

**PERCEPTIONS ON THE UTILISATION OF SANITATION FOR RURAL
AGRICULTURAL FOOD SECURITY PRODUCTION IN GA-MOTHAPO
COMMUNITY IN POLOKWANE LOCAL MUNICIPALITY, LIMPOPO**

By

MAPHOHLA ENNIE MAPONYA

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SUPERVISOR: Prof O. Mtapuri

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DECLARATION

I declare that the Perceptions on the utilisation of sanitation for rural agricultural food security production in Ga-Mothapo community in Polokwane local municipality, Limpopo, mini-dissertation hereby submitted to the University of Limpopo, for the degree of Master of Development has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution and that all the material contained herein has been duly acknowledged.

Maponya M.E (Ms)

Date

DEDICATION

This dissertation is dedicated to my son Paseka and my family who sacrificed the time we should have spent together. May the good Lord allow them to reap the fruits of these study.

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It gives me great pleasure to thank few numbers of people whom this mini dissertation would have not been successful without the valuable support from them. I thank Lord Almighty for giving me strength, guidance and wisdom throughout the course of the study

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- Finally, the respondents for their participation in this project.

ABSTRACT

In South Africa, particularly in the Limpopo Province, the handling of human excreta and the use of human excreta for food production are still not valued and generally not acceptable. The issue of social acceptance is one of the several issues that must be tackled in order to successfully institute the practice of human waste reuse in agriculture. As such, this study explored the attitudes and perceptions towards the utilisation of urine and faeces as the alternative to chemical fertilizer in a rural agriculture in Ga-Mothapo, Polokwane Local Municipality in Limpopo.

The study adopted a qualitative approach using a case study design. Data was collected using face to face interviews. A majority of the households indicated that they are not comfortable with the idea of using human excreta for agricultural purpose. According to them, it was against their cultural beliefs and it is a taboo to use the waste of human as they prefer to use animal waste instead. The health risk and environmental contamination were also highlighted by the households as weighing against the use of human excreta. Even though some respondents mentioned that using human excreta has the potential to enrich their depleted agricultural soils, and that it had the effect of reducing the cost of buying commercial fertilizers, they still felt uncomfortable using it. This study concludes by recommending that there is a need for constant intervention and awareness to address the issue of food security through ecological sanitation which will promote sustainable agriculture by providing soil with nutrients.

Keywords: Ecological Sanitation, Human Excreta, Perceptions, Attitudes, Food Security

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ACRONYMS

ABET: Adult Basic Education Training

CDC: Centre for Diseases Control and Prevention

CSIR: Council for Scientific and Industrial Research

DAFF: Department of Agriculture, Forestry and Fisheries

FAO: Food and Agriculture Organization

GM: Genetically Modified

GTZ: German Technical Corporation

HIV/AIDS: Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome

IFPRI: International Food Policy Research Institute

IMF: International Monetary funds

IWSC: International Water and Sanitation Centre

MDG: Millennium Development Goals

NWP: Netherlands Water Partnership

PRSP: Poverty Reduction Strategy Program

SSA: Sub-Saharan Africa

UDS: Urine Diversity System

UN: United Nations

UNICEF: United Nations Children's Fund

WFO: World Food Organisation

WHO: World Health Organisation

WRC: Water Research Council

CHAPTER 1: GENERAL INTRODUCTION AND BACKGROUND TO THE STUDY

1.1. Introduction

This chapter provides an overview of what the perceptions and attitudes are towards the utilisation of sanitation for the rural agricultural food security production, a sustainable sanitation for agriculture, alternative to be considered by decision makers around the world as an option to help in reaching the Millennium Development Goals (MDGs).

Population growth, climatic changes and over-exploitation of natural resources are at the basis of the world's food crisis, which counts almost one billion people without sufficient food sustenance (Roma, E., Benoit, N., Buckely, C., & Bell, S., 2013). Soil degradation and the high cost of inorganic fertilizers have contributed to reduced crop yields and farm incomes which have further exacerbated poverty among farming households (Cofie, O., Adeoti, A., Nkansah-Boadu, F., & Awuah, E., 2010.). These changes require novel environmental practices which are based on nutrient recovery and management in agriculture. (Roma, *et al.*, 2013). Agricultural production in many African countries is also hampered by the predominance of fragile ecosystems, low inherited soil fertility, and low use of modern inputs such as mineral fertilizers and improved crops varieties (Julio & Carlos, 2006). Throughout history farmers have been in complete agreement to the need to improve and maintain the fertility of the soil. Maintaining the quality of the soil is of paramount importance to food production and an essential component of sustainable agriculture (Akeredolu, M., Ilesanmi, I., & Otterpohl, R., n.d.).

1.2. Background to the study

The current food security challenge in South Africa consists of two dimensions: the first tries to maintain and increase South Africa's ability to meet its national food requirements, and the second seeks to eliminate inequalities and poverty amongst households that is made apparent by inadequate and unstable food production, lack of purchasing power, poor nutritional status and weak institutional support networks and disaster management systems. Food security is not only dependent on the ability of agriculture to produce sufficient food at a national level; food insecurity also results from the failure of communities to guarantee access to sufficient food at the household level (Duncker L.C., Matsebe, G.N. & Moilwa, N., 2007). The South

African Department of Agriculture's definition of food security includes food availability, food access and reliability of food, and it is the lack of access of the poor to these fertilisers that could have significant impact on food security in South Africa (Department of Agriculture, 2002). However, international trends to suggest low-cost, ecologically suitable alternative fertilisers, such as human excreta. Although South Africans generally regard human excreta as a waste product, biophysical concerns such as land degradation, declining soil fertility and limited phosphorus reserves (Rosemarin, 2005) have made it necessary to determine means of changing this perception to one that views excreta as a valuable and useful resource (Water Research Council, 2007).

Human by-products remain a taboo subject in many cultures and contexts (Douglas, 1966; Campkin & Cox, 2007 in Richardson, 2012). In South Africa the perceptions and attitudes, more than beliefs of the people, present a major stumbling block to the use of product from urine diversion toilets as food and human faeces are not supposed to be mentioned in the same time (Duncker & Matsebe, 2008). Scientific advances in hygiene and related behavioural change campaigns over hundreds of years have only reinforced these attitudes. Yet even in the context of religion, the attitude towards human waste remains stubbornly ambivalent (Richardson, 2012). Human excreta management has long been a problem in developing countries with most people resorting to unimproved sanitation practices (Amo, 2013). Recycling of nutrients between urban areas and farmland is a critical step towards an ecologically sustainable development (Ganrot, 2005). Achieving or marketing ecological sanitation (EcoSan) solutions requires a change in how people think about and act towards human excreta. The acceptability of this technology varies from one country to another. Some cultures or social groups do not accept the handling and direct use of human excreta. Therefore, cultural taboos in many parts of the world will have to be changed for people to accept using their faeces and urine as fertiliser for food crops (Duncker, *et al.*, 2007). Use of human excreta for agricultural purposes may not only have the direct benefits of protecting and improving natural resources such as water and soils, and enable households to increase food crops, but also have indirect the benefit of improved food security, resulting in improved health of the individual, greater productivity, increased economic output and opportunities, and a decreasing burden on social services (Duncker, *et al.*, 2007).

According to Esrey, S., I. Andersson, A. Hillers and R. Sawyer (eds.) (2001) the way that sanitation can improve people's health and nutrition is by recovering and recycling the nutrients in excreta to grow food. This is already taking place in many parts of the world (e.g., night soil collection and wastewater reuse). EcoSan adoption and operation invoke a variety of perceptions across the globe, determined mainly by the cultural beliefs and traditions of the groups of concern (International Water and Sanitation Centre, 2003). Most attempts, however, are associated with an increased risk of ill health because faeces are not sanitised prior to reuse, thereby spreading pathogens and increasing people's chances of becoming ill. Ecological sanitation helps to reduce these risks by sanitising excreta prior to recovery and reuse, and recycling nutrients back into the land for productive purposes (Esrey, *et al.*, 2001).

This study addresses the perceptions, attitudes and knowledge amongst farmers on the utilisation of human excreta as an alternative to chemical fertiliser in food security production.

1.3. Problem Statement

In South Africa, particularly in the Limpopo Province, the handling of human excreta and the use of human excreta for food production are still not valued and generally not acceptable. Human excreta are seen as waste products, unhealthy, unhygienic and detrimental to humans (Duncker, *et al.*, 2007). The issue of social acceptance is one of the several issues that must be tackled in order to successfully institute the practice of human waste reuse in agriculture. According to FAO (2008), the challenge in South Africa is predominantly around access to food and the means to produce it. The report further indicates that black South Africans make up the majority of the poor and food insecure households are mostly found in the rural areas. But still, the poor need to grow food and the relatively high cost of standard compost production and chemical fertilisers is a constraint. The majority of poor people also live in areas where the soil is not good enough for growing food as such chemical fertilisers are needed to replenish the soil. Ultimately, these chemical "pollutants" may lead to loss of fresh water, food insecurity, destruction of soils, and loss of biodiversity on land as well as in marine environments, global warming and depletion of the ozone layer (National Department of Agriculture, Forestry and Fisheries, 2011).

1.4.1. Aim

The aim of the study was to explore the attitudes and perceptions towards the utilisation of urine and faeces as the alternative to chemical fertilizers in a rural agriculture in Ga-Mothapo, Polokwane Local Municipality in Limpopo.

1.4.2. Objectives of the study

The objectives of the study were:

- To determine the perceptions and attitudes of Ga-Mothapo community towards the use of human excreta as fertilisers for improving agricultural production;
- Identify factors that motivate and/ or demotivate rural households to adopt ecological sanitation;
- To assess people's perceptions regarding the socially acceptability of the practice;
- To contribute to the extension (body) of knowledge on the perceptions on the use of human excreta as fertiliser for food production.

1.5. Research questions

The main question of the study is as follows:

What are the perceptions of using human excreta as a fertilizer in agricultural food production?

This main question is linked to the following sub-questions:

- What factors motivate and/ or demotivate rural households to adopt ecological sanitation?
- What lessons may be drawn from the use of human excreta as a fertilizer in Ga-Mothapo community in the Limpopo Province?
- What are the benefits of using ecological sanitation?
- What are the guiding principles for the acceptance of ecological sanitation for agricultural projects can be drawn from this community?

1.6. Rationale of the study

Raw human waste or wastewater is valued by farmers in other parts of the world not only as irrigation water, but also for its fertilizing capacity, which provides them with an alternative to expensive chemical fertiliser. The extensive use of chemical fertiliser has been known to result in degradation of arable land. Use of chemical fertiliser in agricultural production is not particularly sustainable (Duncker, *et al.*, 2007).

According to Drangert (2004), reusing of excreta for agricultural purposes improves soil fertility, reduces poverty and ensures food security. People's attitudes and perceptions about the use of excreta vary between cultures and even within specific cultures. This study provided an opportunity to learn about the attitudes and perceptions of communities on the utilisation of sanitation for food production in the Limpopo Province. The use of chemical fertilisers was still prevalent in Ga-Mothapo community. If this continued, the use of alternative means will not be explored to the detriment of the community's agricultural productivity. This prompted my desire to conduct research in this field of study.

1.7. Significance of the Study

The study was important because it provided an understanding of attitudes and perceptions towards the use of human excreta as fertiliser. Ideally, an ecological sanitation system enables the recovery of all nutrients which help to restore soil fertility and to assure food security and minimize water pollution. Thereby improving the situation for farmers, it also ensures that they improve yield of vegetables and other crops strengthening their income. To realistically have a chance of meeting the Millennium Development Goals, we need a revolution in our way of thinking in order to see human excreta and domestic used water not as a waste but as an important natural resource (Werner, C., Abdoulaye Fall, P., Schlick, J. & Mang, H.P., 2003). Few do have some knowledge of the potential of faeces, yet not the fertilizing potential of urine (Drangert, *et al.*, 2002; Duncker, *et al.*, 2007). Human faeces are what resemble most manure which is generally more accepted whereas the use of a liquid fertilizer, urine which has a very potent smell, is unknown (Drangert, *et al.*, 2002). This study was important because it has informed the practice and policy to consider human excreta as a means to restore soil fertility.

1.8. Definition of the concepts

Ecological sanitation

Sanitation system that turns human excreta into something useful and valuable, with minimum risk of environmental pollution and no threat to human health (Austin & Duncker, 2002). A toilet allowing a sustainable and safe re-use of excreta without high needs of water, chemicals or electricity can be defined as an eco-toilet. (Heinonen-Tanski, H.H., Pradhan, S.K. & Karinen, P., 2010). Ecological sanitation systems safely recycle excreta and other organic waste products to crop production in such a way that the use of non-renewable resources is minimised (NETWAS-U, 2011).

Food security

Food security defined in the South African context refers to availability, access and utilisation of nutritious, safe, sufficient quantities in order for all to achieve their dietary needs and a healthy life (Wilkinson, *et al.*, 2010). Food security is commonly defined as sustained access for all individuals to an adequate and safe supply of food for an active, healthy and productive life (Esrey, *et al.*, 2001).

Sanitation

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Inadequate sanitation is a major cause of disease worldwide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal (WHO, 2010). Sanitation refers to a wide range of services and arrangements intended to improve the hygienic conditions of the human environment (NETWAS-U, 2011).

Perception

Perception is defined as a way one views something without full knowledge or understanding (The Free Dictionary, undated). These perceptions are common across societies. However, they are further modified by cultural beliefs and practices, economy, urban/rural population pattern and gender (Drangert, 2004), which in turn influence, guide, motivate or demotivate behaviour and determine the future success of technologies and/or products (Duncker, *et al.*, 2007).

Attitudes

An attitude is one's basic 'mind set', one's outlook, how one views things in a particular situation will be seen as a problem to one person and an opportunity to another. It is usually the person who sees that situation as an opportunity that will be able to think of a useful solution to correct the situation. A positive attitude can see opportunities in a situation where a negative attitude will only see the problems and obstacles (Drangert, 2004). The difference between a positive attitude and a negative attitude can often mean the difference between success and failure of a technology or a product. A positive attitude will transmit positive and friendly signals, whereas a negative attitude repels people.

1.9. Ethical considerations

Ethics are moral principles and rules aimed at protecting the interests of the participants when conducting research (Matsebe, 2011). The study considered the following ethical issues:

Informed consent

Informed consent was gained from the participants by means of a verbal and written agreement. The researcher informed the participants about the study, its goals, the procedure to be followed and the rights of the participants. The researcher also highlighted the extent to which the participants' information would be kept confidential.

No harm to participants

The researcher did not subject the participants to physical or psychological harm. The researcher also created an interview-environment free of physical harm. And did not force the participants to answer questions that they felt were too sensitive for them.

Voluntary participation

The participants were informed that their participation in the study was voluntary and that they had a right to withdraw from the study at any time. The participants also were not compelled to take part in the study.

Confidentiality

The participants were assured by the researcher that all the information obtained from them will be kept in strict confidence.

1.10. Outline of the report

Chapter 1:

This chapter presents the introduction, and clearly outline the problem statement; the motivation and significance of the study, as well as the aims and objectives.

Chapter 2:

This chapter presents the literature review which was reviewed during the study.

Chapter 3:

This chapter presents the study research methods, the qualitative paradigm, the study area, population, sampling methods and sample size, data collection, data analysis, verification, and ethical considerations that were used in the study.

Chapter 4:

This chapter presents the research findings of the study.

Chapter 5:

This chapter presents the summary of conclusions drawn, discussion, and suggestions for future research

1.11. Conclusion

With this new emphasis on ecological sanitation, the production of humus can be linked to agriculture. Infertile soils and the rising cost of chemical fertilisers may force policy makers to rethink sanitation, seeing it in a more positive light. And, ecological sanitation fits in with the current self-reliant approach that encourages rural families to dig their own wells and run their own vegetable gardens (Esrey, *et al.*, 2001).

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter reviews literature in the following areas: sanitation situation, improving food security, poverty, sustainable sanitation, reuse of human waste, closing the loop, reasons to adopt ecological sanitation, ecological sanitation and health, perceptions on the utilization of human excreta, theory of planned behaviour and social marketing.

According to Were (2007), eighty percent of the world's hungry population and those lacking adequate access to sanitation live in rural areas. At a global level, we simply cannot wait to address the sanitation crisis. The progress at achieving hunger and sanitation targets are lagging behind, especially in rural areas. Conventional measures to improve food security and sanitation have been ineffective as chemical fertilizers and water-based sanitation is not only costly but has adverse environmental effects. There are many possible models of utilising human excreta for food production; the oldest and simplest involves distributing raw/untreated sewage onto agricultural land for fertilisation (Richardson, 2012). There is no waste in nature, and all the products of living things are used as raw materials by others. There is now persistent decline in crop yields and per capita food production with some long term implications for land degradation and environmental damages (Adewole, *et al.*, 2013).

South Africa has an essentially dual agricultural economy, comprising a well-developed commercial sector and a predominantly subsistence-oriented sector in the rural areas. The farming in poor soil is another urgent development challenge. The absence of agricultural productivity growth in African agriculture is arguably the strongest manifestation of this problem. The consequences of soil degradation have made policy makers to suggest low-cost ecological suitable alternative fertilizer such as human wastes. Although, Africans generally regard human wastes as useless products, but biophysical concerns such as land degradation, declining soil fertility and limited nutrients resources have made it necessary to determine means of changing this perception to one that views human wastes (urine and faeces) as a valuable and useful resource (Rosemarin, 2005).

In Ecological sanitation (Ecosan) offers an alternative solution by promoting reuse of human excreta on farmland and in essence does boost linkages between sanitation, agriculture and protection of environment (Were, 2007). It is very important to hygienize and recycles the possible waste materials to clean the environment with minimal energy consumptions by using different techniques (Drangert, 1998). The acceptability of exploiting human excreta as fertiliser will depend on peoples' perceptions, which influence and guide their behaviour (WRC, 2007). The recycling of nutrients in urine and faeces is one of the key benefits of ecological sanitation (Werner, 2003). Drangert (2004) states that personal and community attitudes to wastes may be influenced by religious beliefs, long-standing social taboos, ideas about health and diseases; and even proverbs or saying. Societal values and religious belief underpin much waste behaviour and reuse practices. Human excreta evoke the most pronounced reactions. Cultures have been classified as falling along a continuum from faecophilic (willing to handle excreta) to faecophobic (excreta seen as extremely defiling).

According to Furedy and Pitot (2013) understanding how people regard organic wastes, the extent to which they exploit them for benefit or income, and how they 'interact' with the wastes may help achieve better reuse for social gains, good public health, efficient resource management and environmental improvement. People in the developed and developing world are beginning to use this untapped nutrient potential to fertilize crops with great success (Shaw, 2010).

2.2. Sanitation situation

Human excreta are a weapon of mass destruction. Just as a lack of sanitation has life-threatening consequences and spells disease and death so does improved sanitation prevent as many as 1.6 million deaths annually. Good sanitation prolongs life too. Toilets can double a user's lifespan. Sanitation is not just about infrastructure. It is also about rights and dignity. There have been debates about privacy since Aristotle first posited the concept in 350 BC. Poor sanitation is an issue that can affect everyone but women are often the most at risk. Everyone deserves the privacy, health benefits and dignity of a safe toilet but this is especially true of women who are often the most vulnerable to the effects of poor sanitation. Ending the global sanitation crisis is one of the most urgent developmental challenges of the

21st century. By the end of 2011, there were 2.5 billion people, over one third of the world's population, living without safe, adequate sanitation and hygiene. For women in many parts of the global South, the problems are even more pronounced as cultural norms coupled with a desire to maintain some privacy dictate that they must relieve themselves under cover of darkness (Hannon & Andersson, 2001a). Unfortunately these are times when the risk of scorpion or snake bites are highest and the predictability of women's movements also puts them at risk of being attacked or raped (Wherever the Need, 2008; Hannon & Andersson, 2001a). While the South African Department of Water Affairs has attempted to provide alternative technical sanitation options in the form of both dry and wet systems, waterborne sanitation is still the predominant system in urban areas (Matsebe & Osman, 2012). Water-borne system is currently the most used sanitation system in urban areas of South Africa despite water shortage projections for the country (Matsebe, 2011). South Africa is a water-scarce country (Otieno & Ochieng, 2004; Wassung, 2010). The current sanitation system mostly used in South African urban areas depends on extensive use of water in a form of flush toilets.

The poor access to water, sanitation and hygiene results in tremendous human and economic costs and reinforces gender and other societal inequalities, most notably for women and girls (Matsebe, 2011). One third of the global population without improved sanitation and nearly 60 per cent of people who practice open-defecation live in India (Ibid). In South Asia, it is estimated that 692 million people resort to open-defecation (Ibid). All this comes with social, economic and environmental consequences.

2.3. Improving food security

Food insecurity is growing over time all over the world. Broad trends in food production and prices indicate an improvement in food security, but the aggregate picture masks variations in food security among regions, countries and income groups (Esrey, *et al.*, 2001). Household food insecurity is defined as the inability to acquire or consume an adequate quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so. (ADA, 2003). The government of South Africa has committed to halving poverty between 2004 and 2014. In order to achieve this objective it is crucial to achieve household food

security (De Cock, *et al.*, 2013). Food security is seen as a Constitutional Right in South Africa (Chapter 2, Section 27.1b) and guarantees its citizens the right to have access to sufficient food and water, and that “the state must by legislation and other measures, within its available resources, avail to progressive realisation of the right to sufficient food.” Despite national food security, many South African households experience continued food insecurity, malnutrition and unemployment (Were, 2007). FAO stressed that “food security depends more on socio-economic conditions than on agroclimatic ones, and on access to food rather than the production or physical availability of food”. It stated that, to evaluate the potential impacts of climate change on food security, “it is not enough to assess the impacts on domestic production in food-insecure countries. One also needs to (i) assess climate change impacts on foreign exchange earnings; (ii) determine the ability of food surplus countries to increase their commercial exports or food aid; and (iii) analyse how the incomes of the poor will be affected by climate change” (FAO, 2003b: 365-366).

Climate change, environmental degradation and unsustainable consumption of resources are increasingly putting a strain on the Earth’s natural wealth (Benoit, 2013). Besides increases in food production and use of food supplements, food security can be improved by control of public health diseases (Were, 2007). In relation to agriculture, access to fertile land and fertilizer hinder the possibility of being food secure (WRC, 2007; Wilkinson, *et al.*, 2010). By providing human fertilizer, such solutions add a private economic incentive for investment in sanitation. For farming households, this may imply either a decrease in the use of artificial fertilizers (using human fertilizer as a substitute) or an increase in the total amount of fertilizer (using human fertilizer complementary) (Pettersson & Wikström, 2012). The government has recognized several key food security challenges in the Integrated Food Security Strategy (IFSS) (De Cock, *et al.*, 2013). According to the World Food Summit organised in Rome in 1996, food security exists when all people, at all times, have physical and economic access to sufficient, safe, nutritious food to meet their dietary needs and food preferences for an active life (Department of Agriculture, Forestry and Fisheries, 2011).

Maintaining the quality of the soil is of paramount importance to food production and an essential component of sustainable agriculture. Farmers through the ages have recognized the importance of fertilizer in improving and maintaining soil fertility

(Akeredolu, *et al.*, nd). The manners in which food insecurity is dealt with in South Africa included food fortification programmes, nutrition education and promoting the production of one's own food supply through food garden (Wilkinson, *et al.*, 2010). The access to the fertilizers remains a challenge for many and the increase in price of chemical fertilizers in the past five years has made it more difficult for farmers. The incorporation of urine in agriculture could increase production, access and sell extra food produced (Wilkinson, *et al.*, 2010).

2.4. Poverty

Poverty and food insecurity have been considered for decades to be rural problems. Poverty, hunger and food insecurity have human rights implications. Indeed, it is now widely accepted that poverty should not be seen only as a lack of income, but also as a deprivation of human rights and that hunger constitutes a violation of the human right to food (FAO, 2008). The MDG target for drinking water has already been met while the target of halving the proportion of people lacking access to adequate sanitation will not be achieved as 2.5 billion people still live without improved sanitation (WHO & UNICEF, 2012). Improved sanitation has been associated with better health and nutritional status. Evidence accumulated over the last quarter century indicates that improved sanitation substantially reduces childhood illnesses and deaths, and improves nutritional status. It does this primarily by acting as a barrier, keeping excreta away from people who, if exposed to the pathogens in faeces, become ill (Esrey, *et al.*, 2001).

Improved sanitation, through "drop or store" or "flush-and-discharge" approaches, can reduce contamination of these media. Evidence suggests that improved sanitation could reduce diarrhoeal disease by 35-40%, and reduce child mortality by half (Esrey, *et al.*, 2001). If sanitation is provided using urine diversion with subsequent nutrient cycling, further benefits can be reaped by meeting the sanitation target. Urine diversion can provide hygienic fertilizer for "free", which can be used for cultivation purposes. Thus, urine diversion can provide additional positive impacts for meeting the MDGs (Kvarnström, *et al.*, 2006).

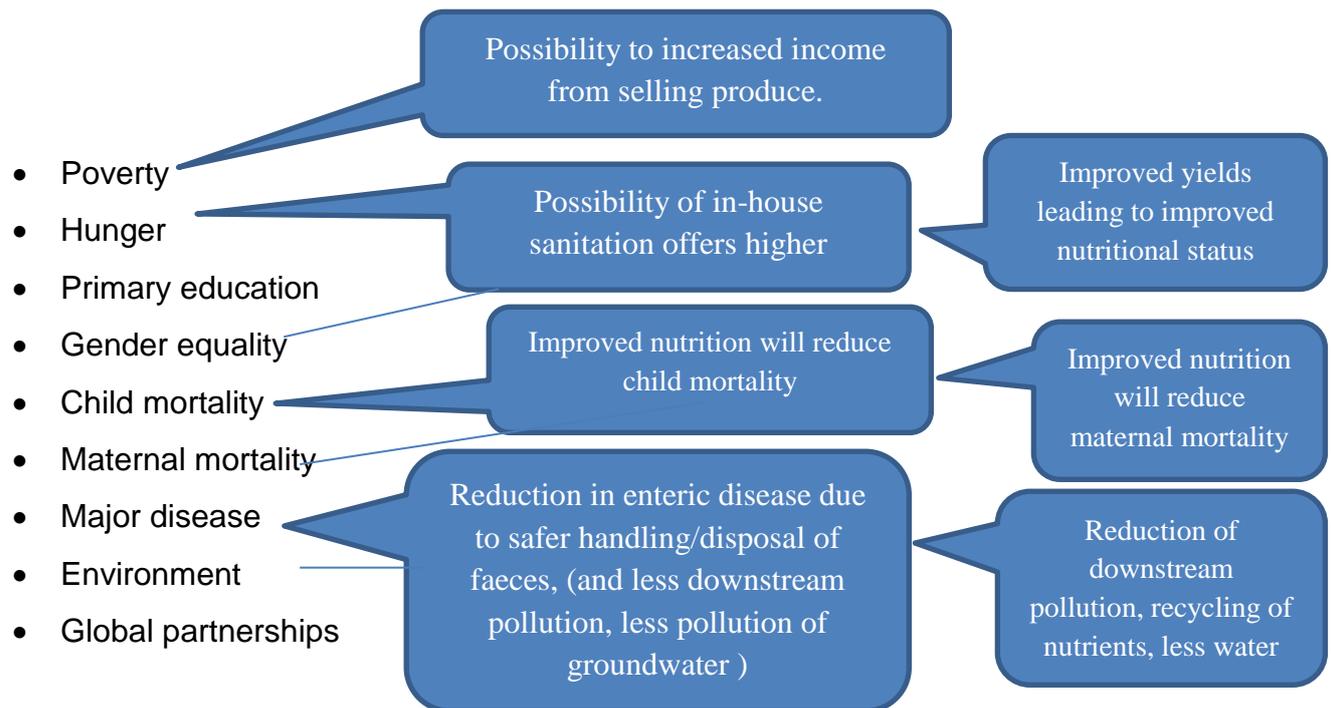


Figure 2.1: Urine diversion as one possibility to meet the millennium development goals (Kvarnström et al., 2006)

Sub-Saharan Africa (SSA) faces more development challenges than any other major region of the World. Rural areas are generally worse off in almost every other aspect of poverty and deprivation: people in rural areas tend to have lower levels of health and education; they are more likely to have limited access to basic services such as water and sanitation; and paradoxically, despite depending on agriculture as their main source of livelihood, they also suffer the most from hunger and food insecurity (Setboonsarng, 2006). In the past few decades, massive investment has gone into promoting Green Revolution technologies based on the use of chemicals, extensive irrigation, and the use of high yielding varieties, including genetically modified (GM) plant varieties. While there is no doubt that this strategy has led to substantial productivity gains over the past 50 years and has eliminated starvation in many countries, recent evidence shows that the Green Revolution has not been effective as a strategy for poverty reduction for majority of the world’s rural poor (IFPRI, 2002). Low-external inputs sustainable agriculture strategies have emerged as viable alternatives to the Green Revolution, particularly for the rural poor in marginal areas. For farmers living in these areas, any strategy to improve agricultural production must therefore be based on the use of low-cost and locally available technologies

and inputs (Pretty, 2002). Overcoming the reluctance of many South Africans to use human excreta as a fertilizer has the potential to strengthen both food security and acceptance of ecological sanitation technologies (WRC, 2007).

2.5. Sustainable sanitation

Sanitation is one of the most established and wide-ranging themes in global human development and development cooperation. It has far-reaching consequences on environmental degradation, health, education and economic development, and it is usually estimated that to date over two billion people still live without adequate access to basic, safe sanitation. Inadequate sanitation is a principal reason for a great amount of suffering and poverty. This is underlined by not only its inclusion in the Millennium Development Goals (UN, 2014a in Andersson, 2014) but also most probably in the upcoming Sustainable Development Goals (UN, 2014b in Andersson, 2014).

Sustainable sanitation would be a convenient way to obtain at least some fertilizers for use in rural areas where many people are so poor. With over one billion people without safe drinking water and over two billion without adequate sanitation facilities, the challenge of providing everyone with safe drinking water and proper sanitation is daunting. Although sustainable sanitation has many facets, the overall objective is always creating sanitation options that are sustainable in every single dimension. Since agricultural production is more likely to be carried out in rural areas, there has been a more successful history of long term implementation of sustainable sanitation projects focused on the reuse of human excreta in those areas than in high density urban areas, where no space for agricultural production is available (Schroeder, 2011).

If sanitation systems to agricultural production are recognized and implemented, multiple benefits can be achieved with positive effects on health, environment and agricultural production (SuSanA, 2012). A contaminated environment places people at obvious risk of exposure to pathogens, harmful organisms that lead to infection and disease. Those most affected are poor people, children, women and men living on marginal rural land and in urban slums- in an environment contaminated with pathogens. Poor people are victims caught in a vicious circle a "pathogen" cycle in

which offenders and victims live, work and play in close proximity to each other (Esrey, *et al.*, 2001). To achieve these advantages in a sustainable way, productive sanitation systems need to be socially acceptable, economically viable, and technically and institutionally appropriate. An integrated community led ecological sanitation and sustainable livelihoods activities has been implemented which helps to mitigate the diverse pressures on the unique Agriculture Ecosystem, and help to ensure that the livelihood needs of local community members are adequately addressed-both through the development of improved agriculture, energy saving and environmental management practices (Goudel, 2012). The search for appropriate solutions has become a pressing problem, particularly for arid and semi-arid zones. With increasing population density and the resultant groundwater pollution, conventional decentralized disposal systems, such as latrines and seepage pits, are also not viable alternatives. In many densely populated areas, the contamination of groundwater by nitrates for example is several times greater than the maximum level recommended by the WHO for drinking water and represents a serious mortal danger to babies. Shallow groundwater is still a major source for local and reliable water supply, especially for the poor in rural and peri -urban areas (Werner, *et al.*, 2003). It is a sustainable, closed-loop system that treats human excreta as a resource, not as a waste product. Excreta are processed until they are free of disease organisms. The nutrients contained in the excreta are then recycled by using the eco-sanitation products to replenish plant nutrients in the soil (WRC, 2007).

What might be considered new is to view urine and faeces separately as two components with different characteristics in terms of pathogens, nutrient content and benefits to soil and plants. Faeces contain basically all the pathogens, while urine has up to 80% of the fertiliser value, in terms of important plant nutrients (N/P/K – nitrogen, potassium and phosphate). By using a “don’t mix” approach, different solutions to old problems can be developed (Esrey, *et al.*, 2001). Human faeces are not easy to handle properly as they contain many microbes that are hazardous to health (Matsui, 1997). It has been suggested that faeces should be sanitised before their application as a fertiliser (Jönsson, *et al.*, 2004). Productive sanitation is more straightforward in rural areas compared to urban areas, considering the relatively short distance between households and productive land and the self-interest of farmers to maintain soil fertility (Cross & Coombes, 2014). According to Werner, *et*

al., (2003) the implementation of sustainable sanitary approaches such as ecological sanitation “ecosan” systems is one of the most relevant solutions for sustainable development and goes towards the Poverty Reduction Strategy (PRSP) initiated in 1999 and supported by the World Bank Group and the IMF.

2.6. Reuse of human waste

The advent of agriculture around 10,000 BC enabled larger human populations to settle in a fixed location for longer periods than had been previously possible. With this settlement, people were for the first time faced with the question of what to do with the large volumes of excreta and used water that accumulated as a result of a sedentary lifestyle. Many old, traditional agricultural societies approached this problem in a logical and pragmatic manner that recognised the nutrient and organic value of excreta by practising the recovery and use of “night-soil” (faeces and excreta) (Bracken, *et al.*, 2007). There is growing interest in returning human excreta directly to the soil, an interest driven by water scarcity and stress, degradation of freshwater resources, increasing population, the resource value of excreta and its nutrients, and delivery of the United Nations Millennium Development Goals, particularly environmental sustainability and eliminating poverty and hunger. In the same goal, it spoke of integrating sustainable development principles into country programmes to reverse the loss of environmental resources. (World Health Organisation (WHO), 2006).

The use of sanitised human excreta as a fertiliser stimulates crop growth and, as a result increases nutrition for those who depend on subsistence farming, or helps to generate or supplement income for those who sell the products they grow (Reed & Shaw, 2003). An alternate source of the same nutrients exist in the form of organic fertilizers e.g. plant and animal manure in various forms, human excreta (Akeredolu, *et al.*, nd). The recovery and use of human excreta for food production is not a new practice. Human urine is a valuable, yet underestimated and underutilized, resource for plant fertilization that has been used in agriculture since ancient times, not least in intensive farming systems in various parts of Asia (Goldstein, 2012; Netting, 1993).

In a very broad sense the recovery and use of urine and faeces has been practiced over millennia by almost all cultures. The uses to which they were put were not limited to agricultural production (although for modern application this may of course be of most relevance), and indeed covered a wide variety of practices (Bracken, *et al.*, 2007). The best known example of the collection and use of human excreta is that of China. It is reported that the Chinese were aware of the benefits of using excreta in crop production before 500 BC enabling them to sustain more people at a higher density than any other system of agriculture. In sustainable agriculture therefore, the same amounts of nutrients that are removed from a field should be returned to it (Jönsson, 1997). The ancient Romans also practiced the use of excreta in agriculture, a practise they may have adopted from the ancient Greeks. The Romans also practiced the reuse of greywater – huge volumes of which were produced as a result of the Roman bath culture (Bracken, *et al.*, 2007).

In some countries in Africa this use of human urine and faeces is also accepted (WRC, 2007). There has long been a focus on human excreta, or humanure, as a valuable agricultural fertiliser. These attitudes are themselves culturally determined, as the use of humanure in countries such as China has continued from the earliest recorded history through to the present day when approximately 90% of agricultural produce is fertilised through untreated human effluent (Black & Fawcett, 2008). In Vietnam a program of toilet building by the government in the 1950's led to the construction of thousands of twin chamber concrete toilets to dry-process human excrement for agricultural fertiliser (with alternating use of each chamber). In these cultural contexts humanure has always been to a large extent freed from the negative connotations elsewhere attached to it (Black & Fawcett, 2008; Rockefeller, 1998; Duncker, *et al.*, 2007 cited in Richardson, 2012).

People have been using human and animal faeces to fertilize crops for centuries (CDC, 2008) because they have understood that faeces helped plants grow, but the re-use of human faeces has not often been implemented in a sanitary manner. The focus of development organizations has therefore generally been the proper inactivation of the faecal pathogens. Sealed pit latrines, composting latrines, and arborloos (CREPA, 2007) have all been used to help keep faeces properly disposed until pathogens are killed. Then the faeces can be used safely to fertilize crops.

Cultural paradigms around human by-products and the role of water in sanitation are however increasingly being challenged by the growing reality of global population pressures, rampant urbanisation and the related challenges of providing clean water and food security for people in the global South; water-based sanitation systems use 15,000 litres per person every year (Jewitt, 2011b). Although traditional societies often have a deep understanding of ecological relationships, traditional or religious values might be in conflict with current environmental values (Paz, *et al.*, 2013). Healthy and productive lives depends on access to sanitation and good hygiene practices, but also on food security, which is achieved when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active life (FAO, 1996 in Dagerskog, 2014). However, the awareness of fertiliser value of human excreta is often low and sanitation initiatives traditionally focus on health and hygiene that is the “danger” aspects of human excreta (Cross & Coombes, 2014).

2.7. Closing the loop

A little more than half of the world’s population has sanitary means of excreta disposal and practices any one or a combination of the following sanitation models; ‘flush-and- discharge’; ‘flush-and- forget’; drop—and-store’ and ‘sanitize-and-reuse’ (Winblad, 1997; Drangert, 1998; Esrey *et al.*, 2001; GTZ, 2003). (See Figure.2.2, 2.3 and 2.4below).

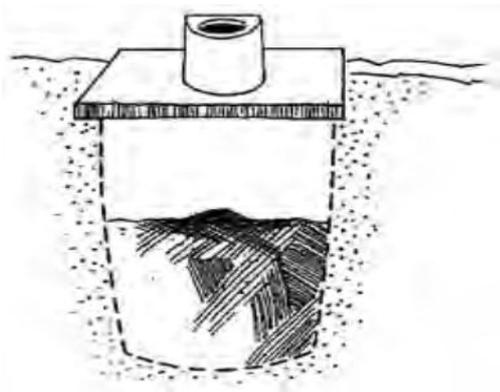


Figure 2.2: Drop-and-Store (Source: ECOSAN programme GTZ, 2003)

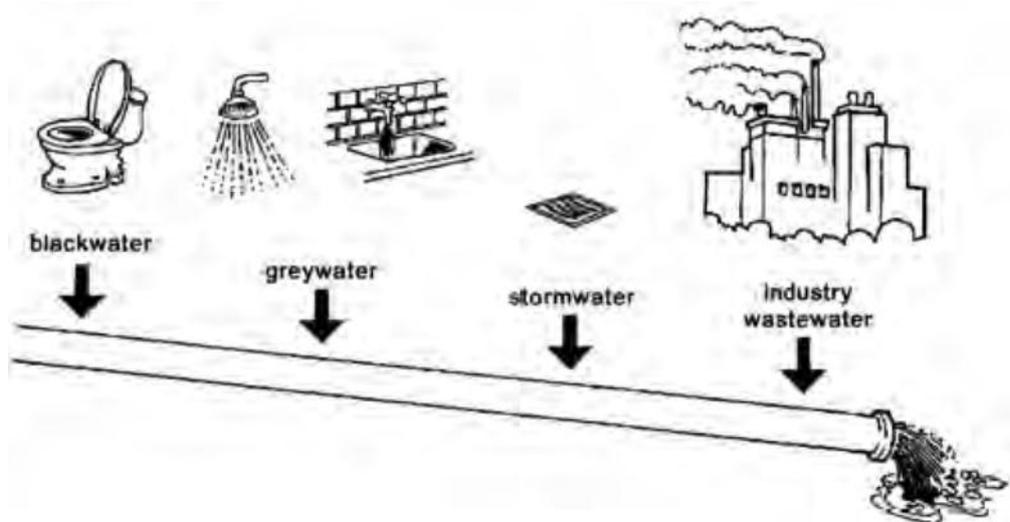


Figure 2.3: Flush-and-discharge (Source: ECOSAN programme GTZ, 2003).

Most rural and peri-urban households in South Africa are not yet connected to a sanitation system for proper management of their wastes. Ecosan is not so much a technology than a sanitation philosophy. It can be viewed as a three-step process: containment, sanitation and recycling of human excreta. The ecosan approach to sanitation promotes a cycle or ‘closed loop’ system.

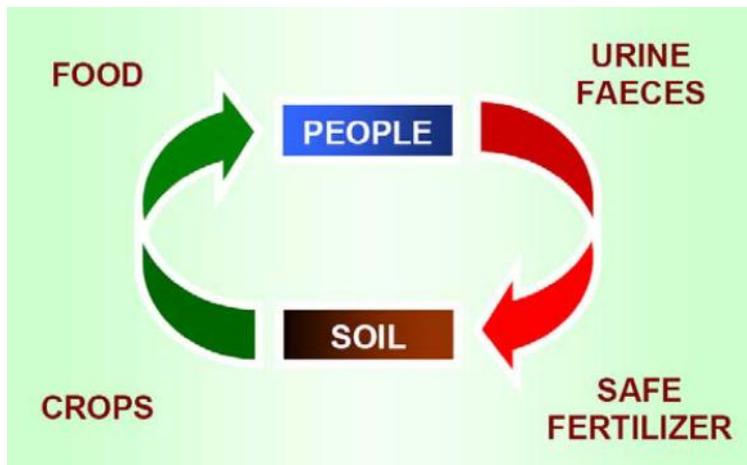


Figure 2.4: Closing the loop on sanitation (Source: EcoSanRes, 2008)

Human excreta is treated as a resource and processed (usually dried and/or composted) until it is completely free of disease organisms. Human excreta are regarded as part of the natural cycle, and burial in soil proved to be a safe method of decomposition (Laines-Kelly, 2010). However, whilst the recovery of nutrients and organic matter from excreta and greywater was addressing the sanitation problems in settlements and contributing to securing and increasing agricultural productivity

the practice was not destined to become the dominant approach to sanitation in the 20th Century (Bracken, *et al.*, 2007). The nutrients contained in the excreta are then recycled by using them as fertiliser in agriculture (Duncker & Matsebe, 2008). As a result, it would have beneficial impacts on food production and security (Benoit, 2013). Human urine is rich in nitrogen and the growing requirement of nitrogen for our food security can be easily met with urine harvesting. Eighty percent of total nitrogen is excreted in urine and there is 5-7 times more nitrogen in urine than in faeces. Urine contains two-thirds of excreted phosphorous and up to 80% of excreted potassium. These are three major nutrients used in chemical fertiliser preparations (Esrey, *et al.*, 2001). This will substitute the requirement of artificial fertilizer and helps in reducing the greenhouse gases (GHG) as well.

The phosphorus value of human excreta is of particular importance given the dwindling resources of non-renewable rock phosphate currently used to produce agriculture fertiliser. The availability and affordability of chemical and high analysis fertilizers to the average farmer is less than optimal hence the need to source for locally available compostable organic materials. More recently, organic farming has become preferable especially for vegetable production particularly in the advanced countries. Research has shown that organically produced foods/ crops are healthier for consumption and safer for the environment. Hence, there is a rapidly growing demand for organic fertilizers that have levels of macro and micro nutrients which are comparable to that of inorganic fertilizers when applied at the same dosages and intensity (Oviasogie, *et al.*, 2013).

Urine has much higher fertiliser value than faeces, which are more useful as organic matter for soil organisms to break down and improve the condition of the soil (Heinonen-Tanski, 2010). As an excellent soil conditioner, humanure increases uptake of nutrients and efficiently regulates light and temperature utilized by plants. It also increases the water holding capacity of soils thus plants grown with humanure require less watering and can withstand better harsh weather conditions such as drought (Were, 2007). Ecological sanitation approaches work in fundamentally different ways, they fulfil the common goals of safely treating human excreta, conserving water, recycling nutrients, and minimising adverse environmental impact Esery, *et al.*, 2001.

2.8. Reasons to adopt ecological sanitation

In many Developing Countries poor soil fertility and the increasing cost of artificial fertilizer is making it difficult for subsistence farmers to grow enough food to feed their families. Survival becomes more perilous as population growth means new land to cultivate is not available (Smet & Sugden, 2006). The fertilizer producing qualities of ecological latrines can help the household economy of poor families as demonstrated by the following comments collected from Malawian farmers who have been using eco-sanitation for a number of years. In water stressed or arid areas, ecological sanitation (which needs no water for flushing) can help save this valuable resource. In the developed countries of the north it has been estimated that use of ecological sanitation could reduce domestic water consumption by 20-40% (Werner, *et al.*, 2003).

If there is an intention for safe reuse of sanitation products, it will be important to create demand for the end products as much as for the toilet. The awareness and know-how or reuse of such organic fertilizer in crop production is promoted with more credibility by the agriculture sector (SuSanA, 2012). It should therefore be high priority to involve agriculture professionals in productive sanitation initiatives. With persistently high chemical fertilizer prices, the need to conserve local resources will become important. If the potential of the excreta recycling is recognized the agriculture sector could drive the demand for sanitation products and the demand for sanitation system can deliver them. This could also channel funds from agriculture for productive sanitation (Cross & Coombes, 2014). With respect to the challenges of soil depletion and sanitation, Ecological sanitation has been studied surprisingly little from an economic perspective. Guzha *et al.*, (2005) find a positive effect on maize production when exhausted soils are restored by sanitised human excreta.

Ecological sanitation (ECOSAN) toilets have been designed to meet these goals (Simpson-Herbert, 1997). The most common ecosan toilet is the urine-diverting type in which the urine is diverted away from faeces via a specially designed pedestal (Figure.2.4). These toilets use little or no water and the excreta is not discharged or buried in deep pits. This system is thus better than the conventional latrine-based systems common in many rural areas in Africa, as it enables the hygienic recovery of faeces and urine for possible use as soil amendments (Mnkeni & Austin, 2009).



Figure 2.5: UDD toilet (Source: EcoSanRes, 2008)

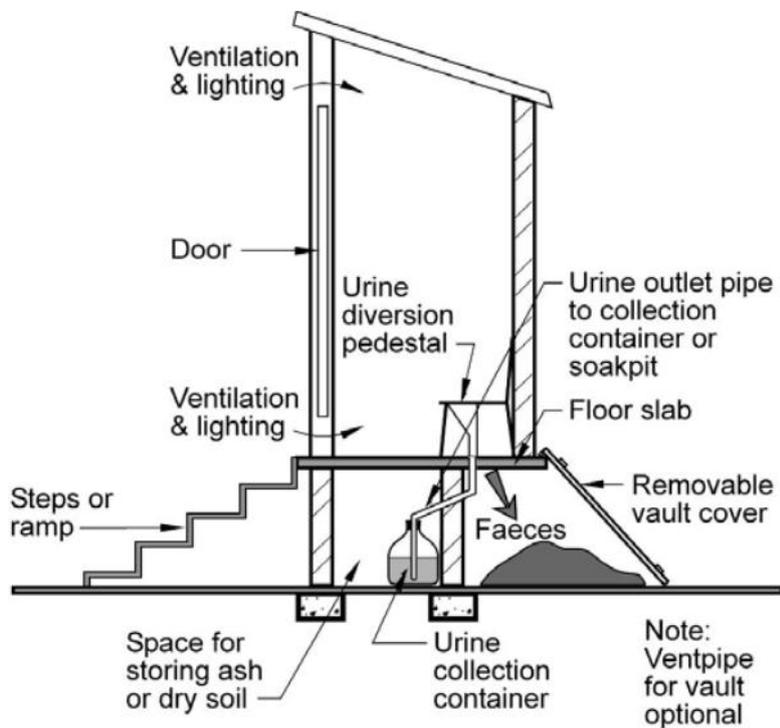


Figure 2.6: Schematic representation of a urine-diversion (UD or “dry-box”) toilet (Austin & Duncker, 2002).

Urine diversion sanitation technology has been used successfully for decades in many developing countries such as Vietnam, China, Mexico, El Salvador, Ecuador, Guatemala, Ethiopia, and Zimbabwe and, since 1997, also in South Africa.

2.9. Ecological sanitation and health

Notwithstanding its merits, the reuse of human excreta for agricultural purposes should, as far as possible, not expose people to the risk of infection. Sanitation systems designed for reuse of the excreta thus pose a special challenge to the engineer to develop technologies that will not pose unacceptable risks to public health (Austin, 2002). The diseases associated with poor sanitation are particularly correlated with poverty and infancy, alone account for about 10% of the global burden of disease. Improved sanitation has been associated with better health and nutritional status. Evidence accumulated over the last quarter century indicates that improved sanitation substantially reduces childhood illnesses and deaths, and improves nutritional status. It does this primarily by acting as a barrier, keeping excreta away from people who, if exposed to the pathogens in faeces, become ill (Esrey, *et al.*, 2001). Untreated excreta and wastewater contains organic matter, plant nutrients, trace elements and micronutrients as well as pathogenic bacteria, viruses, helminths, endocrine substances and medical residues. If they are badly managed they are a major source for the spread of diseases and environmental harm; yet if well-managed they can make a positive contribution to local resources (Werner, *et al.*, 2003).

Health hazards associated with excreta reuse are of two kinds: the occupational hazard to those who handle the excreta and the risk that contaminated products from reuse may subsequently infect humans or animals through consumption or handling (Feachem, *et al.*, 1983). In developing countries especially, excreta-related diseases are very common, and the excreta thus contain high concentrations of pathogens that cause diseases in man (Austin, 2002). The poor sanitation is directly responsible for the high incidence of diarrhoeal disease.

2.10. Perceptions on the utilization of human excreta

The subject of human excretion and sanitation is still taboo to varying degrees in big parts of the world (Pettersson & Wikström, 2013). The perceptions depend on how people obtain their knowledge. The use of urine based fertilizer and consumption of crops fertilized with human excreta in general is influenced by cultural perception, religious beliefs and hygienic concerns (Boh, 2013). Attitudes and perceptions play an important role in the use of sanitized excreta for agricultural purposes. However, these attitudes and perceptions do not fit into the definition of taboos, and most

people do not believe that it is a taboo to handle excreta as claimed in other cultures. In its strictest definition, taboos are viewed as actions and behaviours that tend to offend the gods, spirits or ancestors, and hence demand pacifications (which include punishing the offenders). In fact, handling excreta is not seen as an act that offends a god or a spirit but is rather seen as an act of uncleanness that can pose a health risk (Mariwah & Drangert, 2011). In many cultures, for example, the elderly command traditional authority and influence within the family and community. As regards sanitation behaviour, defecation is often a private matter which people are unwilling to discuss openly, while the burying of faeces is widely practiced to ward off evil spirits. Culture also influences how people interpret and evaluate the environment in which they live. Investments in sanitation seek to improve health by providing a clean physical environment for households (Amo, 2013).

Nevertheless, perceptions about health hazards and attitudes of revulsion towards faeces and urine exist in varying degrees among cultures all over the world. Attitudes towards urine are often different from those towards faeces. Social attitudes and norms of conduct with regard to excreta vary with age, sex, marital status, education, class, religion, locality, employment and physical capacity. For example, there are those who consider urine to be a spiritual pollutant and minimise contact for this reason. Others might hold the belief that urine has beneficial properties either as a disinfectant, or as an antidote to poison ingestion or even as a pesticide. The literature thus makes it clear that different social groups can have widely different views on the use of human excreta (WRC, 2007). Given the current issues we face in managing our excreta, including disease, water scarcity, dwindling phosphorus, and increased demand for food production, the ideal sanitation system is waterless, odourless, and returns our nutrient-rich excreta to the soil with minimum danger to us (Laines-Kelly, 2010).

Transformation from one level and form of hygiene and sanitation practice to another is multifaceted and may take years before being realized. There is a need to identify approaches that will enhance adoption of ecological sanitation. A key ingredient in changing behaviour is to increase belief that human waste is safe and good for crop cultivation (Were, 2007). Urine acceptability as fertilizing agent for vegetable production among the farmers in Nigeria is enhanced by some of their socio-economic characteristics such as religion, culture and the fertility status of the land.

Religious and cultural issues are going to stand as real barriers to its diffusion among the farmers (Adewole, 2013). In Botswana on the other hand, there are also superstitious reasons for the negative attitude; for example, a widespread belief in witchcraft, which holds that urine as a substance could be harmful. Even the fear of spreading HIV/AIDS through the use of urine in the garden was mentioned (Hanke, 2003 cited in Duncker, *et al.*, 2007).

Some of the interviewees in Zimbabwe stated that defecating on someone's property is seen as a taboo; faeces should be disposed of as far as possible from the household and should never be tampered with. An enemy can use one's faeces to bewitch one; therefore, individuals should be careful on how and where they dispose of their faecal matter (Guzha, 2004, cited in Duncker, *et al.*, 2007). One common way to bewitch a family is to place 'medicine' in someone's toilet. This is a cause for concern among those who intend to use the transformed excreta for agricultural purposes. Although it is rarely talked about, many seem to fear the insertion of 'bad medicine' in their latrines by an angry visitor (Breslin, 2003). According to Duncker *et al.*, (2007) some farmers, practicing urban agriculture in Lilongwe and Blantyre, collected sewage from the disposal site for fertilisation of their plants or gardens. Since consumption of fruits and other crops grown from human waste was seemingly widely accepted in Malawi, the promotion of the arborloo, where old pits are used as planting grounds for crops, was seen as a good practice which would be effective.

Human excreta are generally perceived as dirty and they are not used in South Africa. Some of the respondents said that wet faeces were used to heal wounds. They were also applied to the skin of a person bitten by a snake, to remove the poison. This practice was known to only a few people who participated in the survey. Women who used cow dung to plaster the floors also used babies' first urine of the day to wash their hands, prior to working on the cow dung. It was believed that this practice cast a spell to avoid one's hands being handicapped. This is no longer practised, but urine is used to treat eye infections, though on a minimal scale (Duncker & Matsebe, 2008). Urine is also perceived as harmful to plants, even though babies' urine is used for medicinal purposes, for example treating eye infections. However, people tend to use a night bucket which is emptied in the yard in the mornings. Men and small children also urinate in the garden. In this way

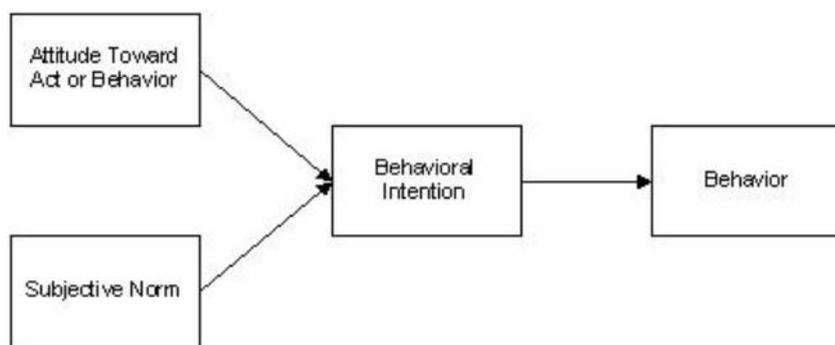
people unintentionally return some of the nutrients in urine to the soil (Duncker, *et al.*, 2007).

Drangert, *et al.*, (1998) reported that faeces are perceived quite differently and are regarded as offensive and unpleasant to handle. Cow dung seems to be less offensive than human faeces. 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 (Tanner & Wijsen, 1993). Such perceptions are difficult to maintain in crowded urban areas and they may gradually disappear, as expected. Another way of approaching people's attitudes to excreta is how sewermen and excreta collectors are viewed (Drangert, 1998). In South Africa, the perceptions and beliefs of the users represent a major stumbling block to the use of human excreta. Even though the use of dry human faeces is promoted, the users feel that it is unhealthy to eat vegetables that are grown in the dry human faeces, especially leafy vegetables that are in contact with the soil. Vegetables such as tomatoes and anything that could be picked of the plant itself and that do not touch the soil are perceived relatively clean and edible, but not lettuce, spinach, cabbage or any vegetable that grows underground (such as potatoes, onions, beetroot, carrots, etc); they are in direct contact with the soil that contains human faeces. Only when the human faeces is processed somewhere else by someone else and becomes unrecognisable as human waste, will it be acceptable to use (Duncker, *et al.*, 2007).

2.11. Theory of planned behaviour

The theory of planned behaviour is useful to this study because it provides a framework for studying human action, perceptions, like behaviour, are influenced by our knowledge, beliefs, values, and norms but can be formed without experience and knowledge of the person. The more knowledgeable we are about human excreta, the clearer our opinion tends to be, and the stronger our (feelings) perception. Similarly, being informed about an issue is even more likely to influence behaviour when knowledge is gained from first-hand experience (Fazio & Zama, 1981 cited in Mariwah & Drangert, 2011). One study found that knowledge about the nutritional value of human excreta will help us to understand and promote behaviour consistent with beliefs and feelings (Wortman, *et al.*, 1992 cited in Mariwah & Drangert, 2011).

According to Ajzen, 2002, human behaviour is guided by three kinds of considerations: beliefs about the likely outcomes of the behaviour and the evaluations of these outcomes (behavioural beliefs), beliefs about the normative expectations of others and motivation to comply with these expectations (normative beliefs), and beliefs about the presence of factors that may facilitate or impede performance of the behaviour (control beliefs). The theory of planned behaviour also assumes that perceived behavioural control, in company with behavioural intention, can be utilized directly to predict behavioural achievement. The theory portrays that behaviour is a function of beliefs pertaining to that specific behaviour.



Source: Fishbein, M., & Ajzen, I. (1975).

Figure 2.7: The theory of planned behaviour (Fishbein & Ajzen, 1975)

The variable names in the model reflect psychological constructs and so they have meaning within the theory (Fishbein & Ajzen, 1975). The theory of planned behaviour has been applied successfully to a number of areas such as healthy eating, hunting, leisure choice, travel mode, unethical behaviour, waste management, and recycling. In this study, recycling was chosen due to the crucial role it plays in conservation of natural resources and solid waste management (Vining & Ebreo, 1992; Hopper & Nielsen, 1991). However, recycling is usually avoided believing that it is inconvenient, messy and requires time and effort (Vining & Ebreo, 1992).

2.11.1. Behaviour

In implementation research, interventions are designed to change the behaviour of individuals. The target behaviour should be defined carefully in terms of its Target, Action and Time (Fishbein & Ajzen, 1975).

2.11.2. Attitudes towards the behaviour

Attitude toward the behaviour is a persons overall evaluation of the behaviour. It is assumed to have two components which work together: beliefs about consequences of the behaviour (Fishbein & Ajzen, 1975). Attitude thus does not predict behaviour perfectly because it is but one contributor to behavioural intentions, potentially tempered by inconsistent normative or control-related psychological constructs.

2.11.3. Subjective Norms (about the behaviour)

Subjective norms are a persons own estimate of the social pressure to perform the target behaviour. Subjective norms are assumed to have two components which work in interaction: beliefs about how other people, who may be in some way important to the person, would like them to behave (normative beliefs) It is furthermore conceivable that the behavioural impact of social norms could be moderated by identification with the group from which the norm originates, as implied by social identity theory and self-categorisation theory (Fishbein & Ajzen, 1975).

2.12. Social Marketing

Social marketing techniques are currently seen as an extremely useful tool in promoting sanitation amongst private households. They involve the application of commercial marketing techniques to advance social goals, in this case the safe use of excreta and grey-water through appropriate sanitation solutions. The marketing side is based on the “four Ps” - Product, Price, Place, and Promotion (Winblad & Simpson-Herbert, 2004). It is clear that attaining the benefits of ecological sanitation still requires a change in how people think about and act towards human excreta. People need to be assisted to overcome cultural taboos if they are to accept human faeces and urine as fertiliser for food crops. Adequate education and hygiene awareness campaigns should accompany the provision of ecosan toilets, both for maintaining public health and for enhancing acceptability of ecosan toilets as a hygienic sanitation solution. In this regard demonstration and visual aids are essential, as they create awareness and enhance understanding. In other countries, demonstration toilets, peer education and peer pressure have been successful in bringing about changes in attitude (WRC, 2007).

In order to increase the number of people benefitting from improved sanitation, there is an urgent need to understand which systems are appropriate in different socio-economic and cultural settings. But a toilet must also be pleasant to use if it is to encourage people to part with their hard earned cash when they could “wrap and throw” for free. In Ghana, disgust with existing public facilities was a major factor encouraging households to consider building private toilets. Elsewhere, a wider desire for cleanliness (environmental and personal) has been important in creating demand for improved sanitation (Jewitt, 2011a). Sanitation promotion is one of the most important roles the health sector can have in environmental health planning, because behaviours must be changed to increase householders' demand for and sustained use of sanitation, especially in rural areas where the pressure for change is lower.

2.13. Conclusion

This chapter provided a literature review surrounding the reuse of human excreta for agricultural purpose and food security. The chapter furthermore explore the theory of planned behaviour as it provides a framework for studying human action, perception, like behaviour are influenced by our knowledge, belief, values and norms but can be formed without experience and knowledge of the person. The next chapter provides research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Introduction

This chapter reviews the research methodology choice and rationale of research design, study area, population of the study, sample, sampling methods and sample size.

3.2. RESEARCH DESIGN AND METHOD

3.2.1. Choice and rationale of research design

The proposed study adopted a qualitative approach. According to Marlow & Boone, (2005) in Matsebe (2011), the qualitative approach involves collecting data that involve non-numerical examination of phenomena, using words instead of numbers. It focuses on the underlying meaning and patterns of relationships. By using qualitative methods, the researcher acquires a better understanding and indepth information about users' perceptions of and attitudes towards the ecological sanitation for agricultural food production. As explained by (Terre-Blanche, *et al.*, 2006, in Matsebe, 2011), qualitative research seeks to make sense of feelings, experiences, social situations, or phenomena in their real world. Therefore it involves studying them in their natural setting. Each research method has its strengths and weaknesses. A qualitative research method was preferred over quantitative research in this study because it provides an understanding of people's personal experiences of phenomena as described by the respondents (Johnson & Onwuegbuzie, 2004 in Matsebe, 2011). The simplest definition is that qualitative methods involve the collection and analysis of information based on its quality and not quantity.

The research also used a case study design by confining itself to Ga-Mothapo community. The case study method is about "asking the 'how' or 'why' questions around a contemporary set of events over which the researcher has little or no control and the focus is on contemporary phenomena within a real-life situation" Using a phenomenological research design enables a direct understanding of the phenomena being studied. This implies that the researcher can understand the circumstances of the object of study because he/she can picture him/herself in the latter's shoes (Welman, *et al.*, 2005 in Matsebe, 2011). By using this method, the researcher must be able to understand the behavioural conditions of the respondents in their own settings (Zaida, 2007 in Matsebe, 2011).

3.2.2. Study Area

The Capricorn District Municipality is situated in the centre of the Limpopo Province, sharing its borders with the Mopani District Municipality to the east, Sekhukhune District Municipality to the south, Vhembe District Municipality to the north and Waterberg District Municipality to the west. The Capricorn District Municipality comprises five Local Municipalities, including Aganang, Blouberg, Polokwane, Molemole and Lepelle Nkumpi. Polokwane local municipality is the study area Ga-Mothapo community, which is located on the eastern part of the municipality, was the focus area of this study.

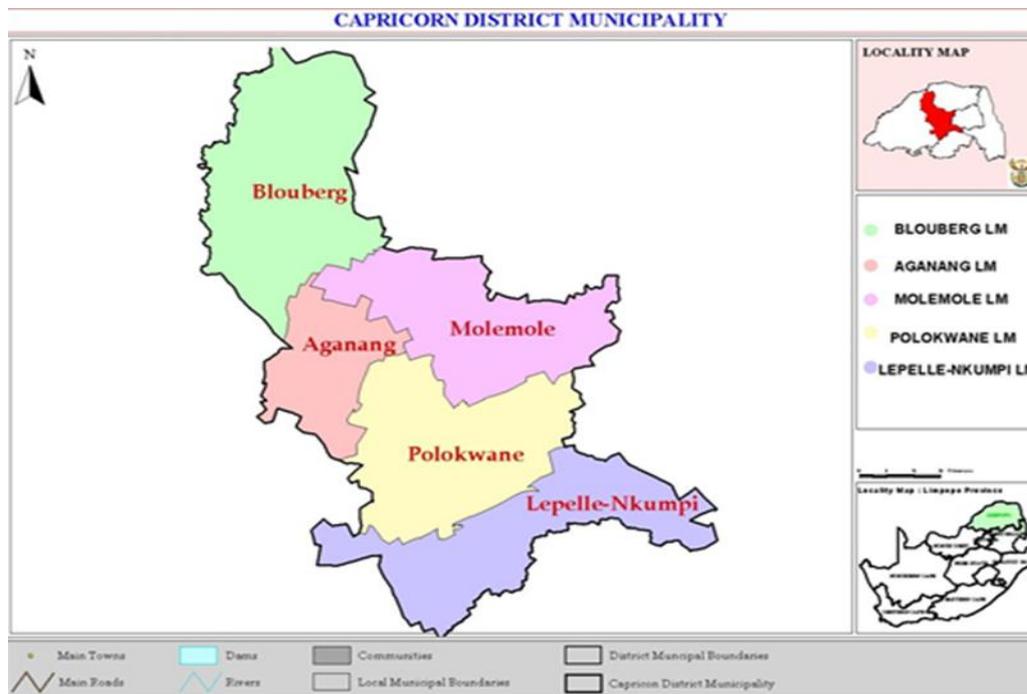


Figure 3.1: Local Municipalities in Capricorn District Municipality (Source: CDM Spatial Development Framework (2007))

3.2.3. Population of the study

Population is a group of elements or cases whether individuals, objects or events that conform to specific criteria and to which we intend to generalize the results of the research (McMillan & Schumacher, 2001). The population for the study was in Ga-Mothapo area which is agricultural dependant community although most of the farmers concentrated on livestock farming but crop production still plays a vital role in their farming activities. The research study focused mainly on the crop production farmers. The general population was about 120 farmers.

3.2.4. Sample, sampling methods and sample size

Babbie and Mouton (2001:164) contends that sampling is the process of selecting observations. Sampling methods are used in research when one is unable to investigate the total population which is involved in the information that the researcher needs to obtain. Purposive sampling was chosen, as it allowed the researcher to sample a small number of participants. Another advantage of this sampling technique is that it uses different non-probability sampling techniques, such as critical case sampling, homogeneous sampling and more. However, it has a limitation in that judgement lies solely with the researcher, which increases elements of bias (Matsebe, 2011). In this study sampling units were households who have vegetable gardens and smallholder crop production farmers in Ga-Mothapo. Six households per village were sampled which gave 30 households in total. Some key informants were also identified.

3.3. Data collection

Data were collected using instrument such as unstructured household interviews, to obtain as much information as possible with a limited sample size. As such, the study conducted qualitative research through the use of unstructured household interviews while validating and cross-checking the responses by physical observation. Data for the study were gathered using face-to-face interviews to obtain responses to an interview guide/schedule. The interview schedule comprised three sections. The first section elicited basic background data on age, gender, education level, income, and income source, source of water, type of crops grown and type of soil improvement of respondents. The second section dealt with respondents' sanitation situation. The third section dealt with respondents' attitudes and perceptions of human faeces and urine.

3.4. Data analysis

The interview schedule contained quantitative data as well as qualitative data. For the purpose of quantitative analysis, the questions that could be quantified were selected and coded the socio-economic characteristics. The data from these quantitative questions were captured and analysed on MicroSoft Excel. Content analysis enabled the researcher to identify important themes that emerged from

data. This type of analysis is inductive in that themes emerge from the data and are not imposed by the researcher (Welman, *et al.*, 2005 in Matsebe, 2011). Content analysis is non-reactive because the process of placing words, messages, or symbols in text to communicate to a reader or receiver occurs without influence from the researcher who analyses its content (Neuman, 2003 in Matsebe, 2011) and it is an ideal for this type of qualitative study. The Nvivo program was used in analysing the qualitative part of the study.

3.5. Conclusion

This chapter is a reflection of how the study was conducted. It showed how the method and procedures the research was employed in the study. It covered the research design, population, sampling, study area, data collection and analysis.

CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents the data management and analysis, research results, and overview of research findings of the study of which are socioeconomic characteristics, sanitation, perceptions and attitudes of the respondents towards human excreta.

4.2. Data management and analysis

Data was collected using the unstructured household questionnaire aiming at 30 households in Ga-Mothapo area of Polokwane Municipality, and only 26 households participated in the study. Data analysis was subjected to Nvivo software for content analysis. Descriptive tools such as percentages and bars were used to summarize the socio-economic characteristics.

4.3. Research results

4.3.1. Gender and household position of respondents

The research revealed that gender distribution of the respondents who participated in the study was 62% female respondents and 38% male respondents. This was due to the fact that, most women in the Limpopo Province are known to represent the dominant gender which is participating in agricultural activities than men. The household interviews revealed that most women were the majority among the household heads and many of them were widows than men as a result, they had to take the responsibility of being household heads, while they were respondents who's household position were children as they are the one who were actively involved in agricultural activities, as shown in figure 4.1 and 4.2.

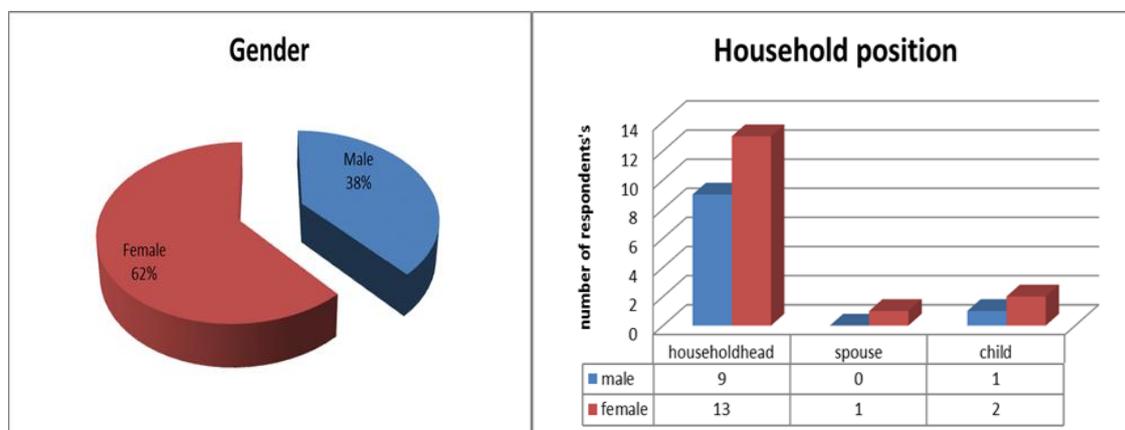


Figure 4.1: Gender of respondent

Figure 4.2: Household position of the respondents

4.3.2. Marital status

Most females in this research showed that their marital status as widows and most males are married and four female respondents were single at the time of the interview.

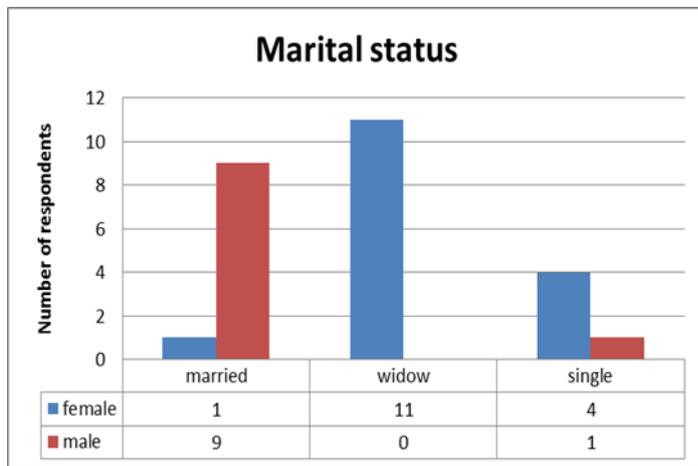


Figure 4.3: Marital status of the respondents

4.3.3. Respondents Level of education

Regarding, the respondents with no or short formal education, 11% (male respondents) had no formal schooling, only 6% of the female respondents had Adult Basic Educational Training (ABET). Amongst male respondents 22% had completed secondary and another 45% had obtained tertiary qualifications, whereas 53% of the female respondents had some primary, and 17% completed secondary school or matric and 12% of them had their tertiary qualifications as indicated in figure 4.4.

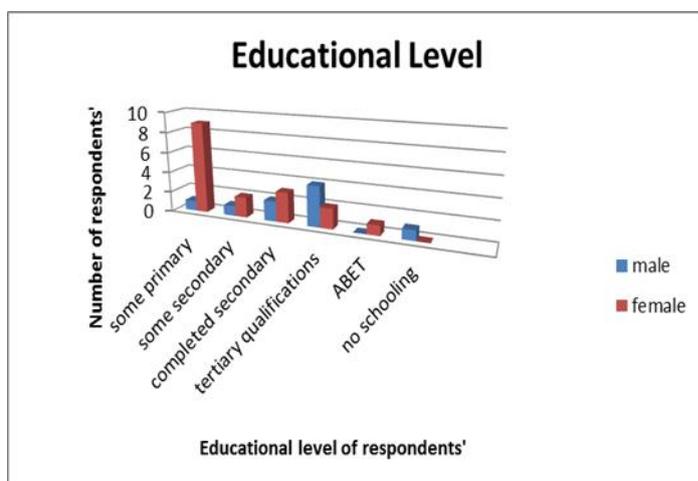


Figure 4.4: Level of education

4.3.4. Average income and source of income of the household

According to this study, data on household income indicated that the majority of the farmers (61%) earned R1200-R3000 and they were pensioners, whereas 35% earned more than R3000, have monthly salary as the source of income (Figure 4.5). 4% earn R801-R1000 on average and the source of income is from social grant; self-employment and their children send money home as shown by figure 4.6.

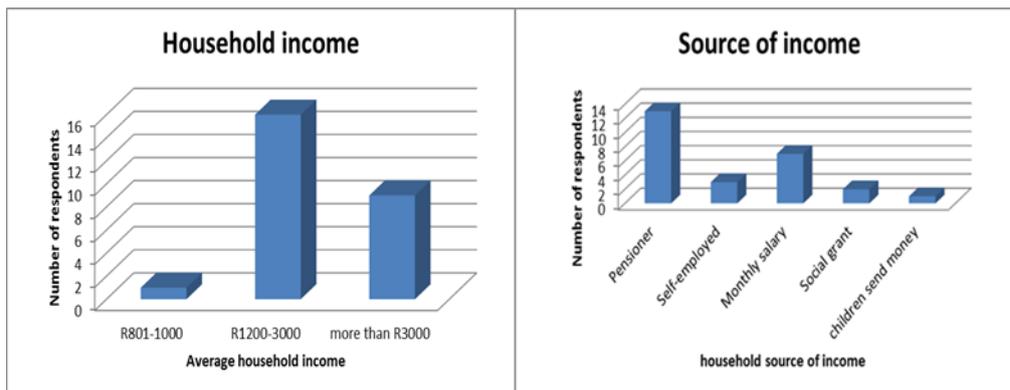


Figure 4.5: Average household income Figure 4.6: Household source of income

4.3.5. Age and farming experience

The study found out that a majority of the respondents (69%) are above 55 years, 31% are 20 to 50 years. The minimum age of the farmers was 20-25 years while the maximum age was 70+ years. The average age of the farmers was 50-55 years. Many of respondents have been farming for more than 10 years. These farmers are smallholders and subsistence farmers (see figures 4.7 and 4.8).

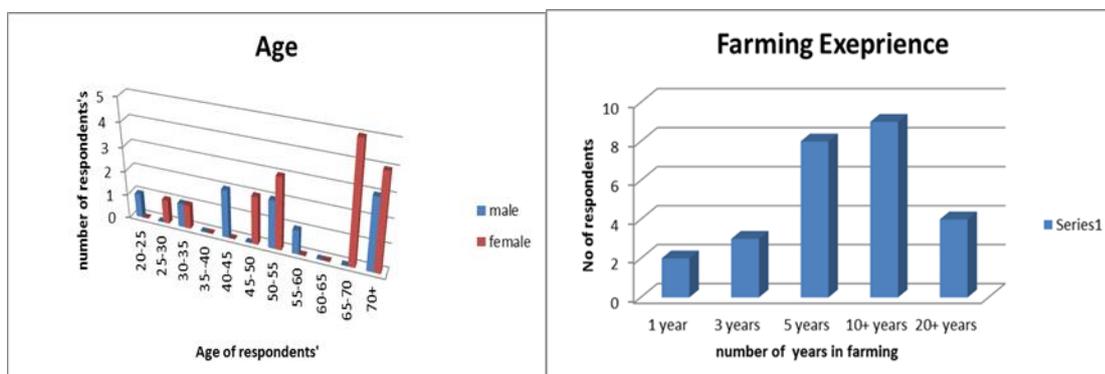


Figure 4.7: Age of respondents

Figure 4.8: Farming experience

4.3.6. Type of crops grown and source of water

This study reveals that the respondents engage in the cultivation of different types of cash crops for home consumption and for income generation for sustainability of their households due to their large family sizes. The 88% of the respondents grow vegetables as compared to 4% who grow fruit. Different water sources are used by the respondents. The 61% of the respondents obtain their water from the borehole. The 19% of the respondents reported having yard taps as a water source, even though the reliability of these was often weak. The grain growers mostly rely on rainfall as their source of water. Only 4% said that they get the water from the spring shown in figure. 4.9 and 4.10.

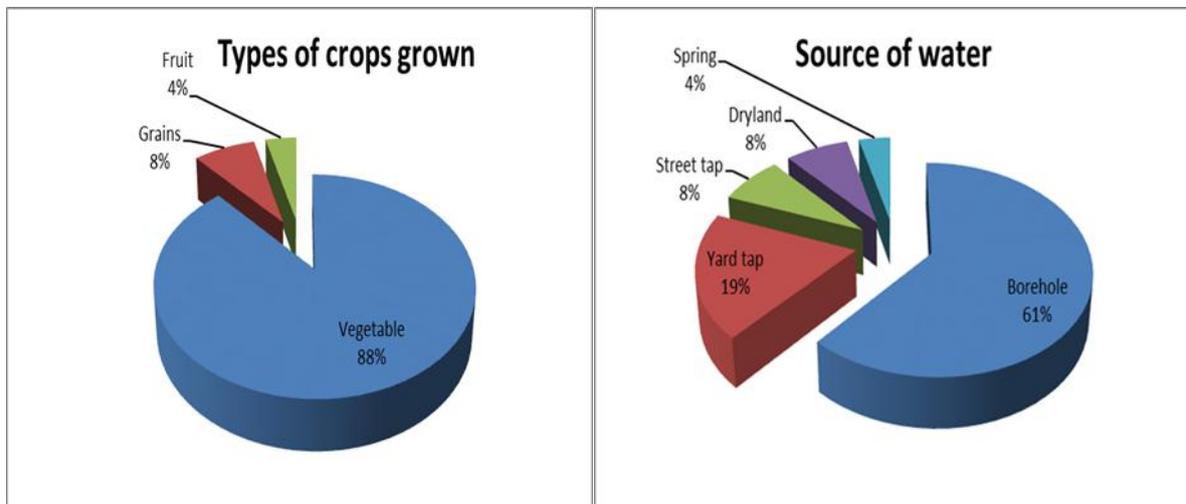


Figure 4.9: Type of crops grown

Figure 4.10: Source of water

4.3.7. Soil improvement techniques

As shown in the pie chart (Figure.4.11: Soil improvement techniques), the major technique being used by the respondents to improve their soil infertility is application of animal manure (35%) and poultry droppings (34%). They were using it because of its ability to improve the soil's water holding capacity. It also improves the performance of vegetables at the same time can be considered cheaper. Only 23% of the farmers were applying fertilizers and 8% use compost to improve their soil.

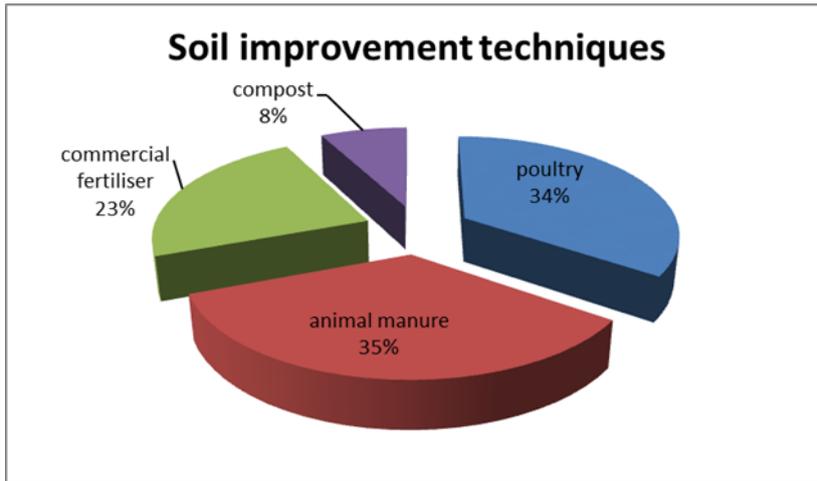


Figure 4.11: Soil improvement techniques

4.3.8. SANITATION

4.3.8.1. Type of toilet

According to the interviewees, the findings reveal that all the people within the study area owned a toilet as the facility in their homes. To answer the question, what type of toilet the respondents had, pie chart (Figure. 12) gives a good overview. As can be seen, the pit latrine accounts for 69% of the responses, while a basic one or as a Urine diversion system (UDS) was recorded at 15% usage; the use of some VIP latrines in the area was also acknowledged, with only 8% of the respondents having them. The 8% of the respondents were found to be using flush toilets in the study area.

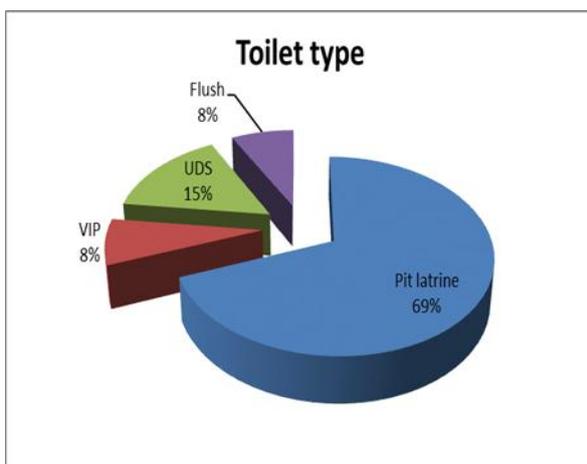


Figure 4.12: Type of toilet used

4.3.8.2. Decision on type of the toilet

The majority of the households are the ones who decided on the type of toilet especially the pit latrines type to erect in their homes and only few of them the municipality erected for them (Urine diversion system) and also the donor erected some type of toilets to the respondents.

4.3.8.3. Respondents whether they like their toilet or not

When the respondents were asked whether they liked their toilet, a majority of them 81% said “yes” they do like their toilet, as revealed by participant 3 who said:

When our families are around they have a place to relief themselves, this is supported in the following excerpts:

I get privacy and I don't help myself in the bush” (Respondent # 14, male, aged 23).

Good sanitation, easy to maintain and easy to keep clean” (Respondent # 23, female, aged 35).

However only 19% of participants said “no” they do not like their toilets, their reasons for not liking it by saying:

It produces a bad smell at times and it doesn't show whether it can be drained or not (Respondent # 13, male, aged 55).

This is corroborated by participant #19 and 23 who had this to say:

After a period of 3 years it will be full and hence there is a need to burn the waste. It is also smelly and therefore is not user friendly (Respondent # 19, male, aged 43).

It can be stinky sometimes (Respondent # 23, female, aged 33).

4.3.8.4. Disposal of urine

The majority of the respondents indicated that the urine is being left out to soak in the pit they do not collect it in a container, only one respondent collects the urine in the container and throw it in the garden.

4.3.8.5. Household action when the toilet vault is full

The respondents were also asked the question, what does the household do when the vault is full? The majority of the respondents indicated that they will crush it and dig new ones, some said that they will use chemicals to burn and empty it whereas only one said that she will use it in the vegetable garden. The diversion of the pit to the side was also acknowledged as another way to deal with full vaults, see figure.20

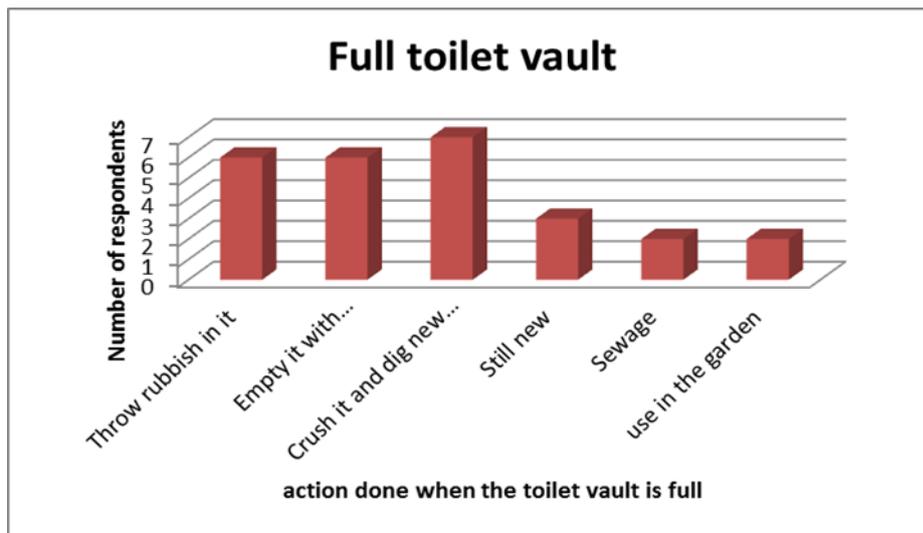


Figure 4.13: Full toilet vault

4.3.9. PERCEPTIONS AND ATTITUDES

The respondents were asked some questions concerning their attitudes and perceptions towards the use of human excreta as a fertiliser.

4.3.9.1. Traditional practical uses of human excreta in the past

Some respondents are aware of some traditional uses of urine especially for medicinal and spiritual purposes. Nine female respondents said they know nothing about it when asked if they knew any traditional practical use of human excreta in the past:

I do not know anything about it (Respondent # 25, female, aged 55)

One female said she thinks that they just had to discard them. Five female regarded human excreta as useful in treating ailments such as eye infections (pink eye), burns from the fire, snake bites and food poisoning. The following excerpt is revealing:

When you suspect food poisoning you urinate in your and drink it
(Respondent # 16, female, aged 59)

Only one man did not answer but the other two regarded human urine as disinfectant to clean wounds and to wash the face to remove pimples; and one man said it was used as the fertilizer for maize.

It was used in farms particularly commercial ones in growing of maize
(Respondent #19, male, aged 43)

Five men said they did not have any opinion regarding human excreta and they thought nothing of it.

4.3.9.2. Knowledge about the use of human excreta for agricultural purpose

The farmers showed little knowledge about the use of human excreta for agricultural purposes. Thirteen respondents do not have any knowledge about it, and the other thirteen said “yes” they do have knowledge about it even though not much as they do know that the University of Limpopo’s experimental farm uses it to fertilize their crops. But they also fear that people might have a negative attitude against it. The following excerpts are insightful:

It can be used productively for agricultural purposes. From the past knowledge I had, it proved to be used in plants particularly vegetables and maize (Respondent # 19, male, aged 43).

I heard that it is a long term process and can be used to build up the soil around fruit trees and flowers or plant based. I heard that both urine and human faeces can be used to make safe organic fertiliser and almost always pathogen free (Respondent #26, male, aged 47).

4.3.9.3. What do the respondents think about human excreta?

Both male and female respondents in all the households interviewed had different ideas, perceptions and what they think regarding human excreta. There were those who were not in support of their use:

They are not healthy when exposed if they are not covered with anything and they are not beneficial and they are not important (Respondent # 2, male, aged 70).

Faeces are terribly smelly and disgusting (Respondent # 3, female, aged 73).

I think human urine and faeces contain harmful organisms, so that we are always told we must wash hands after going to the toilet in order to avoid spreading germs and diseases to others (Respondent # 15, male, aged 56).

They are valuable and can be used for fertilising crops (Respondent #6, female, aged 25).

There were also voices which supported the use of human excreta as shown below:

I think are considered as a waste if you take into account only the humans, other way it can also be sold and creating local markets for fertilizers. But as we know that is human waste therefore needed to be treated separately and used as compost or fertilizer (Respondent # 26, male, aged 47).

4.3.9.4. Cultural meaning attached to human excreta

Cultural meaning attached to human excreta for both male and female respondents was revealed by respondents because about a third of the participants 35% of them said that it is a taboo to use human excreta in the their culture.

The use of human excreta is a taboo to Africans. It was brought to us by whites and therefore it is a taboo. People view it as unclean business also may attract diseases (Respondent #19, male, aged 43).

Only three of the respondents did not answer when they asked about cultural meanings. Even though one respondent remarked:

I have heard about it as being good fertilisers, but they are unhygienic and they bring disease such as cholera, typhoid and gastro-enteritis (Respondent #14, male, aged 25).

This was supported by participant 10 who said:

Our culture and beliefs do not support the use of human excreta maybe other people think it is good to use as medicine as they say it can treat some eye infections by using urine (Respondent # 10, female, aged 66)

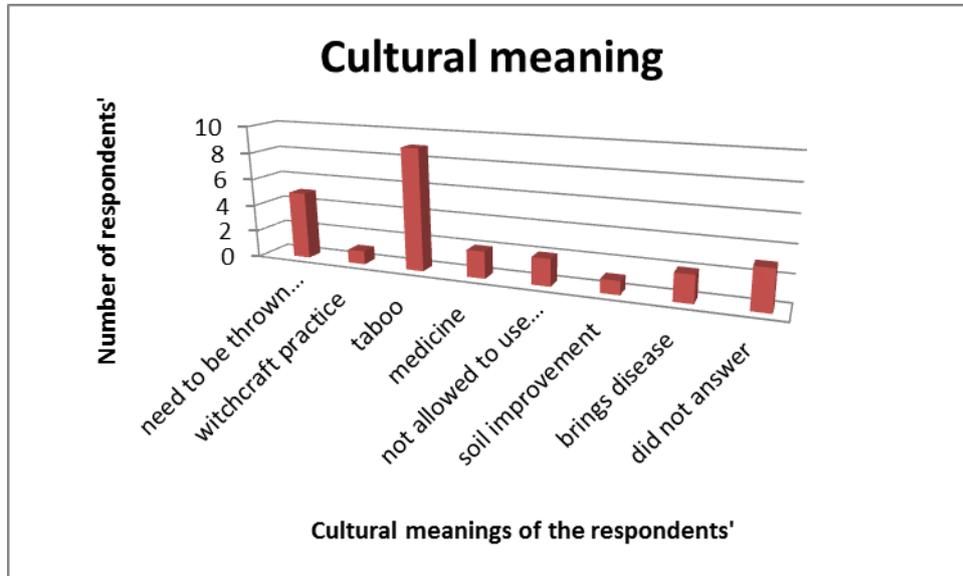


Figure 4.14: Cultural meanings

4.3.9.5. The difference between human excreta and animal excreta

The study also sought to find out: What is the difference between human excreta and animal excreta?

It found that the respondents had varying views regarding the difference between human excreta and animal excreta as 35% said that human excreta are too smelly than animal excreta as revealed in this quote :

Firstly the smelly is not the same as well as the colour and animal faeces are produced from grass and trees while human faeces are produced from many food substances (Respondent # 13, male, aged 51).

The other 23% respondents' indicated that the main diet for animals is grass:

The difference between human faeces and animal faeces is based on the diet; the diet of animals and humans contributes to contents, texture, colour and odour (Respondent # 26, male, aged 47).

Three respondents (11%) said they do not eat human meat hence they eat animal meat, the other three respondents (11%) said there is no difference between both animal and human waste. Two respondents (8%) showed animal wastes are used as a decorating material but not human waste and also another two respondents (8%) said human excreta has potential as a fertiliser, only one respondent (4%) said human excreta is disgusting than animal waste (See Figure. 4.15).

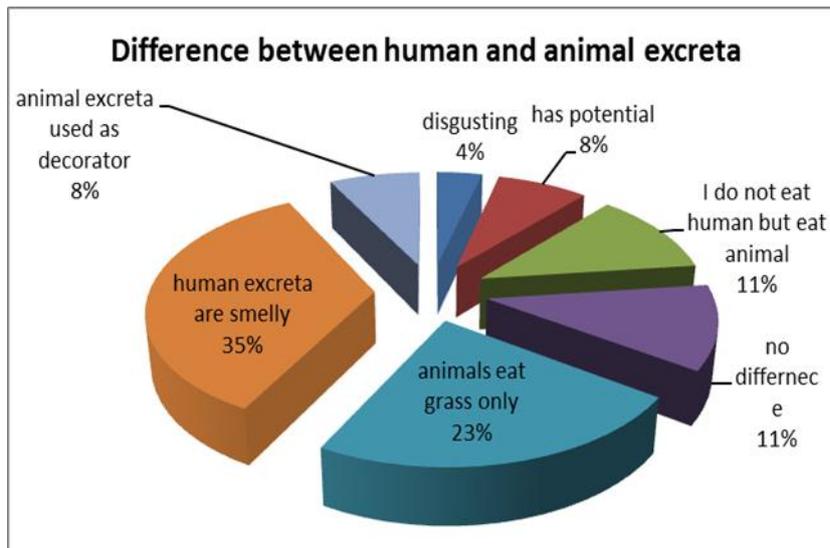


Figure 4.15: Difference between animal and human excreta

4.3.9.6. Acceptability of human excreta for agricultural purpose

In the most parts respondents have a negative view of accepting the use of human excreta for agricultural purposes. It is seen as something “bad, dirty and smelly”. It is also seen as waste, something that has no use and just needs to be thrown away. However, there are respondents who had a more nuanced view on the acceptance of human excreta in agriculture. The 40% of the respondents said “yes” the use of human excreta in agriculture is acceptable against 50% of respondents said “no” saying that it is disgusting and the cultural beliefs do not allow them to use faeces and urine in their gardens. Some said it looks like dirt to them and they contain diseases, they are poisonous to use in the gardens. The smell is terrible and attracts lots of flies and that this may cause contamination of produce. The excerpts below reflect these views:

Health concerns of the people who will be working in the garden and the consumers of the products is of concern (Respondent # 24, male, aged 35)

It is not healthy for my life because it contains diseases and the bad smell the human excreta produce is not acceptable to me (Respondent # 26, male aged 47).

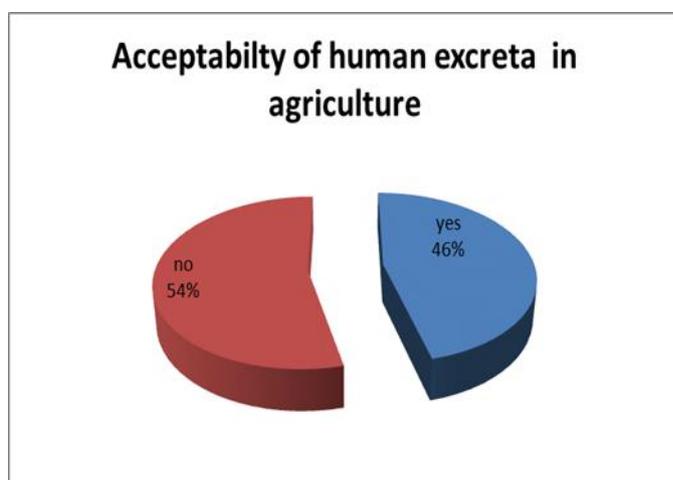


Figure 4.16: Acceptability of human excreta for agriculture

4.3.9.7. Eating food grown from human excreta

When the respondents were asked if they will eat food grown using human excreta 46% of them said “yes” 4% respondent did not answer the question and 50% said “no” they would not eat them (See figure. 4.17) one of the respondent said the likelihood of vomiting is very high when you will be eating and thinking about them; and that there is a belief that the food contains diseases as they are dirty things which are toxic to their health:

Because I fear for my health reasons, the hygienic part of the vegetable, the yard and the garden itself, because they produce bad smell (Respondent # 14, male, aged 25).

Some said they fear that they may get sick and the human excreta are dangerous dirty things and disgusting.

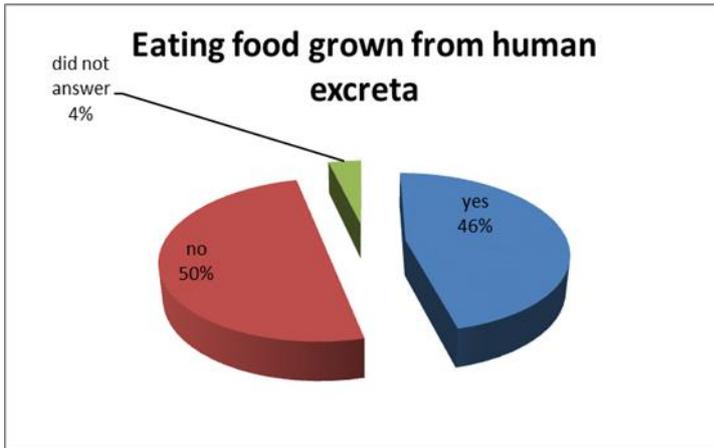


Figure 4.17: Eating food grown from human excreta

4.3.9.8. Handling and touching of human excreta

These responses indicate that touching faeces and urine for most respondents still not acceptable as some indicated that it is disgusting, the thought of smelly faeces that is disturbing. The other respondent said that the reason why we dig a hole for human excreta it is because we are not supposed to touch them. While the majority of the respondents indicated that they do not have a problem with handling as long as it is treated well and not still fresh.

For health reasons and hygienic concerns touching or handling them will be a problem (Respondent #14, male, aged 25).

The other respondents said they do not have a problem handling or touching human excreta, as two respondents confirmed by saying:

I don't have a problem of handling and touching but, not using them for anything else (Respondent # 22, female, aged 69).

I don't have any objection in handling human excreta (Respondent # 1, male, aged 75).

On the contrary, others had this to say:

I just touch it because I take them like any other chemical or animal manure (Respondent # 18, female, aged 71).

I think it will be wise to apply a chemical which can diffuse the smell and by use of gloves it will be something acceptable, if it is handled that way it will be okay (Respondent # 19, male, aged 43).

There is nothing wrong about touching them because we have been touching them when our children were still young changing their nappies (Respondent # 21, female, aged 70).

4.3.9.9. Change of people's mind to start using human excreta for growing food

The majority of the respondents' showed positive thinking when asked what they think will change people's minds to start using human excreta for growing food. In addition, 73% of the respondents indicated that they will definitely change their minds if they get educated and research is conducted. This was corroborated by saying:

If people are enlightened on the benefit of using human waste they will accept it. They must be taught it will increase productivity and yet it is cheaper to get also the experience of those who have done it is a panacea to all experience (Respondent #19, male, aged 43).

Knowledge or starting to make the people or teach them about the importance of it and if there is then they will change their minds and to teach that is totally possible to use human urine and faeces as fertiliser (Respondent #26, male aged 47).

Meanwhile, 27% of the respondents showed that people will never change their minds in terms of using human excreta for growing food; this was confirmed by following words:

The odour, I think once people know what a particular individual consumed, it is difficult to try and convince them otherwise (Respondent # 23).

Nothing will change their minds because human excreta are dangerous (Respondent #7, female, aged 65).

Because of health status of people, they are afraid of being infected
(Respondent # 15, male, aged 56).

4.4. OVERVIEW OF RESEARCH FINDINGS

Findings as per the objectives of the study

This study sought to:

- To investigate the perceptions and attitudes of Ga-Mothapo community towards the use of human excreta as fertilisers for improving agricultural production;
- Identify factors that motivate and/ or demotivate rural households to adopt ecological sanitation;
- To assess people's perceptions regarding the socially acceptability of the practice.

4.4.1. Perception and attitudes towards the use of human excreta as fertilisers for improving agricultural production.

The study showed that people's perceptions on the use of human excreta as something that is disgusting, not healthy for a person if they are exposed not being covered with anything and that they are not even beneficial and important to be reused again. The study agreed with Mariwah & Drangert, (2011), that in considering human excreta for agricultural purpose, it is important to note that actual use of human excreta depends on people's attitude and perceptions. According to Duncker, *et al.*, (2007) human excreta are generally perceived as dirty and are not used in South Africa. However, a study conducted by the CSIR revealed that human faeces have been used in earlier times for various purposes. The idea of reusing human waste in agriculture is still very foreign. Generally, "food and human waste should not be uttered in the same breath" (van Vuuren, 2008).

In this research study, it was revealed that some respondents had little knowledge about the use of human excreta for agricultural purpose and those who knew about it are those who heard that University of Limpopo's experimental farm uses them to fertiliser their crops as Ga-Mothapo, the study area is near to the experimental farm. The respondents even indicated that the faeces especially contain harmful organisms that will even cause diseases. This is in line with Drangert, *et al.*, (1997) who argue that attitudes and perceptions about health hazards, and people's

revulsion from faeces and urine, vary between cultures, and often people's attitudes towards urine differ from those to faeces. Many respondents indicated that it is a taboo to use human excreta for agricultural purpose. Some showed that to use human excreta in the garden or crop field is regarded as witchcraft practice. Cow dung and poultry dropping and other form of fertilizers; seem to be less offensive than human faeces. As the study revealed that most respondents prefer to use cow dung (animal waste) rather than using human waste as a fertilizer to improve agricultural soil. This is corroborated by the fact that even prior to using human waste in agriculture, the mere fact of handling human waste instils fear in many individuals, which may be the result of health and hygiene campaigns promoting hand washing after using the sanitation facilities (Duncker, *et al.*, 2007; van Vuuren 2008 cited in Benoit, 2013). But some of the respondents of which were female of over the age of 70 years revealed that they do not have a problem in handling or touching human excreta of babies not from adults and they indicated that the ones from the babies are safe to handle as they believe that waste are sterile. Whereas others showed that the human excreta should be handled after they have been properly treated and free of pathogens, the respondents were mainly men.

4.4.2. Factors that motivate and/ or demotivate rural households to adopt ecological sanitation

Motivating and demotivating factors for ecological sanitation in the rural areas have already been partly assessed in earlier studies (Gremu, 2004; LSHTM, 2004; Morgan, 2007; Tsirizeni, 2004 cited in Morgan & Mekonnen, 2013). The major motivating factor on the part of households who adopted them and perhaps the most promoted aspect of eco-san toilets are the potential advantages to be gained by the production and use of valuable soil conditioners and/or composts. These have the potential to improve household income and livelihoods (Morgan & Mekonnen, 2013). For Mariwah (2011), the use of organic fertilizer from human excreta could only be achieved through the adoption and use of ecologically sustainable sanitation options. In the study it was found that many of the respondents use animal and poultry dropping/manure as the soil conditioners and only few respondents knew about the use of human excreta as a fertilizer. The farmers also acknowledge the cost of commercial fertilizers as they are very expensive for them to afford. Other motivating

factors are also entrenched within the quest of poor households' to solve persistent problems surrounding access to proper sanitation facilities. Defecation is a fact of life that any conscious being would want to perform in private and in dignity (Morgan & Mekonnen, 2013). The research study showed that most of respondents are using pit latrines (69%) and when the vaults are full they spend more money on buying chemicals to burn them and also some they crush and dig another pit instead of draining the vault and reusing the contents from the toilet vault for their gardens, this was also confirmed by Hanke, *et al.* (2003) cited in Mariwah, 2011, who indicates that the preference for any kind of sanitation facility is influenced by a number of factors, including the absence of smell, the least handling of excreta, low capital and maintenance costs, ease of maintenance, security, privacy and comfort. Benefits of urine diversion toilets include reduced odour, no production of faecal sludge that requires disposal, reduced water consumption, and the collection of pure urine for direct use as fertilizer in agriculture (Morgan & Mekonnen, 2013).

In the study the reason for the respondents to opt for pit latrine is that the flush toilet is not easy for them to have due to the lack of water and pit latrine is easy to erect and maintain. According to Mariwah, (2011), there is a general perception that whatever is used by wealthy people is of high quality and for that matter people associate quality with price. Therefore, the preference for water closet (flush) toilets that are mostly used by people of higher economic status confirms the general perception relating quality to price. In order for sanitation to be successful, people have to experience the toilet as an improvement in their daily life. Therefore, sanitation systems have to be embedded in the local institutional, financial-economic, social-cultural, legal-political and environmental contexts (Netherlands Water Partnership (NWP), 2006 cited in Mariwah, 2011). Most respondents showed that they are the ones who decided on the type of sanitation system mainly pit latrines and those who are using urine diversion system(UDS) the one suitable for ecological sanitation were erected by the municipality and the funding donors.

While the research results show that people are largely (50%) not willing to consume products grown with human excreta fertilizer and to use the fertilizer, as they indicated that for hygienic concerns and health reasons for the yard/garden they will not eat food grown from them. All eco-toilets require far more attention, than the squat and forget type of pit toilet. These include but not limited to the potential health

threat of handling and using poorly processed toilet compost in gardens and on the lands which are not completely rid of pathogenic bacteria (Morgan & Mekonnen, 2013). Forty-six percent acceptance of the EcoSan concept by the respondents and a willingness to consume food grown using human excreta, research showed a certain sensitivity of some respondents towards the produce. This could be either due to the lack of evidence that it is effective, or due to the direct handling of a product containing human excreta substances. Some respondents stated that their unwillingness to use these products is due not to feelings of shame or disgust, but to doubts about the effectiveness of the fertilizer: if other farmers were using these products successfully, they would also use those (Muslim, 2010). However, the amount of nutrients depends on the diet of any one individual, vary depending on the with a culture or the region's diet (Robinson, 2005)

Cultural beliefs are also demotivating factors for the adoption of eco san as most of the respondents remarked it as a taboo, that only animal manure are allowed to be used to grow food. The other belief is that the reasons they dig a hole for the waste is that hygienic and need to be thrown away and people will never eat food grown from them, they need to be discarded. The odour that is produced by the human excreta is disgusting and as well as the pathogens contained in the waste is not what people will be able to handle remarked other respondent. This was also confirmed by (Benoit, 2011) indicating that in the most part respondents have an overall negative view of urine in general. It is seen as something bad, dirty and smelly. It is a waste, something that has no use and just needs to be thrown away. The individual household adoption of ecosan is related to many factors, and only sometimes reflective of the community's sentiment regarding handling human excrement (Robinson, 2005).

4.4.3. People's perceptions regarding the socially acceptability of the practice

The majority respondents have diverging views on the acceptability of the use of human excreta for food security purpose. Some of respondents are aware of the traditional uses of human excreta such as treatment of pink eye (eye infection), food poisoning, to clean wounds and also snake bites; they do not think that human excreta should be used as fertilisers. The other two respondents showed that the use of human excreta is one of the best way to enrich the soil and if the method is applied it will increase production of the crops and also it will be cost effective.

Whereas some believe that human excreta is just not healthy for use in the garden, working on with soil where human excreta has been applied may transmit harmful germs to human. As for handling them respondents remarked that they will never touch or handle fresh and adult human excreta. This is in sync with Furedy & Pitot (2013) who observe that societal values and religious beliefs underpin many waste behaviours and reuse practices. The respondents mostly indicated that it is not acceptable to use human excreta in food production as it possess danger to their health and contamination of the environment will be at risk. Social factors might also play a large role in household's adoption of ecological sanitation. In many cultures, the reuse of human excreta is not an accepted practice. However, households can also behave inconsistent relative to the surrounding culture. In the same vein Robinson (2005) observes that the perception towards the use of human waste in food production was a very crucial indicator of the acceptance level of EcoSan.

4.5. CONCLUSION

This chapter examined the perception and the attitudes towards the utilisation of human excreta in agriculture for food security purpose within the area of Ga-Mothapo. Majority of the households indicated that they are not comfortable with the idea of using human excreta for agricultural purpose showing that it is against their cultural beliefs and taboo to use the waste of human as they prefer to use animal waste instead. The health risk and environmental contamination was also highlighted by the households on the use of human excreta. Even though some respondents mentioned that using human excreta will enrich their depleted agricultural soils, and the cost of buying commercial fertilizers will be reduced.

CHAPTER 5: SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

5.1. Introduction

This chapter presents the conclusions drawn from the findings of the study and recommendations that emerged from this study in terms of perceptions and attitudes towards the reuse of human excreta as a fertilizer for agricultural food security purpose. These findings are presented in a qualitative manner through the use of unstructured household interviews.

5.2. Research design and method

The study adopted a qualitative approach. As explained by (Terre-Blanche, *et al.*, 2006, cited in Matsebe, 2011), qualitative research seeks to make sense of feelings, experiences, social situations, or phenomena in their real world. Therefore, it involves studying them in their natural setting. A qualitative research method was preferred over quantitative research in this study because it provides an understanding of people's personal experiences of the phenomena as described by the respondents (Johnson & Onwuegbuzie, 2004 in Matsebe, 2011). The study employed the interview technique for data collection and analysis using a questionnaire. The interview questionnaires constituted both open and closed ended questions which allowed the respondents to express their feelings on the use of sanitation for agricultural purposes.

5.3. Summary and interpretation of the research findings

The main objectives of the study was to investigate the perceptions and attitudes of Ga-Mothapo community towards the use of human excreta as fertilisers for improving agricultural production; identify factors that motivate and/ or demotivate rural households to adopt ecological sanitation; to assess people's perceptions regarding the socially acceptability of the practice. The majority of rural women and mostly older ones are the people who are involved in food security activities than men. In the study most women had more knowledge about the use of human excreta than men even though it was for traditional uses in the past rather than the use for agricultural purpose. Those women who have that traditional knowledge about the uses of agriculture are the ones with primary schooling as their level of education than men who obtained tertiary education. The research also showed that majority of respondents still regard the use of human excreta as a taboo, disgusting thing that needs to be discarded not to be reused in agriculture for food production purpose.

Respondents are not comfortable in using human excreta, also think that human excreta contain harmful organisms or pathogens that will contaminate their soils and it is not healthy to consume food grown out of human excreta. Most respondents showed that it is not acceptable to use human excreta for agriculture as it is against people's culture and beliefs to use them to produce food only waste from animals are the ones that are more acceptable.

5.4. Conclusions

To sum up, in order to change the household's perceptions of human excreta as a waste product, may require significant education. The idea of utilising human excreta for agricultural purpose, which is ecological sanitation is still very vague in Ga-Mothapo community. The practice still has a long way to go in order to achieve its purpose of being alternative fertiliser to chemical or commercial fertilisers. The ecological sanitation provides the farming community with the safer sanitation system, soil fertility improver and also cost effective fertilisers. It will also ensure provision of food supply which would otherwise be unaffordable to many households, and will provide supplementary income generated from their farming activities. The social and cultural barrier such as it is a taboo to use human excreta as a fertiliser still exists.

5.5. Recommendations

Recommendations on how ecological sanitation can be acceptable to the society at larger are discussed below:

- In order to increase agricultural productivity and reduce poverty it is important to improve women's level of education and empower them through agricultural skills since women are the ones who participate in agricultural activities.
- There is need for constant intervention and awareness to address the issue of food security through ecological sanitation which will promote sustainable agriculture by providing soil with nutrients.
- Trials on the use of human excreta in agriculture may increase the acceptance of the practice by the society. Also the packaging of well treated human waste may increase the acceptance.

- The financial need from public sector and private sector in implementing the urine diversion type of toilet for ecological sanitation.
- There should be focus on ecological sanitation which will ensure improved sanitation by reducing water borne diseases and pollution of the environment.
- Reuse of human excreta should become part of planning of the sanitation sector or waste management sector. The practice of ecological sanitation need to be regulated to ensure public's health is protected.
- Integration of the agricultural sector, the sanitation sector and the waste management sector. The two sectors sanitation and waste management sector will benefits from an integration with the agricultural sector, because recycling of excreta effectively reduces waste management problems: agriculture has a great renewed opportunity in being not only the food supplier for the whole society, but also the waste collector and receiver (Berge, 1994).

Further technical studies and research are essential to know:

- How to use innovative technologies such as ecological sanitation to improve food security and alleviate poverty.
- The impact of climate change on food security with the regard to ecological sanitation.
- How to improve ecological sanitation in rural areas.
- The use of household biogas systems using animal and human excreta as a sustainable energy program.

5.6. Limitations of the study

Participants were households which had backyard gardens, including the smallholder crop production farmers. Due to the nature of this study which is very sensitive, some participants withdrew from taking part.

5.7. Concluding remarks

The utilization of human excreta as a fertiliser has a great potential for improving the depleting soil fertility, soil structure and improving food security at household level. It

will also contribute to the level of agricultural sustainability and productivity also improvement in soil, water and biodiversity.

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APPENDICES

APPENDIX: 1 INTERVIEW SCHEDULE FOR HOUSEHOLD

Date: _____ Name of interviewer: _____

1. SOCIO ECONOMICS:

1.1 Gender

Male	
Female	

1.2 Position in household:

Head of household	
Spouse	
Child	
Grandchild	
Grandparent	
Other (specify)	

1.3 Marital Status

Single	
Married	
Divorced	
Widow	
Other (Specify)	

1.4. Age

< 20 years	
20 -25 years	
25-30 years	
30-35 years	
35- 40 years	
40-45 years	

45-50 years	
50- 55 years	
55-60 years	
65-70 years	
70 years+	

1.5. Educational Level

No schooling	
Some primary	
Completed primary	
Some secondary	
Completed secondary	
Higher / Tertiary qualifications	
Other (specify)	

1.6. Average income per month of household:

Up to R500	
R501 to R800	
R801 to R1000	
R1001 to R 1200	
R1200 to R 3000	
More than R3000	

1.7. Source of income:

Monthly salary	
Seasonal work Period:	
Self-employed	
Pensioner	

Social grant	
Children send money	
Other (specify)	

1.8. Farming experience (years)

Less than 1 year	
3 years	
5 years	
More than 10 years	
Other (specify)	

1.9. Where is the location of gardens?

In the yard	
In communal area	
Outside borders of settlement	
Other (specify)	

1.10. What is your source of water for the garden?

Borehole	
Yard tap	
Street tap	
River/stream	
Other (specify)	

1.11. Which types of crops do you grow?

Vegetables	
Grains	
Fruits	

Other(Specify)	
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1.12. Which type of soil Improvement technique do you apply?

Poultry droppings	
Animal Manure	
Fertilizer application	
Human excreta	
Other (Specify)	

2. SANITATION

2.1. What type of toilet are you using?

Pit latrine toilet	
VIP toilet (Ventilated improved Pit)	
UDS (Urine diversion system)	
Flush toilet	
Other (specify)	

2.2. Who decided on this type of toilet?

Household members	
Municipality	
Funding agency	
Other (specify)	

2.3. How long have the household been using the toilet?

1 – 6 months	
7 – 12 months	
1 – 2 years	
2 – 3 years	

Longer than 3 years	
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2.4. Do you like the toilet you have?

Yes	
No	

2.5. If yes what do you like most about it?

2.6. If no why don't you like it?

2.7. Disposal of urine:

Soak pit	
Collected in container	
Other (specify)	

2.8. What does/will the household do when the vault is full?

Throw it in a rubbish pit	
Use it in the flower garden	
Use it in the vegetable garden	
Other (specify)	

3. PERCEPTIONS AND ATTITUDES

3.1. Do you know any traditional practical use of human excreta in the past?

3.2. Do you have knowledge about the use of human excreta for agricultural purpose?

3.3. What do you think about the human urine and faeces?

3.4. What cultural meanings are attached to human excreta (taboos, religion, witchcraft, medicine, initiation, disease, etc.)?

3.5. What do you think about it?

3.6. What is the difference between human excreta and animal excreta?

3.7. Is the use of human excreta in agriculture acceptable to you?

Yes	
No	

3.8. If no, why not?

3.9. Would you eat food that has been grown using human excreta as the fertilizer?

Yes	
No	

3.10. If no, why not?

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3.11. What do you think about touching or handling human excreta?

3.12. What do you think will change people's minds to start using human excreta for growing food?

Thank you very much for your time and contributions.

APPENDIX 2: PARTICIPANTS' CONSENT FORM
Form of Consent and Respondent Information Sheet

To be filled in by the interviewer prior to the interview

Hello, my name is Maphohla Ennie Maponya and I am a student at Turfloop graduate school of leadership-University of Limpopo. I am conducting research on the Perceptions on the utilisation of sanitation for rural agricultural food security production in Ga-Mothapo community in Polokwane Local Municipality, Limpopo. The aim of the research is to explore the attitudes and perceptions towards the utilisation of urine and faeces as the alternative to chemical fertilizer in a rural agriculture in Ga-Mothapo, Polokwane Local Municipality in Limpopo. The information gathered will be used purely for academic purposes, but the final document will be a public document in the form of a research report. I am asking for 45 minutes of your time.

Participation in this research is voluntary and you are free to withdraw anytime. There will be no remuneration or gifts in exchange for information provided. Your identity will remain anonymous and the information you provide will be confidential. You are entitled to withhold information that you feel is too personal or sensitive to you and you can choose not to answer any of the questions.

If you are willing to participate in this research, please sign this form:

Signature _____ Date _____ Time _____

Place:

Thank you for agreeing to participate in this research study.