

**THE PERCEPTIONS OF THE RESIDENTS OF POLOKWANE ON ALTERNATIVE FAECAL  
SLUDGE MANAGEMENT**

By

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## DECLARATION

I declare that THE PERCEPTIONS OF THE RESIDENTS OF POLOKWANE ON ALTERNATIVE FAECAL SLUDGE MANAGEMENT: A CASE OF POLOKWANE MUNICIPALITY is my own, unaided work and without any plagiarism. This research is submitted in partial fulfilment of the requirements for a Master of Public Administration degree in the Turfloop Graduate School of Leadership, University of Limpopo. All the sources that I have used or quoted have been indicated and acknowledged by means of complete references. The work has not been previously submitted to this or any other university for qualification purposes. I have tried to the best of my knowledge and ability to acknowledge the views and ideas of other writers.

.....

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**22/05/2017**

**Student's signature .....** **Date.....**

## DEDICATION

This dissertation is dedicated to Elijah, Emmanuel, Tshegofatso, Mpho and Blessing.

“To God be the Glory”

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I thank God Almighty for bestowing strength upon me and the wisdom of life; and I acknowledge that it was not by my power nor my strength but by His spirit that I was able to undertake this study to the best of my ability.

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## ABSTRACT

The World Health Organisation (WHO) and World Bank (WB) state that worldwide access to sanitation has improved with countries in the north having 100% access to sanitation. However, only 64% of the world's population has access to improved sanitation. Sub-Saharan Africa has a noticeable improvement with South Africa improving from 73% in 2010 to 74% in 2014. They further estimate that \$260 billion is lost globally each year due to lack of adequate water supply and sanitation. Universal access to water and sanitation would result in an estimated \$32 billion in economic benefits per year globally from reductions in health care costs and increased productivity from reduced illness. Sub-Saharan Africa loses an estimated 4.3% (\$US694 billion) of its Gross Domestic Product (GDP) each year due to lack of adequate water supply and sanitation. Furthermore, the UNDP (2015) indicates that sanitation is one of the Millennium Development Goals (MDG), however many regions are performing poorly in attaining their declared sanitation targets. South African has not reached its target but it is maintaining its commitment to the provision of sanitation as a basic human right. However, it has left the responsibility to local government to work out how this should be done with no legislation. Currently there is no policy on sanitation and municipalities only develop by-laws that serve as guidelines in managing waste and providing the service.

The available literature on this subject speaks very little about the knowledge and understanding that the communities have with regard to faecal sludge management and no study at all deals with the perceptions of people on this issue, particularly around Polokwane Municipality. It is for these reasons that the study was aimed at investigating the perceptions of Polokwane residents regarding alternative faecal sludge management.

Methodologically the study used qualitative research approach where in face-to-face interviews and focus group interviews were conducted around Polokwane Municipality. Among the participants interviewed were Ward Councillors, Community Development Workers, Ward Committees and Traditional Authorities. These stakeholders were intentionally chosen as they are at the coalface of service delivery on a daily basis and they are part of the forums that interact with the Municipality on basic services and other related community matters. Data for this study were analysed using thematic data analysis approach.

- The findings of this study suggest that the “concerned residents” under Polokwane Municipality see themselves being victims and vulnerable to controllable health threats. In addition, the study discovered that the majority of participants were aware of the delegated sewage maintenance duties on the Polokwane Municipality.

This study findings further indicated that there is a growing concern among municipal authorities and communities’ especially in Africa and South Africa in particular, to improve the inadequate faecal management.

The objectives of the study were among others to determine the perceptions and awareness of the Polokwane Local Municipality residents regarding alternative faecal sludge management methods. Indeed, it has been discovered that some of the residents are aware of various management methods but expect authority to develop policies and improve the inadequate methods that are currently used in managing faecal sludge.

The study among others discovered that this study should be used as a point of reference for municipal projects administration, i.e. for the development of Integrated Development Plan (IDP) on the water and sanitation and faecal sludge management in future.

The Ministry of environmental health and management at Polokwane Local Municipality should organise solid and integrated awareness with the community to ensure a healthy environment for all.

The study further realised that there is a need to equip most of residents in Polokwane Local Municipality with knowledge on how best man can improve environmental health, as well as how worse can a person destroy the environment. It should be an important task for the Polokwane Local Municipality to ensure that residents understand the faecal sludge management enterprise developments in the area to reduce the incompleteness of the perceptions among the residents. Various faecal sludge methods should be adopted and encouraged among the Polokwane Local Municipality residents in order to promote the preference for the sanitation methods.

**Key words:** Sanitation, Faecal sludge, Faeces, Health hazards and Sub-Saharan Africa

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## **CHAPTER 1**

### **INTRODUCTION AND BACKGROUND**

#### **1.1 Introduction**

This introductory chapter outlines the background of the research study. It further summarises the problem statement, aim and objectives of the study, the research questions and the limitations of the study. In this chapter the reader will also be introduced to the significance of the study, its justification, definitions of key terms and the summarised outline of the whole study. This chapter is very significant to the study because it gives the background and historical developments pertaining the faecal sludge management. It clarifies the aim and the objectives of this study and reflects to the reader that the study can add to policy changes and environmental awareness. Through the improvement of faecal sludge management, it has been discovered that lives can be saved and residents are ready to engage the Municipality towards sustainable methods of managing faecal sludge. South Africa and Polokwane in particular can prevent health risks and improve methods of managing faecal sludge by improving the level of awareness. Therefore, it is clear that this chapter is an integral part of this study.

#### **1.2 Background**

The possibility to sewer the world is rapidly fading away in the light of global population increase and difficulties in treating waste water exacerbated by an explosive increase in water shortage globally. In a water-scarce country like South Africa sanitation alternatives are needed which could minimize the demand for use of limited water resources towards sewerage systems (Schutte, 1997).

South Africa is highly reliant on sewer plants and pit latrines as the main methods for disposing faecal sludge. The country is water scarce and current predictions are that demand for water is outstripping water availability (Bhangwan J. 2011). Less than half of the surface and ground water that is available is practicably not exploitable due to its poor quality. The current sanitation management methods are not sustainable and progress towards improving the methods has lagged behind that of water provision. The country

intents to proliferate sewer plants and pit latrines for rural communities and eradicate open defecation (Pollard, 2000).

Literature suggests that alternative methods could be applied to manage the faecal sludge. This could be done by separating the waste stream particularly with the aim of reusing the waste. The separation of solid and liquid waste system through diversion of toilets offer an alternative to traditional pit latrine (Drangert, 1996).

According to Schutte (1997) erecting toilets for solid waste and urine separation can be useful for reusing nutrients that are found in urine particularly nitrogen and phosphorus which are essential components of living systems beneficial to human life. Alternatively, solid waste could be burnt wherein water will evaporate leaving the energy that could be used as a source of power. This method of separation may protect people that empty the latrines from pathogens found in traditional pit latrines. Considering these various options in disposing faecal sludge suggests that sanitation is not just a technical fix but an intriguing interplay of norms, perceptions and attitudes among all affected stakeholders including users.

In South Africa, the legacy of the apartheid-era government on natural resources particularly water and sanitation, required a massive and urgent re-orientation, not only at the political, institutional and policy level, but also at the level of individual communities. Hence sections 24 and 27 of the Bill of Rights in the Constitution of the Republic of South Africa grant specific rights of access to sufficient water, an environment not harmful to health and well-being of its citizens and the protection of the environment from degradation. The right to basic sanitation is not an explicit constitutional right. However, it is derived from the right to a clean environment read together with the right of access to clean water (De Vos, 1997). Weighting the two impotent rights, water and sanitation in a country with scarce water resources like South Africa, finding alternatives to save clean water and to dispose faecal sludge is important.

Bhangwan (2011) maintains that in South Africa there are around 2 to 3 million modern latrines. The government has recognized that maintaining its commitment to sanitation as a basic human right means continuing to keep existing toilets operational as well as providing

new ones. After the end of apartheid, South Africa's newly elected government inherited a huge services backlog with respect to access to water supply and sanitation. About 15 million people were without safe water supply and over 20 million without adequate sanitation services. The democratic government thus made a strong commitment to high service standard and to high level of investment subsidies to achieve those standards (Gabru, 2012).

A classic example is at Polokwane Local Municipality particularly within the Seshego cluster where sludge spillages are visible to members of the community as they are not cleared. Flow meters are rightly positioned but not always functional. There is generally a very poor sludge handling practice and facilities. The planned upgrades of infrastructure pose a high environmental pollution risk (Polokwane Local Municipality IDP, 2015). Mindful of the challenges above, there is a necessity for alternative methods and infrastructure that can provide sanitation facilities that are safe and reliable.

### **1.3 Problem statement**

The World Health Organisation (WHO) and World Bank (WB) state that worldwide access to sanitation has improved with countries in the north having 100% access to sanitation. However, only 64% of the world's population has access to improved sanitation. Sub-Saharan Africa has a noticeable improvement with South Africa improving from 73% in 2010 to 74% in 2014. Who and WB further estimate that \$260 billion is lost globally each year due to lack of adequate water supply and sanitation. Universal access to water and sanitation would result in an estimated \$32 billion in economic benefits per year globally from reductions in health care costs and increased productivity from reduced illness. Sub-Saharan Africa loses an estimated 4.3% (\$US694 billion) of its Gross Domestic Product (GDP) each year due to lack of adequate water supply and sanitation.

According to the United Nations International Children's Fund (UNICEF) and WHO only 6% of international aid in 2011 went towards investments in water and sanitation. This high economic burden is left to local governments in poor countries with minimal budget allocation (Boot, 2009).

Boots (2009) further maintains that based on the challenges above, lack of access and provision of basic services results in diseases such as diarrhoea and poor hygiene that kills an estimated 842,000 people every year globally, or approximately 2,300 people per day.

Furthermore, the United Nations Development Programme (UNDP) (2015) indicates that although sanitation is one of the Millennium Development Goals (MDG), many regions are performing poorly in attaining their declared sanitation targets. South African has not reached its target but it is maintaining its commitment to the provision of sanitation as a basic human right. South Africa however, left the responsibility to local government to work out how this should be done with no legislation. Currently there is no policy on sanitation and municipalities only develop by-laws that serve as guidelines in managing waste and providing the service.

In this regard, the Statistics South Africa, (STATSSA) 2011 Census revealed that in South Africa 12% of households receive free basic sanitation whereas 9, 7% of households have no water supply and 3, 9% have no access to sanitation facilities. The key issue with access to water is the poor quality of infrastructure with 24% using sub-standard toilet facilities and 14, 8% using water supply infrastructure that is below required standards. Access to clean water remains a bigger challenge as only 15,2% (2,3 million) households have access to water from communal taps and 54,7% households do not have access to water within their dwellings. Up to 10% of households in rural areas are without access to water. Expanding drinking water and sanitation coverage to achieve universal access would cost an estimated \$540 billion (STASSA, 2011).

There has been little innovation and limited research on the alternative faecal sludge management especially at Polokwane Local Municipality which is not immune to the challenges mentioned above. Polokwane Local Municipality is the largest Municipality in Limpopo Province with a total population of approximately 618 000 people. The re-determination of municipal boundaries that will take place after the 2016 Local Government Elections may increase the burden on the institution to provide water and sanitation. The enormous influx of people from rural and other urban areas migrating to the municipality will escalate the challenges and provision of water and sanitation.

According to 2011 Census, Polokwane Local Municipality has 178 000 households, 78 509 have access to flush toilets, 91 700 use pit toilets, 1 070 use bucket latrines and 5 070 are without toilets. The fact that most households within the Municipality do not have access to sanitation facilities constitutes a major risk in terms of groundwater pollution, environmental and health problems. Households within the Municipality with pit latrines experience overflowing pits and several hundred thousand tons of faecal matter from either open defecation or collected from on-site sanitation installations. The lack of proper management leads to the faecal either used in agriculture or discharged indiscriminately into lanes, drainage ditches and open urban spaces and into inland waters causing serious health impacts and water pollution.

The Integrated Development Plan (IDP) of Polokwane Local Municipality indicates that sanitation backlog may be as a result of a lack of adequate funding and low revenue base. Areas without proper sanitation and water provision give rise to water-borne diseases like cholera, diarrhoea, typhoid and many more. The 2011 Census indicates that the number of households in the municipality using pit latrines increased from 50.4% in 2001 to 57.7% in 2011, marking an increase of 7.3%. The provision of sanitation at Mankweng/Sebayeng cluster is at 12.42%, Moletji cluster 26.53%, Maja/Chuene/Molepo cluster 31, 4%. The total municipal backlog is at 59, 65% (STATSSA 2011).

#### **1.4 Motivation/rationale for the study**

There are considerable knowledge gaps about alternative faecal sludge management as a service and its effectiveness as a component or an integrated part of the city's sanitation service provision. Indeed, most studies have focused on either household latrine acquisition or on treatment or reuse options.

Existing data and knowledge about the market drivers and constraints on non-piped sanitation services, from the time the pit is emptied to when the contents of the pit are disposed of is extremely limited or non-existent. The importance of faecal sludge management is considered less important to most residents than the need for water supply and other services. Raising awareness of residents will be among some of the highlights of the study and improvement of public and environmental health.



The study seeks to ensure the inculcation of the measures to influence changes in the behaviour, favourable to better sludge management. Such behaviour changes might be that people will be sensitized and made aware of the vitality and long-lasting benefits of alternative faecal sludge management. Long-lasting effects with awareness raising are best obtained when promotion of activities is institutionalized, especially within the Municipality.

The other area of importance in the study is what is being done with the sludge after collection from the facilities. The usage of the sludge in areas of agriculture and finding out what actually happens with the sludge is a crucial point, because it is exactly where most of the environmental pollution and health risks are generated.

### **1.5 Significance of the study**

The study will contribute towards building the knowledge base in this area and, in particular, to narrow the information gap on management of faecal sludge. The findings will be widely disseminated in order to share what has been learnt with residents, investors, other donors, implementers and practitioners in the sector to help build sustainable service provision in sanitation stewardship.

The study will assist towards building local capacity of sanitation practitioners in the Polokwane Municipality and formulate policy recommendations to support sustainable alternative sludge management. It will further encourage the hosting of awareness campaigns, workshops with policymakers and other stakeholders, government agencies, treatment, disposal site operators and other institutions. The study therefore, will assist the Municipality to empower communities in increasing access to improved sanitation. The benefits of this study will improve the living conditions in and around faecal sludge management that has merely moved from the residents' toilets to their immediate environment.

### **1.6 Aim of the study**

The study is conducted in order to investigate the perceptions of Polokwane Local Municipal residents regarding the alternative methods to sewer plants and pit latrines methods that are currently used. The study will provide information, knowledge and findings that will add value

to the Municipality and the country. There is a growing concern among municipal authorities and communities especially in Africa and South Africa in particular about the inadequate faecal management.

## 1.7 Objectives

The study is intended to achieve these key objectives:

- To describe the current faecal sludge management methods in Polokwane Local Municipality.
- To determine the perceptions and awareness of the Polokwane Local Municipality residents regarding alternative faecal sludge management methods.

## 1.8 Research Questions

In this study the research questions assist to keep the researcher on track as they attempt to provide answers, alleviate the research problem and increase insight into the problem itself.

The two main research questions that will be asked are as follows:

- What are your perceptions on the current management of faecal sludge in Polokwane Local Municipality?
- What alternative methods can the Municipality use to manage faecal sludge?

## 1.9 Definitions of concepts

**Sanitation:** the science and practice of effecting healthful and hygienic conditions in drainage and disposal of sewage (Gabru, 2012).

**Faecal sludge:** mixture of solids and liquids, containing mostly excreta and water in combination with chemical compounds (Mariwah, 2011).

**Urine:** Liquid produced by the body to rid itself of urea and other waste products (Boots 2009).

**Human waste:** is a waste type usually used to refer to by-products of digestion such as urine and faeces (Mariwah, 2011).

**Faeces:** waste matter remaining after food has been digested and discharged from the bowels (Hutton and Haller, 2004).

**Excreta:** waste matter discharged from the body especially faeces and urine (Boots, 2009).

**Synthetic fertilizers:** they are not natural but designed to feed plants a certain amount of nutrients (Hutton and Haller, 2004).

**Health hazards:** situation resulting in from exposure to environmental pollutants (Hutton and Haller, 2004).

**Millennium Development Goals:** they are 8 international development goals that were established following a summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration (Drangert, 2011).

**Sub-Saharan Africa:** It is geographically an area of Africa that lies south of the Sahara desert (Boots, 2009).

### **1.10 Choice and rationale of research design**

This research study will employ the following research designs that will be discussed in detail in Chapter 3.

**Type:           Qualitative**

**Design:        Exploratory**

### **1.11 Study area**

Polokwane Local Municipality has a population size of approximately 618 000, with 178 000 households and 38 wards. It is situated in the central part of the Limpopo Province. The municipality shares the name with the biggest town in Limpopo called Polokwane. Locally it shares borders with three other local municipalities within Capricorn District as well as local municipalities in Mopani and Waterberg districts. It is the largest metropolitan complex in the north and a major economic centre in the Province. Its proximity to the neighbouring countries of Botswana, Zimbabwe, Mozambique and Swaziland makes it a perfect gateway to Africa. The settlement types indicate that it is more urban than rural.

### **1.12 Research Limitations**

The findings of the research may not be used as representative of the perceptions of the residents of Polokwane Local Municipality regarding alternative faecal sludge management

as the sample size that will be selected will be small and the transferability may not be justified.

#### **1.14 Research report outline**

This section provides a report outline listing all the chapters with a brief description of the contents of each chapter.

##### **Summary of each chapter**

The summary of each chapter will take the following format:

##### **Chapter 2: Literature review**

Chapter 2 forms the core of this research report as it outlines the views of various theorists, authors, residents, municipalities and government officials.

##### **Chapter 3: Research methods**

This is where the techniques and the methodology of the study are explained as well as how the research was conducted. This section reveals the nature of the population, the sampling methods, and how the data were collected.

##### **Chapter 4: Data presentation, Analysis and Interpretation**

The presentation and analysis of data is carried out in this section.

##### **Chapter 5 Conclusions and recommendations**

This is the final chapter of the study. It presents the findings of the study, it also contains the main recommendations made pertaining to the critical issues and the conclusions drawn from the study. Critical issues that warrant further research will also be identified.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The previous chapter introduced the study and discussed the background of the subject matter under discussion. The previous chapter also justified the need for and importance of conducting a study of this nature. This chapter provides an in-depth analysis of literature review pertaining to the topic, in particular the perceptions of the residents of Polokwane Local Municipality regarding the alternative faecal sludge management. Thus, it introduces the framework for the research study that comprises of various aspects on the management of faecal sludge that is described in this research study. This chapter is very necessary for this study as it provides the available literature and the literature gaps with regard to the issues under investigation. Therefore the study would not be complete without this chapter.

#### **2.2 Understanding Literature review as a concept**

Literature review can be defined as a critical evaluation of the previous scholarly writings that are relevant to the research topic (Bless, 2006). On the other hand, Mouton (2001) asserts that it is indeed paramount that every research project begins with a review of existing literature in its particular field of study. A good literature review makes the researcher aware of what has been written to avoid duplication of a study and unnecessary repetition. The review helps the researcher to consolidate the theoretical foundation of the study. It is through a literature review that the researcher discovers whether the study has significance or whether it will lead to new knowledge.

According to Babbie (1998) one of the most crucial elements of a good literature review is that it assesses whether there has been consistent findings on the proposed research or whether past studies disagree with each other. A literature review also assists in finding out whether there are flaws in the body of existing knowledge that one may remedy. In this regard, literature review is necessary in that it deepens the researcher's theoretical framework. It familiarizes and assists the researcher to identify gaps in knowledge and weaknesses in previous studies in order to develop necessary suggestions for improvements. Conducting literature review assists the researcher to discover connections, contradictions and even relations between research results making comparisons between different investigations (Bless, 2006).

Although literature review is essential in acquiring background knowledge before commencing with a study, it is not the only means. There are unpublished personal

experiences, discussions with people involved in a similar issue, direct observation or participation may give a researcher the necessary background about a particular subject of study (Bless, 2006: 33). In the ensuing section, literature review on perceptions of the residents of Polokwane Local Municipality in alternative faecal sludge management is described in the context of the proceeding discussions to aid the understanding of the topic.

### **2.3 Provision of sanitation on a global scale**

According to the World Health Organisation (WHO) (2006), global lack of access to safe sanitation has a profound effect and the consequences to almost 2.6 billion people in the world using unsafe toilets or practicing open defecation. Diseases transmitted through human waste contaminated water include diarrhoea, cholera, dysentery, typhoid and hepatitis causing 115 deaths every hour in Africa alone. Roughly 2 million people that die every year from diarrheal diseases, most of them are children under the age of five. Progress on improving sanitation has been woefully inadequate and the world is far from reaching the Millennium Development Goal (MDG) target for sanitation. Among the reasons for this poor performance in sanitation service provision are an ongoing failure to prioritize the sector and inadequate financing thereof. In a recent report published by the WHO the capital costs of achieving the MDG target for sanitation are estimated at \$23 billion a year from 2010 to 2015, or a total of approximately \$115 billion (Hutton, 2004: 56).

Going beyond MDG goals, achieving universal sanitation coverage would require incremental capital costs of \$217 billion over the five-year period. The provision of urban sanitation dominates funding requirements, making up almost 60% of the need. The economic benefits of addressing this issue are, however, equally significant are estimated at \$54 billion a year globally. Every US\$1 invested in water and sanitation, would yield an economic return of between US\$3 and US\$34 depending on the region (Hutton G. 2004). In this regard, the ground-breaking studies by the World Bank's Economics (WBE) of sanitation initiative, found that the economic costs of poor sanitation and hygiene amount to billions of dollars a year.

The current methods of faecal sludge management entail collection, haulage, discharge and the usage is extremely diverse among different cities even of the same country. Presently, municipal councils and some of the major contractors are sensing that the future may hold in store more of ecological approaches and therefore they are planning to invest in alternatives to faecal sludge that may generate revenue. All these developments show clearly that

assumed norms and attitudes of urine and faeces may change rather quickly if viable alternatives appear.

In line with the above stipulations Bless (2006) states that a person excretes less than 500 litres of urine and 50 to 180 kg (wet weight) of faeces in a year depending on water and food intake, while a dairy cow produces between 30 to 40 litres of urine per day and several kilograms of dung per day. Polprasert (1995) further points out that human faeces contain a large proportion of water (70 to 85%), and the rest is mainly organic material including micro-organisms. One gram of faeces may contain, for example, about 100 million bacteria some of which are pathogenic. Urine contains mostly water, 93 to 96%, and dry solids of some 50 to 70 g per person per day. The urea derived from ammonium and carbon dioxide ( $\text{NH}_3$  and  $\text{CO}_2$ ) easily dissolves in water and becomes accessible to plants. Unfortunately, bacteria present in the faeces (*Micrococcus urea*) can, through an enzyme, decompose the urea into ammonia gas, which dissipates into the atmosphere.

However, the smell of ammonium can be reduced by keeping faeces and urine apart. It has been shown that the nutrient content of human waste collected in a year is approximately equal to what has been eaten during the year. If a person eats some 250 kg of cereals, her excreta contains the amount of various nutrients required for the corresponding cereal or bio-mass production. The figures for phosphorus and potassium in urine are higher than in other studies reported by Cross (1985). The nitrogen content in urine but not faeces seems to vary with the intake of protein (Jacks, 1997). If this can be put to good use it can generate revenue base for most struggling municipalities that merely dispose the excreta as waste without looking at alternative ways of benefiting rather than putting them to waste.

In this regard, South Africa following the advent of democracy in 1994 and the push to deliver services to all, there has been rapid building of ventilated latrines. This has particularly been true over the last ten years and now the number of those latrines nationwide stands at approximately 3 million. While this is certainly laudable, the need to empty them or use the sludge to the benefit of the municipalities and communities whose responsibility is to manage them has not been given full consideration. It is only now that municipalities across the country are waking up to the fact that latrines eventually do fill up and that something needs to be done, particularly in urban areas where relocation is generally not an option. This is an issue as there are undeniably large risks in handling their

contents as pathogens remain active for long periods and recent studies have even shown that they can go airborne. Thus, there are significant health and safety challenges to be overcome both in South Africa and elsewhere.

Based on a study conducted in Kampala, although farmers were not using faecal sludge, 8% of farmers were using wastewater sludge as a soil amendment. Those using compost from animal manure were at 28% and 23% used composted household waste as soil conditioners, and are obtained at the very low price of 0–8 USD/tonne. Among farmers interviewed in Kampala, 58% stated they would use faecal sludge if available, 12% were undecided, and 26% said they were unwilling. Nineteen percent of farmers are already using synthetic fertilisers and 19% have also used urine separately as a fertiliser. In Kampala sewage sludge from drying beds sells for USD 10/tonne. If all of the faecal sludge that is discharged at Bugolobi was sold for this price, it would generate a gross value of USD 81,120/year (Mariwah, Drangert 2011, 45).

In Accra Ghana, 30% of the farmers interviewed used organic soil amendments. Poultry manure was the preferred soil amendment used by 12% of the farmers because it is high in nitrogen, followed by cow dung at 9.8%, and cow dung mixed with poultry manure at 3.6%. None of the farmers were willing to use faecal sludge, but then upon further questioning, 15% said they had actually already used faecal sludge on crops at some point. Reasons given by 46% of the farmers for not using faecal sludge were its market scarcity, others at 27% indicated that it was not a traditional practice, while others at 6% mentioned concerns over odour emissions and those that associated it with health risks were at 1% (Mariwah and Drangert, 2011, 54).

Mariwah and Drangert (2011) indicated that the risks and perceptions of factors in the future can be mitigated by more studies demonstrating the risks associated with alternative methods of land application. For example, in Tamale, Ghana the risk of using raw faecal sludge in agriculture was found to be quite low due to the timing of application and the hot, arid climate. According to Cofie and Jackson (2013) this could also be the case in the hot arid climate of Dakar, but in contrast, Kampala has a more tropical climate with greater rainfall. Presently, most of the farmers interviewed in Accra collect organic wastes for free, except for poultry manure and cow dung, which are sold in 25-kg bags for USD 0.75 or USD 30/tonne. As faecal sludge is not currently being sold in Accra, the range of prices observed



in Dakar and Kampala were used as proxies. If all of the faecal sludge that is discharged at Lavender Hill were sold as soil conditioner, it would generate gross value in the range of USD 53,664 and USD 134,160/year.

As a result, it can be argued that the market potential for faecal sludge differs strongly from city to city, depending on factors such as characteristics, existing markets, regional industrial sectors, subsidies, and locally available materials. In addition, the revenue that could be generated also varied significantly. This illustrates the importance of considering market demand together with potential revenue, capital and operating costs when evaluating solutions. For example, the use of sludge as a soil amendment has traditionally been the most commonly implemented method, but the analyses shows that the market demand is higher for other end products which also potentially have a greater revenue as the alternative usage of faecal sludge has not been adequately tested (Mariwah, Drangert, 2011, 86).

Currently and as cited earlier faecal sludge products are not well utilized. They are mostly landfilled, discharged to the environment, or given away or sold for very little. The values are based on the existing situation, but the faecal sludge market is under leveraged. If valuable faecal sludge-derived products were to be generated, the volumes of raw sludge that are properly collected and managed in cities would most likely greatly increase as a result of the financial market incentive. For example, in Dakar this would increase the values (Bill and Melinda Gates Foundation, 2011). Reducing or eliminating dumping of human waste would give way to healthy and sanitary environments.

According to Heinss (1998) another benefit of using faecal sludge treatment products, is to ensure that technologies are designed appropriately for the intended end use, by not over- or under-designing treatment plants, to ensure that they are mostly cost efficient. The market demand for end products can also help to ensure that the treatments plants are operated properly as operators are trying to fulfil customer satisfaction. The gap in sanitation services could be fulfilled with profitable business based approaches to faecal sludge management. Resource recovery from faecal sludge treatment products could provide a key financial incentive. This is in contrast to the current status quo where sanitation services in low-income countries are not profitable, and hence, typically not fulfilled. This represents a shift in thinking to considering treatment products as a source of revenue generation from

resource recovery, versus a disposal problem. The current state of knowledge for implementing resource recovery end uses of faecal sludge and research needs include evidence suggests that resource recovery from faecal sludge could provide a financial incentive for sanitation service provision.

Moreover, alternative and possible usage of faecal sludge includes combustion as fuel, protein production, bio-gas production, use in building materials, and use as a soil conditioner. However, prior to the implementation at a city-wide scale, investments in research at the full-scale are necessary to prove the robustness of technologies to determine capital and operations costs. Faecal sludge usage as a soil conditioner was historically the most common form of resource recovery. Though there is not one universal sanitation solution, it is imperative to consider the local market when selecting and designing treatment and end use, as markets vary significantly among locations. These results combined with further technical studies will help policy and decision makers in evaluating potential options for managing the sanitation service chain.

Heinss (1998) states that only a few projects on sustainable and decentralised management of faecal sludge have become established to date; examples cited from Kumasi, Ghana and Bamako, Mali, yet several promising and laudable initiatives have emerged very recently (examples cited from Nam Dinh, Vietnam and Vientiane). There appears to be growing concern among municipal authorities in Asia and mostly in Africa on the situation in excreta management. In several places, the need to act has emerged and initiatives have been started to improve the situation. Hence, the need for guidance and training of the various stakeholders in sustainable and alternative sludge management is rapidly increasing.

Based on the above citations, it is arguable that the phosphorus in urine should be considered a valuable resource rather than an inconvenient waste stream and alternative ways should be found to collect and use it productively. Most African countries are far from the sea and making fertilisers is more expensive. Yet there is significant phosphorus content in urine, and some argue that this should be viewed as a valuable resource. Whilst the amount of phosphorus that can be reclaimed from human waste is small in relation to the amounts currently mined for fertiliser use (around a tenth of use in Africa), as mining reserves diminish, this will increase in importance. It is also a local resource for African countries that does not require transporting to long distances. For subsistence farmers and

others this represents good potential, particularly given the low usage of phosphorus rich fertilisers. There is twice as much phosphorus in urine as in faeces. As urine is sterile there are few risks to reusing urine in food crops. This is not the case for faecal matter (Heinss et.al, 1998, 35). This is an argument in favour of urine-diverting toilets, which allow the urine to be captured uncontaminated and potentially reused. It can further be argued that Africa has largely missed out on the 'green revolution', which was brought about by the large-scale transformation of phosphorus and nitrogen into artificial fertilisers. In Sub-Saharan Africa the use of phosphorus is still minimal (4% of East Asian levels). This is a travesty as Africa's red soils (iron oxide rich) sequester phosphorus, making the addition of fertiliser even more important.

Notably the cultural attitudes and general perceptions surrounding the reuse of faecal sludge are important and it should be noted that China has reused excreta for thousands of years. Reuse of urine is therefore to be handled with due caution and 'marketed' appropriately and sensitively (Tanner, 1995, 78).

Cross (1985) believes that, attitudes and perceptions about health hazards and revulsion to faeces and urine vary between cultures and often people's ideas about urine differ from those about faeces. Tanner (1995) writes that every social group has a social policy for excreting; some codes of conduct which will vary with age, marital status, gender, education, class, religion, locality, employment and physical capacity. The human dimension was found by Cross (1985) to be a severely neglected concern in environmental health and yet one that is of central importance to a full understanding of the potential reuse of nutrients in human waste. For example, a process of social conditioning is involved in the identification of those smells which may be categorised as offensive in particular cultures.

Loudon (1977) noted that, it is a matter of common observation that among individuals accustomed to the smells of putrefaction, such as those involved in specialized occupations, conditioning modifies or suppresses a response which may well have a biochemical basis, even though reinforced by socio-psychological factors. A reason for this may be the fact that urine is indistinguishable from water on the ground, and stepping into it is quite different from stepping into human faeces. So it is unclear to what extent this relaxed view on urine would make people prepared to use it for their own benefit. All these developments show clearly

that assumed norms and attitudes of urine and faeces may be altered when viable alternatives are introduced.

#### **2.4 South Africa's wastewater treatment system**

South Africa manages approximately 850 municipal wastewater treatment plants, yet according to research by the South African Department of Water Affairs, less than 50% of the 449 wastewater treatment systems which have been assessed meet the regulatory national and international water quality standards for wastewater treatment. These findings are proof that South Africa's wastewater treatment systems are inadequate to meet the effluent required standards.

This has resulted in the urgent need for the development and implementation of innovative systems to resolve the wastewater treatment given the slow pace of improving access to sanitation, experimenting with new and creative approaches should be widely sought (Cross, 1985, 47).

It is for this reason that interest has been sparked into the investigation of alternative wastewater treatment technologies for the treatment of wastewater. Constructed wetland systems are a good example of such alternative technologies which have the potential to meet the required influent treatment standards as compared to conventional methods. They are an old technology dating from wetland technology which is dated back in 1952 (Siedel, 1973) and has been in full scale operation from 1974 (Kickuth, 1977: 38).

Based on the challenges cited above, Strauss (2000) argues that wastewater treatment will always pose problems if there are no new alternative technologies in place to replace the currently available methods. More recently, it has been estimated that developing countries will run out of water by 2050. This is a cause for concern not only to the communities but also a challenge to the scientists to find new ways of wastewater recycling. Water losses can be avoided through implementation of easy and inexpensive technologies for wastewater treatment.

The recent years have witnessed the launch of several initiatives to alleviate the problem of inadequate water supply and sanitation services, by investing in the transfer of appropriate technologies. However, despite the financial resources and institutional commitment involved, most programmes have failed to deliver the expected benefits. Typically,

unsuccessful interventions have been characterized by top-down approaches to service delivery with little consideration of recipients' demands or their participation in the planning, construction and implementation process (Breslin, 2004: 27).

As a middle-income developing country, South Africa suffers unequal income distribution, with 34% of its population living below the poverty line (UN, 2005). This discrepancy is primarily reflected in the provision of basic services, such as water and sanitation, which are inadequate in informal settlements, characterized by high density of inhabitants, a largely transient population and poor health conditions.

## **2.5 Waste Water Treatment Plants in Polokwane Local Municipality**

The Polokwane Local Municipality is managing three waste water treatment plants located in the city of Polokwane Local Municipality, Seshego and Mankweng. Polokwane Local Municipality waste water treatment plant is the biggest with 28Ml/day capacity and with the current load standing at 24.6Ml/day. There are plans however with limited budget to construct the Regional Waste Water Treatment Plant that will carry all Polokwane Local Municipality Municipal sewage load and cater for new developments. Wastewater treatment samples were taken with the aim of meeting the required effluent standard by the Department of water and sanitation (DWAS). Even though the municipality did not achieve a green drop standard in 2011, there is progressive improvement of the wastewater treatment system.

## **2.6 The provision of sanitation and water in Polokwane Local Municipality**

The Government of South Africa has a mandate to upgrade informal settlements by 2015, by either in-situ upgrading or relocation to Greenfield sites (Department of Human Settlements 2009). In-situ upgrading is provided incrementally by the provision of interim services, including communal water and sanitation services, storm water control, roads and footpaths, electricity and refuse removal.

However, local authorities have had difficulty in providing sustained sanitation services that are effective, dignified and affordable, from both a capital and an operation and maintenance perspective. The selection of appropriate sanitation services to informal settlements is guided by three significant factors. These include, a high backlog of basic infrastructure, including water, sanitation, electricity and roads; worsened by rapid urbanization and population growth; along with physical constraints, namely, high population densities, lack of available space and available land, and poor environmental conditions.

In accordance with Polokwane Local Municipality's Integrated Development Plan (IDP) it is evident that the percentage of households with piped water inside the houses have increased from 19% in 2001 to 40% in 2014. In general, the accessibility to water from a point outside the yard has also increased from 30% in 2001 to 52% in 2014. To date, there are new villages in the Municipality without water and 26 villages are still below the RDP standard. The decrease on the dependence on water vendors as a water source from 3.8% to 0.2% is a significant improvement in the quality of life of the community. This can also be attributed to increased access to piped water by communities that had no access at all. Harvesting of rainwater as a source has decreased by 0.1%. This can be attributed to the increase in access to piped water. While this indicates an improvement in service provision, it is still important for the Municipality to encourage communities to harvest rainwater for household usage. This will be important taking into account that Polokwane Local Municipality is water scarce and therefore it will be beneficial not to let any water go to waste. In providing water, priority should be given in terms of the suggested spatial development plan principles that focus on service and infrastructure provisions. These should be given to growth and population concentration points to ensure sustainable human settlements. There is still a considerable backlog that must be addressed especially in the Maja, Chuene, Molepo clusters, followed by Moletji and Mankweng clusters. (STATSA, 2011: 34).

The elimination of backlog is challenged by limited and /or unsustainable sources of water found in the rural areas and continuous increase of new settlements in some clusters in the municipal area. Funding limitations also affect the eradication of backlog on the expected rate. Other challenges faced by the Municipality to provide water services include, lack of sustainable water sources for future supply of the municipal area due to lack of cost recovery in some areas, ageing water infrastructure in the central business district and limited operation and maintenance of infrastructure.

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to waterborne diseases like cholera, diarrhea, and typhoid. It is therefore important that the Municipality prioritize the service, particularly taking into account the backlog (rural sanitation). According to STATSA (2011) the Municipality has not made significant inroads as far as the provision of sanitary services in rural areas. The number of households using pit latrines increased from 50.4% in 2001 to 58.7% in 2011, marking an increase of 8.3%. The provision of flush toilets, connected to a sewerage system increased slightly from 32.6% in 2001 to 38.8% in 2011.

There is a need to develop a comprehensive sanitation plan in order to meet the national target. By 2015 each household must have attained the sanitation facility which is according to the government required standards. The standards to be met are either waterborne or pit latrines. The waterborne is implemented in the city, Seshego and Mankweng where there is full water supply. The municipality utilises ventilated pit latrines (VIP) a wet and dry technology in rural areas. The dry technology was adopted after the realisation that it is easier and cost effective to maintain. For the past three financial years the municipality only availed approximately 2600 VIP's for each financial year. Based on the limited budget the municipality will only eradicate the backlog by 2031 (STATSA, 2011: 36).

## **2.7 Challenges in sewer management**

Sewer network also depends upon highly professional, well-resourced utilities to operate and maintain them. The rapid pace of urban growth, the share of the urban population with sewer connections in least developed countries fell from an estimated 12 per cent in 1990 to 11 per cent in 2010. Among those urban residents that have access to improved sanitation facilities in Asia and Africa, the large majority use on-site solutions such as pit latrines and pour-flush toilets connected to septic tanks. From an urban planning perspective, the fact that responsibility for financing and maintaining such facilities typically falls to households carries both advantages and disadvantages. Mobilizing private resources for household sanitation eliminates and delays the need for municipal governments to make major investments in sewer infrastructure. However, since a large proportion of residents of urban slums are renters, they rely on landlords who may have limited incentives to invest in sanitation.

In many urban areas, density and poverty levels are such that shared or communal facilities are viewed as the only viable sanitation alternative. However, there is an enduring debate about whether shared facilities can be reliably hygienic and accessible enough especially to deliver the intended public health and well-being objectives. The conditions in many urban areas hamper the success of both private and shared on-site facilities. Low sewer penetration and poor drainage in many cities mean that shared and private facilities alike often face clogging and flooding issues, and rely on pit and septic tank emptying services for managing an estimated 876 million tonnes of faecal sludge each year. In many instances, emptying must be performed manually, resulting in substantial faecal exposure for both service operators and the general public. There remains a pressing need for service alternatives that are better adapted to the challenges of dense, low-income urban areas.

## **2.8 Local Government's allocation of powers and functions to provide sanitation**

The delivery of water services, the potable water supply and domestic waste-water and sewage disposal systems falls within the competence and jurisdiction of the local government. This is confirmed in the statutory framework, which allocates the responsibility for ensuring access to water services authorities that are municipalities. Where there is a backlog in the delivery of water services, and where municipalities are unable to meet their constitutional and statutory obligations, the local government is also most likely to be held legally accountable. However, national and provincial governments should also take responsibility for the failure to perform local government functions or performing them inadequately.

Many of the problems with water services are attributed to the failure of the local government to properly maintain and operate sewage treatment infrastructure; it is fully acknowledged that infrastructure is strained and aging water services provision capacity is limited. There have also been recent media reports on municipal sewage works operating without the necessary permits. Other reports have documented the country's failure to maintain bulk water infrastructure, which poses a serious threat to the country's future access to water.

It has been argued that targets for delivering new infrastructure have been prioritized over systems to operate and sustain existing systems. With a growing scarcity in management, engineering and technical skills, municipalities are struggling to obtain adequate finances. There are serious concerns about the ability of municipalities to fulfil their obligations to deliver water services.

In South Africa, these challenges are greatly heightened by the rapid rate of urbanization driven by low-income migrants from rural and neighbouring countries resulting in the rapid expansion of informal urban settlements. The country is facing a low-income housing crisis, with the current unmet needs estimated at more than 3 million units. The housing policy mostly promotes state-funded home ownership for the poor. Low-cost housing units are usually allocated to residents of makeshift dwellings in the many informal settlements surrounding cities and towns.

Unfortunately, ownership of a new formal house has not been accompanied by any increase in recipient income in these resettlement programs. The owners of low-cost houses exploit one of the few resources they have including space by allowing others to build informal structures called "shacks" by the inhabitants in their backyards, creating rental income. This practice has greatly increased population density in low-cost housing communities, placing



infrastructure under significant strain. In addition, the practice has interrelated effects on water quality, human waste disposal, and health status, especially disease transmission through the faecal oral route.

## **2.9 Alternative methodologies to manage faecal sludge**

South African Biotech has searched internationally to find effective, well supported and researched sanitation products and solutions to answer the local market needs. This includes a secondary benefit to the South African water shortage problem and introduced the hybrid toilet system. The toilet has been approved for world heritage site usage across Australia, within a stringent regulatory framework that governs the design and operation. While this hybrid sanitation technology is a water based system, it does not require a water connection, as with most waterborne systems in use today. This creates a phenomenal saving in water usage, as the initial water is required only to half fill the primary tank in order to activate the system. Thereafter no additional water is required. The self-contained system is an anaerobic mini sewer age system, using the anaerobic water as opposed to oxygen or aerobic based process to treat the waste. After about four to six years the sludge may need to be pumped out. A system of gravitational displacement is used, whereby incoming waste displaces the equal amount through and out the anaerobic system (Bahri, 2009: 67).

The system can be installed within a day, and is normally about 1.5 m<sup>2</sup> in total size, for a ten-adult population capacity. The process taken comprises of a primary sludge tank where the waste enters. During normal usage, faeces and urine enter into this tank where they undergo the initial treatment. Gravity pulls the faeces to the bottom of the tank where anaerobic bacteria begins to digest it. The liquid substances flow to a secondary filtration tank or clarifier, allowing for various filtration processes of the liquid waste. The clarifier consists of several tanks nested together and filled with bio-media. Due to the system design, the incoming waste will spend up to 90 days in this primary tank anaerobic activity usually requires a minimum of a 35-day holding period. The total time taken for the liquid waste to travel through the clarifier can be up to 40 days, which gives a total detention time for the waste of an average of 130 days. The final elimination of the water is from the clarifier, and routed into the ground through a drain or to a holding tank. The quality of the effluent that reaches the outside world is excellent, and can even be used for irrigation and farming requirements (Bahri, 2009: 69).

The South African Biotech reported that the difference between raw sewerage removal (the 'out of sight, out of mind' concept), versus a true reduction, digestion and elimination of dangerous pathogens which quickly multiply in untreated waste, that require proper

management back into the environment. Of all the stand-alone sanitation systems available in South Africa, this is the only system that actually treats the waste, as opposed to only transporting it. A hybrid vault system has successfully been implemented at the Setswetla community in Alexandra and has now been operating for the past few years. Complete hybrid systems have also been installed for the Department of Education Works at numerous farm schools throughout the Free State (Bahri, 2009: 57).

Reuse of treated wastewater and faecal sludge is widely promoted in the sanitation literature because of the potential to conserve water, decrease reliance on non-renewable energy, offset commercially produced fertilisers, and protect surface water Bahri (2009). The use of wastewater effluent for irrigation is the most ubiquitous form of reuse, but where there is no demand for irrigation water; numerous other forms of reuse exist.

According to Bahri (2009) sewage sludge, a by-product of mechanical wastewater treatment processes, and faecal sludge can be environmentally and economically beneficial to be used as alternative fuels, fertilisers, or inputs into manufacturing processes, such as cement. Given increasing water shortage in cities around the world, the urgent need for renewable energy sources, and global depletion of accessible supplies of phosphorus, it seems rational to harness embodied resources in wastewater and sludge to the extent possible.

Where citizens do not have even the most basic access to improved sanitation, environmental protection is seldom a top priority; and consequently, reuse, outside of unplanned reuse of raw sewerage, is seldom part of a sanitation scheme. It can be contended that, in resource-constrained circumstances, where the operational sustainability of sanitation schemes is most precarious, planned reuse may be the incentive that keeps a system functioning and financially viable as a result of harnessing back-end user demand.

Bahri (2009) states that Tunisia represents another alternative and exemplary case of safe and strategic wastewater reuse. Thirty to 43 percent of the country's treated wastewater is used for agricultural and landscape irrigation, an option that is always considered at the planning stage of a treatment plant. Reuse is motivated by interests in protecting coastal waters and mitigating water scarcity.

By 2020, plans in Tunisia include irrigating twenty to thirty thousand hectares with reclaimed wastewater (Bahri 2009). Kolkata's decades-old wastewater-fed aquaculture system is the largest in the world. The system was built in the 1930s and consists of a series of waste stabilization ponds that feed into fish ponds, which span nearly four thousand hectares. The

combination of treatment pond with aquaculture is credited with simultaneously providing a low-cost means of wastewater treatment, 10 to 20 percent of the fish consumed in Kolkata, and employment for more than twenty-five thousand local residents (WHO, 2006, 76).

In Durban, South Africa, water scarcity, rapid industrial development and degraded surface water quality have given rise to industrial reuse of municipal wastewater from the Southern Wastewater Treatment Works. The reclamation facility comprises of tertiary treatment and has a capacity of forty-seven thousand cubic meters per day, equivalent to 7 percent of the city's potable/ industrial water demand. The effluent is used primarily by Mondi Paper as well as oil refineries (Gisclon, McCarley, and McNally 2002; U.S. Environmental Protection Agency 2004: 123).

Whenever possible, the cost of existing and improved faecal sludge management should be viewed not only from a purely financial viewpoint, what are the comparative costs of faecal treatment alternatives but also from an economic viewpoint. Hence, it will be necessary to assess cost and revenue streams over time, to consider direct and social cost incurred by not improving faecal sludge management. This, in turn, calls for including all components of faecal sludge management, including collection, haulage, treatment, use and disposal, as well as other areas upon which faecal sludge management may impact, such as sanitation planning and infrastructure (Gisclon, McCarley, and McNally 2002; U.S. Environmental Protection Agency 2004: 126).

## **2.10 Alternative methods to manage faecal sludge in agriculture**

In South Africa, where beneficial agricultural use of sludge accounts for only 28% of the total sludge produced from South African wastewater treatment plants, the Water Research Commission initially pegged sludge application on land at not more than 8 Mg per hectare per year. This is despite the enormous pressure on South African wastewater treatment plants to dispose off or utilise their sludge in an environmentally sustainable way. This limit has recently been increased to 10 mg per hectare per year (Snyman and Herselman, 2006). Nevertheless, the problem of sludge disposal still persists.

Generally, sludge of acceptable quality for agricultural use is applied according to crop nitrogen requirements (Milne and Graveland, 1972), but some studies have shown that this approach may lead to a build-up of phosphorus in the soil profile. While these sludge application limits may be appropriate for most agronomic crops, they can be exceeded for perennial dry-land pasture without compromising the environment. Perennial grasses have the potential to reduce nitrate leaching compared to annual crops due to their established

root system. They are considered a good choice for repeated sludge applications because of their efficient nitrogen utilisation under intensive management practices and because a number of harvests that can be made in a year (Bary, 2001: 23).

Another example of the economic value of human waste reuse comes from Sulabh International, which estimates that the value of manure produced in the 1.2 million twin-pit toilets they have installed in India is greater than \$33 million per year. Their goal is to reach 700 million users, which would amount to nearly \$3 billion in manure per annum. Sulabh's technology for combining public toilet blocks and biogas generation, if built at a capacity for 1,000 users, generates the daily energy equivalent of 21 liters of diesel, or the annual equivalent of \$4,500 worth of fuel (Bary, 2001: 23).

### **2.11 Flush-and- Drop-and- Sanitise discharge store and-reuse**

Winblad (1997) maintains that there are numerous reasons why the no-mix principle is gaining ground. It will use less or no water for flushing, be more affordable than sewerage systems allow households to manage it and thus put less pressure on municipal resources releasing less or no smell than drop-and-store alternatives dispose of the bulky urine *in situ* and a small volume of faecal compost remains make accessible urine which contains most of the nutrients in the excreta turn waste into a useful resource fertiliser simplify the treatment of the remaining waste water at the treatment plant.

Excreta is not the most common topic for discussion, or for research for that matter. This urine blindness has delayed innovative improvements and left a number of dry options undeveloped. By mixing urine and faeces it creates a compound which smells and is less tempting to reuse in any way. If however, urine and faeces are kept separated, as supplied by the body, the smell from faeces is negligible. The reason is that the smell is caused by bacteria in the faeces which release ammonia from the urea. The smell from urine itself is much less pronounced. It is not until recently that trials have been conducted which keep faeces and urine separated, sometimes called urine diversion (Winblad, 1997, 45).

This is easily done in a closet with two bowls, one in front for urine and one at the rear for faeces. The urine bowl is connected to a pipe and the faeces and cleansing material drop into a container. The urine diversion system not only allows a range of sophistication, but it also provides for step-wise upgrading. The selected combination among all these alternatives is guided by ecological and affordability considerations among the users. Firstly, one or both bowls may be connected to flush water. The urine pipe may lead to the soil/garbage heap where the urine partly evaporates, or enter a shallow infiltration pit, or lead

to a storage tank, from there to be reused as a fertiliser. The faecal material may be flushed or not, and can then be dehydrated and composted before it is incinerated or burnt or used as a soil conditioner. The bowl for the faeces may even be connected to a sewerage system if available. Variations of the principle of sanitise-and reuse are extensively used in China, Central America and Sweden (Winblad, 1997, 45).

### **2.12 The disclosing of “urine blindness”**

Irrespective of differences in exact figures, it is clear that human urine provides the bulk of nutrients, contrary to what is generally believed. This may partly explain why there is a *urine blindness* when it comes to using excreta in plant production. The fact that urine mixed with water is a good fertiliser and that a person urinates almost half a cubic meter annually, gives a reason to look at human excreta from a new perspective. Instead of exclusively regarding excreta as a health hazard and community problem which it evidently is viewed, at least urine as a resource for agricultural production. UNDP (1996) has recently estimated that some 15% of food production in the world comes from urban agriculture. An early, closer scientific look was taken by Pettenkofer's disciple Max Rubner. He estimated that excreta from 80 persons could be used to fertilise a hectare Bary (2001). In other words, one person could fertilise some 125 m<sup>2</sup>.

China has a long record of farmers collecting mixed excreta and applying it onto their farms. Japan imported this tradition in the 12th century, and farmers bought urine and faeces from town dwellers. When cheap chemical fertilisers became available the Japanese farmers switched over to them and the town councils had to solve the arising sanitation problem partly with sewers (Matsui, 1997). Up to this day 50% of the excreta in Japan is collected by the municipality and returned to agricultural land.

### **2.13 The usage of faecal sludge as fuel**

The use of faecal sludge as a dry combustion fuel in industry has not yet been implemented, but seems very promising based on the use of wastewater treatment sludge (biosolids) as an alternative fuel in the cement industry in Europe and the US (Boesch and Hellweg, 2010 and WBCSD, 2005). Laboratory and pilot scale research conducted in Dakar and Kampala has demonstrated the technical viability (Gold, 2014: 67).

The main potential market for sludge as fuel in all three cities was identified as the industrial sector; industries have both the fuel demand and willingness to use the product. It revealed that depending on the city, country and type of industry, a variety of fuel sources could be

supplemented or replaced with faecal sludge. In Dakar, industries were either using electricity as their sole source of energy or liquid fuels such as diesel, heating oil, or kerosene. The use of solid fuels was not observed in Dakar. Also in Accra, industries were most dominantly using electricity and to a limited degree also liquid fuels but not solid fuels. Solid fuels require more air than liquid fuels to burn efficiently, so existing boilers and kilns for liquid fuels would have to be modified (Morvay and Gvozdenac, 2008: 71).

#### **2.14 Using faecal sludge as a medium for rearing insect larvae**

The usage of insect larvae for protein in animal feed is a potential treatment and resource recovery option. There are no full scale implementations, however at the laboratory scale the use of faecal sludge as a feed source for black soldier fly (BSF) larvae, *Hermetia illucens*, has been successfully demonstrated by Nguyen (2010).

Similarly, in South Africa the company Agriprotein is operating a treatment plant processing waste with insect larvae for the production of chicken and fish feed (van Huis, 2013). In addition, insect larvae are widely cultivated for feed in aquaculture, chicken farms, and frog farms using other forms of municipal organic waste (Calvert., 1969, Hem , 2008, Ocio and Vinaras, 1979, Ogunji , 2007 and St-Hilaire , 2007). Given that the global price for fish meal has tripled from 2005 to 2013, and is expected to remain high due to declining wild fish stocks and the on-going increase of aquaculture, the revenue potential from larvae is very attractive (Naylor , 2009: 67).

One tonne of faecal sludge at 40% dry solids can produce 20 kg of dry black soldier fly larval meal (Nguyen, 2010), at 35% protein (Diener , 2009 and St-Hilaire , 2007). In Dakar, 6 tonnes of faecal sludge per day are discharged at the faecal sludge treatment plants. This translates to 300 kg of black soldier fly meal or 105 kg of protein that could be produced per day. Setting a price for black soldier fly meal based on a comparable cost per kilogram of protein of fishmeal results in a gross value of USD 37,440/year. In addition, when considering the amounts of faecal sludge that are generated but currently not collected, the amount would be four times higher (USD 149,760). In Accra the same calculation yields USD 222,768/year, and in Kampala USD 109,200/year.

#### **2.15 Building materials**

No examples of use of faecal sludge in building materials were found in the literature, however, research conducted with wastewater sludge found that addition of 20% by weight of dry sludge in clay bricks did not have a significant impact on functional characteristics (Liew, 2004). In addition, the combustion of sludge within bricks can introduce small cavities that improve the freeze–thaw expansion and bonding adherence to mortar. Brick manufacturing is pervasive in Kampala, so the use of faecal sludge in building materials was pursued during interviews with brick manufacturers. However, there was a relatively negative perception among brick manufacturers with regard to this enduse. The main reasons given during interviews were concerns about consistent characteristics of faecal sludge, and the abundance of conventional raw materials negates the need for an alternative. This indicates that faecal sludge incorporation into building materials can be considered but would probably only be of interest in areas where raw materials are limited.

### **2.16 People's perceptions on the alternative management of faecal sludge**

As cited above, attitudes and perceptions about health hazards, revulsion to faeces and urine vary between cultures and often people's ideas about urine differ from those about faeces. Tanner (1995) writes that every social group has a social policy for excreting; some codes of conduct which will vary with age, marital status, gender, education, class, religion, locality, employment and physical capacity. The human dimension was found by Cross (1985) to be a severely neglected concern in environmental health and yet one that is of central importance to a full understanding of the potential reuse of nutrients in human waste. For example, a process of social conditioning is involved in the identification of those smells which may be categorized as offensive in particular cultures.

However, as noted by Loudon (1977), it is a matter of common observation that among individuals accustomed to the smells of putrefaction, such as those involved in specialized occupations; conditioning modifies or suppresses a response which may well have a biochemical basis, even though reinforced by socio-psychological factors. People's perceptions of urine have hardly been studied. Hansen (1928) reported that urine was stored and used as a detergent for washing clothes and dyeing in the Danish countryside in the 19th century. A century earlier, European artisans collected urine and canine excrement for industrial purposes (Reid, 1991). Urine is considered as a spiritual pollutant by Koranic edict, and demands that Muslims minimise contact with human excreta.

In Sweden urine has been used to smear wounds, and to some extent to drink as therapy (Liew, 2004). Oral information confirms the same uses in South Africa. Recently urine has

been shown to have a disincentive effect. Faeces are perceived quite differently, and they are regarded as offensive and unpleasant to handle (Hamlin, 1990).

Professionals and laymen foster strong perceptions that adult faeces are hazardous to health because the stool may contain a variety of pathogens, like *Giardia* and *Entamoeba* parasites, *Shigella* and *Campylobacter* bacteria and Rota virus. More generally, Douglas (1978) argues that it is difficult to think of dirt except in the context of pathogenicity. European ideas indicate that, more importantly to understand dirt-avoidance before the perception was transformed by bacteriology. Faeces may carry definite cultural meaning, for example that one's faeces can be a medium for revenge and therefore must not be seen by others, or that faeces of certain kin must not be mixed (Liew, 2004, 36).

Such perceptions are difficult to maintain in crowded urban areas and they may gradually disappear. A study in peri-urban Eldoret in Kenya indicates such a change. Only 10% of the participants thought it unsafe to throw children's faeces into the latrine due to reasons like child stool should not be mixed with those of adults as child stool has to be hidden due to the danger of a witch picking on the stool of a particular child and faeces left on shallow latrines can be picked by people with ill will (Akongá, 1996).

Cow dung seems, from its practical usage, to be viewed as less offensive than human faeces. A century ago it became popular in rural Sweden to attach the latrine house with no pit to the stable so that human faeces and dung from the stall-fed animals were mixed to make them less revolting when applied to the fields. Fortes reported a similar practice among Tallensi farmers to use a mixture of human faeces and animal manure as fertiliser. Another common way to get rid of faeces, also today, is to let pigs and dogs scavenge, eat the human faeces and produce their own faeces which are not regarded as equally revolting. Another way of approaching people's attitudes to excreta is how sewer men and excreta collectors are viewed in accordance with (Liew, 2004, 45).

Another example from South Africa tells that the ethnic group Bhaca are eagerly sought after in the whole of the Republic as attendants at sewage treatment works (Mbambisa, 1990). A possibly contrasting example is given by Tanner (1995) who notes about the social position of lavatory cleaners that, in Hinduism it is done by out-casts but much the same status applies to cleaners in western societies. In ancient Rome the cleaning of the Cloaca Maxima was performed by prisoners of war. We may infer from this information that the general perception of human waste was one of disgust.



There are a number of studies of users' experiences from several experiments. For example, Liew (2004) interviewed 14 farmers, 5 property managers and 28 households in Ale in southern Sweden. The farmers expressed positive attitudes to use human urine on their fields, tenants believed in recirculation of nutrients, while the property managers preferred to wait for initiatives from tenants. The Eco-house in Norrköping town is a three-storey house with 18 flats, built in the 1960s and converted into an eco-house. The aim of the conversion was to reduce energy consumption and to handle waste water and garbage locally. Potable water is still taken from the municipal system.

The new toilets are water-driven and urine and faeces are kept separate. The urine is flushed with 0.2 l of water and drains into a urine tank. After some six month storage to allow antibiotics to disintegrate, the content is collected and used by a farmer. Faeces are flushed with 4 l of water to a separator in the basement which separates the liquid. The dehydrated faeces are composted together with household garbage for some eight months before it is used as soil conditioner in the residents' small gardens near the house. The separated flush water is radiated with UV light to kill the germs and led, together with bath, dish and laundry water to a three chamber tank for sludge separation. This treated water is then spread out in a root-filtering system in an ecology park situated in a beautifully formed marsh close to the house. Also the rainwater is taken care of locally.

Bless (2006) contends that user experiences of no-mixing toilets are generally positive, while some of the mixing toilets face dissatisfaction. The compost material is often being used as fertiliser in the home garden. Reuse of urine is less developed and several projects rely on farmers who collect the urine and spread it on their farms.

Any recommendations on how to dispose excreta must, however, be sensitive to people's perceptions and local physical conditions. Residents' skills and knowledge of urban agriculture are important - in addition to their perceptions of use of human excreta. There is a biological limit to what is possible to achieve. Another limit is set by what activities are administratively allowed. In-between these limits there are a "feasibility gap" that is being explored. If the population density is low, say, each person having on average more than 500 m<sup>2</sup> of open space like in peri-urban Trivandrum in India, household members may take care of the spread of urine and faeces in the garden and fields close by. They may urinate directly on the fields or collect urine in a bucket or container in the latrine house, mix it with waste water and spread it on the farm in the evening to reduce losses of ammonia.

In Dakar, customers such as small-scale farmers and horticulturists mix the faecal sludge with animal manure. To achieve a consistency that is easier to work with, as the form in which faecal sludge is currently sold is not considered optimal. Customers reported they would prefer to buy faecal sludge as a fine powder, and all 23 interviewees stated that adequate dryness is the key quality criterion. Nutrients and hygienic aspects were ranked as less important. In Dakar, if all of the faecal sludge that is currently being collected were sold as a soil amendment and assuming 60% dry solids (based on operating experience) it would generate a gross value of USD 12,480/year (Mbambisa, 1990: 45).

### **2.17 Implications for the usage of alternative faecal sludge**

Estimated potential revenues per tonne in each of the cities that could be realized from selling products derived by treatment of faecal sludge from on-site sanitation systems are tremendous. Most treatment technologies required to produce these treatment products have not yet been implemented on a large scale, however they have been tested with faecal sludge at the laboratory or pilot-scale level, or have been successfully implemented with wastewater sludge and therefore show great potential.

It is impossible at this time to evaluate exact net profits, as capital and operating costs will vary greatly depending on type of treatment technology, where it is installed and the distribution and collection networks. There is very limited operational experience of faecal sludge treatment plants to base estimates on. However, research indicates that for example a 15m<sup>3</sup> per day treatment plant with drying beds would be 4.5 times less expensive to build than highly mechanized systems (Robbins, 2014). In general, based on current knowledge, treatment options for protein and combustion have low capital and operating costs, whereas highly mechanized treatments such as anaerobic digestion (i.e. biogas) have high capital and operating costs (Strande, 2014).

Industries have to be convinced that prior implementation to assess factors such as feasibility, quality, transportation, distribution, marketing and performance prior to taking up innovative technologies. Without this type of proof the financial risk is too high for industry to take innovative technologies. To address this, pilot scale kilns were constructed in Dakar and Kampala to demonstrate the technical feasibility of dry sludge as fuel for combustion (Gold, 2014: 59).

## **2.18 Conclusion**

The possibility to sewer the world is rapidly fading away in the light of global population increase and due to difficulties towards the treatment of waste water due to the explosive increase in the use of chemicals by man. In a water-scarce country like South Africa sanitation options are needed which are intended to minimise the demand on water resources (Schutte et.al, 1997). The search for options should include both households with high water consumption, which are mostly connected to sewerage systems, as well as unserved communities.

This shows that sanitation is not just a technical fix but an intriguing interplay of norms and attitudes among professionals as well as users. The reasons for installing an improved collection of excreta may vary, and often include status/pride, convenience, hygiene and improved health. Rarely is improved nutrition mentioned, however, since recirculation of nutrients is hardly practiced or contemplated.

The market potential for faecal sludge varies strongly from one place to another, depending on factors such as characteristics, existing markets, regional industrial sectors, subsidies, and locally available materials. In addition, the revenue that could be generated also varied significantly. This illustrates the importance of considering market demand together with potential revenue (and capital and operating costs) when evaluating solutions. For example, the use of sludge as a soil amendment has traditionally been the most commonly implemented end use, but the analyses show that the market demand is higher for other end products which also potentially have a greater revenue.

Currently, faecal sludge products are not well utilized. They are mostly landfilled, discharged to the environment, or given away or sold for very little. The values are based on the existing situation, but the faecal sludge market is under leveraged. If valuable faecal sludge-derived products were to be generated, the volumes of raw sludge that are properly collected and managed in cities would most likely greatly increase as a result of the financial market incentive. Reducing or eliminating indiscriminate dumping of human waste would give way to healthy lifestyle and environment.

## CHAPTER 3

### RESEARCH METHODS

#### 3.1 Introduction

Chapter two mainly analysed literature review in relation to, among others, the constitutional and legislative framework underpinning the perceptions of the residents of Polokwane Local Municipality on the alternative faecal sludge management. The focus in this chapter will be on the research design and methodology that were considered appropriate and thus adopted for this study.

Remenyi, Williams, Money, and Swartz (1998: 120) assert that one of the most important aspects of research in the Public Administration is to decide on an appropriate starting point for the conceptual framework or research strategy within which data will be collected and analysed. This chapter starts by discussing research design and then goes on to discuss research design and methodology, and clarifies the meaning of qualitative research and its methodologies. The chapter further indicates that the study is qualitative in nature. The main objective of this chapter on research designs and methodologies is to document processes followed in arriving at the research findings and conclusions (see Chapter Five).

Munzhedzi (2011: 55) maintains that when undertaking a scientific research, there are three questions that can be asked, they are reasons for conducting research (why), the emphasis of the study and the unit of analysis of the research (what), and the methods used to undertake the research (how). The why, what and how of the research study have been used in this chapter to further discover and reveal the perceptions of the residents of Polokwane Local Municipality on alternative faecal sludge management.

#### 3.2. Research Paradigm

When researchers talk about different approaches to research, they talk about paradigms. A paradigm is a worldview or a set of assumptions about how things work. Rossman & Rollis (2003) define paradigm as “shared understandings of reality”. This study used interpretivism paradigm as it talks about the importance of ideas, opinions and observations when analysing research findings.

The interpretivism approach views reality as something subjective and based on meanings and understanding. Interpretivists believe that just as people cannot be separated from their knowledge, researchers cannot be separated from their research subject. The goal of the

research is understanding, rather than making predictions. Interpretivist researchers do not consider the knowledge generated from the research to be permanent but accept it as relative to the time, context or culture in which the study was conducted. Researchers are more interactive and participatory in their research studies. The primary data collection methods used in the interpretivist approach include interviews and observations of the subjects.

### **3.3. Research Method**

A well-defined research problem is a prerequisite for any study and thereafter a logical development of a research design follows. Mouton (2001: 55) conceptualises research design as a plan or a blueprint of how a researcher plans to conduct the study. Unlike research methodology, research design focuses on the logic of research.

Research methodology focuses on different things in that it concerns itself with the steps, procedures, techniques and specific tasks to be harnessed when the researcher implements the research design. Validity and reliability of the results measure the quality of research. Munzhedzi (2011: 56) refers to validity as the degree to which a study measures what it purports to measure whereas reliability is an estimate of the accuracy and internal consistency of a measurement instrument. Bless, Higson-Smith and Kagee (2006: 156) assert that validity and reliability often suffer when a researcher selects views and arguments that support personal views, provide insufficient supporting evidence and reasons for final conclusion and are prejudiced. The researcher has attempted to achieve high validity and reliability by ensuring that the views and arguments advanced by the respondents are accurate. The evidence obtained from the data collected was sufficient to make the necessary conclusion on this study.

Munzhedzi (2011: 57) declares that the rationale for a research design is to plan and structure a research project in such a way that the validity of the research findings is maximised through either minimising or where possible eliminating potential errors. Furthermore, validity and reliability should complement each other because it does not help to use a reliable instrument which has no validity. Similarly, an instrument with high validity is not useful unless it can also be proved to be reliable.

The study attempted to minimise errors and bias by ensuring that the research sample was representative and that the researcher did not influence the views of respondents throughout

the entire research process including the data collection phase. The research method is detailed below, namely, the qualitative research method Mouton (1996: 38).

### **3.3.1 Qualitative approach**

Babooa (2008: 137) notes that qualitative research approach involves an in-depth understanding of participants' behaviour and the reasons that govern participants' behaviour. Unlike a quantitative research approach, qualitative research relies on reasons behind certain behaviours and experiences of the participants. This research domain makes an attempt to investigate the perceptions of the residents of Polokwane Local Municipality on alternative faecal sludge management. Babooa (2008: 137) asserts qualitative researchers often depend on four methods of gathering data, namely, participation in the settings, direct observation, in-depth interviews and analysis of responses. Mason (2005: 1) posits that through qualitative research, a wide array of dimensions of the social world is explored, including everyday life, and the understandings, experiences and thoughts of participants. A qualitative research approach also explores the ways of social processes, institutions, discourses or relationships and the significance of meanings that they generate.

Mouton (2001: 148-160) purports that a qualitative research approach can also be divided into two categories namely:

- The study of human beings and their behaviour by means of field studies, case studies, interviews and direct observation; and
- The study of products of human behaviour.

Wessels, Pauw and Thani (2009: 15) concur that the study of products of human behaviour includes implementation and outcome evaluation research as well as programme evaluation and policy analysis.

In the case of this study the focus is on the second category, perceptions of human beings pertaining to a service rendered by a Municipality, which is inclusive of implementation. Qualitative research approaches have been applied in the process of conducting this research study. This method could also be seen through the data collection method used. The method used to collect data will be discussed below.

### **3.4 Research Methodologies**

According to William (2011:1) methodology is used to give a clearcut idea on what the researcher is carrying out of his or her research. Methodology was also defined by Neuman (2003) as the ideas, rules, techniques and approaches that are used when undertaking a

research project. There are two scientific methods in the research domain namely: qualitative and quantitative. Qualitative research is a system of inquiry which seeks to build a holistic, largely narrative, description to inform the researcher's understanding of a social or cultural phenomenon (Cresswell, 1994:16). Strauss and Corbin (1990:10) argue that qualitative methods can be used to better understand any phenomenon about which little is yet known. On the other hand, De Vos (1998:15) states that quantitative approach is that approach of research in social sciences which is more highly formalized as well as more explicitly controlled with a range that is exactly defined and which involves study of subjects and broader understanding.

Interesting enough, Swanson and Holton (1997: 93) believe that qualitative and quantitative research approaches can be effectively combined in the same research project. Strauss & Corbin (1990) also claim that using both quantitative and qualitative data can give insights that neither type of analysis could provide alone. However, this study was centred on qualitative research design. Qualitative research provides a richer and more in-depth understanding of the population under study (Vanderstoep & Johnston, 2009). This is mainly because the study is about perceptions, attitudes and interaction and understanding about the subject matter. Qualitative approach was chosen for this study because it is considered as the best in understanding and explaining the perceptions of the residents of Polokwane Local Municipality on the alternative faecal sludge management.

### **3.5 Population and Sampling**

Population within the context of research is defined by Bryman (2012) as the universe of units from which a sample is to be selected. In this study the population is all those who are affected by the faecal sludge management in the Polokwane Local Municipality; this includes residents, tribal authorities and councillors. It is from this population that a sample was derived from for the purpose of this study. A sample refers to a group of subjects on which information is derived while sampling is the process of selecting a sample. In a broader sense sampling is the process whereby a small population or sub-group of a population of interest is selected for a scientific study (Baumgartner & Hensley, 2006:176). The aim of sampling is to arrive at generalisation for the whole population based on a subset of the entire population. This is done because it is often impossible, impractical or even extremely expensive to collect data from all the potential units of analysis encompassed in the research problem (Nachmius & Nachmius, 1987). It should be clear that this study used a non-probability sampling type called convenient sampling.

### 3.5.1 Non-Probability Sampling

This method is classified as the most rudimentary one as it takes all cases on hand until the sample reaches the desired size. The interviewer chose a convenient place where assurance was made of finding more people. The sample used in this study comprises of the Traditional Authority, Ward councillor, community development workers, youth and adults as residents of the ward including municipal employees responsible for faecal sludge management. The respondents combined are 60 in total. The respondents were interviewed individually and in a group.

The study used convenient sampling where only people who were available and volunteered to participate for interviews responded to the questions posed to them by the researcher (Terre Blanche, Durrheim and Painter 2012;239). Since the majority of people work during the day, fewer men were interviewed compared to women who participated in large numbers.

Table 3.1 provides summarised information regarding the population and participants which served to guide data collection in this study.

<b>Ward 23 Polokwane Local Municipality</b>	<b>Total Population</b>	<b>Participants</b>	<b>Gender</b>	<b>Age</b>
Residents of the ward	3 000	51	Female=31 Male=20	30-50
Tribal Authority	10	8	Female=5 Male = 3	30 - 43
Ward/PR Councillor	01	02	Female= 1 Male = 1	34 - 42
Total	3 011	60	Female= 36 Male = 24	N/A

**Table 3.1. Population and Sampling information**

Cohen and Manion (1995: 55) maintain that a lot of authors often argue about the difficulty of determining the appropriate size of the research sample. In general, it is better to have as large a sample as possible in order to reach a reliable conclusion. Nwana (1988: 80)



highlights that the larger the sample becomes, the more representative of the population it becomes and so the more reliable and valid the results based on it will become. However, De Vos (2011) indicated that with regard to qualitative studies it is not about numbers but quality of information collected, and sampling size depends on what we want to know, the purpose of inquiry, what is at stake, what will be useful, what will have credibility, and what can be done with the available time and resources. Not everyone in the ward is directly affected by the way faecal sludge is being managed and fewer people know about proper ways of managing faecal sludge in the ward.

Babbie (2010:193) maintains that purposive sampling refers to a non-probability sampling method in which the units to be observed are selected on the basis of the researcher's judgement about which respondents are most useful. A purposive sample is representative in nature. The researcher ensured that the sample is representative in that it is inclusive of officials with the occupations ranging from operational workers, deputy-managers, managers and senior managers. Gender and age of the respondents were considered. The individual interview lasted for a maximum of 30 minutes.

### **3.6 Data collection methods**

Hanekom (1987: 28) accords that it is noteworthy to distinguish between two kinds of data, namely, primary data and secondary data. Secondary data refers to the data that is available in published literature while primary data refers to the data which is obtained from the original source. Bless, Higson-Smith and Kagee (2006: 97) postulate that a study relies on the quality of the facts on which it is based. It therefore means that an excellent research design and a representative sample are not sufficient to guarantee a reliable result if an analysis is based on incorrect data. It is necessary to ensure that data collected is accurate, so that analysis and results are reliable. The methods of data collection used in this study are semi-structured interviews which include both personal and focus group respondents. The methods of data collection used are discussed in detail below.

#### **3.6.1 Personal interview**

Jacobs (1996: 341) conceptualises individual interview as a set of written questions and/or statements to which the research subjects are to respond to in order to obtain data which is relevant to the research topic. For the purpose of this research study, an interview guide (see Annexure One) was designed for various segments of the people within Polokwane Local Municipality which included councillors, traditional leaders, community development workers, municipal officials and ordinary residents in the ward. All the respondents reside within Polokwane Local Municipality. Important to note is that only 10 participants were

interviewed using this style. Only tribal authorities and ward/PR Councillors were interviewed using this option as they were very few and manageable.

### **3.6.2 Focus Group interviews**

Group interviews are a means of better understanding how people think or feel about an issue, product or service. In this type of interview participants are selected because they have certain characteristics in common that relate to the topic of the focus group (De Vos, 2011: 360). The researcher creates a tolerant environment in the group interview that encourages participants to share perceptions, points of view, experiences, wishes and concerns without pressurising participants to reach consensus (Barbour & Kitzinger, 1999: 4-5). In this study the researcher selected participants who are affected by the way faecal sludge is being managed in Polokwane Local Municipality. It should be noted that 111 people participated in these focus group interviews. As a result, there were 13 groups of 8 people each and 1 group of 7 people. 13 of these groups were homogeneous, meaning that male participants were grouped on their own and female participants were also grouped on their own. There was only 1 group that was comprised of 4 males and 3 females. During the interviews the researcher made sure that every member of the group participated without fear of being judged and without being interrupted by the researcher or others. As a way of creating a conducive environment for the interview the researcher made sure that all the respondents in the group were comfortable with the use of a recording device before it was used.

However, it is important to note that there were some few challenges with regard to making all these focus group interviews a success. Some of the challenges included the fact that some participants were interrupting others while they talked and I had to play referee. Some participants appeared to be very quiet and I had to ask questions to them specifically so that they get a chance to participate. Again, there were those participants who felt that they knew the subject more than others and they tried to dominate others on the discussions which I had to intervene and bring about a balance by giving others an opportunity to participate through asking for their views specifically. As challenging as it was everyone was given a fair chance to participate on the focus group interview and data were collected.

### **3.7 Field work**

I experienced a lot from these field work research but for the purpose of this study I will just discuss a few. I must say that it was my first time to conduct a field work research and I was a bit nervous on my first appointment. But from the second appointment I was confident and I enjoyed it very much. Some of the challenges that I experienced related to participation.

Some targeted respondents did not want to participate as participation was voluntary, they felt that it brought no incentives for their participation. However, I was impressed by some of the respondents who possessed a lot of information irrespective of their level of education, I guess it was maybe because they are directly affected by this problem. It was a bit challenging to balance my work and fieldwork activities as I had to make appointments that suited well with my work schedules and also suited well the schedules of my respondents.

### **3.8 Data Analysis**

Mouton (1996: 161) consents that data analysis usually engages two key steps:

- (a) Reducing the collected data to manageable proportions.
- (b) Identifying patterns and themes in the data.

Babooa (2008: 152) concurs that the first step in the data analysis is a critical examination of the collected data. In this study, data analysis includes data collected through individual and group interviews. Data for this study were analysed using thematic data analysis. This is a process where data collected tends to be coded on the bases of themes and analysed in themes. The researcher first looked at the responses and discussions from the participants and selected themes from the response so as to group responses and discussions under certain themes. For example, all the data collected that talks about health concerns or issues related to alternative faecal sludge management were analysed under the health theme or sub-topic. The researcher then looked at what was said, how it was said, who said it and why it was said. This assisted the researcher to derive meaning and understanding from the data. As a result, the researcher was able to generalise the responses and discussion and the researcher was able to arrive at informed findings which then made it possible to come-up with some recommendations.

### **3.9 Ethical Considerations**

The researcher took the following steps to ensure that research ethics are observed and upheld:

A). **Ensuring confidentiality:** The confidentiality and anonymity of participants was respected under all circumstances. The respondents were also informed about the outcome of the research. The respondents' privacy, autonomy, dignity and basic human rights as individuals were respected. The respondents' names, photos and video cameras were not used in the study (Mouton, 2014).

B). **Anonymity:** The respondents' names and addresses and any sensitive information was not disclosed. This was to make sure that not a single response can be linked to a particular respondent by anyone who will read this study.

C). **Voluntary participation:** The respondents were not compelled to participate in this study in any way possible, they were made aware that their participation was based on their own free will and that they were free to withdraw their participation without any penalty. Furthermore, the respondents were informed about the purpose of the research, the estimated time of their participation, possible risks, advantages and disadvantages, and the way the information will be used (de Vos, 2012). All these was done so that all the respondents could make informed decisions about their participation or non-participation in this study.

D). **Social value:** The results of this study will benefit the community in addressing the poor public health and environmental pollution factors through alternative faecal sludge management. The researcher's priority was and remains to protect the rights of those who cannot protect themselves, in this context the respondents (de Vos, 2012). It should be clear that the final research report of this study will be available on hard copy and can be accessed for free from the University of Limpopo Turf loop campus library.

### **3.10 Conclusion**

This chapter made it possible for us to learn about how the study was conducted and why it was conducted this way. The research design and methodology used in this research study were clarified in this chapter. The qualitative research approach was discussed with an indication of the preferred method that was applied in the study. This chapter also provided a detailed description of the data collection method used in the study which includes individual and group interviews. The way data analysis was carried out as was also discussed. The research sample, together with the research area, was also provided. The research findings, together with the interpretations, are provided in the next chapter.

## CHAPTER FOUR

### INTERPRETATIONS AND ANALYSIS

#### 4.1. Introduction

The previous chapter discussed research paradigm and then went on to discuss research design and methodology, and clarified the meaning of qualitative research and its methodologies. It further indicated that the study is qualitative in nature. The main objective of the previous chapter was to demonstrate how research designs and methodologies are to link the research findings and analysis. This chapter focuses on presentation, interpretation and analysing data. The main objective of this chapter however, is to analyse data in order to arrive at findings of the research. Data in this chapter as indicated in the previous chapter were analysed using a thematic approach.

Data analysis is the process of bringing order, structure and meaning to the mass of collected data. It is a messy, ambiguous, time consuming, creative, and fascinating process. It does not proceed in a linear fashion; it is not neat. Qualitative data analysis is a search for general statements about relationships among categories of data" (Marshall and Rossman, 1990:111). Furthermore, Hitchcock and Hughes argued that "the ways in which the researcher moves from a description of what is the case to an explanation of why what is the case is the case" (Hitchcock and Hughes 1995:295).

The purpose of analysing data is to obtain usable and useful information. The analysis, irrespective of whether the data is qualitative or quantitative, may: describe and summarise the data; identify relationships between variables; compare variables; identify the difference between variables; and forecast outcomes.

In qualitative research, you are either exploring the application of a theory or model in a different context or are hoping for a theory or a model to emerge from the data. In other words, although you may have some ideas about your topic, you are also looking for ideas, concepts and attitudes often from experts or practitioners in the field. This chapter therefore, presents and analyses data using thematic data analysis approach.

The following interview guide was used in this research:

## **INTERVIEW GUIDE**

1. What is your general perception of living with and disposal of human excrements or faeces?
2. What forms or methods for the disposal of faeces are you aware of?
3. Whose responsibility do you think it is do design methods for the management of faeces in towns and villages?
4. What method/s is/are currently used in your area to manage faecal sludge?
5. What are the challenges and strengths related to the current faecal management methods?
6. What is your perception of the following alternative methods:
  - Separating urine from faeces for the purpose of recycling and use in agriculture; What is your perception of this?
  - Reused of faeces in energy production; What is your perception of this?
  - Reuse of faeces in production of cement; What is your perception of this?
7. Would you embrace the use of these alternative methods and their products in your area?
8. Have you ever given a thought about future population growth and the growth in faecal sludge production and its consequences? What are your perceptions about this?
9. Have you ever given a thought to the amount of water that is currently used to flush away human excrements?
10. What is your perception of the two methods – the current method of managing faecal sludge (flush and pit latrine) and the alternative methods (separating urine from faeces, dry toilets, use for agriculture and cement production)?
11. What role do you think the municipality and the community can play towards the implementation of the alternative faecal sludge management in your area?

### **4.2 Interview question: one**

**What is your general perception of living with and disposal of human excrements or faeces?**

Only the common responses of true raw data answering to this question could be **themed** as follows: **Sewage maintenance liability** and **Hygiene health threats concern**.

#### 4.2.1. Sewage maintenance liability

Thematic analysis was used to familiarise common responses raw data as well as the method of coding adopted to collate together similar versions of responses.

*Interview: **PARTICIPANT ONE.** “The municipality does fix the storage vest but it occurs again if not at the same place but other areas so our only concern is that does it mean maybe we have high volume of faecal fixes because they fix it but we have high volume of faecal over and over again.*

According to Tissington (2011) Sewage were defined as “the subset of waste water that is contaminated with human faeces or urine; however, it is a term often used to refer to any waste water”. Further, he defined Sewerage as ‘the physical infrastructure or system of sewers (pipes) used to remove sewage from its origin to the point of eventual treatment or disposal e.g. at a waste water treatment plant’.

Participant one responded with dissatisfaction about the partial leaking physical infrastructure of the sewage and the sewerage in their area of residence. Section 156(1) of the constitution stipulates that a local government has the executive authority in respect of, and has the right to administer the local government matters listed in Part B of Schedule 4 which includes water and sanitation maintenance.

*Interview: **PARTICIPANT FIVE** “If the municipality delays to respond to the blockages, it will cause pollution and it’s not healthy to the community that reside in areas where the blockage occurs”*

*Interview: **PARTICIPANT EIGHT** “My general perception is, if it’s treated by reliable chemicals and managed well, I have no problem about it; the only problem is when the municipality doesn’t treat it properly, it will be detrimental. The waste contains acids; it can affect animals and humans if not treated well. It’s only through newspapers that I have learnt that it is detrimental to the health of people”*

The response implicates that few people think they could have done something about the problem of water and sanitation to avoid the faecal leakages. It could be from the legislation perspective where the participant may draw their perspectives about the poor maintained

sewages i.e. constitution. Municipality is compelled by the constitution to uphold the good environmental health of the citizen S156 of the constitution.

Contrarily, the health policies perspectives do not advice people on how the sewage leaking problems can be eliminated, except through not getting contact with contaminated water and foods. The WBO normally helps the affected countries with the rescuing of those in danger, and not fixing the source of danger (leaking sewage).

Human excrements can be recycled for the purpose of producing water to alleviate the problems of water. Both the municipality and the community should work hand in hand; the community should report any pipes which burst.

*Interview **PARTICIPANT NINE*** was worried about the negligent faecal sludge practice in the area.

It is proportionally interesting to acknowledge that the ideas provided are focused to a poor service delivery in water and sanitation. Hence it is Improper for the members of the community to remain desperate with environmental health problems not knowing that the local government is bound by the authority to do the quality (pipes) fix without the community having to fall sick or dying.

According to Mafunisa (2013) there has been an existing need for community being informed and a sense for belonging to the public service, because “a feeling of not knowing why actions are undertaken and being cut off from information destroys the credibility on how people see the service provider”.

Perceptions as a social psychological element seem also to be a vital approach to the way the community sees the public service delivery problems. According to ‘social cognition theory’ counterfactual thoughts that occur automatically often left less-informed people with the perceptions and assumptions that technical tragic events remain unavoidable (Baron, Byrne and Branscombe 2006). **PARTICIPANT ONE** indicated that “they (Polokwane Local Municipality Municipality) do fix them often but the pipes will then shortly leak again and again, not knowing whether to blame high volume of sewage usage by the clients or the municipality poor infrastructure”.

#### **4.2.2. Hygiene health concern**

The WBO reports that seven out of ten people still live without improved sanitation facilities, and nine out of ten people still practising open defecation, live in rural areas. The Polokwane



Local Municipality rural majority of respondents expressed health concerns when attempting to respond to this question. They indicated that people are exposed to dangerous diseases such as Cholera due to the leakages of faeces in their area. Three of the respondents said that:

*Interview **PARTICIPANT THREE**: “Firstly I will like to say it causes a health hazard, there are so many ways that you could realise this caused hazards such as when a person has a runny stomach caused by leakages of faeces that are around the area, although I have not been infected by the disease, there are several people infected by cholera in an open space where the place could have been used for other purposes”.*

Further, on the same environmental hygiene health concerns it has been discovered that other respondents deeply highlighted that:

*Interview **PARTICIPANT FOUR**: “Always when I met the blocked pipes or the field the first thing which is coming to my mind about health”.*

*Interview **PARTICIPANT SIX**: “Human extracts such as urine and faeces are generally seen as waste product, unhealthy and detrimental to humans’ life however, the attitude and perception about the health hazards and peoples revulsion against faeces and urine vary between culture and so in my understanding and generally from my culture we usually see faeces as a pathogen and they not good for the human health.*

The message that this particular participant was trying to communicate was that extracts such as urine and faeces should be seen as waste that is dangerous and unhealthy to human beings.

*Interview **PARTICIPANT SEVEN**: “Really it is frustrating to live with these excrements around our homes, it causes diseases, children playing football around and jumping the waste. It’s a problem, it causes more problems”.*

#### **4.2.3. Cholera and other environmental diseases**

Literally the data responses from the above participants, were not easy to maintain the neutrality and pure biases in almost all of above responses, but the researcher has allowed the logic flow of the theory, naturalistic, scholars as well as personal capacity and media to analyses the data. It is from all the perceptions where one could draw an inference that community draw conclusions and health evaluation from their experience than any explicit reference. **PARTICIPANT SIX** explained through his experience and it is from that

perspective, where one can conclude that the majority of respondents' views are based on their past fixed perceptions about health complications that can develop as a result of leaking sewage.

### **4.3 Interview question: two**

#### **What forms or methods for the disposal of faeces are you aware of?**

This question was requiring participants to answer in both open-ended and a bit of close-ended responses, for the purpose of discovering participants understanding as well as differentiating the methods for the disposal of faeces. This section was categorised into three themes namely: traditional disposal and Excreta disposal, the vectors: biology and control methods.

#### **4.3.1 Traditional pit method**

*Interview **PARTICIPANT ONE**: "I'm only aware of two where we will be flushing basically in the rural area, the use of big toilet those are the ones that I know but now in town we do flush Sewerage dams that are keeping faeces that are recycled and used in the areas of agriculture, etc".*

The respondent indicates that he is aware of two methods of which all of them may be referred to as traditional pit latrines. This was because with pit toilet is made out of digging a hole normally at the corner of a yard and builds a small shelter that is enough for entry of one person at a time. In various circumstances the majority of households prefers to erect these types of toilets with bricks, planks, woods or Zink which is possible for many because it is cheap with regard to its building resources gathering.

Another flushing toilet that **PARTICIPANT ONE** mentioned was the pit toilets that are able to flush and are used in farms. They can be described as a form of temporary toilets people use in temporary residence e.g. barracks.

#### **4.3.2 Excreta disposal**

Excreta disposal refers to one of the key elements of any emergency sanitation programme. Containment and safe disposal of human excreta is the primary barrier to transmission of excreta-related disease. Further it is believed that the main objective of excrete disposal is to

reduce the transmission of diseases due to environmental contamination by faecal matter or the proliferation of vectors.

*Interview **PARTICIPANT THREE**: “I’m aware of this one of cartage, this is the form of faecal sludge method whereby the sanitation service provider uses container for disposal of excreta which in most instances is used by mobile toilets and for hospitals patients as well as in the informal settlements, where they use a certain container, in the morning they dispose it into the container where the municipality can come and collect it, which according to the research it is very dangerous for people who come and collect it as well as people who are using it, the other one is that one of pit littering this one is most common, which is usually used in rural areas, where we dig a hole and then the faeces are left to decompose by itself, this one we can say in some instances is good as a pit when its full we can close that pit and we use another one or we buy the chemicals to decompose the faeces very fast.*

**PARTICIPANT THREE** demonstrated some form of advance understanding with regard to excreta disposal that he learned in prison. Excreta disposal was found to be known by few who had an encounter or experience at a prison; hence it was found to be learned in the unfortunate place of residence (prison).

#### **4.3.3 Vectors: biology and control methods**

According to Ebert (2005) ‘Integrated vector management (IVM) was a strategic sanitation method to vector control that was used to be promoted by WHO and includes control of the vectors of dengue’. The WHO defined the IVM method as “a rational decision-making process for the optimal use of resources for vector control”, IVM considers five key points being effective for the faecal sludge management process, namely:

- *advocacy social mobilization and legislation*
- *collaboration within the health sector and with other sectors*
- *integrated approach to disease control*
- *evidence-based decision-making*
- *capacity-building*

The vector method can never be ignored, as *participant 2* was uncertain about the methods that the prison in Venda uses, although the hearsay evidence in his possession was admissible as a new faeces management method in this study, since the question requires.

*Interview **PARTICIPANT TWO**: “I think I know three, the first one, the one for fertilisers when they treat the faeces, maybe twice or trice to make it clean so that it can be good for*

agriculture, and then raw one they just collect it in and just use it at agricultural land, they use it in China, they just use it raw as it is for their agricultural land and then the third one, the one for to burning and to producing gas, and then this one they use it at maximum correctional service at VENDA, I didnt know what happens after it is burnt”.

*Interview **PARTICIPANT FOUR**: “Flushing and pit toilets, with the flushing of toilets it travels in pipes and gets processed and used for manure”.*

The researcher concludes the results of this raw data analysis by outlining that majority of participants were commonly responding with similar types of knowledge e.g., **PARTICIPANTS ONE, TWO** and **FOUR** were commonly aware of pit and flushing toilets methods. This follows a response by one participant citing that “*I’m only aware of two where we will be flushing basically in the rural area and use a big toilet, those are the ones that I know but now in town we do flash Sewerage*”.

The researcher concludes that more education is needed to assist the community members to know the type of water and sanitation that will be for their best of hygiene.

#### **4.4 Interview question: three**

**Whose responsibility do you think it is do design methods for the management of faeces in towns and villages?**

This question was more focused on the way and how participants understand the mandate of the municipality with regard to the management of faeces in towns and villages. Two themes were used to categorise the participants’ responses namely those who are literate on how government services should be run and those who do not understand how the government provides services.

##### **4.4.1 Those who were literate on how the government services should operate**

*Interview **PARTICIPANT FOUR**: “This one I think it is the responsibility for the district municipality as we are aware of the Intergrated Development Plan (IDP) process and then we are aware of Municipal Structures Act 117 of 1998 that provides the power and function of the municipalities, so when she outlined the Structures Act, it says domestic water, waste water and sewage disposal are the function of the district municipality, the establishment. Operation and control of disposal and bulk, waste transfer facilities is for district municipality the determination of water waste disposal strategies and regulation of disposal are done at*

*district level, I guess is the function of the district municipality. Yes, they can assist through awareness, teaching the community more especially Community Based Organisations about the importance of sanitation and how best can they avoid contamination and the reduce the spreading of diseases through human excretas”.*

Only one participant seemed to understand how the municipality services should be rendered, although his response was sounding as that of a person who is working or having worked at the municipality before. This response correlates with the facts and the empowerment theory for it criticizes the government (Mphehle and Kanjere 2013).

These results have a mutual relationship or connection, in which the lack of government information amongst many citizens, affects or depends on the empowerment of the community by the municipality. Petersen (2014) defined empowerment as ‘an active participatory process through which individuals and groups gain greater control over their lives, acquire rights, and reduce marginalisation’. Hence there is a need for an opportunity to learn and grow.

#### **4.4.2 Those who were not aware of how the government provides services**

The average of responses that were captured revealed that participants were slightly aware that the municipalities are mandated and responsible to maintain the good environmental health, but all of them indicated an uncertain perception about how forcefully the municipality is compelled to render proper sanitation service for the benefit of citizens’ health.

The results from three participants indicate a strong gap between the knowledge that every citizen is entitled to know: section 32 of the Constitution of the Republic of South Africa gives the people the right to access to information. The *Batho pele* principle seems not fully utilized because it allows the public institution to provide the information to all who have the need to know. From these results one can draw an inference that the promotion of the access to information seems to be meant for public servants or those who request for it only.

The in-depth knowledge about the functions of the municipality to the citizens seem to be far away from the ordinary people and thus deprivation of freedom.

#### **4.5 Interview question: four**

**What method/s is/are currently used in your area to manage faecal sludge?**

This question required understanding of the process whereby undigested or partially digested slurry or solids resulting from storage or treatment of excreta is managed.

Participants were reflecting their observational experience, particularly in disadvantaged residences such as Seshego, some villages and other surrounding areas of this study in the Polokwane Local Municipality. Notywala (2016) suggests that 'Using a (pit) toilet in informal settlements can be one of the most dangerous activities for residents', hence Polokwane Local Municipality implements the faecal sludge in the area.

#### 4.5.1 Flushing toilets

Results in this question 'reveal that many people have been improved in terms of living conditions by the state from using the pit toilet system to a permanent flushing sanitation system', of which the few indicate how alternative the flushing method can be multi-dimensional during faecal sludge management process. As one of the respondents indicated,

*Interview **PARTICIPANT ONE**: "People use the disposal of faecal to do their gardens at'. In my culture we basically use animal faeces to do gardening, for human faeces I'm not sure if it is healthy unless the municipality says when they allow people to collect them I don't know what they have done to it but we use animal sludge".*

The results of this study also indicate that most flushing sanitation methods still dominate the area in Polokwane Local Municipality, the flushing sanitation could be conducive, but it could be unequally enjoyed due to leakages in various disadvantaged areas.

However, literature indicates that people in the rural area still depend on any available methods, that they are offered. The state of leaking sanitation facilities, threatens all learners' rights to health, education, privacy, dignity, equality and safety.

It is clear from the responses above that only few people do have access to proper sanitation in the area of this study falling under Polokwane Local Municipality.

According to Rademeyer (2014) "the ANC's claim exaggerates its achievements over the past 19 years and is not supported by the available data". Politically, many South African citizens are misguided by the ways and manner which politicians "exaggerate statistics" when lobbying for votes, hence they do not look at the quality of such services offered to them. The illustrated bill-board indicates the delivery of sanitation, without indicating if any faecal sludge management methods are being practiced.

#### 4.6 Interview question: five

##### What are the challenges and strengths related to the current faecal management methods?

For this interview question only two themes were adopted namely; unmaintained sanitary services and leaking dry taps.

##### 4.6.1 Unmaintained sanitary services

*Interview **PARTICIPANT ONE**: “Usually the strength is that mostly the people who are using them are able to get their garden and food from them so the challenge I have is that most people do not collect them so even if we collect them they are not disposed as much as you will expect them to be disposed. At the moment at my place the area where the municipality is disposed is full so people coming to collect and try to use them at their gardens is still a challenge because they can’t collect as much as the faecal will be gone. Some use them some do not so I don’t know if it is an issue of culture or issue of perception that human faeces are not healthy and are not safe”.*

Only one participant could see the positive purpose of faecal sludge and many responded negatively. However, a category of two participants had in majority shared a common water scarcity calamity; in that all they get used to the dry taps service that the municipality is failing them. From this results it is uncertain if the scarcity is permanent since the taps were installed. Nonetheless, according to Bhagwan (2013) from Water Research Council (WRC), practitioners and local municipalities often voiced negligence of resources by the residents over wasteful water use, unaccounted-for water flows that at the end denies them access to proper safe sanitation services.

Critically and exceptionally, *Interview **PARTICIPANT FIVE** indicates that (he) cannot remember any strength except challenges that are taking place due to improper faecal sludge management system in his area.*

##### 4.6.2 Leaking and dry pipes

*Interview **PARTICIPANT TWO, THREE, FIVE and SIX** commonly blamed the “sewage blockage and dry taps”*

According to the Department of Water Affairs (DWA) 2015/16 report, the entity did not have any adequate system of control over the recording of sales of water services in most areas in South Africa. The question has SIX responses from different participants, FIVE participants shared common basic service delivery calamities which include communal taps and house hold taps need for fix due to long-term dryness as they were no longer functional to supply water for use in the community. The results for dry taps may sometimes be influenced by theft and neglected infrastructure resources that supply water (Tissington 2011).

It could not be surprising that the water and sanitation in faecal services, takes a long time to be accessed by users who are participants of this study, most of water service clients seem not too angry about the slow pace of water sanitation delivery, maybe because they might be partially paying for the service. The DWA report 2014/15 also found that there were significant differences between the amounts confirmed as outstanding by individual debtors and the amounts recorded in the accounting records of the entity which management could not substantiate. In addition, it was also noted that interest on debtor balances were not charged and accrued for.

#### **4.7 Interview question: six**

##### **What is your perception of the following alternative methods?**

- **Separating urine from faeces for the purpose of recycling and use in agriculture; What is your perception of this?**

Two themes were adopted in the process of answering this interview sub-question namely; Agriculture and educating of people and Doubtful of the process.

##### **4.7.1 Agriculture and educating of people**

This first sub-question was responded to by nine participants, but the majority of participants indicated that they are buying the idea meaning that they do trust the process of separating urine from faeces for the purpose of recycling and use in agriculture as beneficial. More than five respondents out of nine revealed that they would be happy to see the process taking place to minimize the frequent sewage blockages.

*Interview PARTICIPANT ONE, TWO, THREE, FIVE, SEVEN and PARTICIPANT EIGHT revealed to be trusting and in favour of the “Agriculture and educating of people first”.*



#### 4.7.2 Doubtful about the process

Interview **PARTICIPANT THREE**: “My perception is I think the consequences of just dumping the sledge on our agriculture land will be terrible”.

Interview **PARTICIPANT FOUR**: ‘poor knowledge and trust of the process’

The above participants have commonly revealed to be scared of the process, citing toxic particles from the sewerage of faeces could be harmful to the people. One of the above two participants highlighted that,

*“My perception, I think the consequences of just dumping the sledge on our agriculture land will be terrible because whoever is responsible for cleaning the sledge cannot find a certain way either to keep all the toxins out of the sludge or to get all the toxins out of the sledge. For example, they say that this agricultural land where the cows and horses dine after eating here grow on the sledge and people who live at the same agricultural land to which sludge has been applied developed a very strange disease, but is a research. A long time special rural areas people used to eat fruits, eg. Guava, a long time ago there was no toilet, you will find that this person just ate the guava and just go there to the bush and help themselves after that the guava just grows, and people eat, but I never even heard my grand mom or my parents telling me that we ate the guava from the bush and there is this strange illness which appears, they just eat. Yes, I don’t think they will support the idea, I don’t know especially in Limpopo we have a lot of cultural taboos”.*

From the above response it is clear that the respondents lack significant deep knowledge about the reuse of water and faecal material after being processed. The fear of the process could have been uttered while based on the perspective of the age group difference as well as the level of education and exposure to scientific chemical experimental knowledge.

##### ➤ **Reused of faeces in energy production; What is your perception of this?**

Only few who might be little knowledgeable participants responded with the perspective of seeing the process as the one that can produce usable energy. One of the participants responded thus;

Interview: **PARTICIPANT THREE**: “It will be costly to use for energy, it should not be used”

The majority of participants responded positively to the idea of using faeces to produce the energy, this could be a sign that people believe that south Africa can produce most of its consumer goods from its raw material that were thrown away before while on other hand the

country was spending considerably on importing its consumer goods. One participant responded thus;

*Interview PARTICIPANT FIVE: “No I’ve never seen this before because I think when you think of energy here I was thinking of electricity and paraffin and all those things, unless urine only maybe it can be designed as the urine is acid maybe it can be the product but I’m not really sure, yes”*

It is apparent that the majority of participants support the idea that faeces can be processed as the raw material so to become consumer goods.

➤ **Reuse of faeces in production of cement; What is your perception of this?**

Eight Interviewed participants, supported the production of cement with faeces but the concept was new to them. From this data, the researcher concludes that the respondents could have considered the increase of South African production of goods for its consumers. In other words most of the respondents considered the growth of the economy and creating jobs through manufacturing if the reuse of faeces in production of cement may be considered.

#### **4.8 Interview question: seven**

**Would you embrace the use of these alternative methods and their products in your area?**

Except for only one **PARTICIPANT**, almost **ALL PARTICIPANTS** who responded to this question were positive, agreeing to the idea of embracing the use of these alternative methods of reusing the faeces in production of cement and energy. The perspectives were soundly positive, mostly it could be due to interest in the economic sector growth than consideration of health factors. As one of the participants did not hesitate to respond thus,

*Interview PARTICIPANT SIX: “Yes I would myself personally embrace them and I will accept, learn and understand how this process will go and how it will benefit not only me but also the entire community”*

Only one participant disagreed to the production of agricultural goods with the processed faeces raw material, the same participant maintained that he agrees to the processing of the industrial goods such as cement and energy only. This participant maintained his perception towards reuse of faeces material to produce other food from personal agendas; such could be the indirect belief or psychological point of experience. This could be due to cultural taboos in relating to the use of food against anywhere closed to discrete materials.

#### **4.9 Interview question: eight**

**Have you ever given a thought about future population growth and the growth in faecal sludge production and its consequences? What are your perceptions about this?**

On average more than three participants responded with the perspectives that they believe that the growth in population may increase faecal volume and as such they predicted that such increase in population will increase the possibility of drought in the land; As one of the participants responded that;

*Interview **PARTICIPANT TWO**: “As I’m saying the population is growing very fast and we are living in a difficult time of drought where there are challenges of basic service delivery such as water, so it will raise consequences if we don’t find an alternative method to do away with this way of sewage system to save water, so it cannot be good if we don’t use alternative strategies to save water”.*

Furthermore, another equal group of participants commonly indicated that poor sewage infrastructure might develop due to high volume of faecal flow. These results could have developed to the participants’ ideas maybe due to media awareness, through television, or having studies with similar possibilities. This could also be referred to *Sunday times* (15 May 2016) in which water and sanitation budget was outlined, indicating the level at which the water and sanitation service delivery has reached the area in Limpopo Province.

Another participant indicated that the best option he assumes could be when the population growth increases it could be to burn the faecal material (*this could also be linked to a procedure that he as a former detainee had experienced at the Venda maximum prison*).

#### **4.10 Interview question: nine**

**Have you ever given a thought to the amount of water that is currently used to flush away human excrements?**

The majority of participants responded with “YES” in that they had once given it a thought as to how huge they use water each time when they flush their toilets, although many cited that they had heard that it depends on the toilet water storage capacity, many were just aware that a lot of clean water is being consumed each time when they flush their toilets.

As one of them responded with a broad cautious perspective saying that,

*Interview **PARTICIPANT FOUR**: “Yes roughly six litres, so if we can count the number of households that are living in the area that are using fresh water it means we are losing many litres, not talking about the day within an hour, it’s a lot”.*

Only one participant responded that she honestly has never given it a thought as to how much water does she use each time she flushes the toilet, although at the time of the interviews, it had clicked to the participant’s mind that “each time when she flushes the toilet she uses a lot of water”.

The above results from one respondent who had never given it a thought, about the amount of water being spent each time she flushes the toilet could be that “she does not pay the water bills”. According to the DWA 2014/15 report it was highlighted that the majority of people in rural areas are deliberately not paying for water services hence the level of ignorance is high and they become inconsiderate of the consequences.

#### **4.11 Interview question: ten**

**What is your perception of the two methods – the current method of managing faecal sludge (flush and pit latrine) and the alternative methods (separating urine from faeces, dry toilets, use for agriculture and cement production)?**

##### **4.11.1 Dry toilets**

Few old people have indicated to be keen to their old system of pit latrine while citing the alternative methods as good for people in good position of finance, those who are in cities or township residences. This responses could be motivated by the economic reasons as the participants draw a distinction between how effective the flush may be in the suburbs. As he states that:

*Interview **PARTICIPANT FOUR**: “will go for both, in this way I will recommend that one of pit latrine though many people who are living in townships and suburbs won’t prefer it, however it is an effective way of saving water and this alternative method of separating urine from faeces as it can improve our agricultural productivity, it’s good for energy and cement production”.*

Exceptionally *Interview **PARTICIPANT FIVE*** suggested that “I would go for both in this way I would recommend for the one for pit littering in the modern way that we are using, though in most instances people would not prefer it especially people who are living it townships and

suburbs, but it's an effective way of saving water and this alternative method of separating urine from urine as it can also improve our agricultural productivity, it will be good, and then for cement it can also be good as well".

#### **4.11.2 Flushing method preferred**

Many people on this question were positive and in favour of the use of flushing toilets than pit toilet systems, citing disadvantages that go with pit toilets, although, few of them, among those who preferred the flush sanitary system, show their preference in the septic drain, since it was cited as cheaper than when using water. Hence, other responded so keenly to flushing toilet system but maybe due to the water scarcity they prefer the pit toilet system better since they can save water/cost. As another participant indicated that: *Interview PARTICIPANT SEVEN: "I would prefer the sewage system because it's safer, the pit one is not safer because it contaminates borehole water"*.

#### **4.12 Interview question: eleven**

**What role do you think the municipality and the community can play towards the implementation of the alternative faecal sludge management in your area?**

Results for this question received most common responses which was urging the municipality to take its initiative in educating the community about the importance of faecal sludge management, and its benefits towards economic growth. The massive common responses could be caused by the slow pace in economic growth. One participant indicated that:

*Interview PARTICIPANT FOUR: "I feel the municipality can bring to the people the knowledge about this alternative method and the community itself can assist in embracing this knowledge and trying to see if it can benefit us and also the Municipality in managing our service delivery issues. I feel at the moment the communities really need these alternatives and if the municipality comes on board I believe that the community will embrace such an opportunity"*.

#### **4.13 Conclusion**

The purpose of this chapter was to analyse and interpret the results of the research as presented in the raw data that were gathered. The study was aimed at investigating the

perceptions of Polokwane Local Municipality residents regarding the alternative methods of faecal sludge management. It is important to point out that the methods used proved to be appropriate as the researcher managed to capture the perceptions of the residents in Polokwane Local Municipality. In addition, the objectives of the study were also achieved as the current faecal sludge management methods in Polokwane Local Municipality Local Municipality were clearly described. Again, the perceptions and awareness of the Polokwane Local Municipality residents regarding alternative faecal sludge management methods were also determined. It is therefore, important to indicate that the study found that there were alternatives to sewer plants and pit latrines methods that are currently used. The findings also reveal how the lack of adequate water supply and sanitation affects lives in their residential settlements. Perceptions regarding the alternative methods of faecal sludge management in Polokwane Local Municipality were indicated as well as voiced out. The analysis of the data mostly supported the literature review. Faecal sludge management knowledge among the participants was also documented based on the results.

## **CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS**

### **5.1. Introduction**

The previous chapter was about data presentation, interpretation and analysis. It is the previous chapter that mainly inform the discussion in this chapter. This is because the conclusions and recommendations to be discussed in this chapter were derived from the presentations and analyses that were carried out on the previous chapter. This chapter is therefore critical for this study and without it the study would be incomplete.

### **5.2 Conclusion**

The chapter makes a reflection of the entire research study by ensuring that the research aims and objectives have been achieved and realised. In addition, this section also looks at whether the literature collected for this study was relevant and useful in answering the research questions and that all the methodologies used were appropriate for the study.

#### **5.2.1 Conclusion on research aims and objectives**

The study was aimed at investigating the perceptions of Polokwane Local Municipal residents regarding the alternative methods, and additionally to find out about alternative to sewer plants and pit latrines methods that are currently used. The objectives were to describe the current faecal sludge management methods in Polokwane Local Municipality; and to determine the perceptions and awareness of the Polokwane Local Municipality residents regarding alternative faecal sludge management methods. The study discovered that most participants were aware of the delegated sewage maintenance duties on the Polokwane Local Municipality. Regardless of residents who were found to understand liabilities of the municipal services, many residents perceived the delegated municipal sewage maintenance mandate by the national government. There is however no understanding of how service delivery scrutiny can be enforced by residents to compel the municipality to fix the leaking sewage pipes. The study revealed that the perceptions are that it was supposed to be a government concern to see to it that all environmental infectious diseases that break because of their failure to manage faecal sludge well, and all these diseases can be prevented in advance.

In addition, the study revealed that many residents in the area of the study were only familiar with traditional faecal management methods, which were sewage dams and pit sewages.

From these responses the researcher articulated that certain groups of resident do not pay attention in water and sanitation lifecycle, hence they are concerned for their safety on environmental health. This also means that there is lack of information in these communities regarding the disposal of faeces. This therefore, is a clear indication that the study managed to gather and analyse the information it sought to do and by so doing the aims and objectives of the study were realised.

### **5.2.2 Conclusion on literature**

On the basis of existing literature, the study concludes that the possibility to sewer the world is rapidly fading away in the light of global population increase and due to difficulties associated with the treatment of waste water. These difficulties are mainly caused by the explosive increase in the use of chemicals by man. It is therefore, important to note that in a water-scarce country like South Africa sanitation options are needed that would minimise the demand on fresh water resources.

As far as residents were exposed to the raw sewage leakages, the study revealed that the perceptions are that it was supposed to be a government concern to see to it that all environmental infectious disease that breaks because of their failure to manage faecal sludge well, and all these diseases can be prevented in advance. For environmental health threats management Filho (1997: 80) suggested that “government and communities ought to create new patterns of behaviour of individuals, groups and society as a whole towards the environment”.

This shows that sanitation is not just a technical fix but an intriguing interplay of norms and attitudes among professionals as well as users. The reasons for installing an improved collection of excreta may vary, and often include status/pride, convenience, hygiene and improved health.

Findings for this study reveal how the lack of adequate water supply and sanitation affects lives in their residential settlements. Perceptions regarding the alternative methods of faecal sludge management in Polokwane Local Municipality were indicated as well as voiced out. The analysis results of data were mostly supported by citing and acknowledging of slightly synonymous literature reviews. Faecal sludge management knowledge among the participants was also documented based on the results.



### **5.2.3 Conclusion on methodology**

The study preferred qualitative research approach which was fully discussed in chapter three of this study to answer the following research questions. What are your perceptions on the current management of faecal sludge in Polokwane Local Municipality? And what alternative methods can the municipality use to manage faecal sludge? It proves to have been beneficial to take just a sample form the whole population under study as it assisted the researcher to arrive at generalisation for the whole population based on a subset of the entire population. The method that the study used for sampling purposes was convenient sampling where only people who were available and volunteered to participate for interviews responded to the questions posed to them by the researcher. This bared fruits as those participants who were found provided the researcher with useful information used in this study. Therefore, one can say without a doubt that the sampling procedure used was relevant and beneficial to the study.

Again, the face-to-face interview approach and the focus group discussion approach for data collection assisted the researcher to collect rich information for the study. Although there were some challenges with regard to the facilitation of the focus group discussions, they yielded great rewards. Through the use of thematic data analysis approach the researcher was able to arrive at some useful findings which will assist the researcher in suggesting some recommendations in relation to what the study revealed. One could therefore doubtlessly say that the methodologies that the study adopted were all relevant and important for the study.

## **5.3 Recommendations**

This section discusses three types of recommendations emanating from this research and they are: Recommendations for practical interventions, recommendations for policy formulation or review and recommendations for further and future research.

### **5.3.1. Recommendations for practical interventions**

It would be a great national achievement if the is integrated community engagement initiatives towards development of residents' knowledge with regard to various advantages of faecal sludge management, more especially between the residents, municipality and private stakeholders for them to work together in delivering a benefiting faecal sludge management

methods that will maintain education and enterprise development awareness for all. This is because the study found out that majority of the community members requires various campaigns that may offer lessons and trainings, so that people understand how to work with the municipality infrastructures without fear.

It is clear that there is a need to equip most of residents in Polokwane Local Municipality with knowledge on how best a man can improve environmental health, as well as how worse can a person destroy the environment. The study, therefore, recommends that findings of this study should be used as a point of reference for the municipal projects administration, i.e. for the development of Integrated Development Plan (IDP) on the water and sanitation and faecal sludge management in future. The Ministry of environmental health and management at Polokwane Local Municipality should organise solid and integrated awareness with the community to ensure a healthy environment for all.

In addition, the results have significantly found that there were implications of environmental health dangers that could have been taking place against the innocent residents and non-residents of Polokwane Local Municipality due to unmaintained sanitation infrastructure and dry taps. The study therefore suggests that all maintenance of sanitation infrastructure in this area should be immediately commenced and this should be done by the Municipality being assisted by all relevant stakeholders.

### **5.3.2. Recommendations for policy formulation**

It remains clear that currently, faecal sludge products are not well utilized, especially in South Africa and, particularly in the Polokwane Local Municipality area. They are mostly landfilled, discharged to the environment, or given away or sold for very little. The sales values are based on the existing situation, but the faecal sludge market is under leveraged. If valuable faecal sludge-derived products were to be generated, the volumes of raw sludge that are properly collected and managed in cities would most likely greatly increase as a result of the financial market incentive. Reducing or eliminating indiscriminate dumping of human waste would give way to healthy lifestyle and environment. Important is the suggestion that Environmental health concerned Non- Profit Organisations (NPOs) and other stakeholders should be invited for their ideals intervention to the solution when residents address their views on methods that are used in faecal sludge. The study therefore recommends that a multidimensional policy framework should be thought to bring a lasting solution to this particular problem in this municipality and many others affected by a problem of this kind countrywide.

### **5.3.3. Recommendations for further and future research**

The study encourages researchers to look at various faecal sludge methods that should be adopted and encouraged among the Polokwane Local Municipality residents in order to promote the preference for the sanitation methods. It should be an important task for the Polokwane Local Municipality to ensure that residents understand the faecal sludge management enterprise developments in the area to reduce the incompleteness of the perceptions among the residents. Studies should be conducted about the benefits and cost to the community, municipality and other stakeholders with regard to the process of separating urine from faeces for the purpose of recycling and use in agriculture. This was found to be lacking and it could be one of the long-term solutions to the problem at hand. Again, more studies pertaining to the reuse of faeces in energy and cement production in Polokwane Local Municipality should be conducted to see the viability and feasibility of such initiatives. This is because of the perception with regard to the reuse of faeces in energy and cement production revealed that most of lay respondents were uninformed with regard to how faeces could be used for any economic purposes.

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## APPENDIX 1



**TURFLOOP GRADUATE  
SCHOOL OF LEADERSHIP**

### INTERVIEW GUIDE

#### TOPIC

**THE PERCEPTIONS OF THE RESIDENTS OF POLOKWANE REGARDING  
ALTERNATIVE FAECAL SLUDGE MANAGEMENT**

#### DEAR PARTICIPANT

You are being invited to participate in a research study on “the perceptions of the residents of Polokwane on alternative faecal sludge management”. The study entails how residents of Polokwane perceive the alternative usage of faecal sludge and its management. This research will require about 1 hour of your time, during this time you will be interviewed about your perceptions on alternative faecal sludge management. The interview will be conducted wherever you prefer (e.g. in your home) and will be tape recorded.

There are no anticipated risks or discomfort related to this research. The person interviewing you, however, will give you her name and telephone numbers. You may also find the interview to be very enjoyable and rewarding. By participating in this research you may also benefit others by helping people to better understand the area and scope of the research.

Several steps will be taken to protect your anonymity and identity. While the interviews will be tape recorded, the tapes will be destroyed once they have been typed up. The typed interviews will NOT contain any mention of your name and any identifying information from the interview will be removed.

Your participation in this research is completely voluntary. If you decide to participate however, you may withdraw at any time for any reason. The results from this study will be presented in writing in a research document. At no time however, will your name be used or any identifying information revealed. If you wish to receive a copy of the results from the study, you may contact the researcher at the telephone number given.

I have read the above information regarding this research study and consent to participate in this study.

(Printed name) \_\_\_\_\_

(Signature) \_\_\_\_\_

(Date) \_\_\_\_\_

## **INTERVIEW GUIDE**

1. What is your general perception of living with and disposal of human excrements or faeces?
2. What forms or methods for the disposal of faeces are you aware of?
3. Whose responsibility do you think it is do design methods for the management of faeces in towns and villages?
4. What method/s is/are currently used in your area to manage faecal sludge?
5. What are the challenges and strengths related to the current faecal management methods?
6. What is your perception of the following alternative methods:
  - Separating urine from faeces for the purpose of recycling and use in agriculture; What is your perception of this?
  - Reused of faeces in energy production; What is you perception of this?
  - Reuse of faeces in production of cement; What is your perception of this?
7. Would you embrace the use of these alternative methods and their products in your area?
8. Have you ever given a thought about future population growth and the growth in faecal sludge production and its consequences? What are your perceptions about this?
9. Have you ever given a thought to the amount of water that is currently used to flush away human excrements?
10. What is your perception of the two methods – the current method of managing faecal sludge (flush and pit latrine) and the alternative methods (separating urine from faeces, dry toilets, use for agriculture and cement production)?
11. What role do you think the municipality and the community can play towards the implementation of the alternative faecal sludge management in your area?