use as per WHO Standards of 0/100 ml E. coli. In contrast, water samples collected from taps and the borehole at Bvumbwe Prison were both of good quality. Increasing in number of inmates incarcerated at the two prisons is one of the contributing factors to water shortages; frequent electricity blackouts also cause water shortages as they affect the delivery of potable water from the pipe reticulation system, forcing inmates to use unsafe water from the borehole and shallow well at Chichiri Prison for domestic Consumption. It is recommended that the borehole and the shallow well at Chichiri Prison should be rehabilitated in order to enhance yield and thereby improving the quantity and quality of the water.

Cases of water related diseases is declining as attested by a reduction of cases of diarrhoea recorded at Chichiri Prison, where numbers of inmates affected by the disease dropped from 136 in January 2016 to 55 same year, against the average population of 2004 inmates. Bvumbwe Prison registered 29 cases of diarrhoea in January 2016, dropping down to 17 in December 2016, against the average population of 250 inmates. 33% of the ailments reported at Chichiri Prison and 15% at Bvumbwe Prison were related to water, with nearly zero cases of cholera reported at the two facilities.

The study also established some challenges regarding the state of sanitation facilities at the two prisons. For example, it was noted that Top Yard Cell at Chichiri Prison does not have designated toilets, forcing inmates to empty faecal matter on a daily basis in buckets to cells which have such facilities. This poses a serious health hazard and a sanitation crisis to inmates in that it can easily trigger an outbreak of diseases such as cholera.

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## **LIST OF ABBREVIATION AND ACRONYMS**

APHA	American Public Health Association
DWR	Directorate of Water Resources
GWA	Gender and Water Alliance
GoM	Government of Malawi
ICRC	International Committee for the Red Cresecnt
SDGs	Sustainable Development Goals
MDGs	Millenium Development Goals
MWEM	The Ministry of Water and Environment Malawi
RGC	Rural Growth Centres
SADC	Southern Africa Development Committee
TSU	Technical Support Unit
UNICEF	United Nation International Children Emergency Funds
UNDP	United Nation Development Fund
WHO	World Health Organisation

## **CHAPTER ONE: INTRODUCTION AND BACKGROUND**

### **1.1 Background**

#### **1.1.1 Global Context**

Water is crucial for sustainable development. However, limited access to clean and safe water associated with poor water supply, hygiene and sanitation at household level is widening the poverty gap, gender inequalities and the prevalence of water borne diseases (Mulwijk, 2006). This contributes to 3.7% of the total global disease burden and 2.2 million deaths each year, with women and children in developing countries being the most affected (World Health Organization [WHO] & United Nations International Children's Emergency Fund [UNICEF], 2008). Although the Sustainable Development Goals (SDG 6) target 7(c) sought that “By 2050, it is possible that at least one in four people are likely to be affected by recurring water shortages. Ensuring universal access to safe and clean affordable drinking water by 2030 requires we invest in adequate infrastructure, provide sanitation facilities and encourage hygiene at every level. (Sustainable Development Goals, [SDG] 6, 2015).

But still, some 400 million of the people living in sub-Saharan Africa will be left without access to safe water, with a majority of them being women and children living in rural areas.

According to the International Center for Prison Studies (2012), there are three broad human rights and humanitarian concerns regarding persons in detention, worldwide. These include the following:

- (a) Unsafe prison conditions, including: overcrowding, poor sanitation, inadequate access to food or potable drinking, and poor medical care. It also includes inadequate services for people with disabilities including women; and
- (b) Mistreatment of inmates by prison staff or other authorities.

Unsafe Conditions in Prisons:

### **1.1.2 Significance of Water, Sanitation, and Hygiene in Society**

Water is a prerequisite for good sanitation and the sustenance of human social well-being. However, its importance at times can be compromised by its availability in inadequate quantities and poor quality to different levels of the community. Shortages of water could become a major obstacle to public health and development. It is also well established that shortages of water could become a major obstacle to public health and development (United Nations International Children's Emergency Fund (UNICEF) / World Health Organisation (WHO), 2015). Currently, UNICEF and WHO estimate that 1.1 billion people lack access to water supply services, and 2.6 billion people lack adequate sanitation. The global health burden associated with these conditions is staggering, with an estimated 1.6 million deaths every year arising from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene (WHO, 2000).

Access to safe water and basic sanitation is indispensable for human life and dignity and has been recognised as such through the Human Right to Water and sanitation.(UN Committee on Economic and Cultural Rights (2010).Efforts to improve access were accelerated as well as a result of with the Millennium Development Goals (MDGs) world commitments. Yet lack of access to safe drinking water and adequate sanitation remain widespread global issues. According to the WHO and the UNICEF Joint Monitoring Programme (JMP) in 2015,663 million people were estimated to live without access to improved sanitation

Target 7c of the Millennium Development Goals (MDGS 7c aimed to halve the population that had no sustainable access to water and basic sanitation before 2015.The proportion of the population without sustainable access to safe drinking water and basic sanitation(i.e. improved water supply and sanitation services.)Despite the MDG target 7c achievement with regard to drinking water 42.5% of the world population did not have access to water on premises and needed to fetch it UNICEF/WHO2015).For sanitation the target was not achieved although significant improvements were observed. Open defecation(OD) continued to be practised by 13% of worldwide population among with nine out of ten were living in rural areas UNICEF/WHO 2015. According to the data collected by the joint monitoring programme in charge of measuring progress towards MDG7c, 2.6 billion people gained access to safe water and 2.3 billion people to basic sanitation. (Westrate J, Dijstar, 2019)

Prison settings without good water supply and decent sanitation comprise institutional (prisoners, visitors and staff on duty) and specialized residential areas for prison officers and their families.

Clean water is vital for a healthy living population. In Malawi 80% of the population has access to an improved source of drinking water, but that leave about 4 Million people who still lack access to safe water. Additionally, only 6% of the population has access to an improved sanitation facility. Poor sanitation practices and improper storage of drinking water commonly lead to waterborne illnesses such as cholera. (USAID, 2013). According to the 2010 demographic Healthy Survey, 78% of children under two years old experience at least one incident of diarrhoea. In Malawi, 80% of the population has access to an improved source of drinking water, but about 4 Million people continue to lack access to safe drinking water. Based on international standards, six percent of the population has access to a sanitation facility. (Nembrini P.G, 2013).

Poor practices surrounding transportation and storage of drinking water make waterborne illnesses including cholera still commonplace. In 2009 78% of children under the age of 2 experienced at least one incident of diarrhoea. (USAID, 2013)

Water, Sanitation and Hygiene (WASH) service needs in prison are enormous compared to those of the general civilian population. The characteristics of prison population are similar to those of refugees, fleeing away from a war zone. Many people enter prison from courts of law and very few are released, hence the numbers keep rising. As such, more staff is recruited to match the ever-increasing numbers of inmates.

However observation say that the prison population will tend to go on rising in the future unless some measures are implemented systematically such as bail, community service, diversion mechanism etc. The increase of the prison population has many serious consequences for the condition of detention in particular social aspects like competition for the precious resources (water, food) that may induce unfriendly attitudes that result in fighting, bullying and even economic issues whence selling and purchasing of essential services is conducted, for example the 'shamba'(competition for ideal sleeping place in cell where space is rented for) issue in connection with overcrowding.

It has generally been observed that the ratio of prisoners per water tap, toilet and hand washing facility is generally unacceptable and seriously wanting. However, information about these statistics is not readily available, especially in sub-Saharan Africa, including Malawi.

It is not difficult to prove that water constitutes the lifeblood of the economy and health of every community, and thus each community and each region must guard its interest in water (Montgomery et al, 2007). This is the reason that justifies the need to look critically into the issues to do with water, sanitation and hygiene in relation to the prison environment and the institutional set up of its community. Generally, there is a high demand of water in prisons due to ever increasing number of inmates. Global figures describe alarming shortages of water and sanitation facilities in these institutions. More than 1.1 billion people do not have access to improved drinking water supply that meets health standards such as those set by WHO guidelines for drinking water as stated in the WHO report of 2000 (WHO, 2000).

“The ideology of prison was to punish people by subjecting them to life without a toilet and water inside their sleeping quarters and limiting the time per day the inmate could spend outdoors” thus against Nelson Mandela’s Rules (International Centre for Prison Studies, 2015).

At present, the available space for sleeping in most prisons has shrunk to less than 1m<sup>2</sup> compared to the recommended minimum floor space of 3.6m<sup>2</sup> per prisoner (ICRC, 2013).

In most prisons, the capacity of available water provision infrastructure has been surpassed by more than 250%, which leads to high maintenance cost of the facilities According to International Committee for the Red Crescent (ICRC) Report of 2013, meeting the WASH requirement for prisons in sub-Saharan Africa, and Malawi in particular, has been noted to be a big challenge. There are international minimum specification of 1 tap per 100 detainees, 1 toilet per 25 detainees, and 1 hand washing point per 50 detainees (ICRC, 2013) that can be used as monitoring and evaluation indicators for assessing the status of WASH in prisons in Malawi.

It is therefore this trend in Malawi prisons that has actually persuaded this researcher to conduct thorough observations and analysis of the findings at the two prisons in respect to water availability in Malawi prisons.

It should be stated at the outset that there are several categories of water, sanitation and hygiene related diseases which cause millions of deaths worldwide. However, these diseases may

generally be grouped in four categories as shown in Table 1 (International Committee of the Red Cross (ICRC), 2013).

**Table 1: Categories of water, sanitation and hygiene related diseases**

<b>CATEGORY</b>	<b>DESCRIPTION</b>
Water borne	Caused by ingestion of water contaminated by human wastes (faeces and urine) containing pathogenic bacteria or viruses which includes cholera, typhoid and bacillary dysentery and other diarrhoea diseases
Water based	Caused by parasites found in intermediate organisms living in water, which includes dreneculants, schistosomiasis and other helminthes
Water related	Caused by microorganisms with life cycles associated with insects that live or bleed in water, e.g. Malaria and Dengue fever and lymphatic filariasis
Water washed	Diseases such as skin and eye infections caused by lack of clean water, e.g., scabies, trachoma and skin infections

The classification relate to the following conditions which characterise the situation in most developing countries and are responsible for the continued prevalence of the diseases.

- a) Insufficient water supplies and sanitation as well as solid waste disposal services are important factors leading to the spread of many of the diseases: The presence of adequate quantities of good quality water is a prerequisite for satisfactory personal and domestic hygiene. The installation of sanitation and waste disposal measures are equally essential if the standard of living is to rise for the population of an economically successful irrigation scheme. The introduction of a public health component at this stage only has a relatively small increase in overall cost of the project, much less than that of remedial operations which may have to be undertaken later in the absence of proper initial planning.
- b) Inadequate housing and lack of hygienic conditions: The improvement of housing and hygienic conditions is mainly achieved through education, demonstration and economic changes. For example, latrines have to be built maintained and used. To reduce man-pathogen contact in the case of schistosomiasis settlements should be sited sufficiently far away to discourage the use of irrigation canal and reservoirs water as the main water supply

for a community and another suitable source of water should be provided. Such siting can also serve to reduce man-vector contact, if housing is at a distance from vector breeding places beyond the flight range of mosquitoes. Screening of houses with wire mesh gauze may give protection to the occupants.(WHO,1988)

- c) Lack of proper health care as well as improperly designed and managed water resource development schemes.

## **1.2 Problem Statement**

Access to safe and clean water is one of the fundamental rights to human beings and also a precursor to personal good health and sanitation.

However, the ever increasing numbers of inmates in prisons poses a great challenge to good access to this resource (International Committee of the Red Cross (ICRC), 2012).

Water shortages have a variety of social consequences in overcrowded populations; as it has been noted that International organization that have intervened in most disasters always consider provision of water and sanitation as a priority.

However, in order to improve the delivery of improved sanitation services, which include provision of sewerage facilities, the Government of Malawi intends to undertake a nationwide audit of sanitation facilities in the country in order to identify areas of priority (GoM, 2008). Knowledge and information generated by this research through interviews and field visits to prisons will assist in providing relevant data regarding sanitation and hygiene issues in the targeted institutions.

Therefore, findings of this study will help in establishing interventions that need to be implemented in prisons in order to reduce the adverse health impacts of water shortages in relation to sanitation.

## **1.3 Purpose of the Study**

The purpose of this study was to assess social impacts of water shortages in malawi prisons on human health of inmates in relation to sanitation, with a view to proposing solutions which could be implemented in order to address challenges faced by inmates as a result of water shortages.

It is envisaged that study findings will assist policy makers in developing scientifically based guidelines for managing water and sanitation services in Malawi prisons, thereby improving the general sanitation situation in these institutions in line with Sustainable Development Goals.

## **Objectives of the Study**

### **1.4.1 General Objective**

The main objective of this study was to assess social impacts of water shortages in Malawi prisons on the human health of inmates in relation to sanitation.

### **1.4.2 Specific Objectives**

Specific objectives of the study were as follows:

- a) To assess the water situation in prisons in terms of quality and quantity;
- b) To investigate major contributing factors of water shortages and poor sanitation in prisons;  
and
- c) To determine diseases that could be attributed to water shortages, and their impacts on the population of inmates.

## **1.5 Scope of the study and Location**

This study was conducted in Blantyre and Thyolo districts, at Chichiri and Bvumbwe Prisons, respectively. Blantyre is the commercial capital of Malawi whilst Thyolo is situated almost 10 km away from Blantyre in the southern part of Malawi.

The study was designed to take place at the two selected institutions (Chichiri and Bvumbwe Prisons) for the following reasons: -

- a) The two prisons that were selected offered a representative sample of the targeted group of inmates since Chichiri Prison comprised mixed types of inmates, i.e., women and men whilst Bvumbwe Prison offered a different social group of inmates. At Bvumbwe Prison, the majority of inmates were minors, mostly below the age of 18;

- b) Chichiri Prison acts as a rehabilitation centre, with 14 male and 1 female cells which cater for a population of 2004 inmates. These cells have designated toilets, except for the Top Yard cell which does not have toilet facilities. On average, 100 inmates use one tap, considering that the number of prisoners is high, with very few taps water;
- c) The number of staff at Chichiri Prison was 185;
- d) Bvumbwe Prison situated in Thyolo is predominantly a juvenile rehabilitation centre;
- e) The prison has a population of inmates that fluctuates between 256 and 278; with 52 members of staff, 13 of whom are female;
- f) The facility has one (1) tap located inside the enclosure of the prison, with a borehole located outside the prison, as an alternative source of water supply.

## **1.6 Significance of the Study**

Findings from the literature review have shown that several studies conducted in Malawi Prisons have mainly focussed on gender issues, human rights issues, and other health related problems, but not related to water shortages and sanitation.

In light of the above, this study has brought a new dimension to studies done on Malawi Prisons, an in depth understanding of social issues related to water shortage in Malawi Prisons in relation to sanitation issues, recurring in other prisons throughout the country.

Furthermore, the research has ushered information that policy makers will find very useful undertaking the sanitation audit that the Government of Malawi (GoM) intends to carry out in the country, specifically targeting prisons.

Additionally, study findings will fill the gap of knowledge that existed in this area of sanitation and hygiene in Malawi prisons, and the outbreak of diseases relating to Water, sanitation and hygiene (WASH).

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter reviews literature relevant to the research problem that was investigated during the study. The review involved books, journals, newspapers, libraries, academic publications, reports, magazines, government statistics and other relevant.

#### **2.1.1 History of Prisons in Malawi**

The Prison Department, which is concerned with the safe custody of prisoners or those in conflict with the laws of the land. This is historically a much older creation and was formalized earlier than the civil police. This notwithstanding that from the formal beginning of the police in 1921, prisons service came under the superintendence of the Chief Commissioner of Police who also acted as Chief Inspector of Prisons.

Malawi Prison Service is a government entity established under chapter 17 of the Constitution of Malawi, 1994 and the Prison Act (Chapter 9:02). It exists to rehabilitate offenders for their integration as law abiding citizens. It contributes towards public safety and security by working together with other stakeholders in the criminal justice system and community in general. The department has four administrative regions, South, East, Central and North.

There are a few pointers that in terms of organisation, prisons service was a forerunner to police formalisation. For instance, Prison organisation first appeared on the statutes in 1905 through Prison ordinance No 10 of 1905, whereas the first mention of the Police on the statutes appears in 1909 through Police Ordinance No7 of 1909.

Secondly, whilst acknowledging that the outbreak of World War 1 interrupted the formalizing of organisations like the police and prison, it was not until 1919 when the prison head, ex-military Jack Archer, was appointed followed a year later by the police Chief Commissioner, another ex-military Maj.Francis Trant Stevens in 1920. Accordingly the prison ordinance was enacted earlier on in 1920 followed by the Police Ordinance on 5<sup>th</sup> October, 1921.

The Department of Prisons falls under the Ministry of Home Affairs and Internal Security, and is being managed by Malawi Prison Services. There are 30 district prison stations in the country that

are either first class or second class prisons. Zomba Prison, built in 1935, is the only maximum security prison in Malawi. The facility holds prisoners with long or serious offences.

The prison system dates back to colonial times when Malawi was divided into two regions, namely: Southern Province (now Southern Region), and Northern Province (now Central and Northern Regions). In the Southern Province, there were nine prisons while in the Northern Province were ten prisons. The Prison Department employed fewer than 200 personnel, distributed into several posts such as Superintendent and Guards.

Prisons that were in the districts were used for holding inmates with short sentences. They were controlled by District Commissioners, with Civil Police as Guards.

Zomba Central Prison held people with longer sentences and was under the control of Central African Rifles. It held Europeans, people of colour, and Africans. The prison in Blantyre, which was under the charge of Superintendent, held Europeans only.

Serious overcrowding throughout the prison system provides a conducive environment for rapid spread of the human immunodeficiency virus (HIV) and Acquired immunodeficiency syndrome (AIDS) and Tuberculosis, leading to compromised life expectancy of the inmates.

Notwithstanding the fact that Section 42 (1) of the Malawi Constitution provides that any person who is detained, including every sentenced prisoner, shall have the right to be detained under conditions consistent with human dignity which shall include at least the provision of reading and even writing materials, adequate nutrition and medical treatment at the expense of the state, the situation in Malawi Prisons remains pathetic and deplorable. It is worth noting that this provision in the Constitution justifies the need for consistent provision of potable water to inmates despite frequent lapses in water supply services experienced by our Water Boards. (Malawi Constitution)

Prison Service is grappling with overcrowding, frequent shortages of food, scarcity of clean water, inadequate clothing, limited access to medical services, corruption and prisoner on prisoner human right violation (Human Rights Watch World Report, 2001)

Diseases, often the predictable consequence of overcrowding, malnutrition and unhygienic conditions and lack of medical care, remain the most common causes of death of inmates in prisons.

For instance, food and water shortages in prisons, combined with extreme overcrowding, are the ideal conditions for spreading communicable diseases, such as Tuberculosis.

Prison systems have evolved over centuries into their current form with growing recognition on the importance of rehabilitation programme across the globe (United Nation, 2017). There is a reaffirmed commitment of states to implement and enhance policies for prisoners that focus on education, work, medical care, rehabilitation, social reintegration and the prevention of backsliding. Lehmann and Locke (2005):17) define a prison as any institution/facility where people are held in custody, incarceration, or detention for crimes committed against society and for their rehabilitation and reformation. Prisons provide educational and recreation resources to inmates, through books, newspapers, magazines, movies, and library programmes with the hope that this will aid in the rehabilitation process (Coates, 2016) .Article 26 of the Universal Declaration of Human Rights(United Nations,2015) declares: Everyone has the right to education. This implies that the right to education and training applies to all persons including those in prison (Vorhaus, 2014). Rubin 2017 explains that information is vital in life for all individuals for optimal development and realisation of social, political and economic well-being. Prisons education is a pillar of effective rehabilitation and gives individuals the skills to unlock their potential, gain employment and become assets to their community. Coates, 2016.

### **2.1.2 Population in Malawi Prisons and across the Globe**

According to the Malawi prisons statistics obtained in July 2014, the prison population in the country has risen to 12,156 in total, including pre-trial/detainees /remandees, against the official capacity of 7,000. Currently, prison rate is at pegged at 73 prisoners per 100,000 thousand people.

Pre-trial detainees/remand detainees form 16 % of the whole prison population. However, juveniles/minors/young offenders constitute 7.7% of the prison population whilst women make up 1.1% of the whole prison population, with a foreign population of 0.02% as of July, 2016.

Regarding the 30 prisons established in the country, the occupancy level stands at 177.3% (Government of Malawi 2012). Chichiri Prison in the City of Blantyre, built in the early 1950s for a capacity of 800 inmates, now holds as many as 2004 inmates.

The eleventh edition of the world Prison population list gives details of the of prisoners held in 223 prison systems in independent countries and dependent territories.It shows the difference in the

levels of imprisonment across the world and makes possible an estimate of the world prison population total. The figures include both pre-trial detainees/remand prisoners and those who have been convicted and sentenced. The information is the latest available at the end of October, 2015. There are more than 10.74 Million incarcerated throughout the world with the most being in the United States. (Warmsley, 2013). Figures for Eritrea, Somalia and the Democratic Peoples Republic of (North) Korea are not available and those for China and Guinea Bissau are incomplete. Also missing are prisoners held under authorities not recognised internationally and those pre-trial prisoners who are held in police facilities and not included in published national Prison population totals. The full total is therefore higher than 10.74 Million and is likely to be well over 11 Million.

There are more than 2.1 Million prisoners in the United States of America, 1.65 Million in China (plus unknown numbers in pre-trial detention) 690000 in Brazil, 583000 in the Russian Federation, 420000 in India, 364000 in Thailand, 24900 in Indonesia, 233000 in Turkey, 230000 in Iran, 204000 in Mexico and 188 000 in the Phillipines.

The countries with the highest prison population rate –that is, the number of prisoners per 100000 of the national population—are the United States of America (655 per 100000), followed by El Salvador (604), Turkmenistan (552), U.S. Virgin

Island (542), Thailand (526), Cuba (510), Maldives (499), Northern Mariana Islands-U.S.A (482), British Virgin Islands (470), Rwanda (464), Bahama (438), Bahamas (438), Seychelles (437), Granada (435), St Vincent and the Grenadines (426), Guam-U.S.A (404) and Russian Federation (402).

However, more than half of all countries and territories (53%) have rates below 150 per 100000.

The world prison population rate based on United Nations estimates of national population levels, is 145 per 100000.

Prison population rates vary considerably between different regions of the world, and between different parts of the same continent for example: In Africa the median rate for western African countries is 53 whereas for Southern African countries is 244. In the Americas the median rate for South American countries is 233 whereas for Central American countries it is 316. In Asia the median rate for countries in Southern Asia (mainly the Indian sub continent) is 88 whereas for Central Asian countries is 160.

Since about the year 2000 the world prison population total has grown by 24%, which is about the same as the estimated increase in world's general population over the same period. There are

considerable differences between the continents ,and variations within continents.The total prison population in Oceania has increased by 86%,that in the Americas by 41%,that in Asia by 38% and that in Africa by 29%;in Europe,bycontrast,the total prison population has decreased by 22%.The European figure reflects large falls in prison population in Russia(45%) and also in Central and easter Europe;the prison population in Europe other than Russia has increased by 3%.Particular large rises have been recorded in South America(175%) and south- eastern Asia (122%).

Over the three years since the previuos edition of the world priso population list was published there has been little overall change in world prison population levels.The known prison population population of the world has grown by 386500(.7%) but the national population have grown by almost as much (3%).Thus, the prison popultion level per head of population has risen by less than 1%.However the globe figures masks the substantial changes-both upwards and downwards in some countries.There have been large rises per head of population in Cambodia(68%),Nicaragua(61%) ,Egypt(53%),Phillipines (48%),Indonesia(45%),Ecuado (37%),Jordan and Turkey (both)31%.There have been large falls per head of population in Mexico(23%),Romania((22%),Kazakhstan(21%),Ukraine(19%),Japan(15%),Vietnam(11%) and the Russian Federation(10%).

Blantyre Prison is situated in the central part of the City of Blantyre. At the time of collecting water samples for analysis in 2016, the prison had population varying between 1992 and 2166. However, it was noted in the register that numbers of inmates tend to increase during festive seasons and Easter Holidays due to drunkenness, since security is generally intensified during these periods.

### **2.1.3 Factors Leading to Prison Overpopulation**

There are several reasons attributable to the ever increasing population in our detention centres, among them some include: continued increase in numbers of offenders sent to prison; and sluggish judicial and negligent system where some remandees can even spend seventeen years without being charged due to missing files, or even strikes that at times prevail in judicial institutions/courts.

Recent revelations have also shown that foreign detainees, especially Ethiopians, are taking a long time to be repatriated to their homeland, hence adding a remarkable number of detainees in our prisons, especially Maula Prison in the City of Lilongwe (UNDP, 2009).

#### **2.1.4 Social Impacts of Water Shortages**

Water scarcity is defined as the lack of sufficient available water resources to meet water needs within a region; and in this context, within the prison premises. Water scarcity affects every continent; and around 2.8 billion people around the world are affected every one month every year (United Nations Development Programme [UNDP] Report, 2009)

Scarcity of water arises from different perspectives. Some water problems are a result of the physical environment. For example, water shortages are prevalent in the Middle East due to issues of desertification. Some water problems are a direct result of our everyday water use patterns, which can affect the per capita water demand per day, coupled with environmental degradation. For example, in the City of Abu Dhabi, the average per capita water use per day is at 500 litres whilst the world average ranges from 180 to 200 litres per capita per day (Arab Human Rights Report, 2009).

Pollution levels have also increased due to global industrialization. As a result, available water for some special needs is actually affected. Agricultural production is also one of the factors that are leading to high competition for good water.

Population growth is also one of the contributing factors that have a negative influence on the availability of water everywhere on the continent, and this is very common in prisons in Malawi because of justified increase in everyday population. Lack of water infrastructure development in these prisons also exaggerates the situation since most of the systems are now operating beyond their original design capacity.

### **2.1.5 Social Consequences of Water Scarcity**

Improved water supply and sanitation provide individuals with increased comfort, safety, dignity status and convenience and also broader effects on the environment (Hutton and others 2014). The social welfare effects are difficult to quantify given their being subjective in nature. Nevertheless, those benefits are consistently among the most important for beneficiaries of water and sanitation (Caincross 2004, Jenkins Curtis 2005) and may be particularly relevant for women (Fischer 2006).

Water demand is commonly classified according to the nature of the user. However the ordinary classifications are: Domestic, Commercial, industrial and public use. Domestic. This refers to water furnished to houses, hotels, prisons, etc. for sanitary, culinary and other purposes. Use varies with the economic level of the consumers, the range being 75 to 135L (20 to 100 gal) per capita per day. These figures include water used for air conditioning and watering of lawns and gardens-practices which may have a substantial effect upon total use in some parts of the country. Domestic consumption is typically 50% of the total but represents a larger fraction where the total consumption is small.

Commercial and industrial: this refers to water furnished to industrial and commercial establishment such as factories, offices and stores. The importance of this varies locally, depending on whether there are large industries and whether the industries obtain their water from municipal system. The quantity of water required for commercial and industrial purposes has been related to such factors as units produced, number of persons employed, or floor area of the establishment.

Public use. This is water that is furnished to public buildings and used for public services. These include water for city buildings, schools, prisons, flushing streets and fire protection for which the municipal supplier usually is not paid. Water used for such purposes amounts to 50 to 70 L per capita per day. (McGhee TJ)

Due to the significance of water to human nature and the whole ecosystem and the environment, prolonged shortages result in increased global conflicts, as observed in the Middle East between Israel and Palestinian settlement areas.

Lack of access to clean fresh water leads the vulnerable exposed to deadly water borne illnesses, resulting in increase in death related to water shortages. Scarcity of water also leads to poor agricultural production, and retards economic development of our society.

A significant amount of disease burden could be avoided through access to safe water, adequate sanitation services, and better hygiene practices. Diarrhoea alone accounts for an estimated 3.6% of daily global burden of disease, and is responsible for death of 1.5 Million people every year (World Health Organisation (WHO), 2013). It is also estimated that 58% of the disease burden, or 842000 deaths per year, is attributable to unsafe water supply and poor hygiene practices. This includes 361,000 deaths of children under age of five, mostly in low income countries (WHO, 2013). Water collection can also limit educational and economic opportunities due to the amount of time spent in searching this precious natural resource. Profound water shortages during a growing season can lead to poor harvest, thereby increasing food shortages in society, consequences of which are the prevalence of malnutrition, especially in Children. Water scarcity can have far reaching consequences for a community, with lack of clean water all but guaranteed to disrupt the day to day running of a household. This is particularly true where individuals often don't have the disposable income to buy bottled water. In these communities, a lack of water can have a devastating effect.

Water is crucial to hygiene and hygiene is crucial to health, so households have a tendency to deteriorate when water is removed from the equation. Beyond this water scarcity also increases food prices which again disproportionally affect the most vulnerable members of our society.

### **Issues of Public Health**

Public health, according to World Health Organisation, (WHO) is referred to as all organized measures whether (public or private) to prevent disease, promote health and prolong life among the population as a whole (WHO,2000). Activities of public health aim to provide conditions in which people can be healthy, and focus on the entire population, not on individual patients or diseases. However, the public has three main health functions, and these include:-

- a) Assessment and monitoring of health of communities and populations at risk to identify health problems and priorities; as such, findings of this study will assist in this aspect;
- b) The formulation of public policies designed to solve identified local and national health problems and priorities. This study has highlighted areas of interest in this perspective; and
- c) To ensure that all populations have access to appropriate and cost effective care, including health promotion and diseases prevention services.

However, also data from the joint monitoring program report indicate that access to improved sanitation facilities in the Southern African Development Community (SADC) region was at 42% in 2011 while in Malawi it was at 50% (WHO/UNICEF, 2013). The third Integrated Household Survey of 2012 indicated that access to improved sanitation in Malawi was at 74.2% (Government of Malawi (GoM), 2012). The Malawi Growth and Development Strategy (MGDS) II which is the medium-term development agenda for Malawi outlines the country's challenges in the area of sanitation, such as low access to sanitation, inadequate sewer facilities and inadequate capacity to manage sewer facilities (GoM, 2012).

## **2.2 Conceptual Framework**

In view of the preceding discussion, it is clear that adequate social amenities have to be provided in prisons to counter the adverse effects of overcrowding on the quantity as well as quality of water sources. In line with the country's development challenges outlined in in relation to sanitation (GoM, 2012), the findings of this study will provide information regarding the state of sanitation in prisons. The data collected during the study will help in forming the basis for the development agenda as per government's desire to improve sanitation services in prisons. The information gathered through the interviews and the observations made during field visits will provide vital information necessary for the improvement of sanitary conditions in prisons in Malawi (Mdolo 2016).

## **2.3 Water Quality**

Water quality, a term that is commonly used to describe the non-aqueous components of a volume of water, consisting of suspended sediment, biota and dissolved species or dissolved salts. Temperature, suspended solids, turbidity, colour, taste and odour make up the list of physical water quality characteristics.

Biological contamination of drinking water poses the most significant health risk to humans hence pathogens and pathogen indicators form a crucial water quality characteristic. Escherichia Coliform bacteria (*E. coli*) may be indicative of contamination by faecal material of man and other animals. These comprise a group of gram-negative rod shaped bacteria that are found in vertebrate gastrointestinal tract (digestive system). Some waterborne pathogenic diseases that may coincide with faecal coliform contamination include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A.

Although water comprises several dissolved minerals, only a few are analysed in order to assess its suitability for various purposes, namely: major cations - sodium, potassium, calcium, magnesium, iron and manganese; major anions - carbonates, bicarbonates, chloride, sulphate, nitrate and fluoride); minor elements - boron, arsenic, etc.; and other variables such as alkalinity, pH, hardness, total dissolved solids and electrical conductivity.

Biological characteristics; Water for drinking and cooking purposes must be made free from disease producing organisms. These organisms include bacteria, viruses, and helminths (worms). Some organisms that can cause diseases in humans originate with the faecal discharges of infected individuals. It is seldom practical to monitor and control the activities of human diseases carriers. For this reason, it is necessary to exercise precautions against contamination of a normally safe water source or to institute treatment methods which will produce a safe water.

When water seeps downward through overlying material to the water table particles in suspension, including microorganisms may be removed. The extent of removal depends on the thickness and character of the overlying material. Clay or hardpan provides the most effective natural protection of ground water. Silt and sand also provide good filtration if fine enough and thick enough layers. The bacterial quality of the water also improves during storage in the aquifer because storage conditions are usually unfavourable for bacterial survival. Clarity alone does not guarantee that ground water is safe to drink.

Certain forms of aquatic vegetation and microscopic animal life in natural water may be either stimulated or retarded in their growth cycles by physical, chemical, or biological factors. For example the growth of algae, minute green plants usually found floating in surface water is stimulated by light, heat, nutrients such as nitrogen and phosphorus and the presence of carbon dioxide as a product of organic decomposition. Their growth may in turn be retarded by changes in pH, the presence of inorganic impurities, excessive cloudiness or darkness, temperature and the presence of certain bacteria species.

**TDS:** Total dissolved solids (TDS) are a summation of the total solute content of a water and is expressed in mg/L. It is commonly measured by the evaporation of a known volume of sample and weighing the residue. TDS comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates) and small amounts of organic matter that are dissolved in water. In drinking water, TDS may originate from natural sources, sewage, urban

runoff and industrial wastewater. High TDS values suggest that water has been in contact with the aquifer formation for a sufficiently long time. The long residence time of groundwater and base flow may imply the existence of low hydraulic gradients, with subsequent low flow velocities, or low transmissivities due to the nature of the aquifer material. Concentrations of TDS in water vary considerably in different geological regions owing to differences in mineral solubility. Reliable data on possible health effects associated with the ingestion of TDS in drinking-water are not available. However, the presence of high levels of TDS in drinking-water (greater than 1200 mg/L) may be objectionable to consumers. Water with extremely low concentrations of TDS may also be unacceptable because of its flat, insipid taste. TDS does cause problems in industrial and irrigation processes such as corrosion damage to equipment, interference with processes, product quality and soil salinity from insoluble salt precipitation and complexity in waste handling.

**Electrical conductivity:** Specific Electrical Conductivity (EC) may be defined as the ability of a unit length and cross section of a substance to conduct electricity at a specified temperature. Conductivity arises from the presence of ions in the water. As the concentration of dissolved salts in the water increases, so does the conductivity. It is sensitive to various variations in the dissolved solids, mostly mineral salts. In other words, this parameter gives an idea of the salt concentration in water. EC is measured in  $\mu\text{S}/\text{cm}$ , and is often used to estimate total dissolved solids using the approximate relationship:

$$\text{TDS (mg/L)} = \text{EC} * 0.65 \dots \dots \dots 1$$

**Total suspended solids (TSS):** TSS may be defined as the amount of inorganic and organic material suspended in the water. The impact of total suspended matter on the suitability of water for use depends on three factors, namely: the physical presence of particles in the water, the degree to which it attenuates light, and the delivery of particulate-associated contaminants, which can be subsequently desorbed into the soluble phase. Water with high loads of suspended matter often supports high microbiological growth. TSS is measured in terms of concentration of suspended matter per litre (mg/L), or as turbidity (NTU), the light scattering ability of water. Considerable quantities of suspended material are derived from natural processes of weathering and erosion, although anthropogenic activities, such as deforestation, poor agricultural practices, general construction and mining operations, often exacerbate the rate of these processes. Soil particles constitute the major part of the suspended matter contributing to the turbidity in most natural waters. Discharge of sewage and other wastes can contribute significantly to turbidity.

**pH:** This is a measure of the acid balance of a solution, i.e., the degree of acidity or alkalinity of a medium. The pH scale ranges from 0 to 14, with pH values ranging from 1 to 6 being acidic, 7 neutral, and above 7 to 14 being alkaline. pH may be expressed by the following relationship:

$$\text{pH} = -\log_{10}(\text{H}^+(\text{mg/L})), \text{ with Acidic } <\text{pH } 7 < \text{Alkaline} \dots\dots 2$$

In water quality, low pH is corrosive to metals, gives metallic taste whereas high pH gives bitter taste. A range of 6.5-8.5 was determined as that pH which would achieve the maximum environmental and aesthetic benefits.

**Alkalinity:** Alkalinity is imparted to water by carbonates and bicarbonate or hydroxides of elements such as calcium, magnesium, sodium, potassium and ammonia. Of these calcium and magnesium bicarbonates are most common. Borates, silicates, phosphates and similar compounds can also contribute to the alkalinity. Alkalinity in water helps to resist changes in pH caused by the addition of acids components. The presence of these compounds is determined by standard methods involving titration against a standard acid with various indicator solutions. The results are expressed in terms of calcium carbonate. Knowledge of alkalinity components is useful in treatment of water supply.

**Bicarbonate and Carbonate:** These may be conveniently grouped together for purposes of discussion. They contribute essentially most of the alkalinity of water. Water will generally contain bicarbonate and carbonate, except where it is strongly acidic (pH below 4.5). The relative amount of these two anions largely depends on the pH of the water, with bicarbonate increasing as the pH decreases. More natural water (pH of 7.0 to 8.0) will contain much more bicarbonate than carbonate. Hem (1986) stated that bicarbonate concentrations of over 1000 mg/L commonly occur in waters that are low in calcium and magnesium, and especially where processes releasing carbon dioxide (such as sulphide reduction) are taking place in groundwater reservoirs.

**Hardness:** Hard water and soft water are relative terms. Hard water retards the cleaning action of soap and detergents, causing expense in the form of extra work and cleaning agents. Furthermore, when hard water is heated it will deposit a hard scale {as in kettle, heating coil, or cooking utensils) with a consequent waste of fuel. The mineral content of ground water reflects its movement through the minerals which make up the earth's crust. Generally harder and more mineralized than water in regions of high rainfall. Also deeper aquifers are more likely to contain higher concentrations of minerals in solution because the water has more time (perhaps millions of years) to dissolve the

mineral rocks. Calcium and magnesium salt, which cause hardness in water supplies are divided into two general clarification: carbonate, or temporary hardness and noncarbonated, or permanent hardness. Carbonate or temporary hardness is so called because heating the water will largely remove it. When the water is heated bicarbonates break down insoluble carbonates that precipitate as solid particles which adhere to a heated surface and the inside of pipes. Noncarbonated or permanent hardness is so-called because it is not removed when water is heated. Noncarbonated hardness is due largely to the presence of the sulphates and chloride of calcium and magnesium in the water.

**Chloride:** The main source of chloride is the dissolution of halite. Small amounts occur naturally in rainfall. Pollutant chloride is very common and occurs in human, animal and industrial wastes. The differential permeability of clay may be considered to be a major factor in the behaviour and composition of saline groundwater associated with fine grained sediments. Chloride held back when the water molecules pass through a clay layer might accumulate till high concentrations are reached. In such a situation, the clay layer also influences the residual concentration of cations mostly calcium. However, most common type of water in which chloride dominates have high sodium content. Most chlorine occurs as chloride in a solution. High chloride can make waters unpalatable, and therefore unfit for drinking

**Iron and Manganese:** These are usually treated together because of their resemblances in chemical behaviour and occurrence in groundwater (Gibson and Singer, 1969). Main natural sources of iron are the dissolution of iron rich cements in sandstones and the dissolution of mafic minerals in igneous rocks. Iron and manganese cause staining of laundry and plumbing fixtures. Iron-containing waters also have a characteristic taste which some people find unpleasant. Such waters when first drawn may appear clear and colourless; but upon allowing the water to stand, the iron settles out of solution and gives the water a cloudy colour and later accumulates at the bottom of the container as a rust-coloured deposit.

**Sulphate:** Main natural source of sulphates are oxidation of pyrite in igneous and sedimentary terrains, and the dissolution of gypsum and anhydrite in sedimentary environments. Some organics will also release sulphate on breaking down thus making sewerage contamination a possible explanation for high sulphate content in water if no natural source is obvious. The principal impact of high sulphates is on industrial processes (damage to equipment through chemical precipitation, promotion of microbiological corrosion, interference with chemical processes and deterioration in

product quality). Similar issues exist for damage to irrigation equipment. Gastrointestinal effects (opening of the bowels) can result from ingestion of drinking-water containing high sulphate levels. The presence of sulphate in drinking-water may also cause noticeable taste and may contribute to the corrosion of distribution systems. Sulphate is the stable, oxidized form of Sulphur that can be used as an oxygen source for bacteria which convert it to hydrogen sulphide and then produce unpleasant smell. High Sulphate levels in water impart unpleasant taste and may be toxic.

**Nitrate:** Main natural sources of nitrate are decaying legumes and other organic matter, although large amounts may originate from sewerage and nitrate fertilizers. High concentration of nitrate in water may produce an effect known as cyanosis (methemoglobinemia or “blue babies”) in infants. This condition, which is characterized by a bluish discoloration of the skin, listlessness and drowsiness, can be fatal. Methaemoglobin is formed when iron in the haemoglobin molecule is oxidised from  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ . Methaemoglobin occurs when haemoglobin is oxidised at a rate exceeding the normal enzymatic capacity to reduce the haemoglobin.

**Fluoride:** Important natural sources of fluoride are apatite, mica, amphiboles and fluorite. When present in concentrations less than 1.0 mg/L in water, fluoride generally reduces tooth decay in small children and is desirable. However, excessive concentrations result in the discoloration and pitting of the teeth called dental fluorosis. Electrode and colorimetric methods are currently most satisfactory for determining fluoride ion concentration. The fluoride ion activity is a specific ion sensor designed for use with calomel reference electrode and a pH meter having a millivolt scale. The key element in the fluoride electrode is the laser type doped single lanthanum fluoride crystal across which a potential is established by the presence of fluoride ions. The crystal contacts the sample solution at one face and an internal reference solution at the other. An appropriate calibration curve must be developed that relates meter reading in millivolts to concentration of fluoride. Fluoride activities depend on total ionic strength of the sample and the electrodes do not respond to fluoride that is bound or complexed. These difficulties are overcome by the addition of (CDTA) (cyclohexylenediaminetetra acetic acid) solution, which is a buffer of high total ionic strength to swamp out variations in sample ionic strength. The colorimetric method is based on the reaction between fluoride and a zirconium-dye lake. The term lake refers to the colour produced when zirconium ion is added to SPDNS dye. Fluoride reacts with the reddish colour dye lake, dissociating a portion of it into a colourless complex anion and the yellow-colour dye. As the amount of fluoride is increased the colour becomes progressively lighter and a different hue. This

bleaching action is directly proportional to fluoride ion concentration. Either a spectrophotometer or a colorimeter may be used to measure sample absorbance for comparison against a standard curve. Higher incidence of cancer is also suspected among populations with high fluoride exposure.

**Phosphate:** This element may occur as point source or diffuse source. 'Point source' pollution may originate from industrial or waste water treatment plant pipelines. 'Diffuse' source pollution may include nutrient losses from manure and waste products spread over large agricultural fields, sediment from eroded soils, nutrient leaching or runoff from residential or agricultural areas. Too much phosphate in the diet can cause health problems, such as kidney damage and osteoporosis. Elevated phosphate concentrations in surface waters raise the growth of phosphate-dependent organisms, such as algae and duckweed, because it is a limiting nutrient in most freshwater systems. These organisms use great amounts of oxygen and prevent sunlight from entering the water.

**Boron:** Main sources of boron are igneous rocks, volcanic gases, sewerage and industrial wastes. Small amounts are required for plant growth but excessive concentrations in soil and water for irrigation are harmful because they cause toxicity.

**Chlorides:** Chloride is a constituent of concern in water and wastewater as it can impact the final reuse application of treated water. Chlorides in natural water result from the leaching of chloride containing rocks and soils with which the water comes in contact and in coastal areas from salt water intrusion. In addition, agricultural, industrial, and domestic wastewaters discharged to surface waters are a source of chlorides. Human excreta for example, contain about 6g of chlorides per person per day. In areas where the hardness of water is high, home regeneration type of water softeners will also add large quantities of chlorides. Because conventional methods of waste treatment do not remove chloride to any significant extent, higher than usual chloride concentration can be taken as an indication that a body of water is being used for waste disposal. Infiltration of ground water into sewers adjacent to saltwater is also a potential source of high chlorides as well as sulphates.

## **CHAPTER THREE: METHODOLOGY AND MATERIALS**

### **3.1 Introduction**

This included analysing the water situation in terms of quality and quantity from different designated sources at Chichiri and Bvumbwe Prisons. The study also involved investigating major contributing factors to water shortages and poor sanitation in prisons, and this was done through the administration of questionnaires and conducting Key Informant (KI) interviews and Focus Group Discussions (FGDs). The prevalence of diseases that could be attributed to water shortages and their impacts on the inmates were analysed through observations and data recorded at these two facilities.

This chapter presents methodologies that were adopted in conducting the study. It explains the research design, study population, data collection methods and instruments, data collection procedure, and data analysis.

### **3.2 Review of the Previous Related Studies**

This was done in order to get vital and supportive information about the study prior to the commencement of this research. This approach was adopted because of the need to coordinate the previous related studies with the current one, and to gain insight into the history of the subject matter as well.

### **3.3 Water Quality and Water Quantity Analyses**

Water samples were collected from different water points (taps, or boreholes/shallow well) that are used by inmates, both outside and inside prison premises in relation to their daily social needs, e.g., domestic use such washing clothes, drinking, irrigation, animal husbandry(pig farming); and most of all in solid waste management in their cells, e.g., like toilet flushing. Four critical sampling points were identified, i.e. boreholes, taps, the kitchen, and storage containers. Additionally, swabs were done from at identified places, such as handles of containers, and at boreholes and taps. Water samples were then analysed for physical, chemical and biological characteristics of interest in relation to the objective of the study and in line with water use in the prisons.

The physical parameters of interest included the following: Conductivity, Turbidity, Temperature and Total Dissolved Solids. Chemical characteristics that were analysed included pH and hardness. Biological examination of water was involved investigating Coliform counts (i.e. indicator organisms) using Membrane Filtration Technique.

### **3.4 pH/Temperature**

pH of the water was measured immediately after sample collection on site using a microprocessor controlled pH/Temperature Meter Jenway 3310. The pH meter was first calibrated using pH 4, 7 and 9 buffering solutions. The electrode was rinsed with deionised water before determining the pH of any subsequent samples to prevent inter-sample contamination (American Public Health Association [APHA], 1995). (MS682-1:2002)

### **3.5 Conductivity/Total Dissolved Solids**

The Conductivity/Total Dissolved solids meter was first calibrated using a calibration fluid with conductivity of 1413Micro Siemens per cm, and then the conductivity meter was also rinsed three times with deionised water before determining the Conductivity/Total Dissolved Solids of any subsequent sample (APHA, 1995) to prevent inter-sample contamination. (MS682-1:2002)

### **3.6 Hardness Test**

The total hardness in the water was measured through the titration method. The samples were first titrated using Hydrochloric acid with Phenolphthalein indicator from red to colourless end point and then titrated again by adding Methyl indicator and titrated again with hydrochloric acid to red end point (MBS, 2008). (MS682-1:2002)

### **Coliform bacteria (*E. Coli*)**

A group of gram-negative rod shaped bacteria that are found in vertebrate gastrointestinal tract (digestive system); their presence in water is an indication of fecal pollution. In order to determine the number of coliforms, the initial activity involved preparation of medium for microbes' growth and sterilizing all the apparatus to be used. The media were then poured in the petri-dishes on the membrane pads. Then a known volume of sample from the intended source was filtered through the membrane filters. The membrane filters were then incubated on the membrane pads with media

for 24 hours. After 24 hours the membrane filters were observed for the coliforms, which showed yellow colonies as per the medium used. The colonies were counted and recorded. Well known coliform bacteria include *Escherichia Coli*, *Sarmonella*, etc. The enumerated coliform bacteria in the exercise were *Escherichia Coli* (MS682-1:2002)

### **3.7 Water Quantity from Source (Borehole and Tap)**

In order to determine the borehole yield, three empty buckets, a metronome, and a stop watch were used. The empty buckets were in turn placed below the spout of the outlet pipe of the borehole in order to collect water which was being pumped from the well, noting the time taken to fill each of the buckets. From this procedure, it was possible to determine the rate at which water was issuing out from the borehole, i.e., the borehole discharge or yield. The discharge vale was computed by dividing the volume of water collected in the bucket by the time taken to fill it, and taking an average of several values. In order to be systematic and consistent in determining the borehole yield, two people (also named “Pumpers” for this purpose) were assigned the task to pump the borehole in turn at a constant stroke determined by the metronome placed on top of the pump head. The initial rate of the stroke was set at 40 beats per minute on the metronome, which are roughly 2 strokes every 3 seconds. The stop watch was started as soon as water started coming out of the outlet pipe of the borehole. Spillage of water was avoided and minimised whenever the buckets were being changed. Also, when nearing each minute count down from 5 seconds and on zero, the stroke counter shout the count and the time to fill the bucket was recorded. The test was continued for a period of 30 minutes, maintaining as close as possible the same rate of stroke of 40 beats/minute.

Discharge values of water from taps were determined by opening the taps to full throttle and noting the time taken to fill the 25 litre bucket at that rate.



**Figure 1: Water quantity test in progress in Bvumbwe Prison**

### **3.8 Condition of Water from Containers Used in Prison Cells**

In order to assess the level of faecal contamination of the containers/Jerri cans/buckets that were being used by the inmates for drawing water from water points (i.e., boreholes and taps) for use in their respective cells, water samples were collected from the buckets for microbiological analysis. Swabs were also taken from various parts of the buckets, e.g., handles, bucket sides, etc. for biological analysis. Also, water samples were collected from a number of places within the premises of the prisons, e.g., the kitchen, cells, etc. The swabs were then tested for the presence of *Escherichia Coliforms* to determine the level faecal contamination.

### **3.9 Membrane Filtration Technique**

Over 200 ml of water samples were collected in 250 ml universal sterilised sampling bottles. The collected samples were then kept in a cooler box and transferred to the laboratory at the Malawi Polytechnic within six hours of sampling for analysis.

The internal part of the metal filtration funnel was sterilized by passing the funnel through a flame several times. The funnel was thereafter cooled by inverting it in the filtration bottom base which

had methanol flame as it went off before any subsequent sample analysis was done to avoid inter-sample contamination.

Then the tip of the metallic forceps was flamed and allowed to cool, and then the 45 micron pore membrane filter was removed from the sterile pack and transferred to the sterile filter holder.

Then the sterile Whatman adsorbent pad was placed in the sterile petri dishes of 47 mm diameter. The pads were saturated with the sterile Membrane Lauryl Sulphate broth over the surface. The sterilized forceps were then used to remove the membrane filter from the filtration unit and placed face up on each saturated pad. This was done in order to ensure that no air bubbles were trapped between the membrane filter and the pad. The incubation was done as follows:-

(a) One membrane filters gradually at 37 Degrees Celsius for 24 hours for presumptive test.

(b) One membrane filters gradually to 44 Degrees Celsius for 24 hours for Escherichia Coli determination.

Escherichia Coli is a member of coliform group that ferment lactose at 44 Degrees Celsius and it is found in water of food and it indicates faecal and imminent health danger.

Then after 24 hours the yellow colonies were counted to quantify the number of colonies.

### **3.10 Data collection methods**

First and foremost, preliminary investigations were conducted to identify key players in the water supply, quality and sanitation in relation to health in the two designated prisons.

A letter of introduction was obtained from the Dean of Postgraduate Studies and Research which was presented to prison authorities in seeking permission to gain access to the two prisons for data collection from the sample community. Quantification of cases of illnesses resulting from diseases related to ingesting polluted water, sanitation issues or indeed use of inadequate water for personal hygiene, was sourced from prison records, e.g., dispensary files. The data was organized and scrutinized; and a statistical analysis was undertaken on these data in order to better understand relationships between the parameters.

In order to achieve the objectives of the study, a careful consideration of the selection of data collection methods was conducted prior to a data analysis. This was done through extensive literature review. The research was a cross sectional survey, where questionnaire method was used to collect data. The data collected using this method was quantitative.

The questionnaire surveys were supplemented by the interviews and observation method that were done to collect data regarding perceptions, opinions, emotions and feelings of the respondent.

### **3.11 Participant Observation**

Participant Observation was the most common approach that was adopted in this study for data collection. Any observations that were noted at the prisons were recorded in terms of the event and the time when it took place. Indeed, the researcher was work based and the researcher was part of the study. This enabled the researcher to generate rich and genuine results. Some of specific areas observed during the study included sanitary areas, kitchen, water point sources, living cells, garbage bins, communication patterns, behaviors and attitudes of individuals.

### **3.12 Structured and Unstructured interviews**

The study also involved the formulation of questions that were administered to different stakeholders through questionnaires and one-on-one interviews. To facilitate the process one on one interviews were incorporated through the use of questionnaire where the need arisen.

### **3.13 Data collection Instruments**

Data were collected from both primary and secondary sources. The primary sources of information included questionnaire surveys, and structured interview guides. An observation checklist was used to capture all the aspects of the study that the questionnaire survey method could not adequately address. Secondary information was obtained from the library at the Malawi Polytechnic as well as from the internet.

Additionally, prison staff provided the researcher with information on the health status of the inmates. This information was obtained from prison dispensary records. These data proved very useful in that they assisted the researcher in analysing the association between the state of water quantity and quality at the prisons and cases of the most predominant illnesses including those related to water availability. Historical information about prisons in Malawi and various developments taking place at the two prisons was obtained from prison magazines. Other members of the public like relatives/visitors were also drawn in to provide their side of the experiences in relation to the subject at hand.

### **3.14 Data Collection Procedure and Population Sample**

Before going to the field to collect data, the office of the Dean of Post Graduate Studies and Research at the University of Malawi – The Polytechnic gave the researcher letter of introduction,

authorizing the researcher to seek permission from prison authorities to conduct the study. However, due to the institutional set up of the prisons and the tight security maintained at the premises, the request for permission to undertake the study took a long time to be granted the go-ahead by Prison authorities at Headquarters. This bureaucratic process delayed the commencement of stakeholder consultations and field surveys.

It was noted during the field visits that Bvumbwe Prison had 52 warders and wardresses, and a maximum number of 252 prisoners who lived in four (4) cells, with one flush toilet and four external ones. For this study, Bvumbwe prison had a sample population of 128 participants, from whom 58 participants were provided with relevant information about the study through guided interviews and interaction. This sample, represented over 50 % response rate.

### **3.15. Sample size**

The sample size was calculated using the Yamane's formula for categorical data. This formula was used because the sample estimate gives the risk the researcher is willing to accept (margin of error) and level of acceptable risk the researcher is willing to accept. The margin error used was 5% and the confidence interval of 95% was envisaged to offer reliable results.

The formula is written as  $n = \frac{N}{1 + N(e^2)}$  where  $n$  = the sample,  $N$  = total population of area of study, 1 is a constant and  $e$  is error limit or margin of error its usually accepted at 5% or 0.05 thus sample population for Chichiri prison was calculated as  $n = \frac{2046}{6.11} = 334$  and for Bvumbwe prison the calculated sample population was  $n = \frac{252}{1.63} = 155$

At Chichiri Prison, the average number of prisoners was noted to be 2046. These lived in 14 Cells, each provided with 1 flush toilet, except for Top Yard which has no inbuilt toilets. The total number of staff was 152, comprising both women and men. A total 326 participants were considered as a sample for the study though the calculated sample value was 334 due to other inmates who opted to give information in the company of a colleague, although only 123 responded to stakeholder interviews, representing slightly over 40% response rate. At Bvumbwe prison the calculated sample size was 155 even though 128 participants were involved in the responses as others did not respond and others due to the willingness of the interviewees to give the information as a coordinated compact in groups for reasons best known to the inmates themselves.

### **3.16. Data Analysis and Ethical Considerations**

The analysis of the data that was collected for the study involved the identification of trends, patterns, inconsistencies, and relationships between parameters. I used SPSS, Microsoft Excel, and WHO and Malawi Standards as my main tools for data analysis. Statistical tests were also used to evaluate whether the findings of the study were significant or not. The information that was obtained from stakeholders and field observations was also used in analysing study results. In assessing the suitability of the water for domestic consumption, the quality of water from different sources was compared with the results of water analysis that were obtained from prison water points with WHO and Malawi Standards. These findings have been presented in this dissertation.

### **3.17. Ethical Considerations**

Consent to carry out the study in Chichiri and Bvumbwe prison was sought first from the prison (Authority) Central Office in Zomba before actual consent of individual participant (inmates) in the prison settings. To ensure that the respondents understood the study before consenting to participate, each member of the research team introduced themselves to the respondents and explained the purpose of the study. Also, a verbal consent was obtained from the respondents before administration of questionnaires. Questionnaires and observation checklists had no space to capture names of respondents to ensure anonymity and participation of the respondents was voluntary.

The data collected was checked for both reliability and validity in a number of areas. For instance some of the respondents were too immortional such that it could be difficult for them to give right details of information pertaining to the subject matter. To correct this problem prison authorities were consulted in the selection of the interviewees, by selecting those who ought to be in stable conditions. Some respondents could not give correct information deliberately because they expected a reward of monetary value hence provided wishy wash information. However to overcome this problem the explanation and the purpose of the questionnaire was first defined and discussed with the inmates so that they give the information willingly based on their personal experiences and understanding of the issue at hand. Additionally more information was sourced from other independent members of the community like visitors/relatives that offered another variety of response.

### **3.18. Limitations of the Study**

The major limitation of this study was that the scope of the study was limited to Chichiri and Bvumbwe prison, as such the findings may not apply to prison in other districts and the whole country. Inadequate time allocated to various activities of the project; starting with literature review and desk studies, stakeholder consultations, and then field surveys also provided another challenge. Only nine months, i.e., from January to September, were allocated for the implementation of all the tasks listed above. As such, it was not possible to collect as many water samples from taps and boreholes at the two prisons as It would have wanted for water quality analysis, because of being mindful of the limited time allocated to the study. If there had been adequate time to undertake this study, for sure It would have involved collection of more water samples from the water points at the two prisons than the few that were collected. Doing so would have given the researcher a better picture of the water quality status of the water points at the two prisons and Malawi in general, and their associated diseases.

The nature and environment of the institutions. i.e., prisons, where this study was conducted required the observance of tight security; and that being the case, It was not easy to take photos in some areas of the prisons, since doing so would have meant compromising security. It is also worth noting that cameras and phones were not allowed in prison cells.

## CHAPTER FOUR: RESULTS AND DISCUSSIONS

### 4.1 Introduction

The chapter gives the explanation and details of the findings and how they have been interpreted and used in the context of this research. Considering the specific objectives set for the study among others relating to objective number one that is looking at the quality and quantity of water status in the two prisons.

To characterize the quality of the water, qualitatively the microbial analyses in the findings offered the indication on the condition of the water in relation to human health. The conclusion was based on comparison with the related standards in water of the coliforms. The number of coliforms in the water are greater than the recommended standard of zero thus depicting a threat of waterborne disease. (Table 1 and 2 ). From Table 1 and 2 the amount of coliforms in the water samples from different water sources were observed and compared to World Health Organisation Drinking Water Standards. At Chichiri Prison water samples from tap and borehole gave 0 value of coliforms indicating no pollution. However the water tested from the buckets from cells and water from kitchen showed positive readings of 27 and 18 respectively signifying pollution occurred after collection from source. Similarly though at Bvumbwe Prison water from bucket also tested positive for coliforms registering 6 colonies against the desired zero value. The water from the sources, i.e. tap and borehole at Bvumbwe gave 0 coliform reading signifying no pollution occurred at water point source. The trend observed regarding the microbiological quality of the water suffice to conclude that the water is getting polluted away from the source be it in the kitchen and cells.

The research also provided good information regarding the available amount of water found in these prisons in times of dire constraints as depicted in the findings. Important information relating to the prevalence of water borne diseases and the other top five illnesses has also been analysed to highlight the trends being observed as per the findings. Furthermore results had emphasis put much on determination of the diseases that could be attributed to water shortages and their impacts on inmates analysed in this research included diarrhea scabies and how the welfare of the inmates is influenced. The following were some of the findings regarding water quality and quantity in the two prisons:

#### **4.1.1 Quantity,Quality of Water accessible to inmates**

(a)The quantity of water from taps at Chichiri Prison was enough to supply the whole Prison in times of consistent water flow. Considering 40l water demand per capita per day, provision of water was adequate in both Prisons considering all water sources to be operational.Considering Chichiri prison on assumption that both tap and well water is available the average consumption per capita per day is 464 L per capita per day taking an average population of 2200 inmates and this value is above the recommended requirement of 50 to 70L per capita per day.When the taps stop the consumption rate is 65L per capita per day at Chichiri prison. However the challenge comes when tap water stops since the yield rate of the borehole cannot manage to provide adequate water for the population at Chichiri considering that the staff in the prison campus also tend to use the same water sources with the inmates.

Bvumbwe prison shows that it has reliable sources of water, for considering both the tap and well being functional the consumption per capita per day is 2402L per capita per day which is way above the recommended 50 to 70L per day per capita.When the taps stops the average consumption per capita per day is 677L per capita per day considering a population of 350 inmates which is already way above the recommended amount.This explains better that due to the low number of inmates at Bvumbwe prison the minimum requirement for water use by inmates is easily accessible. Thus bvumbwe prison has adequate water on most of the year period.

(b)The quality of water from taps in Chichiri and Bvumbwe is good except for water fom borehole and well at Chichiri was contaminated with Escherichia Coli bacteria.The water from Bvumbwe is also good microbiologically thus Bvumbwe Prison has good quality and quantity of water.The water from the borehole at Chichiri prison gave 0 reading on number of coliforms per 100ml showing that the water is good for human consumption since the result agreed with the WHO standard of 0.

(C) It was also observed the water was safe when tested on source, however evidence showed that the water getting polluted inside prison cells. This was obseved when water from prison jerricans was tested for coliforms. However considering all the water sources physically the water from both prisons has shown to be good as evidenced by the turbidity values that are all below World Health standard of 0.

The water tables below justifies the low values of water quality compared to the water standards according World Health Organisation(W.H.O)

**Table 2: Water Quality Parameters in Chichiri Prison**

Parameter	Turbidity (NTU)	TDS(mg /l)	Temperature(°C)	pH	Conductivity(µS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Tap	0.12	128.70	25.0	7.14	195.60	25.0	0
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

Parameter	Turbidity (NTU)	TDS(mg /l)	Temperature(°C)	pH	Conductivity(µS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Borehole	0.81	131.33	24.53	6.42	206.57	17.67	0
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

Parameter	Turbidity (NTU)	TDS(mg /l)	Temperature(°C)	pH	Conductivity(µS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Kitchen	20.87	135.13	25.03	6.12	216.63	22.67	18
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

Parameter	Turbidity (NTU)	TDS(mg /l)	Temperature(°C)	pH	Conductivity(µS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Bucket	15.07	133.43	25.37	6.15	212.6	26	27
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

Parameter	Turbidity (NTU)	TDS(mg /l)	Temperature(°C)	pH	Conductivity(µS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Borehole	0.46	120.07	23.47	6.20	189.03	19.67	0
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

**Table 3: water quality parameters in Bvumbwe Prison**

Parameter	Turbidity (NTU)	TDS(mg/l)	Temperature(°C)	pH	Conductivity(μS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Tap	0.47	131.00	25.10	6.61	203.05	22.50	0
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

Parameter	Turbidity (NTU)	TDS(mg/l)	Temperature(°C)	pH	Conductivity(μS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Bucket	0.82	131.77	24.50	6.29	207.23	25.00	6
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

Parameter	Turbidity(NTU)	TDS(mg/l)	Temperature(°C)	pH	Conductivity(μS/cm)	Hardness(mg/l)	Escherichia Coli(n/100ml)
Kitchen	0.43	121.47	24.27	6.22	191.03	19.67	0
W.H.O.	0-5	1000	-	6.5-8.5	1000	600	0

The physical, chemical and microbiological parameters like Turbidity fall within the recommended WHO standards of between 0 and 5. However, the conductivity, Total dissolved solids of the water sources lie within the recommended WHO 2017 standards, depicting good water from sources as illustrated in (Table 2 and 3).

However though, considering the biological condition of the water from the buckets from cell sources. The observations depict unsafe water which justifies the improper handling of water within the cells due to other anticipated use as the water assists in disposal of solid waste within the cell premises. (Table 2 and 3) explain better when you refer water from buckets from both Chichiri and Bvumbwe prisons recorded 27 and 6 respectively on number of coliforms per 100ml sample against WHO standard of zero. This justified the suggestion that the water was getting polluted either in transit to the cell or presumably in the cells confinement.

The water from Chichiri tap and borehole physically, chemically also portrays compliance with the WHO Standards, however the water from the borehole and the well shows to be polluted.

Observations on the positioning of the well and borehole at Chichiri suggests that the water from the well is the one reentering the borehole hence polluting the borehole water source.

However the research findings have highlighted that water from the containers in the cell was polluted with faecal bacteria. This portrays problems with hygiene conditions in handling the water inside the cells. This has been vindicated by the presence of Escherichia Coli bacteria present in the water samples from the cells containers.

The microbiological condition also satisfied the WHO standards as the water contained no traits of Escherichia Coli from the two sources of the water.

The situation at Chichiri is quite contrary as observation showed that the other sources of water like the well and the borehole contain polluted water with low flow rate which make huge competition for this precious natural resource in times of electricity failure. On occasion sampling the water from different points like Kitchen and buckets showed to contain E.Coli at Chichiri Prison due to the fact that the water used was from the borehole and the well due to tap water shortages.

**Table 4: Water quantity from different sources in Chichiri and Bvumbwe Prison**

<b>Yield of Water From Different Water Sources</b>					
<b>Chichiri Prison</b>			<b>Bvumbwe Prison</b>		
	<b>Borehole</b>	<b>Tap</b>	<b>Borehole</b>	<b>Tap</b>	
Time taken(s)	623	128	380	149	
Amount of Water Collected(ml)	22500	22500	25000	25000	
Yield Rate(m <sup>3</sup> /h)	144	705	237	604237	

Further the research also established the contributing factors influencing water shortages included Contributing Factors of water shortage in Prisons :

Considering specific objective 2 that is looking at the contributing factors to water shortages the following observations were made:-It was established that

- (a) Overcrowding among inmates is the one which brings competition for water and
- (b) Lack of enough water infrastructure for the provision of water at these institutions.

The comments coming from the interviews also indicated that members of the prison staff wives tend to prefer collecting water from the prison compounds due to high cost of water. This has been happening since the water board meters were installed on their household water sources which was not the case before. This increases competition for the availability of water when electricity fails prompting the inmates to use the only wells located inside the prison perimeters for their daily use thereby straining the already meagre source of water and also compromising on security issues due to complex movement of people.

Frequent blackouts by the the electricity supplying firms also accelerates shortages of water since the water pumps at both Walkers Ferry and Mudi waterboard stations depend very much on the ESCOM generated electricity.

#### **4.1.2. Prevalence of Water Related Diseases in Chichiri and Bvumbwe Prisons**

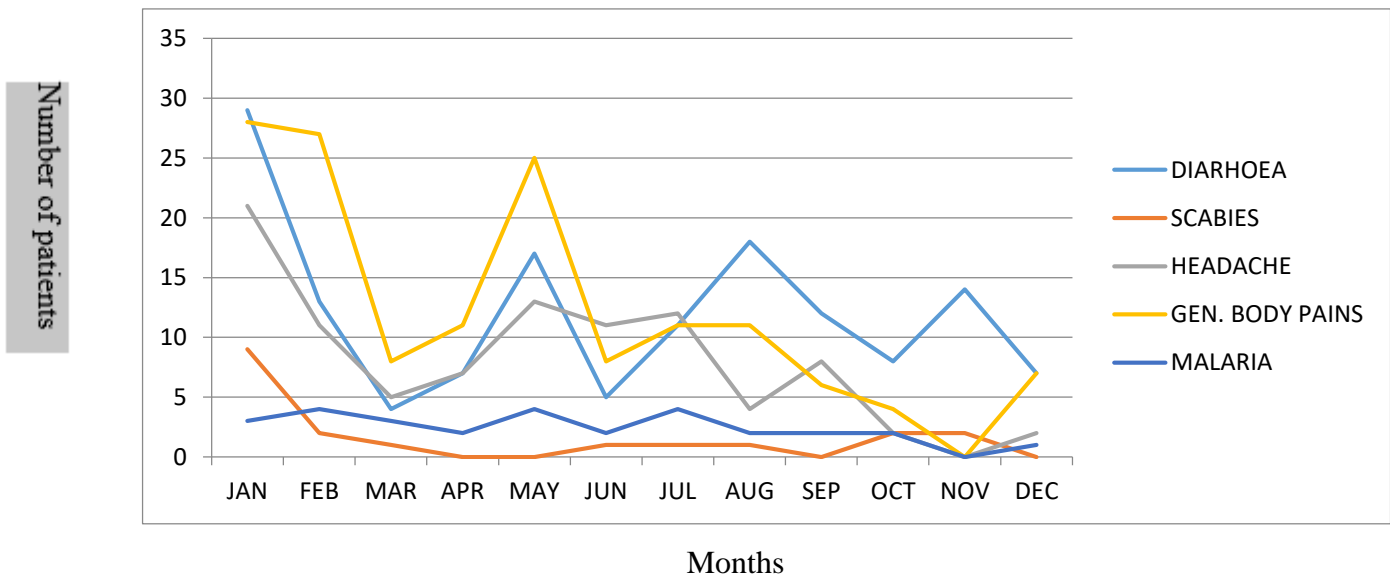
The Research also considered the most top five diseases and related to the waterborne diseases to evaluate their magnitude in relation to sanitation. The diseases of interest were Diarrhoea, Scabies, Headache, General body pains and Malaria.

However it was established that the prevalence of water related diseases was reducing between January to December, 2016. Considering diarrhoea and scabies at Chichiri prison, the occurrence of diarrhoea was 136 observed in January and reduced to only 65 cases in December the same year, similar trend was observed with scabies which registered 21 cases in January whilst only 10 cases were registered in December the same period as shown in Table 5 and Table 6. However when Bvumbwe prison was considered using diarrhea and scabies as a yard stick as well, 29 cases of diarrhea were observed in January and 7 cases in December same period whilst scabies also registered 9 cases in January and only 2 cases same period. The trends observed in both incarceration centres here actually signifies a significant downward trend in the decline of water related diseases suggesting there is no inducement of outbreak of water related disease in the two prisons that can be attributed to water and sanitation.

The data and graphs below also explain the observations regarding the ailments in our targeted prisons.

**Table 5: 5 most common diseases in Bvumbwe prison**

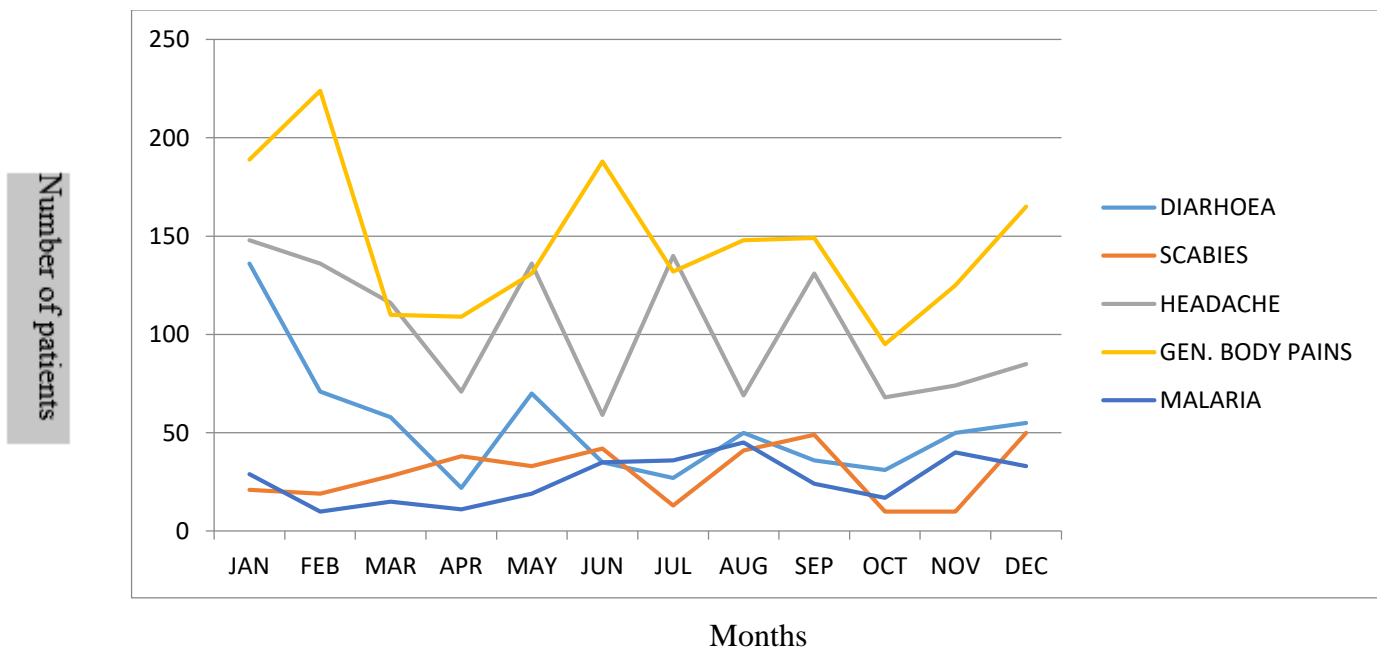
FREQUENCY OF MOST COMMON DISEASES AT BVUMBWE PRISON												
	MONTH (2016)											
DISEASES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
DIARHOEA	29	13	4	7	17	5	11	18	12	8	14	7
SCABIES	9	2	1	0	0	1	1	1	0	2	2	0
HEADACHE	21	11	5	7	13	11	12	4	8	2	0	2
GEN. BODY PAINS												
PAINS	28	27	8	11	25	8	11	11	6	4	0	7
MALARIA	3	4	3	2	4	2	4	2	2	2	0	1
TOTAL No. OF SICKNESSES	<b>90</b>	<b>57</b>	<b>21</b>	<b>27</b>	<b>59</b>	<b>27</b>	<b>39</b>	<b>36</b>	<b>28</b>	<b>18</b>	<b>16</b>	<b>17</b>



**Figure 2: Trend of occurrence of the 5 diseases in Bvumbwe**

**Table 6: Most Common diseases in Chichiri Prison**

FREQUENCY OF MOST COMMON DISEASES AT CHICHIRI PRISON													
	MONTH (2016)												
DISEASES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
DIARHOEA	136	71	58	22	70	35	27	50	36	31	50	55	641
SCABIES	21	19	28	38	33	42	13	41	49	10	10	50	354
HEADACHE	148	136	116	71	136	59	140	69	131	68	74	85	1233
GEN. BODY PAINS	189	224	110	109	131	188	132	148	149	95	125	165	1765
MALARIA	29	10	15	11	19	35	36	45	24	17	40	33	314
TOTAL No. OF SICKNESSES	<b>523</b>	<b>460</b>	<b>327</b>	<b>251</b>	<b>389</b>	<b>359</b>	<b>348</b>	<b>353</b>	<b>389</b>	<b>221</b>	<b>299</b>	<b>388</b>	<b>4307</b>



**Figure 3 Trend of the occurrence of diseases in Chichiri Prison**

(a) Having a thorough observations on the trends on health irrespective of the water quality and quantity in the two prisons under considerations remarks uttered by Dr Kelita Kamoto (Malawi Prison Magazine,2015) appreciates and suffice to agree with the trend the water related diseases trend showed. This research has agreed “what the cooperation and respectfulness of inmates have on health personnel has played on health, as it has actually contributed to the positive trend in the improvement of good health aspects in prisons in general”.

### **Social Impacts of water shortages**

To assess the social impacts of water shortages in the two prisons on the human health of inmates in relation to sanitation, economical ,physical and interactive aspects of the inmates were considered. However social issues in relation to culture and religion were also examined and related to the water use in times of shortages and how they also affect the livelihood of the inmates on their health as well. Issues to consider the availability of descent sanitation facilities and provision of consistent water supply to inmates were also considered.The research enquired much on the perspective of how the inmates rated their sanitary conditions,how they rate the aesthetic quality and quantity of their water supplies too. The findings established that at Chichiri prison the probability of inmates commending the good quality of the water aesthetically and being good for domestic use like bathing/washing was at 0.79 whilst at Bvumwe the probability was at 0.93. The probabilities from the two prisons were all on the higher side explaining the satisfaction and confidence the inmates had on their use of the water sources . The probability of the inmates having the negative assessment of aesthetic acceptability of the water sources being good for their use was 0.21 and 0.07 for both Bvumbwe and Chichiri prisons respectively. Furthermore considering consistency in the provision of water to inmates were evaluated through knowledge relating the frequencies of water shortage during the preceeding twelve months. The provision was evaluated considering the supply efficiency for the previous preceeding twelve months. The probability that the inmates experienced water shortages in the two evaluated prisons:Chichiri prison registered 0.21 whilst Bvumbwe prison registered 0.05 and these values lie way below consderation to suggest that there were remarkable problems emanating from water supply.

To establish whether some inmates use water shortage to gain monetary advantages by either selling the available water to fellow inmates or otherwise were evaluated. However referring to table 7 and 8 on the findings the probability that water is sold in the cells at Chichiri was at 0.15 compared to 0.02 at Bvumbwe prison.The probabilities obtained are comparatively low suggesting

that in the two prisons issues to do with economical gains in relation to water are very rare though suggesting water is not marketable.

Issues related to physical interaction between the inmates and how they relate with one another in times of water shortages were gathered in relation to water shortages as well as sanitation. The physical behaviour of inmates towards fellow inmates were considered with respect on how they also interact with the outside community as well. It was established that the probability of inmates having conflicts/confrontation with fellow inmates at Chichiri prison was at 0.31 as compared to 0.05 obtained at Bvumbwe prison. However considering how the inmates interact with the community issues of bullying/mockery were also considered. The research established that the probability of bullying was at 0.17 at Chichiri prison compared to 0.03 at Bvumbwe prison, however significantly all values are all lying in the extremely low probability values.

Issues to deal with physical condition of the sanitary facilities in terms of their state and maintenance levels were considered. This assisted in assessing whether sanitary conditions in the cells are that dignified for the social acceptability without being cause of anxieties and dejection.

**Table 7:**Results from key informant interviews at Chichiri Prison

<b>Attribute</b>	<b>Response</b>	<b>Frequency</b>	<b>Probability</b>
How do you describe the water sources in the compound in terms of taste and use like washing/bathing and drinking	Good	97	0.79
	Bad	26	0.21
How many times have you experienced water shortages in the previous 12 Months	Very often	27	0.21
	Not often	96	0.79
When tap water stops do you experience water related problems like quarelling/fighting with fellow inmates due to competition for water	Yes	38	0.31
	No	85	0.69
Have you ever been bullied/mocked/embarrassed by members of the community when drawing water together	Yes	21	0.17
	No	102	0.87
Does selling of water happen inside cells when tap water stops	Yes	16	0.15
	No	107	0.85
How can you describe your sanitary facilities,their state as well as their maintenance	Good	21	0.17
	Bad	102	0.83
Have you ever had an outbreak of water related diseases like cholera/dysentry in the past twelve Months	Yes	104	0.85
	No	19	0.15

**Table 8:Results from key informant interviews at Bvumbwe Prison**

<b>Attribute</b>	<b>Response</b>	<b>Frequency</b>	<b>Probability</b>
How do you describe the water sources in the compound in terms of taste and use like washing/bathing and drinking	Good	54	0.93
	Bad	4	0.07
How many times have you experienced water shortages in the past 12 Months	Very often	3	0.05
	Not often	55	0.95
When tap water stops do you experience water related problems like quarrelling/fighting with fellow inmates due to competition for water	Yes	3	0.05
	No	55	0.95
Have you ever been bullied/mockd by the members of the community when drawing water together	Yes	2	0.03
	No	56	0.97
Does selling of water happen inside cells when tap water stops	Yes	1	0.02
	No	57	0.98
How can you describe your sanitary facilities (toilets/shower room) their state as well as their maintenance	Good	33	0.57
	Bad	25	0.43
Have you ever had an outbreak of water related diseases like cholera/dysentery in the past twelve Months	Yes	4	0.07
	No	54	0.93

The interviews conducted in the focus group discussion provided an in depth understanding of the scenario in the two prisons. The results obtained were characterized through the ratings which were ranked 1 through 5. (b)The findings through observations and interviews also appreciated the role some other well-wishers like Sister Anna and Medicines Sans Frontiers have contributed towards sustenance of improved health in Prisons in relation to Sanitation.

However though other factors like mode of funding in health and sanitation sector still push the philosophy otherwise as observed in lack of sanitary facilities in the case of Chichiri prison solid waste management considerations.

**The research conducted a Focus Group Discussion (FGD) with inmates in areas outlined below.**

## **WATER QUALITY/QUANTITY ISSUES**

### **Experience water shortage in the recent time**

During the FGD, 10 inmates at Chichiri and Bvumbwe mentioned that they have not experienced much water shortage for the past twelve months. Some agreed that they experience water shortage but not as alarming rate.

*“Tivomereze kuti madzi amavuta nthawi zina monganso achitira makomomu koma nthawi zambiri timakhala nawo” – Bvumbwe and Chichiri inmate.*

### **Quantity of the water**

According to majority of the inmates both at Bvumbwe and Chichiri, there is high quantity of water. They mentioned that apart from taps, they draw water from the borehole and wells that is very good for their domestic use. There was a contradiction from Chichiri inmates who lamented that water from the well and boreholes are not enough because at some point are contaminated. They suggested that due to congestion, there is need for more water.

*“Whether we draw from the tap or borehole, we have safe water” – Bvumbwe inmate*

### **Testimony and experience of water shortages rendering prison is a living hell**

Both inmates from Bvumbwe and Chichiri pointed that water shortage in prisons could indeed be a living hell. They highlighted that prisons are often overcrowded as such shortage of water compromises their health. Female worried about their sanitation that requirement water availability.

*“You know, as women, we have a lot of health issues that need water for a better sanitation like sanitary pads” – Female inmates at Chichiri.*

### **Satisfied with the provision of water and its quality in terms of amount you use per person per day and taste**

The inmates are satisfied with the provision of water but requested for more provision due to congestion. In terms of amount, inmates from Bvumbwe are satisfied with the availability of taps and wells while those from Chichiri mentioned that taps, borehole and well provide additional water. Both inmates from Bvumbwe and Chichiri conquered that the need for more water supply arises especially during bathing and washing.

*“We share one shower for more than 180 people”* Chichiri inmates

As regards to quality, Chichiri inmates worried about contamination of water from boreholes and wells whilst those from Bvumbwe complimented that their water is of quality.

*“Sometimes, water from the boreholes and wells mix up resulting into contamination”* – Chichiri inmates.

### **However it is proclaimed that the prison is there to offer punitive conditions to punish the offenders how can you explain this in relation to water availability in the prison settlement?**

The inmates explained that while they understand that the prison is there to offer punitive conditions to punish the offender, shortage of water could toughen the conditions. They narrated that they translate the situation as a deliberate move to further punish offenders. In a situation where water is adequate supply, the inmates feel being cared. Such care translated into reformation.

### **Water incident related to water in terms of quality or quantity**

Most female felt bad especially during menstruation periods where there no water. Both male and female recalled that at some point they fight over water. They revealed that during festival period of December and New Year, the cells are congested than usual as such there experience scramble for water. Due to congestion, the quality of water is affected resulting into contamination of water from boreholes and wells.

## **HEALTH AND SANITATION ISSUES**

### **Toilets in residential cells**

The inmates from a cell at Chichiri bemoaned that they do not have a toilet. This was also echoed by those from both Bvumbwe and Chichiri who mentioned that they use buckets then pour into the toilet.

### **The status of toilets - cleanliness and level of maintenance**

Inmates from both prisons pointed that their toilets are clean though at some point it smells bad. Due to few and long queues on the toilets, cleanliness is sometimes not well practised. They explained that there has been rehabilitation taking place. They mentioned that they clean and maintain the toilets.

### **Last encountered an outbreak of water related disease like cholera/dysentery or typhoid fever**

Inmates from both prisons mentioned that they did not encounter any water borne diseases for the past twelve months. Some inmates mentioned that they were told that there was a time 20 prisoners had died of cholera at Chichiri prison. These are amongst the top five diseases. The causes are unhygienic and unsanitary conditions in which prisoners live. Apart from overcrowding and a shortage of water points to draw safe drinking water, several prisons regularly have their water supply cut off by the Water Board because the Prison has failed to pay the bill.

*“Overcrowding and water shortages makes susceptible of communicable diseases scabies, cholera, diarrhea” – Inmate Chichiri Prison*

## **SOCIAL ISSUES RELATED TO WATER ECONOMICS**

### **Any form of business related to water in the past twelve months**

The inmates in both prisons declined having seen any water business. Some from Chichiri mentioned that they saw water business especially outside the cells.

### **Relationship with your fellow inmates when tap water stops**

In both prisons, inmates' explained that there is always good relations. At some point, due to misunderstandings and scramble for water, a quarrel is experienced but does not last long.

**Ever been bullied /had an internal squabble with fellow inmates on issues related to water**

In both prisons inmates bemoaned inadequate water supply point like shower where 180 scramble for one shower which result into conflicts during bathing. They explained only the strong ones survives. They mentioned that inmates quarrel even fight over shower. At times when there is shortage of water, inmates quarrel and fight over buckets. They added that having a bucket of water in prison is not easy, even a plate.

*“There are times I stayed two weeks without bathing because the strong inmates bulled me out of the bathroom” – Inmates Bvumbwe and Chichiri.*

## **CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS**

### **5.1 Conclusion**

The study assessed social impacts of water shortages in relation to sanitation at Chichiri and Bvumbwe Prisons. The findings of the study showed that:-

- (a) The quality of water drawn from taps and boreholes at Bvumbwe Prison is suitable and adequate for domestic consumption. However, the same is not true of groundwater being used at Chichiri Prison, where water was noted to be contaminated with faecal matter, although water collected from taps water was observed to be safe for domestic use;
- (b) Water drawn from the borehole and the well at Chichiri showed that there was cross contamination between the two water sources, posing a health challenge to inmates. According to Malawi Prison Magazine, (2015) this observation is in agreement with sentiments made by Dr Kelita Kamoto's that 'Water, sanitation and housing, lack of water, lack of enough working toilets, congestion and insufficient nutrition'; indeed pose a great health challenge in prisons Living cells; this was evidenced by the presence of microbes in the water sample from cell buckets. Water was getting more polluted as it moves further away from the source into the
- (c) The research also managed to establish that the main contributing factors of water shortages included the overcrowding of inmates and lack of reliable emergency infrastructure like water storage tanks in the institutions. Frequent blackouts of electricity supply often disrupts the provision of steady water from the prison taps in both Chichiri and Bvumbwe prison.
- (d) Generally overcrowding dominates during public holiday periods like Christmas period and Easter Holidays due to exciting environments which catches most culprits on the wrong side of the country's law.
- (e) The research also managed to establish that the trend of water related diseases is decreasing though potential sources of pathogens exists in the water sources as was the case with Chichiri borehole.

- (f) The research also managed to establish some of the social impacts of water shortage in relation to how they affect the life of the inmates. The findings established that fights and quarrels were the most likely social consequences attributed to issues of water shortages in relation to sanitation and health. However information gathered revealed that both the two prisons were operating in harmony with no recorded issues. This was evidenced during the interviews where the probability of inmates having social problems related to water is close to zero.
- (g) The research also managed to look into the economic impact the water shortages has in relation to whether some inmates use the deficiency in the water supply as an added advantage to sell the water at a low price or otherwise. The research therefore established that water is easily accessible to all the inmates thus bringing harmony amongst themselves no hussles are related to water shortages. Thus inferred that water shortages in the two prisons do not have economic impact on the prison inmates as per findings.
- (h) The research also looked into the diseases that could be attributed to water shortages like diarrhea/scabies and cholera and their impacts. The research findings established that the water related disease were taking a reducing trend whilst both prisons registered few or no cases of water related disease outbreaks like cholera the previous 12 Months qualifying that there were no attributable impacts on the life of the inmates.

## **5.2 Recommendations**

The following recommendations were suggested to be incorporated to assist in improving the efficiency of good sanitation delivery to improve the social welfare of the inmates.

There are needs to further invest enough funds to consider rehabilitating the borehole at Chichiri Prison. This will help in improving water infrastructure for the prison population thereby easing competition for water in case of water shortages.

It was also established that at Chichiri prison there is a serious need to consider issues of water quantity by constructing an extra borehole due to the number of inmates such that if the water stops borehole water source should be able to suffice the requirements.

Issues of having a water tank would also assist in provision of enough quantity of water during frequent blackouts.

Regarding the issue of water quality, it would also be advisable to intensify use of chlorine in cells to safeguard the water quality by increasing the residual chlorine in the Jerri cans to kill all the harmful micro-organisms.

Issues of water quality should also be looked into holistically at Chichiri Prison regarding cross pollution between borehole and well in order to establish the actual cause and type of contamination taking place.

Issues of sanitation in the Top yard cell should also be dealt with as a matter of urgency before any induced disease outbreak may emanate from the current precarious situation.

There is need to isolate and decentralise in terms of funding issues related to water at Chichiri for there is a great need to increase the basic domestic requirement of amount of potable water before embarking on ventures that would compete for the same scarce water resource in time of blackouts which usually affects supply of tap water.

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APPENDICES

**Appendix 1: Questionnaire for Key informants**

1. General information

- a. Name of City/Project Area
- b. Name of township
- c. Village(s).....

2. Population to be served

a) Housecell population

- 1) List down the major economic activities in the area (include main trade items)
- 2) Are there activities that need a lot of water?
- 3) What is the present budgetary allocation for water and sanitation this financial year “2016/17”?

**Public Sanitation**

Present public sanitation facilities

- 1) What is the average distance to latrines in the area
- 2) Has the area experienced any disease outbreaks in the last one year?
- 3) If yes mention the types of outbreaks and dates when they occurred
- 4) What measures were put forward to control the diseases?

**Housecell sanitation**

- 1) What is the present latrine coverage in the area?
  
- 2) What is the present mode of solid waste disposal in the areas?
  
- 3) What are the most important sanitation problems in the area (indicate order of priority)?

**Appendix 2: Questionnaire Cell Informants**  
**CELL QUESTIONNAIRE**

Enumerator name:.....

Name of Housecell head.....

Housecell code No.....Date.....

**Household Location**

	Name	Code
City		
Township		
Village(LC 1)		

**HOUSEHOLD CHARACTERISTICS**

1. How many Inmates live in this house cell?.....

1 1 and 2

2 Between 2 and 5

3 Between 5 and 10

4. Above 10

2. How many Adults(15 years above).....

1 1 to 2

2 Between 2 and 5

3 Between 5 and 10

4 Above 10

3. How many children (below 15 years to 0).....

1 1 to 2

2 Between 2 and 5

3 Between 5 and 10

5 Above 10

4. What is the age of the head of the headcell?

.....

5. What is your relationship to the head of the headcell?

1 Household head

2 Spouse

3 Son

4 Daughter

5 Niece/Nephew

6 Relative

7 Others Specify.....

6. What is your marital status?

1 Married or living together

2 Divorced or separated

3 Widowed

4 Never married

7. What is your religion?

a. Protestant

b. Catholic

c. Moslem

d. Seventh Day Adventist

e. Savedee

f. Others Specify.....

8. What was your main occupation ?

a. Peasant

b. Trader/Business person

- c. Causal laborer
- d. Government Employee
- e. Private sector or CSO or NGO Employee
- f. Not employed
- g. Self employed
- h. Others Specify.....

9. What was your monthly income? ( MK)

- a. 0 - 5000 MK
- b. 5000 - 20000 MK
- c. 20000 - 50000 MK
- d. 50000 - 100000 MK
- e. 100000 - 500000 MK
- f. Above 500000 MK

10. Would you be willing to spend 5% of the total income on water monthly?

- a) Yes
- b) No

11. What were the three major sources of income for your household?

- 1 .....
- 2.....
- 3.....

12. What were the three major areas of expenditure for your household?

- 1.....
- 2.....
- 3.....

**SECTION 1: WATER SUPPLY**

13. Where do you collect your water?

- a) Borehole
- b) Protected spring
- c) Un-protected spring
- d) Well/dam
- e) Piped/ public tape
- f) Others specify.....

14. What are the different uses of water in your Cell?

- a) Domestic use only
- b) Business
- c) Brick making
- d) Brewing
- e) For animals
- f) Farming
- g) Others Specify.....

15. What containers do you use to collect water?

- 1 Jerrican
- 2 Bucket/ basin
- 3 Pots
- 4 Saucepan
- 5 Others specify.....

16. How much water do you collect per day?

- 1 20- 60 litres
- 2 60-100 litres
- 3 100 -160 litres
- 4 160 -200 litres
- 5 200 and above

17. Where do you collect your water for cooking and washing?

- a. Protected Spring

- b. Borehole
- c. Pond/Water hole
- d. Roof tank
- e. Tape stand
- f. Water Vendor
- g. Un-protected spring
- h. Stream/River
- i. Others Specify.....

18. Where do you collect your water for drinking?

- a. Protected Spring
- b. Borehole
- c. Pond/Water hole
- d. Roof tank
- e. Tape stand
- f. Water Vendor
- g. Un-protected spring
- h. Stream/River
- i. Others Specify.....

19. How far is the nearest water source from your Cell?

- 1 50 - 100 metres
- 2 100 - 250 metres
- 3 250 - 500 metres
- 4 500 - 1000 metres
- 5 More than 1 kilometre

20. How long does it take to draw water? ( state time in minutes)

- 1 1– 5 minutes
- 2 5 – 10 minutes
- 3 10 – 30 minutes
- 4 30 – 60 minutes

5 Above 60 minutes

21. Do you have water available through out the year? ( if yes skip to qtn 25)

1 Yes

2 No

22. If no in which season is water less available?

1 Rainy season

2 Dry season

3 Don't know

4 Others speccify..... ..

23. Which source is more reliable in terms of availability through out the year?

a) Protected Spring

b) Borehole

c) Pond/Water hole

d) Roof tank

e) Tape stand

f) Water Vendor

g) Un-protected spring

h) River / Stream

i) Others Specify Borehol

24. How far is the most reliable water source from your house cell?

a. 100 metres

b. 250 metres

c. 500 metres

d. 1000metres

e. More than a kilometre

25. When you go to collect water during dry season, what problems do you encounter?

a) Heckling and quarrelling at water source

b) Long queues

- c) Sharing water source with animals
- d) Harrasment from the opposite sex
- e) No first come first serve
- f) Others specify.....

**SECTION 2: QUALITY OF WATER**

26. Is the water from your main water source hard ( hard to form lather) or soft (easy to form lather)?

- 1 Hard does not form lather
- 2 Soft, forms lather easily
- 3 Sometimes soft and other times hard
- 4 Don''t know

27. Is the water from your water source treated?

- 1 Yes
- 2 No
- 3 Don't know

28. Do you treat the water you use for drinking?

- 1 Yes ( skip to question 30)
- 2 No

29. If no, why?

.....  
.....

30. How do you treat the water you use for drinking?

- 1 Boil the water
- 2 Filter the water
- 3 Use water guard tablets/other chemicals
- 4 Other specify.....

31. Are you satisfied with the quality of water you receive from your main source?

- 1 Yes, satisfied
- 2 Yes, somewhat satisfied
- 3 A bit satisfied
- 4 Not at all

32. If not satisfied at all, why not?

.....

.....

**SECTION 3: SANITATION**

33. What toilet facility does your cell use? ( observe)

- 1 Covered Pit latrin with slab
- 2 Covered Pit latrine no slab
- 3 Un covered Pit latrine
- 4 Flush toilet
- 5 VIP latrine
- 6 Others specify.....

34. If no toilet facility, where do you go (alternatives)

- 1 Neighbourhood
- 2 Bush or garden
- 3 Community latrine
- 4 Others specify.....

35. How far is your latrine from the house cell?

- 1 5 - 10 metres
- 2 10 - 20 metres
- 3 20 - 50 metres
- 2 Above 50 meters

36. Do all households in this community have latrines?

1 Yes

2 No

37. If no, where do they go?

1 Neighbourhood

2 Bush or garden

3 Community latrine

4 Don't know

5 Others specify....

38. Why? (possible reasons for not having latrines)

a. Cultural reasons,

b. Poor soil type,

c. Lack of land

d. No need

e. Others specify.....

39. Where do you dump your gabbage? ( observe and comment. Measure if it is a pit)

1 Rubbish pit

2 In the open

3 Burn it

3 Others specify.....

40. If there is a rubbish pit, how far is it from the house?

1 5 - 10 metres

2 10 - 20 metres

3 20 - 50 metres

4 Above 50 meters

41. How far is the nearest latrine from the water source?

1 0 - 50 metres

- 2 50 - 100 metres
- 3 100 - 250 metres
- 4 250 – 500 metres
- 5 Above 500 meters

#### **SECTION 4: DISEASES**

42. What are the common diseases in this area?

- a) Diarrhoea
- b) Dysentery
- c) Cholera
- d) Malaria
- e) Flaria,
- f) Kwashiorkor,
- g) HIV/AIDS
- h) Bilharziasis
- i) Typhoid
- j) Others specify.....

43. Which of these do you think is caused by poor sanitation? (Only those mentioned)

- a) Diarrhoea
- b) Dysentery
- c) Cholera
- d) Malaria
- e) Flaria
- f) Bilharziasis
- g) HIV/ AIDS
- h) Typhoid
- i) Others specify.....

44. What do you think can be done to minimise the occurrences of these diseases?

- a) Set a bye law for all households to have latrines.

- b) Keeping the water source clean
- c) Treating water that we drink
- d) Others specify.....

45. Do you have any comments / suggestions in relation to water systems ? (probe on best ways to be used on implementation and sustainability)

.....

.....

.....

.....

.....

.....

.....

### Appendix 3: Consent Letter

TO : The Officer in Charge, Blantyre Prison, 30117 Chichiri,  
Blantyre 3

From : .....

Date : 10<sup>th</sup> December, 2016

**Subject : REQUEST TO CONDUCT A RESEARCH STUDY**

I am Owen Gwerere-Kapudzama student pursuing Master of Science Degree in Sustainable Engineering Management-(Water Management) at The Malawi Polytechnic. In partial fulfilment of the course, I am requested to carry out a research study of my choice. My research title is “Assessing the Social Impacts of Water Shortages in Malawi Prisons in Relation to Sanitation. (A Case Study of Blantyre and Bvumbwe Prisons).”

The Information will be utilised ONLY for the research purpose and will not be discussed or shared unprofessionally in any way. I would therefore ask for permission to collect data for the study at your Institution during the period of Sampling.

I will be grateful if my request is considered.

Yours Sincerely,

Owen Gwerere-Kapudzama

**Appendix 4: Consent Letter**

TO : The Officer in Charge, Bvumbwe Prison, Thyolo.

From : .....

Date : 10<sup>th</sup> December, 2016

**Subject : REQUEST TO CONDUCT A RESEARCH STUDY**

I am Owen Gwerere-Kapudzama student pursuing Master of Science Degree in Sustainable Engineering Management-(Water Management) at The Malawi Polytechnic. In partial fulfilment of the course, I am requested to carry out a research study of my choice. My research title is “Assessing the Social Impacts of Water Shortages in Malawi Prisons in Relation to Sanitation. (A Case Study of Blantyre and Bvumbwe Prisons).”

The Information will be utilised ONLY for the research purpose and will not be discussed or shared unprofessionally in any way. I would therefore ask for permission to collect data for the study at your Institution during the period of Sampling.

I will be grateful if my request is considered.

Yours Sincerely,

Owen Gwerere-Kapudzama

## **APPENDIX 5: Interview Schedule**

### **Guidelines for key informant interviews with inmates/Staff/members of community/Visitors**

#### Water Supply

Types of water sources/different uses of water in the prison set up

Discuss quantity of water used per day/Instrument used to collect water/Distance from cell to water source and time taken to draw water from source was also taken into consideration.

#### Water Quality

Description on how water is treated in from the different water sources for human consumption

Discussions on how water from different sources related to domestic use of water such as washing/bathing

#### Sanitation

Discussions on types of latrines used whether are available or not in the cell

Enumeration of inmates using one source of latrine present in the cell

Issues related to distance of latrine and other social issues related to sanitary provision services.

Discuss most common types of ailments present in the prison inmates and those related to water and sanitation

Establish strategies to minimise the occurrence of water related diseases and sanitation diseases.

## **APPENDIX 7: Topic guide index for Focus Group Discussions (FGD) interviews**

### **Water quality/quantity issues**

- When did you experience water shortage in the recent time, you may consider the previous twelve months?
- Water is very important for our daily domestic use at every community level, at this institution how do you describe the quantity of the water that is provided on daily basis?
- It is understood that prison is a living hell how do you relate this to water shortages at this institutions for the previous twelve months according to your testimony and experience if any.
- Describe how satisfied are you with the provision of water and its quality in terms of amount you use per person per day and taste?
- However it is proclaimed that the prison is there to offer punitive conditions to punish the offenders how can you explain this in relation to water availability in the prison settlement?

Do you have any incident that you can explain related to water in terms of quantity or quantity that linger in your mind?

### **Health and sanitation issues**

How many toilets do you have in your residential cells?

How can you describe the status of your toilets in general, you may consider issues of their cleanliness and level of maintenance?

When did you last encountered an outbreak of water related disease like cholera/dysentery or typhoid fever?

### **Social issues related to water economics/**

Have you noticed anyone doing any form of business related to water in the past twelve months?

How can you describe your relationship with your fellow inmates when tap water stops?

Have you ever been bullied /had an internal squabble with fellow inmates on issues related to water?