THE STATUS OF FAECAL SLUDGE MANAGEMENT IN EIGHT SOUTHERN AND EAST AFRICAN COUNTRIES

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The publication of this report emanates from a project entitled The Status of Faecal Sludge Management in Eight Southern and East African Countries (WRC Report No. K8/1100/11)

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Executive Summary

Background

Sub-Saharan Africa still lags behind in achieving the Millennium Development Goals for sanitation. In 2012, 644 million people in sub-Saharan Africa, that is 70% of the population, used an unimproved toilet facility or resorted to open defecation (WHO/UNICEF, 2014). The percentage for open defecation has dropped by 11% in the period 1990-2012, but the number of people defecating in the open is still increasing in 26 of 44 countries in sub-Saharan Africa.

The statistics of projected growth in population and the rate of urbanisation mean that sub-Saharan cities have an ever increasing population to serve with water and sanitation. As most of the urban poor rely on on-site sanitation, these statistics present a growing challenge for faecal sludge management.

Reported daily collections of faecal sludge show that only a fraction of the estimated volume of faecal sludge to be collected and disposed of daily reaches safe disposal sites. The rest is either used in agriculture or aquaculture or discharged indiscriminately into lanes, drainage ditches, inland waters, estuaries and the sea, or onto open urban spaces, posing a serious health risk.

Managing faecal sludge that reaches safe or legal treatment or disposal sites has its own challenges. Research from around the world indicates that faecal sludge varies widely in physico-chemical characteristics, even within the same city, making management of this waste stream more challenging than wastewater.

Despite the seriousness of the health risk, the management of faecal sludge from on-site sanitation systems does not get the attention it deserves. Development goals focus primarily on providing sanitation facilities and often overlook the need for cost-effective processes to collect, transport, treat and re-use the faecal sludge that accumulates in them, and the operation and maintenance needed to keep the toilets in an acceptable condition.

The Water Research Commission of South Africa has commissioned several projects over the years to solve challenges along the faecal sludge value chain, but further research on faecal sludge management is still urgently needed. For example, there is a general lack of scientific knowledge of how pit toilets work and how fast they fill up. Most disposal and treatment solutions are still in pilot or testing stage, making it difficult for local authorities and private pit emptying service providers to make informed decisions. Moreover, there is a general lack of reliable information in sub-Saharan Africa on the actual numbers of each of the different types of toilets or toilet practices out there and the condition in which they are in.

The Sanitation Research Fund for Africa (SRFA) Project

In 2012, the Water Research Commission, together with the Bill and Melinda Gates Foundation, took a strategic decision to develop capacity in Africa to deal with faecal sludge management. This initiative, known as the Sanitation Research Fund for Africa (SRFA) Project, provides an exclusive research and development grant of up to US$200 000 to African institutions and organisations.

12 African institutions and organisations from eight Southern and East African countries were awarded research grants:

a. **East Africa:** Kenya, Ethiopia and Malawi (2 research teams)

b. **Central Africa:** Uganda (2 research teams)

c. **Southern Africa:** Botswana, South Africa (3 research teams), Zimbabwe and Zambia

The Project comprises two focus areas:

a. The physical and chemical processes occurring in "dry" pit toilets and their contribution to the physico-chemical characteristics of faecal sludge, the level of pathogens and pit filling rates.

b. Technology for desludging, transporting, treating and disposing of faecal sludge, which would benefit people and the environment.

The first task of the research teams was to research the baseline conditions of faecal sludge management in their respective countries. **This report presents a consolidated review of their findings, which cover the sanitation policy environment and faecal sludge management practices in these eight Southern and East African countries.**

Summary of findings

General state of sanitation

The challenges that these countries experience with faecal sludge management in urban and peri-urban areas are similar, but the general state of sanitation differs considerably as figures from the latest WHO/UNICEF report (2014) indicate.

Substantial progress has been made in access to sanitation since 1990; yet only South Africa and Botswana serve more than 50% of the population with an improved sanitation facility.

The figures for toilet facilities are based on infrastructure projects; they **give no indication in what condition these toilets are or how the wastewater and faecal sludge that they collect are managed.**

The enabling framework

Since the 1970s, sanitation programmes focussed mainly on infrastructure development to eradicate open defecation and bucket latrines. (See details of South Africa's bucket eradication programme in the sub-sections on South Africa.)

Sanitation legislation, policy and strategy reflect this drive for infrastructure development. What would happen when the pits were full, were not a concern at the time. As a result, faecal sludge management is largely absent in policy and legislation as the country profiles in the report will illustrate.

The responsibility for sanitation is vested in a range of government ministries and agencies. In most of the countries studied, these ministries include the Departments of Water Affairs, Environmental Affairs, Local government, Health and Education.[1]

In most of the countries, institutional arrangements are complex and fragmented. The structure of local authorities and the delineation between urban and rural jurisdiction vary considerably between the eight countries. In the majority of the countries, implementation is the responsibility of the local authority. Limited capacity, inadequate by-laws and enforcement, action plans and budgets hamper effective faecal sludge management.

In some countries, the distinction between urban and rural sanitation has turned peri-urban sanitation into a no-man's land in terms of policy and legislation - see the Zimbabwe profile.

There are exceptions: in an attempt to consolidate the sector, Botswana, for example, rationalised water and sanitation services under a single state-owned utility in 2009.

National budgets allocate significantly more to water than to sanitation. To meet the Millennium Development Goal for sanitation, sub-Saharan Africa needs to invest an estimated 0.6 percent of its gross domestic product (GDP) annually on sanitation. Five of the eight countries (Ethiopia, Kenya, Malawi, Zambia and Zimbabwe) spent less than 0.6%, according to an AICD DH/MICS Survey Database of 2007 (Morella et al., 2008).

[1]Each country has its own name for these Ministries.

The focus of these limited budgets is on the provision of sanitation facilities, and less on operation and maintenance. As a result, local authorities do not have enough budgeted funds for faecal sludge management.

Water and sanitation made up an average of 6.48% of donor spending in Africa in 2012[2]. Donor funding and other aid to sanitation goes mainly to infrastructure development and health and hygiene education. 80% of aid flows in the water sector were extended in the form of projects (mainly investment projects). Projects for large systems are still predominant and accounted for 41% of total contributions to the water and sanitation sector in 2010-11.

Faecal sludge management in practice

Many issues regarding faecal sludge management have not been resolved yet; as a result there are no common standards and best practices for on-site sanitation:

Pit latrines

Pit latrines are by far the most common on-site facility in informal urban and peri-urban settlements and rural areas.

Only three of the eight countries developed a minimum standard for a sanitation facility: Botswana (the double vaulted VIP latrine), South Africa (the VIP latrine) and Zimbabwe (the Blair VIP latrine).

In Botswana, South Africa and Zimbabwe, there has been large infrastructure programmes to supply sanitation that meets the basic standard.

The wide variety of pit latrine technologies and sludge characteristics in the countries studied makes management of these systems difficult. For example, many pit toilets that the research teams encountered had no slab covering to access the sludge, unlike in South Africa where it is a requirement.

It is commonly acknowledged that pit latrines could contaminate groundwater in certain circumstances. Yet, the literature gives disparate guidelines on the safe distance between a pit latrine and a water source.

Alternative improved options, such as the pour flush, urine-diverting toilet and other eco-sanitation types have been mainly confined to small-scale donor-funded projects. An exception is the eThekwini urine diversion dehydration toilet (UDDT) project. Several research reports mention that the social acceptability of handling and re-using dried or treated faecal sludge or urine on-site remains a challenge.

Operation and maintenance

Pit latrines, even if it is a VIP that is not full yet, continue to be an unpleasant solution due to odour, flies and safety. In practice, eco-san alternatives such as UDDT do not seem to resolve the issue of odour and flies.

The literature on faecal sludge management abounds with pictures of dirty and blocked toilets, but it does not indicate to what extent this problem is an engineering problem or an operation and maintenance problem. When users do not clean up their own urine and faeces spills on the seat and the floor, or faeces sticking to the inside of the bowl, someone has to clean up behind them. If no-one takes this responsibility, and disinfectant and cleaning materials are unaffordable or absent, any toilet, whether waterborne or a pit latrine, will smell and become unhygienic to use. In cities such as Kampala, Uganda, where most pit latrines are communal or shared among households, the problem is exacerbated.

All over the world, from households to public spaces, thousands and thousands, probably millions of cleaners, mostly women, have to clean toilets after they have been used.

Nowhere in the literature have we seen this problem, which is also a gender one, being addressed directly.

The country reports do not make a link between open defecation and dysfunctional or unhygienic toilets. It is likely that open defecation will continue to be practised in Africa as long as there are toilets that are dysfunctional or unhygienic.

[2]http://webnet.oecd.org/dcdgraphs/CPA_recipient/

Also, the reports emphasise that all aspects of the sanitation value chain are affected if solid waste is indiscriminately disposed of into toilets. If solid waste is not regularly removed from peri-urban and urban settlements, some of it end up in toilets.

Full pits

The rate at which pits fill up in a particular country is a function of many variables, such as pit size, soil quality, groundwater level, the number of people who share the latrine, anal cleansing practices and solid waste dumped into the pit. It is therefore difficult to plan a pit-emptying programme that would fit all scenarios. Emptying on demand seems to be the common approach.

Full pits are either emptied or replaced. Where there is space available and soil conditions are favourable, the common practice is to replace the pit.

Sludge removal

Sludge removal technologies are either mechanised or manual, or mixed. Vacuum trucks are the most common mechanised pit-emptying technology. In many low income areas, the plots or the top structures of latrines are not accessible to vacuum trucks and these residents have no choice but to resort to manual removal. In some instances, faecal sludge can only be accessed by removing the toilet or other structural components. Also, vacuum trucks struggle to deal with thick sludge and solid waste found in the pits.

Mechanised pit emptying is expensive and low income residents can't afford vacuum trucks, unless the service is subsidised by the local authority, which the local authority, in turn, cannot sustain.

Innovative pit emptying technologies seldom survive the pilot stage due to a lack of institutional support, maintenance issues such as a spare part that has to be imported or inadequate fees to cover costs.

Manual emptying is still common in areas where people cannot afford the mechanised service or where the mechanised service has broken down or cannot access the pit.

While there seems to be no lack of manual pit emptying entrepreneurs, they lack business skills and the financing to add some mechanised support to their operations. See the eThekwini project in the South Africa profile for an example of a large-scale manual emptying programme. Also, most mechanised options for manual operators have not scaled up beyond the pilot phase as a result of unforeseen mechanical problems or costs. The work conditions of manual emptiers are unpleasant and unsafe, because occupational health and safety measures are mostly absent.

Sludge disposal, treatment and re-use

Inadequate treatment and re-use of faecal sludge seems to be a common problem of most urban local authorities. The country reports mention lack of institutional support, funds and skills.

Most city wastewater treatment plants receive faecal sludge where it is co-treated with wastewater. Shock loads are a risk, but in some African cities, the wastewater treatment plants are dysfunctional irrespective of whether they receive faecal sludge or not. The effect of large quantities of faecal sludge on activated sludge plants still has to be studied further. Various new technologies to treat faecal sludge, such as deep row entrenchment, are being introduced, but there is no single solution yet.

In some countries, treatment plants in the major cities are being upgraded to make provision for faecal sludge. For example, the city of Kampala is currently building two faecal sludge treatment plants with a capacity of 200 m^3/day each, one at Lubigi and another one at Nalukolongo. A donor-funded project, FaME, will be piloting the use of faecal sludge to fuel brick kilns at the Lubigi plant in Kampala.

In the absence of proper regulation and law enforcement, manual emptiers tend to dump their sludge loads as fast as possible and where it is the most convenient, creating a hazard to the environment.

So far, there has not been much success with the on-site treatment and re-use of faecal sludge in the eight countries studied. Eco-san facilities, such as the urine diversion dehydration toilets (UDDTs) and Arborloos, have had slow uptake for various reasons. Residents don't like to handle faecal sludge or they don't perceive these toilets as an improved sanitation facility, because they still have a smell nuisance.

The commercial re-use of faecal sludge takes place on a small scale, but there are some successful and innovative pilots, for example the biogas projects of the Umande Trust in Nairobi and the Dream Team in Zambia.

Considerations for the future

Faecal sludge is a valuable resource that is still largely unexplored. It is evident that challenges and the areas to be addressed listed above call for an integrated management solution that can turn faecal sludge from waste to resource on a large scale.

It is essential that the sanitation managers of local authorities and utilities meet regularly at a sub-Saharan forum to share success stories and lessons learnt. It is also essential that the required budgets, skills and technology are harnessed to solve the faecal sludge problem of African cities effectively.

Possible focus areas:

- *WASH campaigns that include educating children and adults (males and females) to be responsible and hygienic toilet users and cleaners.*
- *Solid waste removal services to informal settlements. Privatising re-cycling services might work.*
- *A cost effective and safe alternative for the pit to solve the problems with pit-emptying and potential groundwater contamination.*
- *Research and development of financially viable and scalable solutions for the treatment and re-use of faecal sludge. The cost-benefit calculation must reverse the money flow, i.e. pay toilet owners or collectors in money or by-products for faecal sludge.*
- *Supportive policy and legislation, and micro financing for the private sector to invest in these solutions.*

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NOORDWES-UNIVERSITEIT

water for people

RHODES UNIVERSITY
Where leaders learn

UBUNTUSAN
THE FUTURE IS OURS TO CREATE

1. Introduction

1.1 The challenge of faecal sludge management in sub-Saharan Africa

Sub-Saharan Africa still lags behind in achieving the Millennium Development Goals for sanitation. In 2012, 644 million people in sub-Saharan Africa, that is 70% of the population, used an unimproved toilet facility or resorted to open defecation (WHO/UNICEF, 2014).

On-site sanitation systems, such as septic tanks, pit latrines of different types and bucket latrines, prevail in both rural and urban areas in sub-Saharan Africa. In fact, in most cities in developing countries, on-site sanitation facilities make up the majority of toilet facilities, because off-site (sewered) sanitation is not feasible or affordable (Koné & Strauss, 2004).

Reported daily collections of faecal sludge show that only a fraction of the estimated volume of faecal sludge to be collected and disposed of daily reaches safe disposal sites (Koné & Strauss, 2004). The rest is either used in agriculture or aquaculture or discharged indiscriminately into lanes, drainage ditches, inland waters, estuaries and the sea, or onto open urban spaces, posing a serious health risk (Klingel et al., 2002).

The causes for the unrecorded and clandestine disposal of faecal sludge are multiple: long haulage distances to treatment sites, non-affordability, the difficulty for mechanical and manual pit emptying services to gain access to toilets in densely-populated areas and the dumping of solid waste into toilets (Ingallinella et al., 2002; Ahmed & Rahman, 2003; Koné & Strauss, 2004; Koottatep et al., 2012; Bakare, 2014).

Managing faecal sludge that reaches safe or legal treatment or disposal sites has its own challenges. Research from around the world indicates that faecal sludge varies widely in physico-chemical characteristics, even within the same city, making management of this waste stream more challenging than wastewater (Ingallinella et al., 2002; Ahmed & Rahman, 2003; Koottatep et al., 2012; Bakare, 2014).

Given the high volumes of sludge produced, and the large number of on-site sanitation technologies, one would expect most developing countries to have faecal sludge management policies and legislation in place. However, this is not the case. Most African countries do not have guidelines for the management of faecal sludge from on-site sanitation systems, except for the guiding documents developed by the Department of Water and Sanitation in Developing Countries (Sandec) at the Swiss Federal Institute of Aquatic Science and Technology (Eawag) (Klingel et al., 2002).

Research on faecal sludge management is still scant. For example, there is a general lack of scientific knowledge of how pit toilets work and how fast they fill up. Most disposal and treatment solutions are still in pilot or testing stage, making it difficult for local authorities and private pit emptying service providers to make informed decisions. Moreover, there is a general lack of reliable information in sub-Saharan Africa on the actual numbers of each of the different types of toilets or toilet practices out there and the condition in which they are.

1.2 The Water Research Commission (WRC) of South Africa

The WRC, the primary water and wastewater research funding organisation in South Africa, has commissioned several projects over the years to solve challenges along the faecal sludge value chain.

In the early 2000s, as a result of the rapid upscaling of dry sanitation technologies in South Africa, the eThekwini Municipality, with the city of Durban at its core, was confronted with the challenge of emptying thousands of pit latrines. The municipality required critical know-how in faecal sludge management. It was evident to the WRC that research and development on faecal sludge management was urgent and of strategic importance. The organisation therefore decided to fund a series of research and development projects to support municipalities with this task.

The research funded by the WRC investigated faecal sludge management with reference to ventilated improved pit latrines (VIPs), the South African basic level of improved sanitation. A series of three volumes was produced:

1. Understanding sludge accumulation in VIPs and strategies for emptying full pits (Still and Foxon, 2012);
2. A scientific understanding of sludge build up and accumulation in pit latrines (Still and Foxon, 2012); and
3. The development of pit emptying technologies (Still and O'Riordan, 2012).

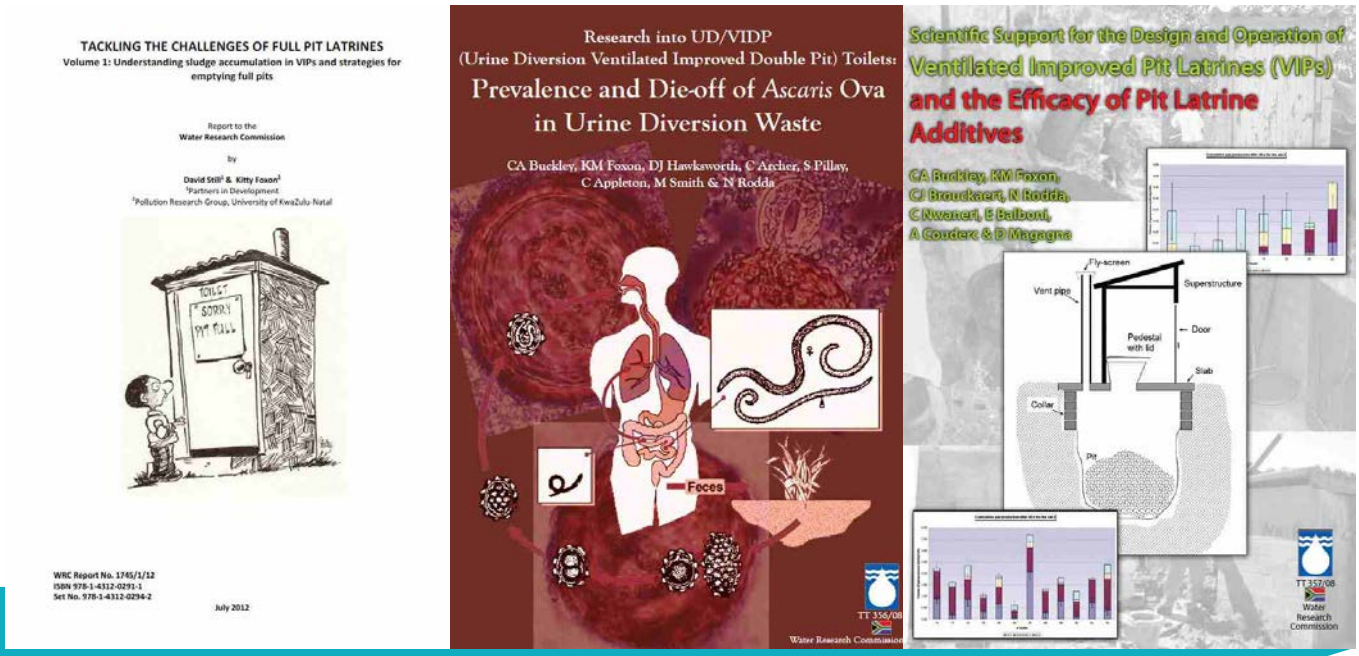


Figure 1. Some of the WRC research reports on faecal sludge management

Over the years, the WRC has continued to commission several research projects to investigate and evaluate options for on-site sanitation systems and faecal sludge treatment technologies. Solutions that stimulate sludge beneficiation, entrepreneurship and job creation are encouraged.

An example of this is the social franchising concept piloted in the Eastern Cape to run the operation and maintenance of the water and sanitation facilities of 400 schools in the Eastern Cape (Wall & Ive, 2013). The improvement of sanitation facilities within the pilot area was so successful that the Department of Education requested that the programme be extended to a further 1,000 schools in the Eastern Cape. The WRC, through a partnership with the African Development Bank, has also recently embarked on a project to upscale the social franchising concept and incorporate innovative technologies into the faecal sludge management chain.

A new programme, in partnership with the Department of Science and Technology and the Bill and Melinda Gates Foundation (BMGF), will pilot the next generation of toilet technologies in South Africa, using innovative processes to transform faecal sludge into products that have commercial value (WIN-SA, 2014).

1.3 The Sanitation Research Fund for Africa (SRFA) Project

The WRC is well aware of the strategic importance to develop human capacity to solve the challenges of faecal sludge management in Africa. A strategic partnership was formed with the BMGF Water, Sanitation and Hygiene Programme to fund solutions and develop capacity in this regard in sub-Saharan Africa.

This initiative, known as the **Sanitation Research Fund for Africa (SRFA) Project**, provides an exclusive grant of up to US$200 000 to African institutions and organisations.

In 2013, an open request for proposals was issued. 12 African institutions and organisations from eight Southern and Eastern African countries were awarded research grants:

a. **East Africa**: Kenya, Ethiopia and Malawi (2 research teams)

b. **Central Africa**: Uganda (2 research teams)

c. **Southern Africa**: Botswana, South Africa (3 research teams), Zimbabwe and Zambia

SRFA Project

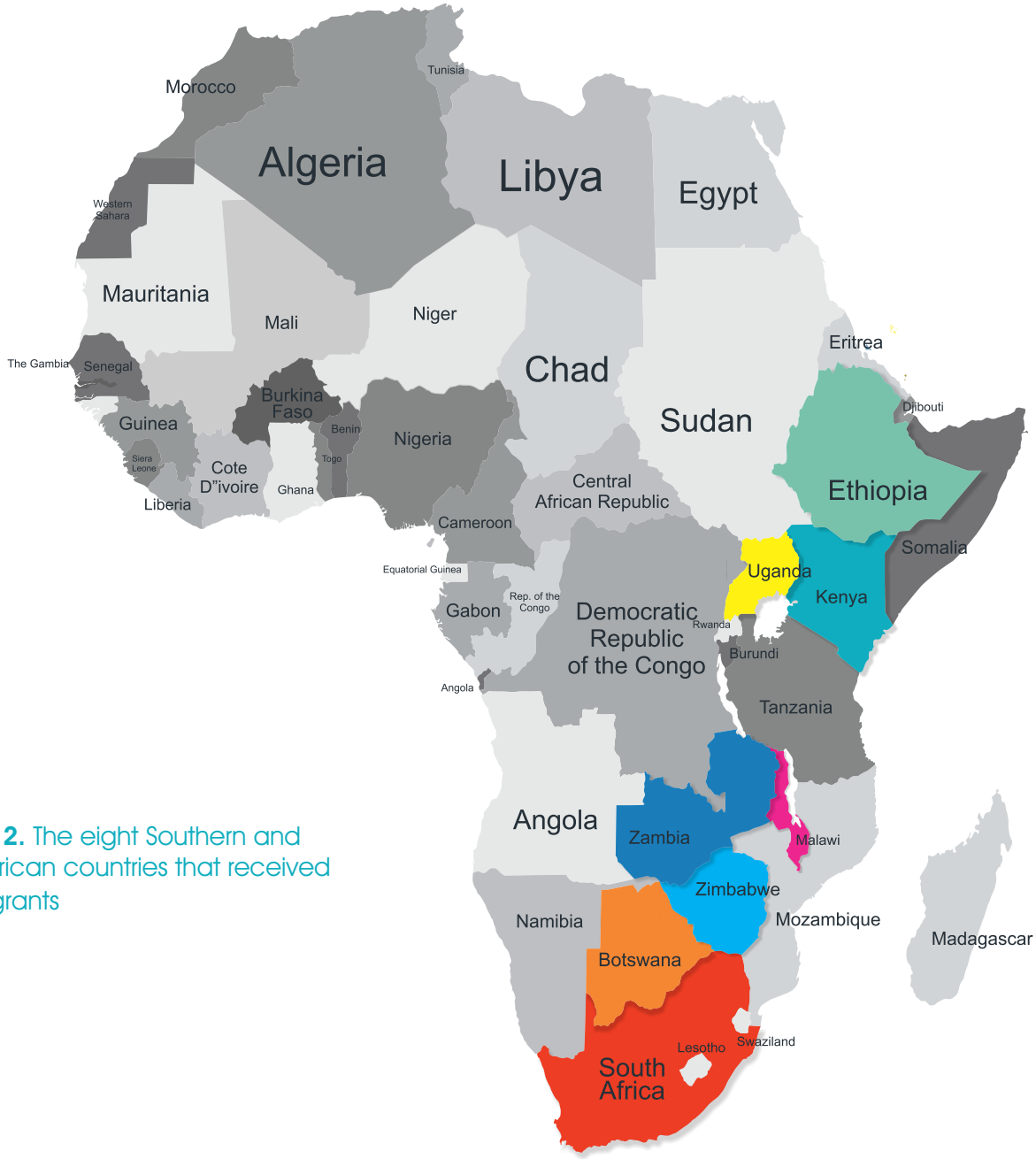


Figure 2. The eight Southern and East African countries that received **SRFA** grants

No more than two research grants were awarded per country. South Africa was the exception, because the WRC provided the funding to two universities.

The WRC's research funding model was applied to the grantee projects: payment based on deliverables and a peer review of project progress through a Reference Group, consisting of the world's leading sanitation experts. The funding makes provision for capital expenses and capacity and competency development in the form of post-graduate studies.

The Project is divided into two focus areas:

1. The physical and chemical processes occurring in “dry” pit toilets and their contribution to the physico-chemical characteristics of faecal sludge, the level of pathogens and pit filling rates (six research teams). The pit characterisation studies aim to expand the knowledge base that the WRC developed with reference to eThekwini to different user habits and local conditions. The results will assist designers and operators of desludging and treatment technologies, and also inform management plans and policies around faecal sludge management.
2. Technology for desludging, transporting, treating and disposing of faecal sludge, which would benefit people and the environment (another six research teams). The treatment processes that the research teams are investigating include solar pasteurisation and hybrid anaerobic technologies (combined with pasteurisation or co-digestion). It is envisaged that the end-products from the treatment processes will be sterile and hold some monetary value, the proceeds of which can be channelled back into the faecal management chain, in particular the operation and maintenance of on-site sanitation technologies (WIN-SA, 2014).

Decentralised anaerobic plant for pit emptiers to reduce transportation costs (Photo: Water for People, Uganda) | Solar pasteurising unit for on-site faecal sludge treatment (Photo: ATL-Hydro, South Africa).

Figure 3: Some of the technologies being piloted in the **SRFA** Project.

The Project provides a mechanism for African researchers to showcase their abilities and develop solutions customised to their environment and the available resources. It also provides an opportunity for African researchers and developers to gain more experience in research-related project management and to learn from a peer review of their work by an international panel of sanitation experts.

1.4 The scope of this report

The first task of the research teams was to research the baseline conditions of faecal sludge management in their respective countries. This report presents a consolidated review of their findings, which cover the sanitation policy environment and faecal sludge management practices in these eight Southern and Eastern African countries.

The report comprises the following subsections:

1. Scope of the report
2. Methodology – the methods used to source and collate the information that the reader will find in this report
3. Definitions
4. The economic context
5. The sanitation policy environment
6. A dashboard of the status of sanitation in eight Southern and East African countries
7. A short profile of the individual countries:
    - i. Main issues
    - ii. On-site facilities
    - iii. Faecal sludge management practices
8. Conclusions

2. Methodology

The country studies used mainly two types of research methods:

1. Desk research to report on faecal sludge management in **sanitation policy and legislation, and institutional arrangements**; and
2. Primary research in the form of field visits, surveys, in-depth interviews and focus groups to report on faecal sludge management practices in specific areas of the capital or main cities of the country.

   Some reports also relied on desk research to report on faecal sludge management practices in general in that country.

   The research institutions, the coverage of findings on faecal sludge management practices and their research methodologies are summarised below:

   Botswana

   - University of Botswana
   - Coverage: The whole country
   - Method: Desk research

   Ethiopia

   - Jimma University and Ministry of Water and Energy
   - Coverage: Addis Ababa
   - Method: Household survey: 40 households from 2 districts in 5 sub-cities – randomly selected

   Kenya

   - Egerton University
   - Coverage: Major urban areas: Nairobi, Kisumo, Mombasa
   - Method: Desk research

   Malawi

   - University of Malawi
   - Coverage: Ntopwa settlement in Blantyre
   - Method: Household survey: 221 households, randomly selected

   South Africa

   - ATL Hydro: Coverage – national; methodology – desk research
   - Rhodes University: Coverage – Eastern Cape municipalities; methodology – desk research
   - University of North West: Coverage – North West Province; method – interviews with municipal officials (no numbers) and 43 residents in 10 municipalities

   Uganda

   - Makarere University: Coverage – mainly Kampala; method – desk research
   - Water for People: Coverage – national; method – desk research and seven stakeholder interviews

Zambia

- University of Zambia
- Coverage: Lusaka only
- Method: Desk study: one stakeholder workshop and four community Focus Group Discussions (one in each of the four selected study areas) — latrine surveys (25 in each of the study areas and administration of a total of 115 household questionnaires on sludge handling and utilisation in the four study sites)

Zimbabwe

- Chinhoyi University
- Coverage: Eight urban centres, including the cities of Harare and Buluwayo
- Method: Site visits and field observations; interviews and focus group discussions with local officials, NGO staff and community members (no numbers)

The country reports were supplemented with information from the following sources (see references):

- The websites and reports of local water management institutions and research organisations.
- Websites and reports of international organisations, such as OECD, WaterAid, USAID, UNICEF and the World Health Organisation (WHO).
- Statistics from WHO/UNICEF and the World Bank.

In the next chapter, the basic definitions are presented to provide the reader with a better understanding of terminology and the concepts presented later in the report.

3. Definitions

The report uses the following definitions of key terms and technologies:

3.1 Faecal sludge management[3]

3.1.1 Faecal sludge

For the purpose of this report, faecal sludge will be defined as human excreta that is disposed of in facilities located on a housing plot (on-site sanitation facilities) and in fields, forests, bodies of water or other open spaces (open defecation) (EAWAG/SANDEC, 2008). EAWAG/SANDEC (2008) also uses the following technical definition: "Faecal sludge is the general term for undigested or partially digested slurry or solids resulting from storage or treatment of black water or excreta".

This report does not consider sludge from septic tanks as faecal sludge as it is biochemically more stable due to longer storage periods than sludge from dry sanitation installations. On the other hand, sludge from septic tanks is often collected and treated together with faecal sludge. In this instance, the report will mention sludge from septic tanks.

3.1.2 Faecal sludge as a health hazard

In many developing countries, increasing urbanisation has led to a backlog in services, such as housing, water and sanitation. As a result, large informal settlements or slum areas with inadequate water and sanitation services have become typical of cities in developing countries. Large quantities of faecal sludge accumulate in these areas, which may have the following negative effects on the urban environment and on public health (Klingel et al., 2002):

- Environmental pollution is caused by effluents of not regularly de-sludged on-site sanitation facilities;
- Large amounts of faecal sludge removed from sanitation facilities are dumped indiscriminately into the environment due to a lack of disposal facilities;
- Faecal sludge is used in unhygienic ways in agriculture because no sludge treatment is available.

Proper management of faecal sludge can avoid these problems.

3.1.3 Faecal sludge management

According to EAWAG/SANDEC (2008), faecal sludge management comprises the following aspects:

- Legislation, policy and strategy to set objectives and criteria
- Implementation
  - Collection
  - Treatment
  - Re-use and disposal
  - Responsibilities, communication and coordination; financial arrangements, timeframe

[3] Faecal sludge management as defined by Klingel, Montangero, Konè and Strauss (2002).

3.1.4 Collection and discharge

Collection is either manual or mechanised. The most basic manual collection method involves climbing into a pit with shovels and buckets and hoisting the sludge up and into some container. Safety equipment is typically absent. More advanced methods involve some mechanised apparatus that pumps the sludge out of the pit. The sludge gulper, the diaphragm pump, the motorised pit screw auger, the nibbler and MAPET are innovations that have been used in pilot studies (Strande et al., 2014).

Vehicle-mounted mechanised methods include the following:

- The conventional vacuum tanker is often the favoured technology when able to access the housing plot and the pit, because there is minimal contact with the pit contents and it is more efficient in evacuating sludge than its alternatives (Eales, 2005). A hose connects the pit contents to a truck-mounted tank (1–10 m^3 in capacity) and a vacuum pump is connected to the tank (Klingel et al., 2002). Large trucks often have difficulty accessing pit latrines or septic tanks in areas with narrow or non-driveable roads.
- In 1997, with the sponsorship of UN-HABITAT, the Vacutug was developed and piloted in Nairobi, Kenya. The aim was to develop a pit latrine exhauster that was suitable for areas that are inaccessible to vacuum trucks. The simple design consists of a small gasoline engine, a 500-litre tank and a 4 m PVC hose that can suck up to 1700 litres of sludge per minute. The vacuum can be reversed to discharge the faecal sludge at a centralised facility or collection point. The Vacutug requires two operators and can move at speeds of up to 5 km per hour. Ideally, the point of discharge should be within 1 km of the service area. Since then, four further versions were developed, but there was no reference to their use in the countries studied.

Discharging practices include adding the faecal sludge to the urban wastewater stream for co-treatment in wastewater treatment plants, sea outfalls, burial onsite, disposal at landfill sites, agroforestry, and taking the sludge to a point where it is treated for re-use.

3.1.5 Treatment and re-use

Klingel and co-authors (2002) identified a list of faecal sludge treatment processes that the authors considered potentially suitable for developing countries. These are:

- Solids-liquid separation;
- Settling/thickening tanks or ponds (non-mechanised, batch-operated);
- Unplanted drying beds;
- Constructed wetlands;
- Pond treatment of faecal sludge supernatants or percolates;
- Combined composting with organic solid waste; and
- Anaerobic digestion with biogas utilization.

New treatment technologies still being experimented on or in pilot stage include :

- Pyrolysis – the thermal decomposition of human solid waste in an oxygen-free environment to produce biochar;
- Electrolysis – using electrical currents to break down the chemicals in human liquid-waste;
- Pasteurisation – a heat treating process which thermally sterilises human waste;
- Plasma gasification – using microwave technology to gasify human waste; and
- On-site membrane technology to purify liquid waste through filtration.

According to Sudhir Pillay of the WRC, despite 10 years of further research, there is currently still no definite conclusion as to which treatment method is the most suitable as the physico-chemical properties of faecal sludge is highly variable and most solutions have not been demonstrated at scale (Personal communication, 2015).

3.2 The sanitation ladder

In line with the approach of the World Health Organisation (WHO), this report presents sanitation statistics as a four-step ladder (WHO/UNICEF, 2013):

Figure 4. The sanitation ladder

3.3 On-site sanitation

WHO/UNICEF (2013) group sanitation facilities as follows:

Open defecation[4]	**Defecation in fields, forests, bushes, bodies of water or other open spaces, or disposal of human faeces with solid waste.**
Unimproved	Facilities that do not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines and bucket latrines.
Shared	Sanitation facilities of an otherwise acceptable type shared between two or more households. Shared facilities include public toilets. Only facilities that are not shared or not public are considered improved.
Improved	Facilities that ensure hygienic separation of human excreta from human contact. They include: • Flush or pour-flush toilet/latrine to piped sewer system, septic tank or pit latrine; • Ventilated improved pit (VIP) latrine; • Pit latrine with slab; • Composting toilet.

3.3.1 On-site sanitation facilities

EAWAG/SANDEC (2008) defines on-site sanitation as "a system of sanitation whose storage facilities are contained within the plot occupied by a dwelling". On-site sanitation can be classified into two main categories: wet (which requires water for flushing) and dry (which does not require water for flushing). Pit latrines, VIPs and urine diversion (UD) toilets are all forms of on-site sanitation (Tissington, 2011).

[4] Open defecation encourages the spread of faeces-related diseases, such as diarrhoea, worm infestation, typhoid, cholera and dysentery. Water pollution is also caused by the run-off surface water from areas where people have openly defecated.

On-site sanitation facilities can be either **unimproved** or **improved**.

Sanitation statistics sometimes also refer to sanitation facilities as basic, safe or 'adequate'. For example, the WHO/UNICEF definition for "adequate sanitation at home" for post-2015 refers to:

- Using an improved sanitation facility at home, and
- Sharing this facility between five households or less.

This report refers to 'unimproved' or 'improved', but it will also use the description of the respective countries where applicable.

3.3.2 Unimproved on-site facilities[5]

3.3.2.1 Simple pit latrines

The basic elements of a pit latrine are: a hole dug in the ground, a squatting slab and a super structure erected over it. The excreta falls into the hole where the urine and other liquids soak into the ground and solid materials are retained and decomposed in the pit.

Pit latrines are a drop-and-store sanitation system. Little or minimum operation and maintenance are required and not much focus is given to the facilities until they eventually fill up with the faecal matter and other materials dropped inside. The problem-in-waiting emerges when the pit requires emptying or replacement.

Advantages:

- a better solution than open defecation,
- easily constructed and cost effective,
- does not require water to operate, and
- the technology is simple and understandable.

Disadvantages: Simple pit latrines attract flies and create a smell nuisance, frequently collapse if not well lined, can pollute groundwater and are not easy to construct on rocky ground.

3.3.2.2 Hanging latrines

Hanging latrines are toilets built over the sea, a river, or any other body of water, into which excreta drops directly (WHO/UNICEF Joint Monitoring Programme, 2015).

3.3.2.3 Bucket latrines

Bucket latrines refer to the use of a bucket or container, usually placed in a hole under the floor, for the retention of excreta, along with anal cleaning material, which needs to be periodically removed for treatment, disposal, or use as fertiliser (WHO/UNICEF Joint Monitoring Programme, 2015).

3.3.3 Improved on-site facilities

Facilities that are classified as improved on-site sanitation include the following:

3.3.3.1 Waterborne sanitation with a septic tank

Septic tanks are watertight buried receptacles that are designed and constructed to receive waste from waterborne toilets.

3.3.3.2 Riflo septica sanitation system

Developed in Italy, and introduced to Kenya by Riflo Industries, this system is similar to a septic tank and uses micro-organisms to biodegrade toilet waste and the discharge is recyclable water. The unit is available in a wide range of sizes for domestic, commercial and industrial sanitation and costs between US$ 750 to US$ 1000 (Egerton University, 2014).

[5]Definitions from http://www.wssinfo.org/definitions-methods/watsan-categories/

3.3.3.3 Aqua-Privy

An aqua-privy functions in a similar manner to a septic tank whilst avoiding the need for a consistent water supply to operate a flush toilet. It consists of a squatting plate constructed above a small septic tank that has an integral drop pipe that is submerged into the water tank to form a water seal (Egerton University, 2014).

Regular emptying and maintaining the water level are burdensome requirements. Failure to maintain the water seal has been the main problem. This leads to intense odour release and fly and mosquito nuisance. The aqua-privy has no advantage over pour-flush, which is less expensive and easier to maintain.

3.3.3.4 VIP latrines

Ventilated improved pit (VIP) latrines can overcome the disadvantages of the simple pit latrine. The basic elements of a VIP latrine are a pit, a cover slab and ventilation pipe hole, a super structure for privacy and protection from weather, as well as a fly screen to keep the latrine free from flies and odours. See illustration below. To deal with overflow, VIP latrines are sometimes connected to a septic tank (Makerere University, 2014).

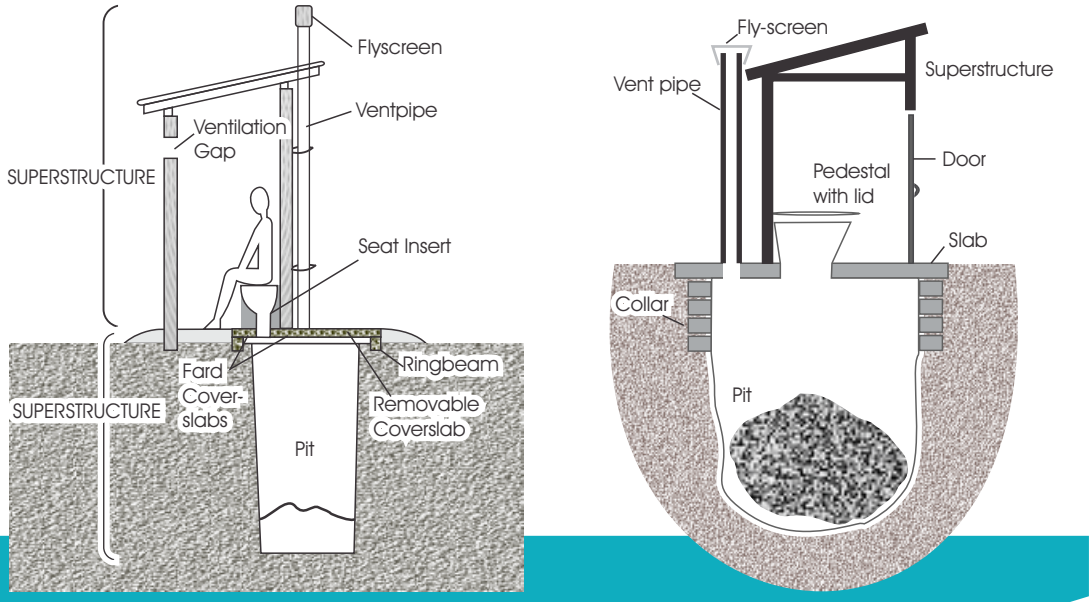


Figure 5. The BOTVIP (left) and The South African VIP (right) (Odirile et al., 2013)

3.3.3.5 The Blair VIP latrine

The Blair VIP latrine has been developed by the Zimbabwean Blair Research Institute, now called the National Institute of Health Research.

The main disadvantages are the high costs, and the fact that the design does not seem to enable the easy emptying of pits when full.

3.3.3.6 Pour-flush Toilet

A water-seal is created by a plastic U-bend that prevents odour and flies (this system is less susceptible to building errors than the VIP system). The system only requires a few litres of water and so should not put a strain on resources (Harvey et al., 2002; Ahmed & Rahman, 2003). The Water Research Commission of South Africa, together with Partners in Development, has recently began piloting an innovative variation of the pour–flush toilet that prevents blockages from toilet paper and newspaper (Pillay, 2014).

3.3.3.7 Urine Diverting Dry Toilet (UDDT)

A Urine Diverting Dry Toilet (UDDT) is a toilet that operates without water and has a divider so that the user, with little effort can divert the urine away from the faeces. The UDDT toilet is built in such a way that urine is collected and drained from the front area of the toilet, while faeces fall through a large chute (hole) in the back (EAWAG/SANDEC, 2008). The UDDT, unlike other sanitation systems has two outlets and two collection systems that separate the urine and the faeces in order to simplify their safe recycling and the use of their unmixed nutrient content (Kvarnström et al., 2011).

The UDDT is applicable where water is inadequate for waterborne systems and the ground condition has unstable soils, rocky ground or flooded area and generally not suitable for construction of pit latrines. Education and demonstration projects are essential in achieving good acceptance with users (EAWAG/SANDEC, 2008).

3.3.3.8 Ecological compost latrines

Two types are found in the countries studied: single-pit or single-compartment latrines (for example, Arborloo) and twin-pit or twin-compartment latrines (often called Fossa alterna).

Composting latrines are shallow vaults, into which excreta, kitchen waste and similar materials are added. The waste and excreta break down together to produce a compost which can be dug out and used as fertiliser.

The Arborloo or Eco-pit is the simplest type of ecological sanitation system. A sanitary slab and a light weight latrine super structure is placed on a shallow un-lined pit (as deep as the soil conditions allow) and when the pit is full, the slab and the super structure are moved to a new pit and the existing pit covered and a tree planted on top of the pit (Egerton University, 2014).

In a twin-compartment latrine or Fossa alterna there are two shallow vaults, one of which is used at a time. When one is nearly full, it is covered with soil and left for at least two years for the excreta and waste to decompose and for the pathogenic germs in it do die. While the first vault is closed, the second is used. When the second is nearly full, the first is opened, the compost dug out for use as fertiliser and the first vault re-used (WHO, no date).

Compost formed by the combination of urine and faeces is better, but these toilets are more likely to smell if used carelessly and they require much greater quantities of carbonaceous residues like sawdust and straw. Many of the more complex types require dry access under the toilet via a basement or cellar room (Pickford, 1995).

4. The socio-economic context

4.1 Overview

The table below gives a brief overview of the eight countries' political stability, population growth, the increase in urbanisation, economic growth, gross domestic product per capita and donor involvement in sanitation.

Table 1. Overview of economic and political indicators in eight Southern and East African Countries

Country	Population increase (1990-2011)	Increase in urban population (1990-2011)	Average GDP growth in past 5 years[6]	GDP[7] per capita, 2013 in US$	% Donor spending on water and sanitation (2012)[8]	Donor spending per capita (US$ million) 2012[9]	Political stability
Botswana	1,47%	20%	+/-5%	7,315.0	0,9%	63.2	Stable democracy
Ethiopia	1,75%	4%	+/-10%	505.0	7,31%	30.6	Stable democracy Largely uncontested ruling party
Kenya	1,77%	7%	+/-6%	1,245.5	7.6%	49	Unstable democracy Security threats posed by local militants
Malawi	1,64%	4%	+/-4.5%	226.5 Down from 2010	5.53%	55.7	Stable democracy
South Africa	1,37%	10%	+/-2.5%	6,617.9 Down from 2010	0.4%	21.8	Stable democracy
Uganda	1,95%	5%	+/-5.5%	57.0	5.52%	44.8	Stable democracy
Zambia	1,71%	0%	+/-7%	1,844.8	7.66%	69.3	Stable democracy
Zimbabwe	1,22%	10%	+/-8% Down from 2012	953.4	7.83%	47.8	Vulnerable but stable democracy

Sources: (CIA, 2015), (The World Bank, 2015b), (WHO/UNICEF, 2014)

The population growth (annual %) in sub-Saharan Africa was last measured at 2.53% in 2011, according to the World Bank (2015b). The statistics of projected growth in population and the rate of urbanisation mean that sub-Saharan cities have an ever increasing population to serve with water and sanitation. As most of the urban poor rely on on-site sanitation, these statistics present a growing challenge for faecal sludge management (WHO/UNICEF, 2014).

[6] http://www.imf.org/external/pubs/ft/reo/2014/afr/eng/sreo1014.pdf

[7] GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Figures are in current US$.

[8] http://webnet.oecd.org/dcdgraphs/CPA_recipient/

[9] http://webnet.oecd.org/dcdgraphs/CPA_recipient/

4.2 Donor aid for sanitation

Sub-Saharan Africa received 25% of total aid to the water sector. Water and sanitation made up an average of 6.48% of donor spending in Africa in 2012[10].

Projections for aid until 2017 are stable. The amounts remain the same, but population increases lower the amount per capita (OECD, 2012). Per capita Country Programmable Aid[11] is slightly down from the average of 38.7 million US$ per capita in 2010-2012 to 36.9 million US$ projected for 2017.

Aid to water and sanitation is predominantly in the form of infrastructure investment projects. In 2010-2011, the distribution of Development Assistance Committee (DAC) members' bilateral flows in the water sector by aid modality was as follows (OECD-DAC, 2013):

- 80% of aid flows in the water sector were extended in the form of projects (mainly investment projects). Projects for large systems are still predominant and accounted for 41% of total contributions to the water and sanitation sector in 2010-2011;
- 6% were allocated through sector budget support mainly by the EU institutions;
- 6% through technical assistance;
- 5% through pooled contributions to specific purpose programmes managed by international organisations, e.g. Inter-American Development Bank Water and Sanitation Fund, UN-Habitat Trust Fund for Water and Sanitation, World Bank Water and Sanitation Programme;
- 2% through pooled contributions to basket funds.

Below is the breakdown of aid to water versus sanitation projects (2010-2011) (OECD-DAC, 2013):

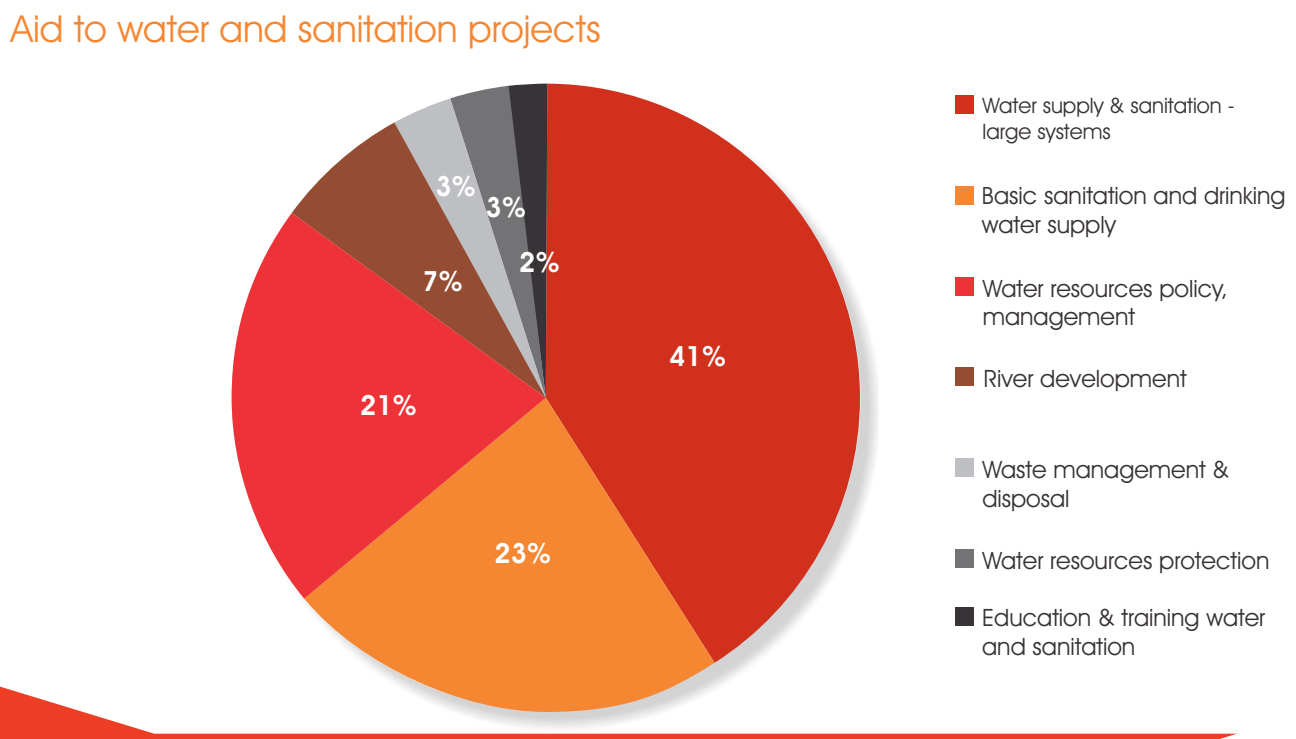


Figure 6. Breakdown of aid to water and sanitation projects

[10]http://webnet.oecd.org/dcdgraphs/CPA_recipient/

[11]Country Programmable Aid (CPA) is a concept of the Organisation for Economic Co-operation and Development (OECD). It captures the flows of aid that go to the partner countries.

Faecal sludge has recently become the focus of several donor-funded research programmes of which the SFRA Project is one. Another example is SPLASH, funded by ADA (Austria), MAEE (France), SIDA (Sweden), SDC (Switzerland) and DFID (UK) and the Bill and Melinda Gates Foundation's Water, Sanitation and Hygiene Programme. In this programme, European researchers work in collaboration with colleagues in Cameroon, Ghana, Kenya, Uganda, Rwanda, Mozambique and Senegal on all aspects of the sanitation value chain (WIN-SA, 2014).

5. The sanitation policy environment

The overview below indicates how different aspects of faecal sludge management are addressed in policy and legislation in the eight countries. Where information was available, the section also refers to institutional arrangements.

Since the 1970s, sanitation programmes focussed mainly on infrastructure development to eradicate open defecation and bucket latrines. (See details of South Africa's bucket eradication programme in the sub-sections on South Africa.)

Only three of the eight countries developed a minimum standard for a sanitation facility: Botswana (the double vaulted VIP latrine), South Africa (the VIP latrine) and Zimbabwe (the Blair VIP latrine).

Sanitation legislation, policy and strategy reflect this drive for infrastructure development. What would happen when the pits were full, were not a concern at the time. As a result, faecal sludge management is largely absent in policy and legislation as the country profiles below will illustrate.

Policies and legislation that relate to sanitation originate from different Ministries, such as Water, Environment, Education and Health. However, local authorities, which fall under another Ministry, are in most cases responsible for implementation.

In most of the countries, institutional arrangements are complex and fragmented. The structure of local authorities and the delineation between urban and rural jurisdiction vary considerably between the eight countries. The distinction between urban and rural sanitation has turned peri-urban sanitation into a no-man's land in terms of policy and legislation - see the Zimbabwe profile below.

There are exceptions: in an attempt to consolidate the sector, Botswana, for example, rationalised water and sanitation services under a single state-owned utility in 2009.

5.1 Botswana

5.1.1 Brief history of sanitation development

5.1.1.1 Urban Sanitation Research Project (USRP)

In 1971, the government of Botswana introduced the scheme of providing latrines at subsidised costs to households in urban areas with this project. The aim of the USRP was to improve the poor sanitary conditions in growing towns and cities.

The project introduced VIP latrines in Botswana. **Later, a double vault VIP latrine was adopted as the standard sanitation facility in urban areas.**

A self-help approach was followed. In 1979, the City and Town Councils resolved to provide substructures for the latrine and each plot-holder was responsible for completing the super structure. All registered plot-holders were required to pay a monthly service levy to cover the costs of road maintenance, water supply, refuse collection, toilet emptying, secondary infrastructure and administration (Ghanie, 1982).

5.1.1.2 Environmental Sanitation and Protection Pilot Programme (ESPP).

By 1980, the USRP was extended. This programme was funded by UNICEF, the United States Agency for International Development (USAID) and the German KFW Development Bank.

The aim of the project was to develop, test and evaluate approaches to health education and to provide on-site sanitation technology in rural areas that is affordable and easy to understand. The ESPP was piloted for two years in six small and medium villages in Kgatleng and Southern Districts.

During the project implementation a single vault VIP latrine was installed and was eventually adopted for use in the whole of rural Botswana (Jacks et al., 1999; DSWM, 2002). At the end of the two-year pilot project, 245 latrines were constructed.

5.1.1.3 Self-Help Environmental Sanitation Project (SHESP)

By 1984, with the help of UNICEF, the Government of Botswana initiated the second phase of the project under ESPP, known as Self-Help Environmental Sanitation Project (SHESP). The aim of the project was to address the shortcomings of ESPP in relation to health, education and project implementation and enhance community commitment to the programme. The SHESP provided pit latrines, but also acted as a social mobilisation and health education project. The SHESP, like the ESPP, was piloted in four District Councils: Southern, Kgatleng with two additional districts of Kweneng and Central. By 1988, 3500 latrines had been constructed under this programme.

By the end of 1990, the project covered approximately 80 rural settlements and the process of extending this project to the remaining district villages got underway (TAG, 2003).

5.1.1.4 The National Rural Sanitation Programme (NRSP)

In 1991, a study was commissioned to assist the Government of Botswana in designing a National Rural Sanitation Programme (NRSP) strategy for the National Development Plan 7 (NDP7), and beyond.

Between 1992 and 1997 (Brandberg, 1991), the National Rural Sanitation Programme (with support from the Swedish International Development Agency and UNICEF) provided more than 30 000 pit latrine substructures (Bolaane & Ikgopoleng, 2011; Odirile et al., 2013).

5.1.2 Policy and legislation

The legislative framework for sanitation services in Botswana comprises the Acts, strategies and policies listed below:

5.1.2.1 Waste Management Strategy (1998)

This strategy provides for the efficient management of waste, as well as the implementation of the Basel Convention. It promotes the health and well-being of the people of Botswana through the provision of appropriate and sustainable wastewater and sanitation management.

5.1.2.2 Policy for Wastewater and Sanitation (2001)

This policy aims to "promote the health and well-being of the people of Botswana through the provision of appropriate and sustainable wastewater / sanitation management and to introduce mechanisms for the protection and conservation of water resources" (Centre for Applied Research, 2011). The specific objectives are to:

a. Develop regulatory and legislative framework on wastewater / sanitation issues;
b. Introduce development planning concepts in wastewater / sanitation at district and national level;
c. Promote stakeholder involvement in wastewater management;
d. Introduce effective and sustainable operation and maintenance of wastewater / sanitation systems;
e. Establish basic principles for pricing and cost recovery for wastewater / sanitation facilities;
f. Establishment of national effluent discharge guidelines;
g. Establish an industrial pollution control framework based on the Polluter Pays Principle;
h. Conserve water by re-use of return flows; and
i. Promote health and sanitation education and awareness initiatives.

This policy is being implemented under the Department of Pollution Control and Waste Management.

5.1.2.3 National Master Plan for Wastewater and Sanitation (2003)

The Botswana National Master Plan for Wastewater and Sanitation developed strategies for the implementation of the National Wastewater and Sanitation Management Policy. **The Master Plan is the foundation for sanitation and wastewater management until 2030.**

The Master Plan recommends (Centre for Applied Research, 2011):

a. Enactment of legislation for the wastewater and sanitation sector;

b. Upgrading of existing and development of new wastewater treatment facilities (capital investment plan up to 2030); and

c. Re-use and recycling of treated wastewater. The objective is to re-use and recycle 96% of the outflow by 2030 through agricultural re-use and reduction of losses in the treatment systems.

It comprises a set of 13 planning and technical design manuals with strategies and a budget for each village in the country.

5.1.3 Institutional arrangements

The National Rural Sanitation Programme is delivered through a complex institutional arrangement: The Ministry of Environment Wildlife and Tourism and the Department of Waste Management and Pollution Control coordinate the programme, but it is implemented by the ten District Councils (Botswana Association of Local Authorities, 2015) under the Ministry of Local Government.

In May 2009, the Water Sector Reforms Programme came into effect to simplify institutional arrangements. The programme resulted from a study to rationalise the water sector in Botswana and ensure uniform service levels for all.

In terms of these reforms, the government of Botswana made the Water Utilities Corporation (WUC) responsible for wastewater and on-site sanitation management, in addition to water services, in the whole of Botswana. The WUC was scheduled to take over wastewater services in all the urban centres and villages in the whole country by the end of 2014 (Water Utilities Corporation, 2015).

The WUC is a parastatal organisation, wholly owned by the Botswana Government. It was established in 1970 by an Act of Parliament (Laws of Botswana Cap 74:02).

5.2 Ethiopia

Besides legislation and policy that refer to sanitation in broad terms, the researchers from Jimma University and the Department of Water and Energy could not find legal instruments, policies, strategies and plans that specifically refer to faecal sludge or pit emptying, and its management.

Operational guidelines and clearly defined stakeholder responsibilities are also lacking (Jimma University, 2014).

Below are some examples of sanitation legislation and policy.

The Federal Democratic Republic of Ethiopia (FDRE) Constitution is the basis for all development-related policies, and legal provisions and related outcomes within the country. Article 44/1 of the Constitution gives all persons the right to live in a clean and healthy environment, while Article 92/1 of the Constitution states that the government has the duty to ensure this right. Article 92/2 of the Constitution requires that the design and implementation of development programmes and projects should not damage or destroy the environment (FDRE, 1994).

Several policies refer to environmental and personal health in relation to sanitation services and mention sanitation as a high priority:

- The Environmental policy of Ethiopia (EPA, 1997).
- Health policy of Ethiopia (Ministry of Health, 1993).
- Ethiopian Water Resources Management Proclamation No. 197/2000 article 11 and 13 prohibits the release of untreated waste into natural water bodies.
- The Ethiopian Public Health Proclamation No. 200/2000 article 12 states that *"no person shall dispose solid, liquid or any other waste in a manner which contaminates the environment or affects the health of the society"*.
- A national hygiene and sanitation strategy (Ministry of Health, 2005) as well as protocols for hygiene and on-site sanitation (Ministry of Health, 2006) were developed by the Ethiopian Ministry of Health.
- A National Water, Sanitation and Hygiene (WaSH) implementation framework was ratified by the Ministry of Health, Water and Energy, Education, and Finance and Economic Development in 2013 (FDRE, 2013).

5.3 Kenya

5.3.1 Policy and legislation

Kenya has laws, policies and regulations relating to the water supply, sanitation, waste management and environment, but they are "scattered" over different government departments and institutions. Some aspects are duplicated or repeated several times in the various policies and laws (Egerton University, 2014).

5.3.2 Institutional arrangements

Institutional arrangements are complex and duplication occurs at local level as the table below illustrates:

Table 2. Institutional roles and relationships in water and sanitation in Kenya

Sectors and subsectors	Institutional roles and relationships				
	Water supply	*Sewerage and related hygiene promotion*	*General sanitation and hygiene promotion*	*School sanitation*	*Urban sanitation*
Sector leadership (national)	Ministry of Water and Irrigation		Ministry of Physical Health and Sanitation	Ministry of Education	
Regulation (national)	Water Services Regulatory Board				Water Services Regulatory Board
Service development and provision (national)	National Water Conservation and Pipeline Corporation		Water Services Trust Fund (WSTF)		
Service development and provision (regional)	Water Services Boards				
Service development and provision (local)	Water service providers District Water Officers	District Public Health Officers			Local authorities

Roles and responsibilities are not clearly defined and often the institutions lack the capacity (technical, human resources and financial) to monitor and enforce the laws (Egerton University, 2014).

5.4 Malawi

5.4.1 Policy and legislation

Similar to the countries above, Malawi does not have explicit legislation on faecal sludge management. The reference to faecal sludge is by inference and obtained in different legislation on public health, environmental protection and occupation safety, as the table below illustrates:

Table 3. Legislation on public health, environmental protection and occupation safety in Malawi

Government institution	Policy or legislation	Faecal sludge management (FSM)
Ministry of Irrigation and Water Development	National Sanitation Policy (2008)	The mission of the policy is "to ensure that all people in Malawi own and have access to improved sanitation facilities, practise safe hygiene, and practise safe recycling of liquid and solid waste for sustainable environmental management and socio economic development". No specific targets, responsibilities, treatment or re-use technologies, responsibilities or funding mechanisms
	National Water Policy (2005)	No mention of FSM Emphasize research and private-public partnerships in sanitation
	National Water Development Programme (NWDP) (2011)	No mention of FSM Refers to "investments and technical assistance for sanitation and hygiene investments".
	Malawi Growth and Development Strategy II (MGDs II)	No mention of FSM Focuses on thematic areas, of which one is Public Health, Sanitation, Malaria and HIV and AIDS.
	Water Resources Act (2013)	No mention of FSM Focuses on the establishment of river basin authorities and sub-catchment management units
Ministry of Natural Resources and Environmental Affairs	National Environmental Policy (2004)	No mention of FSM Focuses on hygiene and sanitation provision

5.4.2 Institutional arrangements

The relationship between policy and legislation, and institutional arrangements is complex. Roles and inter-relationships are not well coordinated as the examples in the next paragraph illustrate:

The Ministry of Irrigation and Water Development, the water boards and city assemblies are responsible for water supply. The main institutions responsible for sanitation are the Ministry of Irrigation and Water Development, city assemblies and the Ministry of Health and Population. However, water supply and sanitation are also provided by civil-society organisations and international donors who set up and fund their own water and sanitation projects.

Local governments are mandated by the Local Government Act to be responsible for water and sanitation, while the Water Works Act and the National Sanitation Policy mandate the water boards to have this responsibility (Zeleza-Manda, 2009).

The Malawian government's priority with regard to funding, even in seeking donor support, remains water supply. Sanitation is neglected or at best left with non-government organisations. The only major government concern in connection with sanitation is hygiene education or treatment of sufferers in cases of disease outbreak (Zeleza-Manda, 2009).

WaterAid UK confirmed this finding. According to the organisation, the root cause of lack of progress in the sanitation sector is political neglect: sanitation "is given low priority by donor and recipient governments alike. In sub-Saharan Africa, at current rates of progress, the 2015 MDG target for sanitation will not be met until 2076" (Water Aid Malawi, 2007). In the same report, WaterAid ranks Malawi the lowest of 12 countries in prioritization of sanitation.

The quote below from The Nation illustrates this neglect.

> *Further evidence of the relative neglect of sanitation is apparent in Mchesi in Lilongwe. Biwi Primary School was built in 1983 with four toilet blocks for 2,300 pupils. In 1995 a community secondary school opened on the same site. The toilets were used by both schools and also by the surrounding communities, but became blocked in 2003. For five years, the schools remained without any toilet facility, forcing pupils to use the nearby woodlot, and leading to a high drop-out rate among female pupils. As the government took no action, school teachers requested public support by organizing walks to raise funds for toilet construction.*

(Source: The Nation newspaper, 21 July 2008: "Two Lilongwe schools without toilets for five years")

5.5 South Africa[12]

5.1 Policy and legislation

The disposal of faecal sludge is subject to regulation and control by the Department of Water Affairs in terms of the National Water Act (Act 36 of 1998) and the Environment Conservation Act (Act 73 of 1989). The current regulatory legislation that governs the handling, disposal, management and re-use of pit sludge includes the following:

- Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947)
- Water Act (Act 54 of 1956)
- Conservation of Agricultural Resources Act (Act 43 of 1983)
- Environment Conservation Act (Act 73 of 1989)
- Water Services Act (Act 108 of 1997)
- National Water Act (Act 36 of 1998)
- National Environmental Management Act (Act 107 of 1998)
- National Health Act (Act 61 of 2003)

The acts above do not address faecal sludge directly, but they can be and have been interpreted and used to develop further policies, frameworks or guidelines for the handling, disposal, management and re-use of pit latrine sludge.

The Strategic Framework for Water Services (DWAF, 2003) includes faecal sludge, although not by name, when it defines sanitation services as:

> *"[...] the collection, removal, disposal or treatment of human excreta and domestic wastewater, and the collection, treatment and disposal of industrial wastewater. This includes all the organisational arrangements necessary to ensure the provision of sanitation services including, amongst others, appropriate health, hygiene and sanitation related awareness, the measurement of the quality and quantity of discharges where appropriate, and the associated billing, collection of revenue and consumer care."*

In 2006, the Department of Water Affairs (DWA) developed the 'Guidelines for the Utilisation and Disposal of Wastewater Sludge' comprising five volumes. The guidelines were developed to encourage the implementation of beneficial use of sludge (Still & Foxon, 2012). Volumes 1 and 2 were published in March 2006, Volume 5 was published in March 2008, and Volumes 3 and 4 in 2009.

The five volumes addressed the following:

- Volume 1: Selection of management options (Snyman & Herselman, 2006a)
- Volume 2: Requirements for the agricultural use of sludge (Snyman & Herselman, 2006b)
- Volume 3: Requirements for the on-site and off-site disposal of sludge (Herselman & Snyman, 2009)
- Volume 4: Requirements for the bene cial use of sludge at high loading rates (Herselman & Moodley, 2009)
- Volume 5: Requirements for thermal sludge management practices and for commercial products containing sludge (Herselman et al., 2008)

However, like previous acts and the Minimum Requirements Waste Management Series, these guidelines do not include or address pit latrine sludge specifically, even though VIP latrines are considered a basic minimum level of sanitation in South Africa. Therefore, a growing need to further develop policy, guidelines and procedures for the management of pit sludge in South Africa is required so that WSAs can be properly equipped to deal effectively with full pit latrines (Still & Foxon, 2012).

[12] This section is based on Snyman (2007).

5.5.2 Institutional arrangements

The roles and responsibilities of government with regard to basic sanitation; and in particular the key role played by local government, are set out in the following Acts:

- The Constitution of the Republic of South Africa (Act 108 of 1996)
- The Municipal Systems Act (Act 32 of 2000)
- The National Water Act (Act 36 of 1998)
- The Water Services Act (Act 108 of 1997)
- The Municipal Structures Act (Act 33 of 2000)
- The National Environmental Management Act (Act 107 of 1998)
- The Division of Revenue Bill

In terms of the institutional roles and responsibilities for sanitation service provision, the Constitution places the direct responsibility at local government level. This was then translated to authorised local government institutions (Water Services Authorities), which are either a Metro, a District municipality or a Local Municipality.

In 2000, the Department of Water Affairs and Forestry (DWAF) published the Model Water Services By-laws (DWAF, 2000) under the directive of the Water Services Act. It suggests that:

> *"Charges in respect of the removal or collection of conservancy tank contents, night soil or the emptying of pits will cover all the operating and maintenance costs arising from the removal of the pit contents, its transportation to a disposal site, the treatment of the contents to achieve a sanitary condition and the final disposal of any solid residues and are payable by the owner."*

From a national and provincial perspective, the responsibility was initially within DWAF from 1994 to 2001, the funding and monitoring function then moved to the Department of Provincial and Local Government in 2001 via the Municipal Infrastructure Grant funding instrument.

In 2009, the National Sanitation Programme Unit (NSPU) was moved from the Department of Water Affairs (DWA) to the Department of Human Settlements, but with DWA retaining certain responsibilities in the sector, including regulation, information management, high level planning and management of the Bulk Infrastructure Grant. At provincial level, responsibility for sanitation now rested with the Department of Human Settlements, but with certain links to the Departments of Health, Water Affairs, Education and Public Works.

In 2014, the sanitation function moved back to the Department of Water Affairs and the Department's name changed to Water and Sanitation (DHS, 2012).

The 2012 government report on the status of sanitation services in South Africa, says the following about the institutional arrangement:

> *"Fragmentation of responsibilities for sanitation at national, provincial and local levels results in no single national authority taking responsibility for performance monitoring of municipal service provision (including monitoring of construction of infrastructure) and unclear performance standards."*

Most municipalities and Water Services Authorities do not have operation and maintenance procedures and plans for VIP toilets and it was reported that they had no budgets or plans to ensure the long-term sustainability of VIP toilets (Mjoli, 2010).

A strategic sanitation review by the South African Local Government Association (SALGA)[13], found that 68 of 169 Water Services Authorities claim to empty pit latrines. Only 25 of these WSAs had a policy concerning these activities, of which 7 had this policy in draft stage.

The lack of policies and budgets could be ascribed to an interpretation of the Strategic Framework of Water Services, in terms of which VIP toilets are an interim measure for urban and peri-urban settlements to be eventually replaced by waterborne sanitation (Berner et al., 2013).

[13]South African Local Government Association. Strategic sanitation review on operations, maintenance and sustainability of Ventilated Improved Pit toilets including aspects of sustainability related to the eradication of buckets within the Free State province, June 2009. http://www.salga.org.za/app/webroot/assets/files/Research_Results/SALGA%20VIP%20%20BUCKET%20STUDY%20DOC%2009%20v2%20for%20WG.pdf.

5.6 Uganda

The policy and legislative framework for the water and sanitation sector in Uganda has evolved tremendously since the late 1980s and can be described as reasonably well-developed (Makerere University, 2014). The table below summarises major policies and legislation that relate to sanitation.

Table 4: Major policies and legislation that relate to sanitation in Uganda

Ministry	Policy & Legislation	Relevance to sanitation
All	Constitution of the Republic of Uganda (1995)	A clean and healthy environment is a basic human right.
	Poverty Eradication Action Plan (PEAP) (1997-2010) Later replaced by the National Development Plan	No mention of faecal sludge. Sets government's overall objective for the water and sanitation sector: sustainable provision of safe water within easy reach and hygienic sanitation facilities to rural and urban populations with effective use and functionality of the facilities.
	The Uganda Country Strategy (2010-2015)	No mention of faecal sludge. Recognises importance of sustainable sanitation.
Ministry of Water and Environment	National Environmental Management Authority (NEMA) Statute (1995)	No mention of faecal sludge. Regulatory standards for drinking water quality, effluent.
	Water Statute (1995)	No mention of faecal sludge management. Provides for water and sewage authorities to be constituted. Provides for the control of pollution and the promotion of safe storage, treatment, discharge and disposal of harmful waste.
	National Environment (Waste Management) Regulations, S.I.No 52/1999	NEMA to licence any person intending to transport waste or operate a waste treatment plant or disposal site. (This would include faecal sludge.)
Ministry of Water and Environment (continued)	National Water and Sewerage Corporation Statute (1995)	Provides for National Water and Sewerage Corporation (NWSC), a parastatal that provides water and sewerage services in large urban centres, and in any area in which it may be appointed to do so under the Water Statute (1995).
	Water Policy (1999)	No mention of faecal sludge. Same objectives set as above.
	National Environmental Health Policy (2005)	No mention of faecal sludge. Provides a framework for the development of services and programmes at national and local government levels. Objectives linked to MDGs.
Ministry of Education and Sports	The Universal Primary Education Policy	This policy emphasises that all primary schools shall have health programmes, and aims at a rapid expansion of facilities, including sanitation infrastructure.

Ministry of Local Government	Local Government Act (1997)	Decentralises services to local level, including giving urban councils the responsibility to provide "sanitary services for the removal and disposal of night soil (human excreta)". Weak interaction between the local authorities and faecal sludge service providers results in an unregulated service.
Ministry of Health	National Sanitation Guidelines	The objective of the guidelines is to provide a guide for local authorities and to promote a standardised approach.
	Public Health Act (1964)	Local authorities may give notice to owners to clean or upgrade sanitation facilities in their buildings.

The fact that sanitation does not appear in any of the Ministry names is telling.

The Ministry of Water and Environment is the lead agency for formulating national water and sanitation policies (Plan International, 2011). The responsibility for sanitation is shared between the Ministries listed above. In 2001, they signed a Memorandum of Understanding (MoU) on their respective responsibilities and tasks. In terms of this, the Ministry of Health took responsibility for household sanitation, the Ministry of Water and Environment for sanitation in urban areas and rural growth centres, and the Ministry of Education and Sports for school sanitation (Plan International, 2011).

Lack of skills at local government level and weak enforcement seem to be the main reasons why policies and legislation are not implemented (Musabe & Nsubuga, 2014). Musabe & Nsubuga (2014) cites the approach of the Ministry of Water and Environment as a success story in this regard. The Ministry requires that households in small towns put in place the required basic sanitation facilities as a pre-condition to accessing a water connection. Apparently, this has significantly improved latrine coverage in many of the small towns in Uganda.

The National Sanitation Working Group was created to coordinate the responsibilities split between the different Ministries. It is responsible for establishing clear budget mechanisms for sanitation to fulfil the institutional mandates in the MoU between the ministries and to coordinate between local governments and national government on policy guidance and advocacy.

Sector reforms in the period 1998-2003 included the commercialisation and modernisation of the National Water and Sewerage Corporation (NWSC) operating in cities and larger towns, as well as decentralisation and private sector participation in small towns (UN-Water/World Water Assessment Programme, 2006). Presently, the NWSC supports the faecal sludge management sector by receiving and treating faecal sludge that service providers deliver at any of the 15 designated wastewater treatment plants across the country. They charge a small fee per delivery (Musabe & Nsubuga, 2014).

5.7 Zambia

In 2011, the government of the Republic of Zambia recognised the urgent need to address and remedy the water supply and sanitation situation in urban areas, specifically peri-urban settlements, by introducing the National Urban Water Supply and Sanitation Programme. The aim of this programme was to create a robust and sustainable water and sanitation health service system (MLGH, 2011). Despite these initiatives, very little has been achieved with respect to the standard of the sanitation services offered in the country (Tembo & Nyambe, 2013).

The National Urban Water and Sanitation programme budget for 2011 provides for 61% of allocation to water and 14% to sanitation with 25% going to other functions (WaterAid, 2014).

5.7.1 Policy and legislation

As far as could be established, no policy or piece of legislation directly refers to faecal sludge management (Tembo & Nyambe, 2013). The following pieces of policy and legislation imply faecal sludge management in Zambia:

- The National Water Policy of 2007
  This policy promotes the development of sustainable water resources with special regard to providing adequate quality and quantity water for all users in Zambia. Sustainable quality water implies preventing the pollution of water resources. This is relevant for faecal sludge management as the pollution of water resources might occur if pit contents are incorrectly disposed of (Tembo & Nyambe, 2013).
- The National Decentralisation Policy of 2002
  Through this policy, local authorities are reaffirmed as the institutions responsible for water supply and sanitation in Zambia. Local authorities are therefore responsible for all sanitation services in peri-urban areas, including faecal sludge management (Tembo & Nyambe, 2013).
- Local Government Act (CAP 281)
  The Act mandates local authorities to maintain environmental health services, environmental conservation and prevention of pollution of water resources in Zambia (Tembo & Nyambe, 2013).
- Sixth National Development Plans
  The Sixth National Development Plans contains a chapter on water and sanitation. This chapter's vision of the Water and Sanitation sector is “a Zambia where all users have access to water and sanitation and utilise them in an efficient and sustainable manner for wealth creation and improved livelihood by 2030”. The sector goal is furthermore to “achieve 75 percent accessibility to reliable safe water and 60 percent adequate sanitation by 2015 in order to enhance economic growth and improve the quality of life”. The vision and goal imply all aspects of adequate sanitation, including faecal sludge management (Tembo & Nyambe, 2013).
- Environmental Management Act of 2011
  This Act provides for the protection of the environment and the control of pollution. It prohibits the pollution of water resources with untreated wastewater or faecal sludge (Tembo & Nyambe, 2013).
- Water Act (CAP 198)
  The Water Act provides direction to the use, diversion and allocation of water in Zambia. This act relates to faecal sludge management, because improper disposal of faecal sludge from pit latrines could pollute water bodies (Tembo & Nyambe, 2013).
- The Water Supply and Sanitation Act No. 28 of 1997
  The Act provides for the establishment of the National Water and Sanitation Council (NWASCO), which acts as regulator in the provision of water and sanitation services. NWASCO regulates the water utilities. As most urban and peri-urban areas in Zambia fall within the jurisdiction of the water utilities, urban pit emptying activities will therefore be regulated by NWASCO (Tembo & Nyambe, 2013).

- Public Health Act (CAP 295)
  The Public Health Act regulates public health in Zambia. All faecal sludge management services should be operated in accordance with the stipulations of this Act. However, it is common practice in the peri-urban areas of Zambia to discharge pit contents in drainage channels, especially where the emptying is done informally. This creates a health hazard (Tembo & Nyambe, 2013).

5.7.2 Institutional arrangements

The National Rural Water Supply and Sanitation Programme (2006-2015) and the National Urban Water Supply and Sanitation Programme (2011-2030) are being rolled out under the leadership of the Ministry of Local Government and Housing.

Rural water, sanitation and hygiene service delivery is decentralised to local authorities (Government of Zambia, 2012).

Most local authorities in urban areas have created commercial utilities to provide services. 50 commercial utilities were formed by local authorities, some of which have subsequently merged. Approximately 20 local authorities still provide water and sanitation services through their Works departments. The local authorities have a particularly bad service record, with coverage levels actually declining (USAID, 2010).

5.8 Zimbabwe

According to the country report, water, sanitation and hygiene policies are coordinated by various institutions and government departments. Their specific roles on faecal and other sludge management are not clear (Bangira et al., 2014).

5.8.1 Policy and legislation

The table below depicts important milestones in the development of the water and sanitation sector in Zimbabwe since independence.

Table 5: Milestones in the water and sanitation sector in Zimbabwe

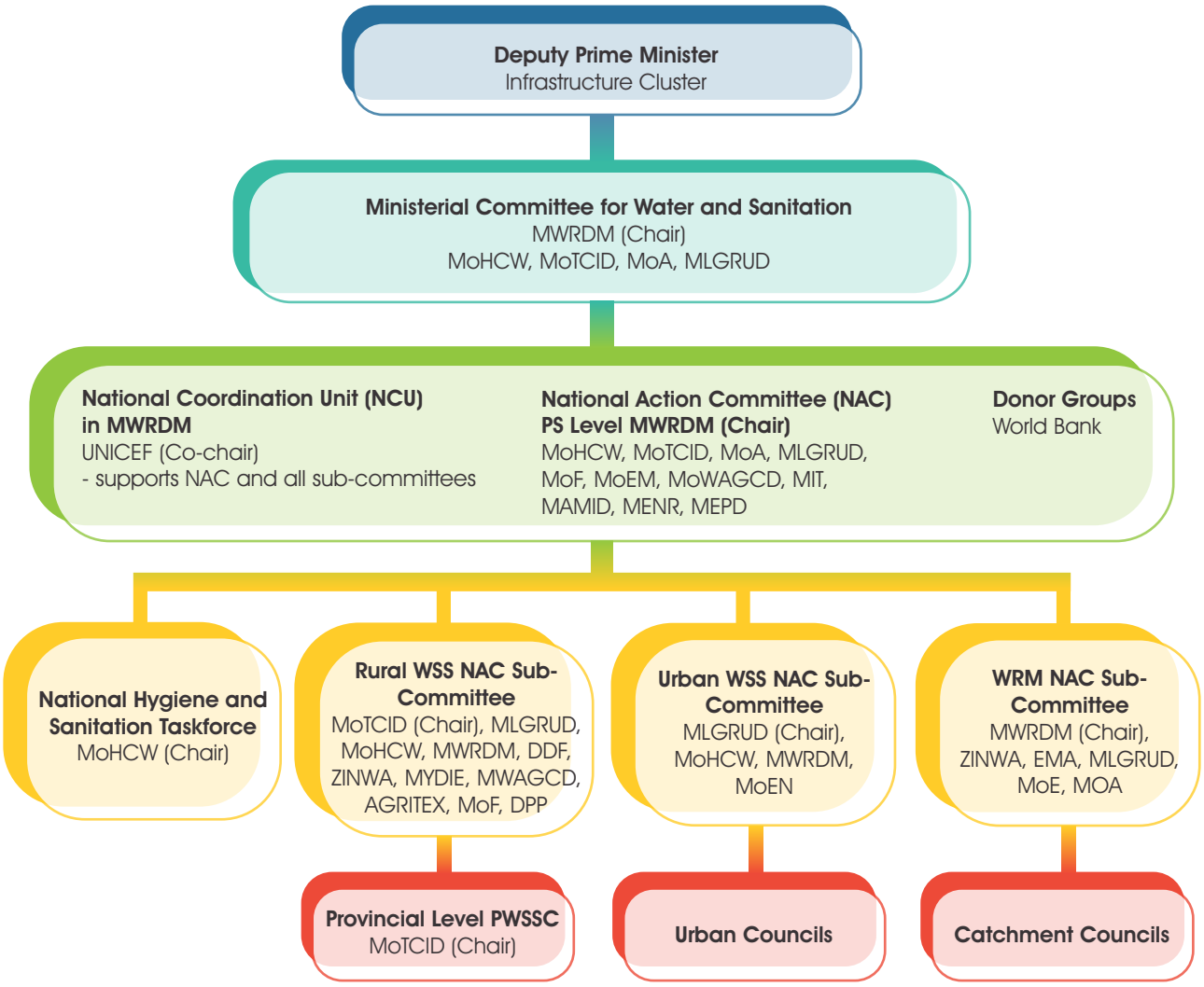
Date	Event
1980	National Independence
1985	National Master Plan for rural water supply and sanitation
1987	National Action Committee (NAC) established
1987	Integrated Rural Water Supply and Sanitation programme launched
1999	Water Act
1999	Zimbabwe National Water Authority established
2004	Draft Water and Sanitation Policy
2008	Cholera outbreak kills more than 4000 people
2010	National Action Committee (NAC) re-launched
2011	National Sanitation and Hygiene strategy
2013	National Water Policy

Source: (GoZ, 2011)

No national policy describes the provision of sanitation services in informal settlements, or the roles and responsibilities of different agencies. No national policy or legislation also mentions faecal sludge explicitly (Bangira et al., 2014).

5.8.2 Institutional arrangements

Institutional arrangements in the water and sanitation sector are complex as the diagram below shows[14]:



Thus, coordination and allocation of responsibilities is often a challenge (Bangira et al., 2014).

Zimbabwe comprises 10 administrative provinces and 32 urban local authorities. Local authorities are classified and ranked according to their size and levels of development into city councils, municipalities, town councils and local boards (GoZ, 2011). These local authorities are autonomous bodies that are responsible for the administration of their areas of jurisdiction and for the provision of services and infrastructure to rate payers. They have the authority to levy rates and charges on rate payers in order to raise revenue to cover the cost of council activities (GoZ, 2011).

However, roles in sanitation management and provision between rural and urban local authorities, and local authorities and government departments, especially with respect to peri-urban areas are fuzzy (Bangira et al., 2014).

Enforcement of environmental and public health regulations relating to sanitation is often weak and ineffective. Political interference has also been an issue (Bangira et al., 2014).

The water and sanitation sector has a record of poor engagement with the private sector (Bangira et al., 2014).

Sub-economic tariffs have led to insufficient funds for normal operation, repair and maintenance. Additionally, for most local authorities, water and sanitation revenue is not ring-fenced to benefit the sector. Revenue collection mechanisms are largely unclear (Bangira et al., 2014).

[14] The acronyms are not explained as the purpose of the diagram is to illustrate the complexity of institutional arrangements.

6. Dashboard of progress in sanitation

6.1 In sub-Saharan Africa from 1990 to 2012

According to WHO and UNICEF's updated report on global trends in sanitation and drinking water of 2014 (WHO/UNICEF, 2014), progress in sanitation in sub-Saharan Africa can be depicted as follows:

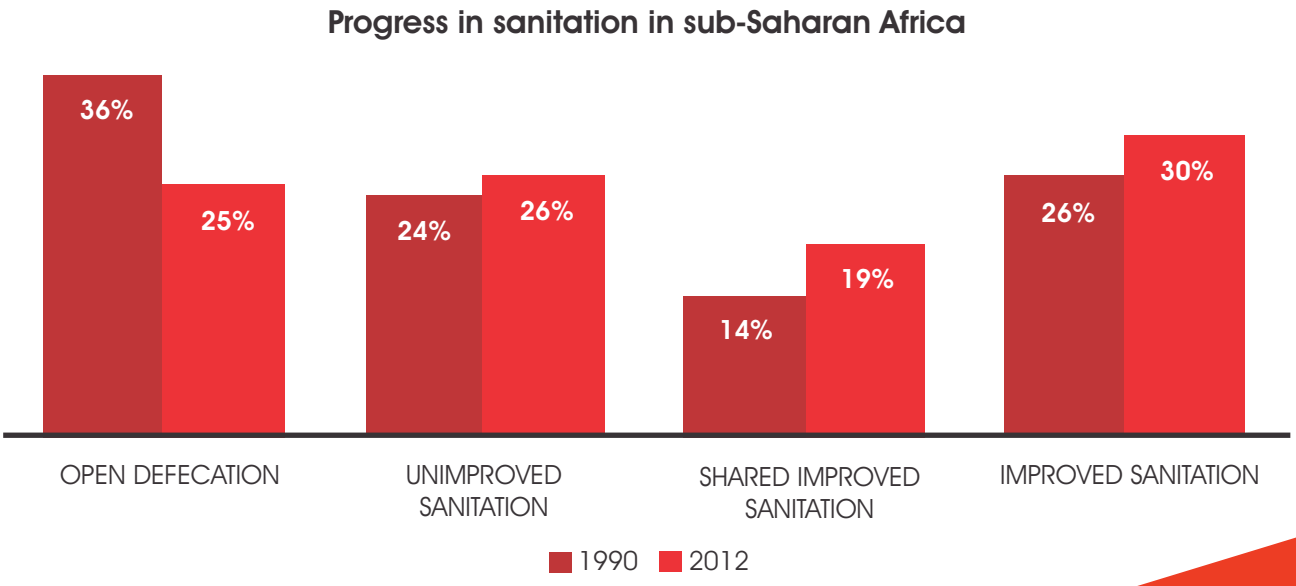


Figure 7. Progress in sanitation in sub-Saharan Africa

The percentage for open defecation has dropped by 11% in the period 1990-2012, but the number of people defecating in the open is still increasing in 26 of 44 countries in sub-Saharan Africa. Of the eight countries studied in the region, Ethiopia has made the most remarkable progress during the past 25 years: open defecation declined from 92% in 1990 to 37% in 2012. The number of people in this part of Africa who are still using unimproved sanitation facilities has increased slightly. This probably indicates a shift from open defecation to an unimproved facility.

6.2 In eight Southern and East African countries

The status of, and progress in, sanitation in the eight countries that participate in this project is summarised in the table below:

Table 6. Sanitation in eight Southern and East African countries (WHO/UNICEF, 2014)[15]

Country	Year	USE OF SANITATION FACILITIES (percentage of population)												Proportion of the 2012 population that gained access since 2000 (%)
		URBAN				RURAL				NATIONAL				
		Improved	Unimproved			Improved	Unimproved			Improved	Unimproved			
			Shared	Unimproved	Open defecation		Shared	Unimproved	Open defecation		Shared	Unimproved	Open defecation	
Botswana	1990	61	5	23	11	22	6	20	52	39	5	21	35	19
	2000	70	6	18	6	32	8	17	43	52	7	18	23	
	2012	78	6	16	0	42	11	12	35	64	8	15	13	
Ethiopia	1990	19	29	12	40	0	0	0	100	2	4	2	92	18
	2000	22	34	17	27	6	2	7	85	8	7	9	76	
	2012	27	42	23	8	23	7	27	43	24	13	26	37	
Kenya	1990	26	40	31	3	24	16	38	22	25	20	36	19	10
	2000	29	44	24	3	26	17	38	19	27	22	35	16	
	2012	31	48	18	3	29	19	35	17	30	26	31	13	
Malawi	1990	27	22	47	4	7	4	56	33	10	6	55	29	3
	2000	25	20	52	3	8	4	66	22	10	6	65	19	
	2012	22	18	58	2	8	4	80	8	10	6	77	7	
South Africa	1990	75	13	10	2	40	7	26	27	58	10	18	14	19
	2000	78	13	7	2	49	9	21	21	65	11	14	10	
	2012	82	14	3	1	62	12	16	10	74	13	8	5	
Uganda	1990	32	49	17	2	25	13	40	22	26	17	37	20	14
	2000	32	50	16	2	29	15	40	16	30	19	36	15	
	2012	33	50	15	2	34	17	40	9	34	23	35	8	
Zambia	1990	61	26	10	3	29	7	22	42	41	14	19	26	14
	2000	59	25	14	2	31	7	29	33	41	13	24	22	
	2012	56	24	18	2	34	8	33	25	43	14	27	16	
Zimbabwe	1990	54	46	0	0	35	18	0	47	41	26	0	33	3
	2000	53	45	1	1	34	17	5	44	40	27	3	30	
	2012	52	44	2	2	32	16	12	40	40	27	8	25	

Although the figures reflect substantial progress in six of the eight Southern and East African countries, only Botswana and South Africa serve more than 50% of the population with an improved sanitation facility. Improved sanitation has come to a virtual standstill in Malawi and Zimbabwe since 1990. The only shift seems to be from open defecation to using an unimproved facility.

The figures above might also paint a rosier picture of sanitation services than the actual state of affairs. The figures state how many toilets have been built; **they give no indication in what condition these toilets are or how the wastewater and faecal sludge that they collect are managed**.

[15]Most of the figures (also for 1990 and 2000) have changed from the WHO/UNICEF 2013 update to the 2014 update. The Malawi figures in previous versions seem to have been corrected in the 2014 update.

The challenges that these countries experience with faecal sludge management in urban and peri-urban areas are similar, but the general state of sanitation differs considerably as the figure below illustrates.

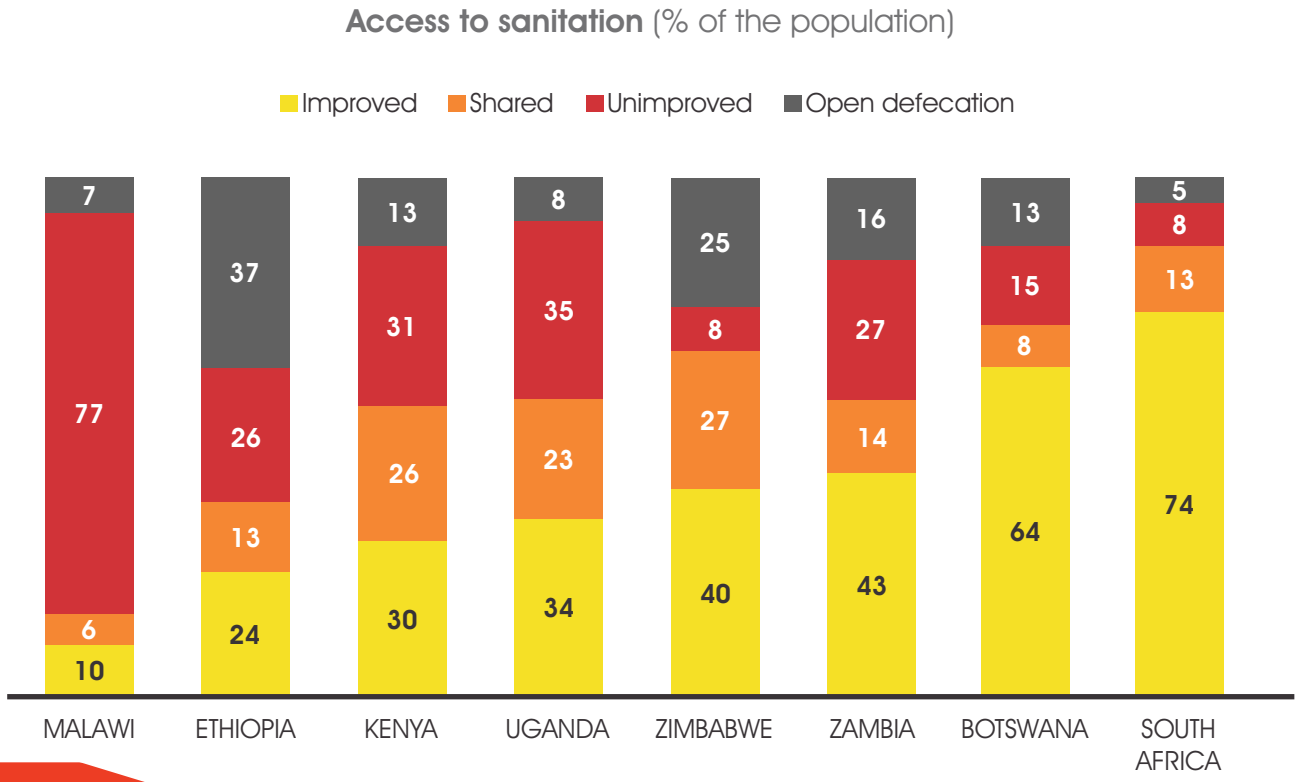


Figure 8. The general state of sanitation in the 8 participating countries (WHO/UNICEF report, 2014)

According to WaterAid (2011)[16], inadequate water and sanitation services are estimated to cost sub-Saharan Africa more than the whole continent receives in development aid – US$47.6 billion in 2009.

Water and sanitation health (WaSH) are being side-lined as governments concentrate on health and education, says the WaterAid report. "Meanwhile, people's lack of access to clean water and basic sanitation services is holding back social and economic development in the region, costing around 5 percent of gross domestic product (GDP) every year. The World Health Organisation (WHO) estimated the financial impact of inadequate WaSH facilities by looking at the health issues linked to poor hygiene, child mortality, waterborne tropical diseases, the time people spend collecting water; and reductions in educational achievement due to illness and girls' attendance rates at schools."

[16]http://www.irinnews.org/report/94241/africa-sub-saharan-sanitation-targets-two-centuries-away

7. Country profiles

This section gives a brief overview of on-site sanitation facilities and faecal sludge management in each of the studied countries.

In summary, the country reports found the following:

Figure 9. Research team from Ethiopia sampling a pit toilet (Photo: Jimma University).

1. Pit latrines are by far the most common on-site facility in informal urban and peri-urban settlements and rural areas. In Botswana, South Africa and Zimbabwe, there has been large infrastructure programmes to supply sanitation that meets the basic standard. Alternative improved options, such as the pour flush, urine-diverting toilet and other eco-sanitation types have been mainly confined to small-scale donor-funded projects. Several research reports mention that the social acceptability of handling and re-using dried or treated faecal sludge or urine on-site remains a challenge.
2. Different types of facilities are called a "pit toilet". The lack of standardisation adds a layer of complexity to the faecal sludge management process. For example, many pit toilets that the research teams encountered had no slab covering to access the sludge, unlike in South Africa where it is a requirement. Sludge samples, in these cases, had to be obtained through the pedestal (see picture).
3. The rate at which pits fill up in a particular country is a function of many variables, such as pit size, soil quality, groundwater level, the number of people who share the latrine, anal cleansing practices and solid waste dumped into the pit. It is therefore difficult to plan a pit-emptying programme that would fit all scenarios. Emptying on demand seems to be the common approach.
4. Full pits are either emptied or replaced. Where there is space available and soil conditions are favourable, the common practice is to replace the pit.
5. Vacuum trucks are the most common mechanised pit-emptying technology. Manual emptying is still common in areas where people cannot afford another service. Innovative pit emptying technologies seldom survive the pilot stage due to a lack of institutional support, maintenance issues such as a spare part that has to be imported or inadequate fees to cover costs (Strande et al., 2014).
6. Inadequate treatment and re-use of faecal sludge seems to be a common problem of most urban local authorities. The country reports mention lack of institutional support, funds and skills.
7. Some of the country reports relate success stories, which have potential for replication in other cities and countries.

7.1 Botswana

7.1.1 Main issues

Due to Botswana's scarce water resources, the country's population relies heavily on groundwater as a source of drinking water. The drawback of low-cost on-site sanitation facilities is however the potential pollution of groundwater resources (Odirile et al., 2013).

According to the country report (2013), most of Botswana's groundwater sources are contaminated by poor faecal sludge management. In 2000, a groundwater quality survey sampled 47 public and private wells in and around Francistown. Analyses showed that nitrate concentrations well above the maximum allowable limit of 45 mg/litre for drinking water in Botswana were frequent within the city area, often reaching values between 100 and 300 mg/litre.

Though enviro-loos were introduced to curb underground water pollution across the country, these have not functioned well. Various reports on the evaluation of these technologies show that communities prefer waterborne toilets or the VIP latrine (Odirile et al., 2013).

Pit-emptying procedures are not always effective. Pits are often inaccessible to emptying vehicles. Traffic congestion prevents efficient emptying and haulage; emptying services are usually poorly managed. As such, much of the faecal sludge produced, collected, hauled and disposed of in urban centres remains as yet unaccounted for (Odirile et al., 2013).

7.1.2 Types of on-site facilities

Pit latrines are the most commonly used form of on-site sanitation in Botswana (Odirile et al., 2013).

A double vault VIP latrine was adopted as a standard sanitation facility in urban areas.

These latrines can either be ventilated or not, and are fitted with a concrete slab. Similar to South Africa, the Government of Botswana does however, not consider a non-ventilated pit latrine to be adequate.

Pit design varies according to terrain, but research found most to be between 1.5 and 2.5 metres deep. Most of the rural BOTVIP latrine designs provide removable cover slabs (Nostrand & Wilson, 1983, as quoted in Odirile et al., 2013). These enable the pit to be maintained, repaired or emptied, if a vacuum tanker truck is available and can get access.

7.1.3 Faecal sludge management practices

Although the Water Utilities Corporation (WUC) is responsible for wastewater services, there is no mention of faecal sludge management on the WUC's website. It is also evident from the latest annual report of the WUC that faecal sludge management still requires development:

> *Wastewater services continued to be a burden to the Corporation as they did not generate any revenue, but remained expensive to run. These services were taken over from the former operators without any applicable tariff and the Corporation continued to operate in the same fashion. In a quest to make the service self-financing, the Corporation set out to develop a cost reflective tariff which was still under development by the close of the reporting period. (Annual Report 2013/14:21)*

According to the country report (Odirile et al., 2013), the following management practices are followed:

In urban areas, faecal sludge is collected by individuals in private pick-up trucks. There are no health and safety measures in place. These private emptiers use small or large vacuum tankers.

In some instances, the sludge is added to the wastewater stream or combined with wastewater at the wastewater treatment plant, where it is then treated. In other instances, faecal sludge collected from pit latrines and septic tanks is transported to the main wastewater treatment plant, dried in drying beds and sold to the public for use in gardens as manure.

In the rural areas, it is not common to remove faecal sludge. Most rural householders will close the pit and relocate their latrine when it is full. The BOTVIP components may be re-used in the new location.

7.2 Ethiopia

The information on faecal sludge management in Ethiopia is based on a survey of 403 households in urban slums in Addis Ababa (Beyene, Hailu, Faris & Kloos, 2015). No conclusions can therefore be made about the rest of the country.

7.2.1 Main issues

Due to the fact that 80% of the residents in Addis Ababa live in urban slums (UN-Habitat, 2007), the city has many sanitation problems. 26% of the houses in the city, mostly the peri-urban areas, do not have access to any type of sanitation facilities and thus use rivers, flood ditches and open spaces (Jimma University, 2014).

Poor on-site sanitation practices ultimately expose the whole community to the risk of acquiring waterborne and environmental diseases. In Ethiopia, institutional and legal aspects regarding faecal sludge management have not yet been implemented. It is therefore urgent to establish a regulatory basis for proper faecal sludge management in the country (Jimma University, 2014).

7.2.2 Types of on-site facilities

Pit latrines are the most common type of low-cost on-site sanitation facility used in the peri-urban areas of Addis Ababa (Jimma University, 2014).

The survey found that 63.28% of the households have access to a pit latrine with a super structure, whereas 22.33% use a pit latrine without a super structure. Open defecation is practiced by 8.19% of the households. The other types of sanitation facilities used are a VIP latrine (5.21%) and a pour flush toilet (0.99%) (Jimma University, 2014).

7.2.3 Faecal sludge management practices

In the peri-urban areas of Addis Ababa, most of the pit latrines are full (Jimma University, 2014). The disposal of pit latrine sludge is therefore a major concern in the city.

The City Government of Addis Ababa Water and Sewerage Authority is responsible for the provision of the city's water supply and sewerage services (Jimma University, 2014). The Authority is also responsible for the construction of shared and public sanitation facilities and sludge emptying services in peri-urban areas.

In its business process re-engineering programme, Addis Ababa Water and Sewerage Authority identifies and states that it works closely with the following key stakeholders: Municipality of Addis Ababa, Ministry of Water and Energy, Ministry of Finance and Economy, Addis Ababa Roads Authority, NGOs and Funding Agencies (World Bank, UN-HABITAT, African Development Bank), the Ethiopian Environmental Protection Authority, Addis Ababa Office of Land Administration, Addis Ababa Infrastructure and Construction Authority, Addis Ababa Health Bureau, and Oromia Regional State. The survey did not find evidence of this cooperation.

The Addis Ababa Water and Sewerage Authority mostly uses pit emptying trucks to collect and dispose of faecal sludge. Sludge from toilet facilities and septic tanks is transported and disposed of into drying beds near the Kaliti treatment plant and in Kotebe Yerer Ber.

The survey indicates that 327 of the households (88.38%) use municipal emptying services whereas 29 (7.84%) connect their on-site sanitation facilities to nearby flood ditches or rivers (Jimma University, 2014). Other faecal sludge management practices include private pit emptying (1.62%), being connected to a sewer system (1.08%), and constructing a new on-site sanitation facility (1.08%).

Among the households that use municipal or private pit emptying services only 14.6% were satisfied with the services. The availability of the services (few trucks; three-month waiting period) and high cost of the services (between US$9.30 and US$36.00) were the main reasons for the dissatisfaction. On average, the pit latrines are emptied twice a year, but, due to the severe constraints of pit emptying services, most of the households' sanitation facilities were full (Jimma University, 2014).

There were no on-site faecal sludge recovery, treatment or disposal facilities available in the peri-urban areas surveyed (Jimma University, 2014).

7.3 Kenya

The information in the Egerton University report (2014) on faecal sludge management practices is mainly based on information from:

- A survey that Losai Management Ltd (2011) conducted with funds from the BMGF in Nairobi, Mombasa and Kisumo;
- Another BMGF-funded report (Chowdry & Koné, 2012), which summarises the Losai report; and
- Studies by Muchiri (2009) and Sagwe (2010) in the town of Nakuru.

7.3.1 Main issues

WHO data shows that diarrheal diseases accounted for 16% of under-five mortality in Kenya in 2006 and 7% of deaths overall.

Waterborne sewerage systems are found in the cities of Nairobi, Mombasa and Kisumu, as well as in other larger municipalities, but only 14% of the country's population, living in urban areas, have access to waterborne sanitation systems (MoWi, 2007). Most of the water supply and wastewater collection, treatment and disposal systems have been deteriorating rapidly and fail to meet the water demands of the ever-increasing population.

On-site sanitation, on the other hand, is a common mode of disposing of human waste in the peri-urban and rural settlements of Kenya. The faecal sludge of urban households in Kenya that make use of on-site sanitation facilities are disposed into nearby streams, which contaminates ground- and surface water (Egerton University, 2014).

Open defecation is down but still widely practiced in rural areas: In 2012, only 3% of the population in urban Kenya practiced open defecation in comparison with 17% of the rural population (WHO/UNICEF, 2014).

7.3.2 Types of on-site sanitation

In Kenya, over 70% of sanitation systems are pit latrines, because they are cheap, easy to construct and do not require water (Egerton University, 2014). No distinction is made between improved and unimproved pit latrines, but the report refers to a survey conducted in the town of Nakuru, which found that 49% of respondents used simple pit latrines (Muchiri et al., 2009, as quoted in Egerton University 2014).

The study referred to above found that 88% of households in Kisumu have access to sanitation facilities of one type or another, within their compound. In Mombasa, this is 91% whilst in Nairobi it is 85%. Of this, 43% in Kisumu, 62% in Mombasa and 56% in Nairobi, use facilities that may be categorised as safe or hygienic management of human waste (VIP latrine, septic tank, cesspool, and waterborne linked to the sewer system). The average number of users per toilet in Kisumu is 8, Mombasa 4 and Nairobi 12. Of those without access to a sanitation facility at home, 40% in Kisumu and 50% in Mombasa and a lower 20% in Nairobi, dispose of human waste in open spaces, drainage channels and other unsafe sites (Losai Management Ltd, 2011).

7.3.3 Faecal sludge collection and disposal practices

The sludge accumulation rates in pit latrines are dependent on the number of users, the type of anal cleaning material, the degree to which the pit is used for disposal of other household waste and the degree to which the pit is drained (Still, 2002). In Kenya, the average sludge accumulation rate is between 25 and 30 litres per user per year varying from as little as 10 litres to as much as 100 litres per user annually. In coastal cities such as Mombasa, pit latrines are shallow due to the high groundwater level and frequent emptying is therefore required (Egerton University, 2014).

In Nairobi, and other cities and towns, the task of emptying is mainly the role of the city and local authorities. Most local authorities however lack the specialised equipment and trucks required. In Nakuru, for example, the municipal council has since 2008 stopped providing their mechanical emptying service due to the breakdown of their exhauster truck. Spare parts are not locally available and have to be sourced abroad. As a result, the private sector is left with the responsibility of offering the service.

In 1997, with the sponsorship of UN-HABITAT, the Vacutug was developed and piloted in Nairobi, Kenya. The aim was to develop a pit-latrine exhauster that was suitable for areas that were previously inaccessible. Unfortunately, the apparatus developed some mechanical problems in the pilot phase.

No information could be found on the UN-HABITAT website as to the current status of the Vacutug in Kenya.

Pit emptying services, whether mechanical or manual, are in high demand.

According to the Losai survey (Losai Management Ltd, 2011), there are 74 trucks operating in the 3 cities (Nairobi, Kisumu and Mombasa) while there are 43 registered operators. In Mombasa, there are operators who do not own vehicles but hire one when they get a client. The truck capacity ranges from 6,000 litres to 22,000 litres. The trucks are strategically displayed and mobile numbers for contact are printed on the trucks.

The city authorities in Nairobi, Mombasa and Kisumo require faecal sludge extraction trucks to have a licence and pay a fee. Each truck providing faecal sludge extraction is classified broadly as a sanitation truck and is required to meet certain design and fitting requirements (Chowdhry & Koné, 2012).

Manual emptying is usually done in areas that are inaccessible by mechanical trucks – usually slums and informal settlements. In Kenya, manual labour is also being used to empty out the public sanitation blocks or bio-centres (see below), which are located in low-income areas unreachable by trucks.

> *"Given the social stigma, illegality of the work and difficulty of performing this job, many choose to do this in the middle of the night for fear of being arrested or recognized. Some reported needing to use alcohol before starting the work in order to get through it. In Kenya, teams of five workers provide emptying services in the urban informal settlements, and lease the equipment from an umbrella group that rents the equipment to the various manual emptiers operating in the settlements"(Chowdhry & Koné, 2012, p. 46).*

Eales (2005, p. 3) describes the conditions under which these pit emptiers work as follows:

> *"The job is generally done by men, working in teams of two to four people. Sometimes they begin by pouring paraffin into the pit to override the smell of the excreta. The three men interviewed for this study had no protective clothing, gloves, boots or face-masks. They sometimes use plastic bags over their hands. The waste is removed using a bucket on a rope, and the contents are then transferred to a 100 litre drum. Depending on the nature of the access path, the drum might have to be carried 50 or 100 metres to a handcart, which is used to wheel the waste to a disposal site. The waste is disposed of by emptying it into the sewer system (where there is no structure obstructing the manhole cover), dumping it in a stream, or transferring it to a mechanical desludger for disposal elsewhere."*

There are many pit-emptying entrepreneurs in Kenya, but they lack the necessary business management skills, such as accounting skills, to be successful. The report of Chowdhry and Koné (2012) gives financial details of these businesses, including start-up loans. These entrepreneurs are also subjected to the negative attitudes of the community towards pit emptying as a business, expensive registration procedures, and the harassment from local authorities since their activities are often classified as a nuisance (Egerton University, 2014).

Studies conducted in Kibera, a peri-urban area in Nairobi, shows that 33% of the households make use of mechanical emptying whereas 28% rely on the manual emptying of their pit latrines. Other techniques used include gravitational emptying where the content of septic tanks is directed to flow to lower water channels by means of gravity (Egerton University, 2014).

Pit emptying services are more active in the rainy season, when ingress of storm water tends to fill pits and when it is convenient to dump faecal sludge in full streams.

In Kisumu, mechanical emptying costs on average US$52 while manual emptying costs only US$30 (Chowdhry & Koné, 2012).

City authorities allow mechanical and manual operators to empty the sludge into manholes once they take it out of the pits after getting a permit. In Nairobi, they must get a permit from the Nairobi Water and Sewerage Company. Faecal sludge collection operators are required to discharge the sludge at designated tipping points that are connected to the sewage lines.

7.3.4 Treatment and re-use practices

Nairobi, Kisumo and Mombasa each has two wastewater treatment plants (Chowdhry & Koné, 2012, p. 29).

The faecal sludge from the designated tipping points in Nairobi and Kisumu mixes up with sewage and ends up in wastewater stabilization ponds. At the Kisat plant in Nairobi, faecal sludge is conditioned in cold digestion tanks and dried in sludge-drying beds before disposal.

According to the Losai report (2011), the Mombasa plants are dysfunctional and untreated effluent (including faecal sludge) goes into the ocean.

Treated faecal sludge, when available, is sold in Kisumu and Nairobi at a price of US$1.25 to US$1.45 per ton. The main challenges with sales of treated faecal sludge in Kenya are that the product is bulky and not packaged. Logistical problems therefore arise in the transportation and distribution process. Faecal sludge from waste treatment plants is acceptable among the local residents, but they are resistant to the use of dried faecal matter from urine diversion dry toilets (Chowdhry & Koné, 2012).

However, faecal sludge re-use in Kenya does take place in what are referred to as bio-centres. The bio-centres are communal toilet and bathroom facilities that have been built by the Umande Trust, a local NGO. The toilets generate methane gas (biogas) for local residents17. More than 100 bio-centres exist in the three cities studied (Nairobi, Kisumo and Mombasa). At these bio-centres, faecal sludge generates biogas that is used for cooking purposes at the cooking facilities present at these centres. The bio-centres typically produce 12 m³ gas per day (Chowdhry & Koné, 2012).

The Sanergy for-profit enterprise[18] operates in a similar way. It designs and manufactures toilets with a sealable container, called Fresh Life. Local residents are their franchise partners. These operators purchase and operate the facilities. Sanergy daily collects the sealable containers and replaces them with clean, empty ones. The faecal sludge is converted at a centralised facility into organic fertiliser and biogas. Sanergy generates about US$1 250 from each toilet from the sale of by-products. The revenue is channelled back to the operators as an incentive to service the toilets (Bayrasli, 2011).

These examples of faecal sludge re-use can be regarded as success stories.

[17]Shimanyula, James (27 October 2014). "Biogas helping to clean up Nairobi slum". Deutsche Welle. Retrieved April 2015.

[18]http://saner.gy/our-work/the-sanergy-model#

7.4 Malawi

7.4.1 Main issues

According to the USAid country report on water and sanitation in Malawi (2010), the interaction between pit latrines and shallow wells make sanitation particularly problematic in peri-urban areas in Malawi. Financial, managerial and technical capacity are severely lacking at all levels.

Between 2010 and 2030, Malawi's urban population is expected to double. The challenge to provide adequate sanitation and efficient faecal sludge management in urban areas will therefore increase (Zeleza-Manda, 2009).

7.4.2 Types of on-site sanitation

Pit latrines (simple or improved), with or without a super-structure of logs or a concrete slab over the pit, are by far the most common type of on-site sanitation.

For example, a study of 220 households in the Ntopwa settlement in Blantyre (Polytechnic University of Malawi, 2013) found that 92.8% of households use pit latrines, but many of these pit latrines are shared. 54.7% of the households with latrines allow others to use their latrines free of charge. Most people in the settlement are tenants and therefore unwilling to pay for better toilets. 50% of households without a pit latrine cited lack of labour and money as the reason.

According to Zeleza-Manda (2009), the adoption of eco-san toilets in Malawi has been slow and very limited to date, except in Malawi Homeless People's Federation villages where adoption is tied to acceptance of Federation membership. For example, in Mgona, a squatter area in Lilongwe City, the eco-san toilet project, which is supported financially by WaterAid and Training Support for Partners[19], is still in its infancy, largely because adoption is a matter of conviction – and many, including government officials, are reluctant to handle faecal matter. In Mgona, fewer than 10 households have adopted the Fossa alterna, about 6 have adopted the Arborloo, while the Skyloo is totally shunned on account of its cost and lack of understanding the operation of the new technology. Even in the Federation villages, some households use ordinary pit latrines "disguised" with a Skyloo super structure. For instance, at Angelogoveya Federation Village, there are 55 pit latrines, some with Skyloo super structures. The reason for the disguise relates to the stigma of touching faecal matter (Zeleza-Manda, 2009).

7.4.3 Faecal sludge management practices

7.4.3.1 Sanitation Systems

Pit Latrines

According to a survey conducted with 1 178 respondents in nine areas in Malawi's largest cities, Blantyre, Lilongwe and Mzuzu (Zeleza-Manda, 2009), full pits are common for the following reasons:

Most housing plots in all nine settlements studied have more than one household living there, and many have more than two households. One of the main ways in which housing in informal settlements has expanded has been through increasing the number of people and households living on each plot. For instance, 8% of plots have between 10 and 55 households (Zeleza-Manda, 2009).

Of those who shared toilets with other households, 14.5% shared with two households, 12.6% shared with three households and nearly 3% shared with between 15 and 55 other households. The sharing of toilets may be a major cause of early filling up. While most pit latrines are intended to last for 10 years, experience shows that most stay usable for less than 5 years (Vasquez, 2008), sometimes due to fall-ins especially in sandy soil and water-logged areas.

When full, the toilets are supposed to be emptied by special equipment provided by city authorities, but the equipment is often lacking. Blantyre has only one vehicle on the road and depends on hiring another from Luchenza township. Even if the equipment were available, high fees deter clients from low-income communities. For example, the cost of emptying a septic tank in Blantyre is MK10 000 (US$20)[20] per load, while for pit latrines it is MK3 000 (US$10.5) per load. In Mzuzu, it costs MK9 000 (US$19). In Lilongwe, where the service has been privatised, pit-latrine emptying costs MK11 000.62 (US$23).

[19]Training Support for Partners is a process-oriented capacity building NGO registered as a trust. https://www.facebook.com/TrainingSupportForPartnersTsp

[20]1 US dollar = plus-minus 450 Malawian Kwacha

In the absence of emptying services, and encouraged by large plot sizes, many people simply dig a new latrine when an old one is full. Plot sizes (15 m x 25 m) in planned low-income areas are designed to encourage the digging of successive pit latrines. In the yards of old houses, several pit holes line the backyard, posing continuous danger to children and groundwater (Zeleza-Manda, 2009).

According to city authorities, the major hindrance to emptying pit latrines is the illegal nature of developments and congestion that makes it difficult for vehicles to enter the areas. However, while this may be true of squatter areas, evidence shows that little or no such service is provided in areas that are planned and have access roads (Vasquez, 2008).

Ecological toilets

Because of problems with Arborloos and Fossa alterna, the Malawi Homeless People's Federation then changed to urine-diversion dry toilets (UDDTs), or Skyloos, to avoid or reduce problems of contamination and foul smells. The adoption of urine-diversion dry toilets however has yet to solve all these problems, as the urine, rather than being collected, is diverted into drains or small soak pits at the back of the super structure thereby producing a foul smell for neighbours, and possibly endangering groundwater (Zeleza-Manda, 2009).

Observations showed that some of the UDDTs did not have roofs and in the rainy seasons would get flooded, affecting the drying and composting process of faeces. Further, many households do not add ash and soil as recommended: either they use too much soil, leading to early filling up, or the soil it too sandy, leading to poor composting (Zeleza-Manda, 2009).

7.4.3.2 Re-use

The first harvest of urine diverting dry toilet or Skyloo manure in Blantyre went at a test price of MK1 000 per 50 kg bag. It was sold to the Blantyre City Parks Department. Because of the value attached to the manure, other organisations are also adopting the technology and there might be potential for the Skyloo technology to be scaled up. Zeleza-Manda (2009) cites a fertiliser manufacturer, Optichem Ltd, which has tested Skyloo faecal manure, and found it to have such high nutrient content that the company ordered 20 tons.

7.4.3.3 Non-government involvement

WaterAid in Malawi is strongly committed to addressing the issue of exclusion, to ensure that the poorest and the most vulnerable and marginalised groups, including women and children, have access to clean water and sanitation.

7.5 South Africa

7.5.1 Main issues

Most municipalities and Water Services Authorities do not have operation and maintenance procedures and plans for VIP toilets and it was reported that they had no budgets or plans for ensuring long-term sustainability of VIP toilets (Mjoli, 2010).

In the urban areas of South Africa, faecal sludge is usually added to the wastewater stream where it is subject to co-treatment in wastewater treatment plants, as well as waste stabilisation ponds (Mjoli, 2010). The wastewater treatment plants where faecal sludge from VIP toilets is emptied into are often not equipped for proper sludge management.

7.5.2 Types of on-site sanitation

The Strategic Framework for Water Services (DWAF, 2003) defines a basic level of sanitation as the provision of a facility, which is easily accessible to a household and should include the sustainable operation of the facility, including the safe removal of human waste and wastewater from the premises when appropriate and necessary, and is inclusive of the communication of good sanitation, hygiene and related practices. The definition of a basic level sanitation service has led to the adoption of the VIP toilet as the minimum acceptable level of sanitation within South Africa (Salisbury et al., 2009). South Africa's groundwater guidelines recommend that pit latrines are located at least 75 m from water sources (Still & Nash, 2002).

Based on the 2003 Strategic Framework for Water Services, the Free Basic Sanitation Implementation Strategy (DWAF, 2003) guides Water Services Authorities in "providing all citizens with free basic sanitation by 2014" and aligning their own policies with national policy.

Large-scale infrastructure programmes were subsequently implemented to build VIPs to reach this goal.

The large-scale construction of VIP toilets also followed from the active bucket eradication programme. In February 2005, the bucket sanitation backlog in formal townships was estimated at 252 254 buckets (DWAF, 2009). Former President Mbeki, in his state of the nation address of February 2006, set a target for the eradication of all pre-1994 sanitation buckets from the formal townships by December 2007.

In reality, the achievement of the minimum standard for sanitation is less favourable than official figures indicate:

- In 2007, the then Department of Water and Forestry commissioned the CSIR to conduct a national audit of water and sanitation projects (SALGA, 2009). The audit reported that, of the 2,410 on-site sanitation projects, only 41% had actually been completed. Approximately 25% of on-site toilets were inadequately designed for ventilation.
- 68% of on-site top structures were constructed in a way that meant they could not be mobilised when the pits were full.
- At 60% of the facilities, municipalities were only conducting reactive maintenance; and 40% of municipalities had inadequate maintenance capacity (SALGA, 2009; DHS, 2012).
- Furthermore, the construction of VIP toilets was carried out without putting in place any plans for emptying the full pits as the national sanitation policy did not provide guidelines on how municipalities should deal with full pits.

7.5.3 Faecal sludge management practices

7.5.3.1 Collection and disposal

Presently there are two options available to the owners of single pit VIP toilets when these become full. Users can either empty the full pit or construct a new toilet on an adjacent site (Bester & Austin, 2000; Thye et al., 2009; Still & Foxon, 2012).

Alternatively, if the pit is full, municipalities provide a new VIP or an agent is added to the pit contents to liquefy the sludge. Then a vacuum tanker removes as much sludge as possible.

Most municipalities and Water Services Authorities use a vacuum tanker to empty septic tanks.

Water Services Authorities often experience problems in providing a reliable, effective and affordable mechanised service to empty pits in unplanned urban settlements, as well as rural areas as tanker trucks often cannot reach households which need to be serviced because roads are poor and paths are too narrow (Bester & Austin, 2000; Still & Foxon, 2012). Furthermore, households do not always have the funds to pay for mechanised pit emptying, using cheaper manual pit emptying methods as an alternative.

Some municipalities provide additives to slow down filling despite evidence that the additives have little effect. For example, the Alfred Nzo District Municipality treats 20 000 urban pit toilets monthly with additives (Rhodes University, 2014).

7.5.3.2 Treatment and re-use

In the urban areas of South Africa, Water Services Authorities use various treatments and disposal methods for dealing with highly concentrated pit sludge from VIP toilets. The figure below gives an overview of methods and implications.

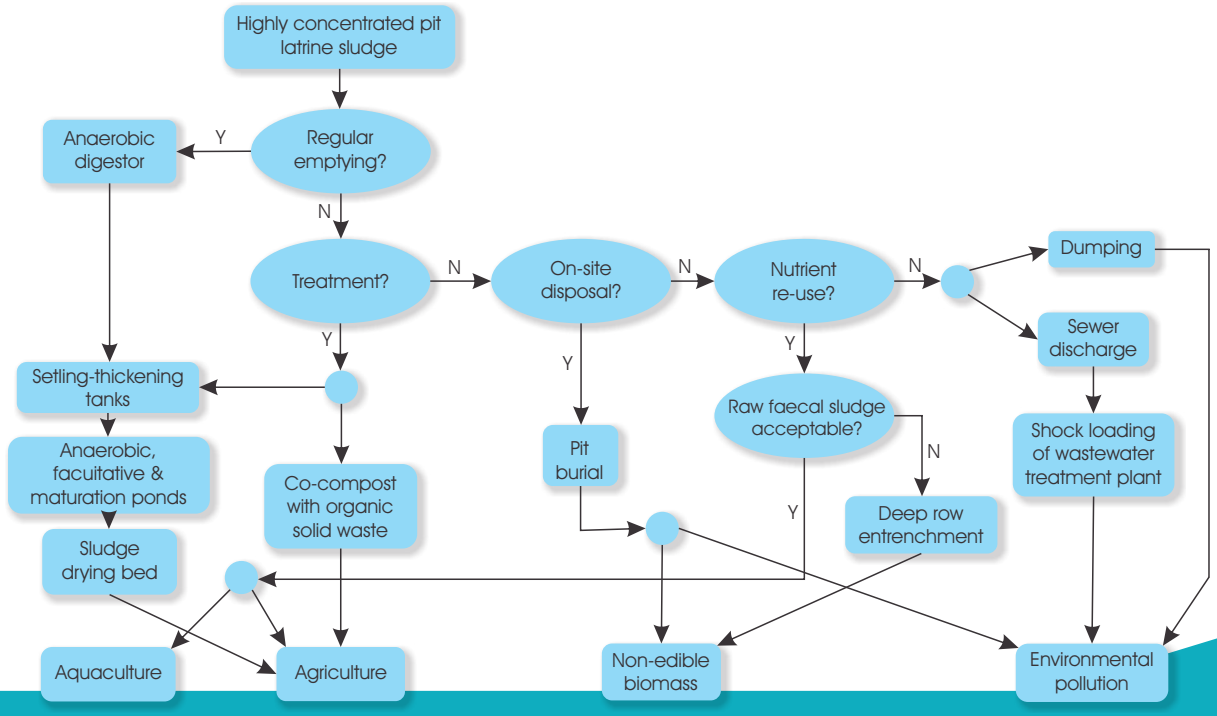


Figure 10. Overview of available treatments and disposal methods of faecal sludge in South Africa (Radford et al., 2011)

Vacuum tanks usually dispose of faecal sludge at the municipal wastewater treatment plants. In a number of municipalities, these plants struggle to meet regulatory requirements. Part of the problem might be the vacuum tanks that discharge their sludge into the inlet structure of the wastewater treatment plant. This might cause shock loads. There seems to be little experience regarding the treatment process and there are no established strategies to deal with problems (Berner et al., 2013). See also the experience of eThekwini in this regard below.

The figures below (Snyman, 2007)[12] summarise sludge treatment technologies at municipal wastewater plants in South Africa.

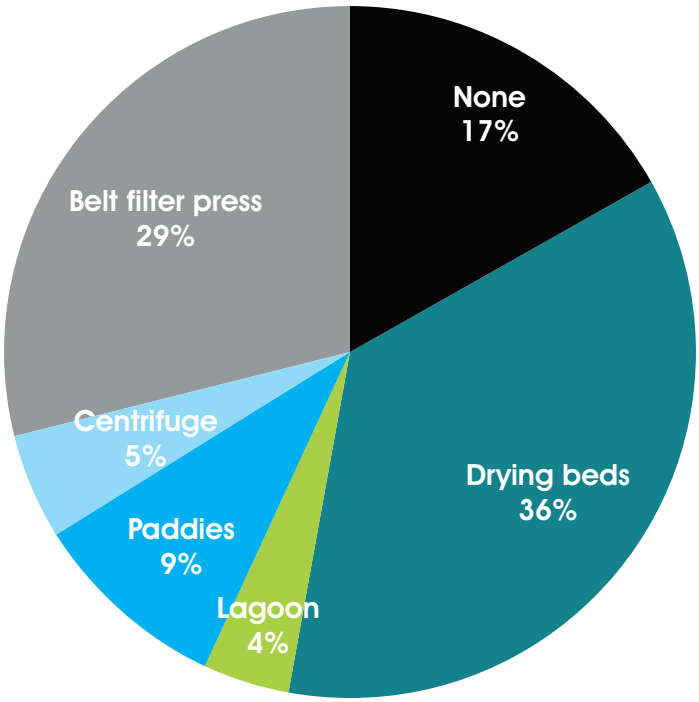


Figure 11. Dewatering technologies employed in South Africa (dry mass % as base)

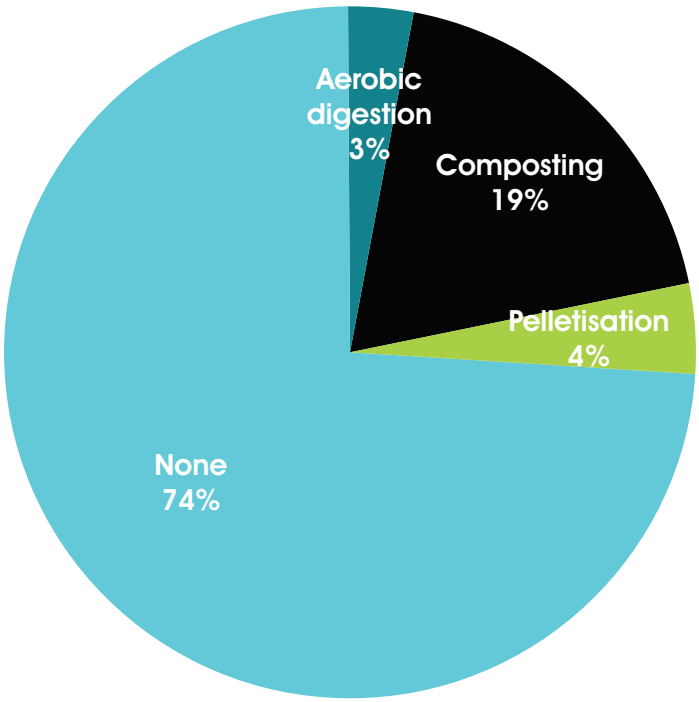


Figure 12. Tertiary treatment and additional stabilisation technologies employed in South Africa (dry mass % as base)

[21] If the data for dewatering technologies is reworked to represent the number of plants rather than the dry mass percentage, the figures are significantly different. Drying beds are used at 45% of the plants followed by belt filter presses (15%), ,centrifuges (5%), paddies (9%), lagoons (4%) while 24% of the plants employ no dewatering (Snyman, 2007).

Composting is used by both metropolitan city councils and plants in smaller towns while pelletisation is only employed by large metropolitan councils, which is why the mass percentage is relatively high (19%). Only 9% of the number of plants surveyed composted the sludge (Snyman, 2007).

Final disposal methods employed by the wastewater treatment plants surveyed in South Africa are still dominated by on-site disposal methods. This includes direct land application and stockpiling of the sludge on site. The beneficial use of sewage sludge includes the use of the sludge by the local municipality or farmers to generate compost, using it as the bottom layer for golf courses or using it to cultivate instant lawn. In some cases, the sludge is sold or given to a contractor in exchange for bulking agent (Snyman, 2007).

7.5.4 eThekwini Metro

7.5.4.1 From manual emptying of VIP latrines to UDDTs

The eThekwini Metro municipality in KwaZulu-Natal has initiated several bold and innovative large-scale projects to manage faecal sludge[22]. These projects generated valuable lessons for other cities in Africa and other developing countries.

eThekwini Metro comprises the city of Durban and the surrounding peri-urban and some rural areas. It has a population of just over three million. With VIP toilets as the preferred basic sanitation option in informal settlements and peri-urban areas, a sustainable pit emptying service is crucial. In 2005, the city had 100 000 VIP pit latrines in its area. The municipality made a commitment to empty pits at least once every 5 years. That meant emptying 20 000 pits per year, which was a huge challenge.

Mechanised emptying was found to be expensive; often the site could not be accessed and the process could frequently not deal with heavy sludge and solid matter found in the pits. The municipality then embarked on a large-scale manual emptying programme in collaboration with the private sector.

Cost remained an issue. At the time, the municipality charged R80 to empty a pit, but the actual cost could be up to R1 000. The municipality subsidised the balance. This was obviously not sustainable in the long term.

Therefore, the municipality had to reconsider its infrastructure solution for sanitation in previously unserved peri-urban and rural areas. A limited water supply meant that it had to be a dry sanitation system. Subsequently, the municipality embarked on a project that installed a urine diversion dehydration toilet (UDDT) and a yard tank, filled free of charge with 9 kℓ of water per month in an estimated 74 606 households in 65 areas (Roma et al., 2013).

In 2011, the eThekwini municipality conducted a survey with 17 449 householders in 65 areas. The purpose of the survey was to evaluate the use and conditions of UDDTs. 80% of households reported that they always use the UDDTs. 14% had a pit latrine in close proximity. Satisfaction with the UDDTs was disappointing: 70% reported dissatisfaction; bad smell was the most critical challenge. Interestingly, there was a correlation between dissatisfaction and households that have a pit latrine on the plot. The researchers concluded that the pit latrine's closer proximity to the house might contribute to the perception. Awareness of the economic benefit of the UDDT was found to be low. The research recommended that acceptance could be improved if users understand the importance and potential of waste as a useful resource (Roma et al., 2013).

7.5.4.2 Treatment

When a WRC study (Bhagwan et al., 2008) confirmed the municipality's experience that co-treatment of large volumes of faecal sludge with municipal wastewater in activated sludge wastewater treatment plants could lead to operational problems, eThekwini Metro started to experiment with alternative treatment options.

Deep row entrenchment was adapted for faecal sludge[23] (Still et al., 2012). The results were positive: Limited nitrate leaching was found in the soil and tests conducted in the area showed that surrounding groundwater bodies remained free from pollution. It also appeared that the fast growing trees took up the additional nutrients. However, environmental regulations will only allow deep row entrenchment for pit sludge disposal at pilot scale in the near future (Still et al., 2012).

[22] http://www.infrastructurene.ws/2013/01/09/tackling-durbans-sanitation-crisis-head-on/

[23] Deep row entrenchment consists of digging deep trenches, filling them with sludge and covering them with soil. Trees are then planted on top, which benefit from the organic matter and nutrients that are slowly released from the FS (Roma et al., 2013).

eThekwini Water and Sanitation also combined drying and pelletizing faecal sludge. The method is called LaDePa (Latrine Dehydration and Pasteurisation). The LaDePa system was developed in conjunction with the municipality's technology partner, Particle Separation Systems. The pellets can be sold and used as a fuel or as a soil amendment.

7.5.4.3 Sharing lessons learnt

eThekwini had many lessons to share from its faecal sludge management programme. The municipality set up MILE (the Municipal Institute of Learning) in Durban, South Africa, to transfer knowledge and experiences to other municipalities throughout Africa. MILE offers training courses and field visits on a regular basis with funding from the United Nations Institute for Training and Research (UNITAR) and the municipality. eThekwini Water and Sanitation also partners with municipalities throughout Africa to share knowledge and bring about improvements in service provision.

The senior management of eThekwini Water and Sanitation also interacts and shares experiences with the management of other water and sanitation organisations in low- and middle-income countries with funding provided by the Water and Sanitation Programme of the World Bank (Strande et al., 2014).

7.6 Uganda

7.6.1 Main issues

The situation in Kampala is typical of all the urban centres of Uganda:

A large proportion of the population lives in low-income informal settlements. Due to rapid population expansion, general disregard of proper urban planning and failure to adhere to existing construction guidelines, only 10% of the city's population is connected to the sewer lines of the National Water and Sewerage Corporation (Makerere University, 2014).

According to an earlier study by Water for People (2013), there is a shortfall of 63% in the supply of pit emptying services in Kampala (Musabe & Nsubuga, 2014).

As a result, sanitation provision in Kampala is grossly deficient: most people do not have access to a hygienic toilet and large amounts of faecal waste are discharged to the environment without adequate treatment (Hutton et al., 2007).

According to Musabe & Nsubunga (2014), the main issues with sanitation services and faecal sludge management are the following:

- Local authorities do not provide standard latrine designs.
- Lack of price regulation for emptying services.
- Lack of faecal sludge transfer stations and decentralised treatment facilities, which makes faecal sludge transport very expensive for operators.
- Limited re-use of treated faecal sludge.
- Lack of technical skills to develop faecal sludge management technologies and logistics.

The majority (70%) of Kampala's poor households are tenants (Günther et al., 2011). Landlords are often absent and tenants are unwilling to spend the little money they have on upgrading sanitation facilities (Musabe & Nsubuga, 2014).

7.6.2 Types of on-site sanitation

The pit latrine is the simplest and most common excreta disposal system in Uganda. According to the Uganda National Household Survey (2010), 89.2% of households own pit and VIP latrines; 2.2% own flush latrine facilities and 8.7% do not own a toilet (Musabe & Nsubuga, 2014).

Most pit latrines in Kampala are communal and shared among different types of households. On average, one pit latrine is used by 30 individuals or 7 households. Günther et al. (2011) noted that only 22% of households have access to private sanitation facilities and this explains, according to them, why only 47% of the sanitation facilities are clean enough to be used properly.

In addition to human excreta, pit latrines are also used to dispose of a whole range of other products including sanitary towels, diapers, broken bottles and plastics. This may shorten the filling time of the pit latrine. 45% of latrines are abandoned after 5 years because they are full or broken down (Günther et al., 2011).

Other types of on-site facilities used in the city include (Makerere University, 2014):

1. Flying toilets: The use of polythene bags for disposal of faecal matter, which is thrown into drainage channels or any other place like rooftops and roadsides. This is common in the majority of the slums around Kampala.
2. Double storey pit latrines: These are built in swampy areas where toilet pits cannot be sunk without water filling up. The only solution they have is to build a tank-like structure on the soil surface with stairs to climb up to the seating area. These tank-like structures have an outlet at the bottom, which they can easily open and close. This outlet is normally opened when it is raining to allow the pit content to flow with the run-off. Some of these pits are lined with cement to prolong their lifespan. Some are built as VIPs and others like simple pit latrines.

3. Eco-san toilets: Uganda has initiated several programmes to generate useful products from human faeces and improve hygiene through eco-san toilets. Some communities in Uganda have been found to be very sceptical about eco-sanitation in general and the use of faecal products as soil fertility enhancers. The unwillingness to use fertilisers from human faeces was attributed to a lack of knowledge, fear of associated health risks and cultural beliefs. The use of UDDTs is new. Acceptance is problematic, due to ash shortages. Ash is used to cover the faeces. Some of the eco-san toilets have been abandoned without using them.

7.6.3 Faecal sludge management practices

The city of Kampala is characterised by illegal sanitation practices, lack of regulation and enforcement, and the limited functionality of wastewater treatment works, all of which have impacted negatively on the sanitation situation and caused contamination of water resources. The enforcement of by-laws varies considerably and public sector capacity to do this is weak. Moreover, efforts to improve urban sanitation are highly fragmented, and mandates are not fully adhered to. Consequently hygiene, the environment, and the water quality of and around Kampala are all seriously threatened by the inadequate sanitation services (Makerere University, 2014).

7.6.3.1 Practices to control odour and improve decomposition

Odour is a major problem with toilets. The practices below are quoted in the country report (Makerere University, 2014) and illustrate that people need a simple, cost effective method to control odour. Unfortunately, not all methods are effective and some inhibit natural decomposition in the pit latrines:

- Effective microorganisms (EMO). This seems to still be in an experimental stage (Makerere University, 2014).
- Some people throw used radio cells in pit latrines with a belief that these used cells will react with the faecal matter and reduce its volume, thus controlling the filling-up of the pit.
- Others pour used motor vehicle oils into the pit latrine to control odours and flies. This probably works because the oil floats on top of the liquid part of the pit content and cuts off the supply of oxygen to maggots and other micro-organisms that need oxygen.

7.6.3.2 Pit emptying practices

The following pit emptying techniques are used in Kampala (Makerere University, 2014):

- Trucks locally referred to as *"kabuyonjo"*, which are equipped to empty pit latrines by suction. The pit content is then either taken to a treatment plant or disposed of at another place convenient to the truck operator. Most trucks are imported. High costs and import tax, plus difficulty to get spare parts, create shortages and broken down trucks.
- The gulper is a new pumping tool that can reach pit latrines not accessible for trucks. It is promoted by Water for People and has been used successfully in experiments.
- Manual emptying.
- Wetland emptying: This method is used in storeyed pit latrines located in wetlands. The faecal waste outlet is opened when it rains to allow pit content outflow to run off.

Swopping is a variation on the traditional pit-emptying practice. This method is used by people who have two pit latrines. When the one latrine gets full, the second pit latrine is opened for use. By the time the second one gets full, the faecal matter in the first pit is assumed to have stabilised with low levels of pathogens. The first pit is emptied before it is re-used, closed and the cycle continues (Makerere University, 2014).

Faecal sludge that is emptied manually is usually buried. A pit is dug near the pit latrine to be emptied and the faecal matter is put in there and then covered with soil (Makerere University, 2014). Faecal sludge that is removed from the plot through manual or mechanical means is disposed of at designated wastewater treatment plants. Operators need a licence to transport faecal sludge, but this is seldom enforced (Musabe & Nsubuga, 2014).

7.6.4 Treatment and re-use

Most of the wastewater treatment plants are designed for wastewater treatment and not faecal sludge. Overloading of plants has been reported at some of the plants (Musabe & Nsubuga, 2014).

The Makarere University report (2014) mentions composting and incineration as treatment methods in Kampala, but no details are given.

The city of Kampala is currently building two faecal sludge treatment plants with a capacity of 200 m^3/day each, one at Lubigi and another one at Nalukolongo. A donor-funded project, FaME (one of the SPLASH projects), will be piloting the use of faecal sludge to fuel brick kilns at the Lubigi plant in Kampala (WIN-SA, 2014; EAWAG, 2014).

A study by GTZ (2010) shows that attitudes toward the re-use of faecal sludge probably also affect the success of re-use technologies. Small-scale farmers in Uganda, who cannot afford to buy commercial fertilisers, would be willing to use excreta and urine, provided they didn't have to incur transport costs. The medium scale farmers were also willing to use faeces and urine, but considered the collection process tiresome and would prefer a distribution scheme or company to do it. On the other hand, large-scale farmers did not think it was economically viable to use human waste and would prefer to use commercial fertiliser due to the high ratio of nutrients to weight. Ogwang, quoted in the Makarere University report (2014), advised that human faeces would be more acceptable as fertiliser if blended with animal waste.

7.7 Zambia

This country report refers to on-site sanitation in Lusaka only.

7.7.1 Main issues

Most of the areas of Lusaka without sanitation services rely on groundwater (boreholes) as sources of water. Two major concerns arise. Firstly, most plot sizes are small: rarely going beyond 1000 square metres. This puts boreholes in close proximity to soakaways. Secondly, the geology of Lusaka is mostly dolomite, which has a low pollution attenuation capacity. This implies that with continued use of on-site sanitation systems, most of the city's ground water will get contaminated and the likelihood of disease outbreaks will increase (Tembo & Nyambe, 2013).

7.7.2 Types of on-site sanitation

In most high density, low income urban areas of Lusaka (mostly peri-urban areas), disposal of excreta via sewerage systems is non-existing. High connection charges are often a prohibiting factor. This leaves on-site sanitation systems as the most common form of excreta disposal – 70% of the population use on site sanitation facilities. The common types are:

- Septic tank systems;
- Pour Flush latrines;
- Improved single-pit latrines;
- Ordinary Pit latrines;
- Ventilated Improved Pit (VIP) latrines; and
- Eco-san toilets (Urine Diversion latrines).

In most peri-urban areas, pit latrines are the most common means of excreta disposal. Where financial resources are available, an improved single-pit latrine (provided with structurally safe squatting plate and super structure) is constructed. However, the majority of pit latrines are of a very poor quality with some just comprising a hole in the ground and a basic super structure (Tembo & Nyambe, 2013).

7.7.3 Faecal sludge management practices

Formal emptying of septic tanks is done by registered enterprises that use vacuum trucks or tankers. In this case, the emptying is usually at one of the city's treatment plants with Manchinchi conventional wastewater treatment plant being the most used for this purpose.

Where the septic tanks are emptied informally, unregistered individuals carry out the task. In this case, chemicals are sometimes added to the contents of the tank to fluidise it. Removal is through scooping using different types of improvised tools. The scooped out contents will then be buried in a pit specifically dug to receive the tank contents without any form of treatment. In a few cases, HTH (a commercial dry chlorine product) will be added to the contents as a way of disinfecting (Tembo & Nyambe, 2013).

Years back, the pit emptying was done by the local authority (Lusaka City Council). Unfortunately, the local authority could no longer sustain this service. The result was accumulation of solids in the tanks, which eventually got into the small-bore[24] sewers. This resulted in clogging since the sewers were not designed to transport the solid component of wastewater. Consequently, overflows on the streets became common.

Recently, a Community Based Enterprise (CBE) calling itself "The Dream Team", managed by a Water Trust in one of the settlements (Kanyama) has mobilised local residents to start a formal pit latrine desludging enterprise. They are using modified scooping tools to empty the pits. The scooped faecal matter is loaded into 60 litre barrels on push-carts. The contents are discharged at a biogas producing facility, which is managed by a Water Trust. This service is offered at a cost of about US$50 per 1 to 12 barrels scooped. For barrels between 13 and 24, the charge is US$65 (Tembo & Nyambe, 2013).

Most of the eco-san facilities in Lusaka are emptied by individuals. Emptying is usually done at night. A pit will be prepared during daytime in readiness for the vault contents. The pits are usually dug just in front of the vault doors. After the contents has been offloaded into the pit, the pit is covered with soil and the cycle is repeated.

[24]**Simplified sewerage**, also called small-bore sewerage, is a sewer system that collects all household wastewater (WC wastes and sullage) in small-diameter pipes laid at fairly flat gradients. Small-bore sewerage is prone to blockages if not managed properly. http://en.wikipedia.org/wiki/Simplified_sewerage

7.8 Zimbabwe

7.8.1 Main issues

Historically, Zimbabwe had a dual sanitation policy: waterborne sanitation linked to a sewer system for urban areas and the indigenous Blair VIP latrine for rural areas. The Blair VIP latrine was developed by the Blair Research Institute, now called the National Institute of Health Research.

Up to about the year 2000, Zimbabwe had a robust water and sanitation sector in urban areas, with modern, highly mechanised, and well designed and functional sewer networks and wastewater treatment works. The latter consisted mainly of biological nutrient removal systems, trickling filters and waste stabilisation ponds. However, these systems are currently either totally non-functional or only partially functional, because local authorities are struggling to operate and maintain the highly mechanised and technically complex energy-demanding sanitation systems (Bangira et al., 2014).

As a result, most of the wastewater treatment plants currently simply bury sludge on site, contaminating groundwater (Bangira et al., 2014).

The rural water, sanitation and hygiene sector had an impressive record of researching and implementing rural sanitation programmes, with the Zimbabwean designed Blair Ventilated Improved Pit toilets being built in large numbers, mainly through donor-assisted funding mechanisms. The considerable donor support (up to 5 bags of cement per family) had to be matched by a large contribution from the family (bricks, labour, paying an artisan). This design did not focus on the re-use of sludge or on the emptying of pits, as one would have had to dismantle the toilet physically to easily access the pit contents (Bangira et al., 2014).

Half a million units were built, serving an estimated three million people. The programme was promoted vigorously by the Environmental Health Department of the Ministry of Health. The Blair toilet was built in households and as multi-compartment units at schools, clinics and other institutions. No consideration was made to the issue of pit emptying and faecal sludge management. A new set of toilets was simply built when the old set was full. When donor support faded, the number of units built rapidly declined. The standardised Blair VIP latrine was too expensive for most families to build themselves (Bangira et al., 2014).

Since the 1990s, years of drought, political, economic, and social upheaval brought economic challenges that saw high unemployment[25]. This pushed people into the informal economy and migration from rural to urban areas increased (Bangira et al., 2014). Following the National Land Reform Programme in 2000, there has been a rise in peri-urban and informal settlements in and around major towns and cities.

National policy stipulates that only waterborne sanitation is allowed for urban areas. But, urban centres cannot afford or sustain waterborne sanitation in these settlements. In the absence of donor support, the possible improved alternative, the Blair VIP latrine, has also become unaffordable. As a result, no sanitation (and water) services are provided in urban and peri-urban informal settlements. In cases where these services are provided, they are in the form of public latrines that are used by large numbers of people (Bangira et al., 2014).

Faecal sludge accumulates and there is no policy or formal management guidelines in place to deal with the situation (Bangira et al., 2014).

[25]Unemployment figures found in the literature, range from 10% (the official figure, based on a 2011 survey) to as high as 95%. None of these figures seem to be reliable.

7.8.2 Types of on-site sanitation

In the absence of formal service delivery, informal settlement dwellers dig their own unimproved pit latrines or defecate in the open.

NGOs in Zimbabwe have repeatedly ignored legislation and promoted and constructed various forms of eco-friendly on-site sanitation facilities. A case in point is the work of the Mvuramanzi Trust in the peri-urban informal settlements of Hatcliffe extension, Dzivarasekwa extension and Porta Farm since 1999. By 2002, about 1650 ecological pit latrines had been built with the intention that the pit contents (after proper storage) would be used as a soil conditioner. The Mvuramanzi Trust built Arborloos (shallow pit toilets), Fossa alterna and Skyloos (urine diversion toilets) at individual homesteads, and some urine diversion toilets at institutional premises (Bangira, et. al., 2014).

7.8.3 Faecal sludge management practices

Currently there is no policy in place on the emptying of pit latrine toilets. Most of the settlements are relatively new and it appears that the pits have not yet filled up, although a crisis is looming, given that the pits may fill up soon. The current practice is that when a pit is full, the latrine is simply abandoned, and a new one is constructed adjacent to it. However, challenges due to space have been encountered given the small stand sizes (Bangira, et. al., 2014).

In the town of Chinhoyi, 115 km from Harare, the NGO Homeless People's Federation assisted a community to build Skyloo and Fossa alterna latrines. The Skyloo serves a household of six. They can use each vault (roughly 1 square metre volume) for 1 year and 6 months, after which a layer of topsoil is put on top, the vault is sealed and left to compost for a further 6 months before the contents are extracted. The community is organised into a club, which centres on the management of these latrines and disseminates educational material, besides also assisting others with no latrines to set up their own (Bangira et al., 2014).

8. Conclusions

Most sub-Saharan countries are characterised by high population increase rates and rapid urbanisation. An ever increasing number of people flock to informal settlements in and on the outskirts of cities and towns. Governments and local authorities specifically fail to keep up with service provision. In many cases water, sanitation and solid waste removal services do not ensure environmental sustainability.

Because there is no alternative, most people in these informal urban and peri-urban settlements make use of unimproved on-site sanitation, creating large amounts of faecal waste. Faecal sludge management is often hopelessly inadequate. As a result, large quantities of faecal sludge are discharged to the environment without treatment. This creates unhygienic living conditions and is likely to increase the outbreak of infectious diseases, such as diarrhoea, worm infestation, typhoid, cholera and dysentery.

The challenges surrounding faecal sludge management affect all aspects of the sanitation value chain.

8.1 Policy and legislation

In all the studied countries, a range of ministries has policies and acts that relate to sanitation. These policies and legislation have broad sanitation objectives; however, few mention faecal sludge management and its aspects specifically. Targets and timeframes, if set, are for sanitation facilities.

Sanitation regulation is complicated by overlapping lines of authority between different government departments (Bahri, 2012). For example, in South Africa, eThekwini Metro's successful pilot with deep-row entrenchment cannot be upscaled, because environmental legislation prohibits the large-scale use of faecal sludge in deep-row entrenchment.

Focus areas:

- ✓ *National policy and legislation that specifically deal with faecal sludge management.*
- ✓ *Aligning policy and legislation across different government departments.*

8.2 Responsibilities, capacity and funding

As mentioned above, the responsibility for sanitation tends to overlap between a range of government ministries and agencies. In most of the studied countries, these ministries include the Departments of Water Affairs, Environmental Affairs, Local government, Health and Education[26]. However, in practice, it is usually the local authority (under different names), which is ultimately responsible for faecal sludge management. In most instances, the high-level policies and legislation do not link sufficiently to by-laws and implementation at local level.

National budgets allocate significantly more to water than to sanitation. The focus of sanitation budgets is mainly on the provision of sanitation facilities, and less on operation and maintenance. As a result, local authorities do not have enough budgeted funds for faecal sludge management. Also, capacity for implementation and law enforcement at local level seem to be generally weak.

Donor funding and other aid to sanitation go mainly to infrastructure development and health and hygiene education.

[26]Each country has its own name for these Ministries.

Focus areas:

- ✓ *Is the responsible authority supported by the necessary by-laws and implementation strategies?*
- ✓ *Is the responsible authority equipped with an adequate budget and capacity to manage faecal sludge efficiently and enforce by-laws?*
- ✓ *If not, can this be addressed or should one look at an alternative responsible authority, such as an urban or a national water and sanitation utility? To what extent can faecal sludge management be privatised?*

8.3 Standards for on-site sanitation facilities

Pit latrines are the most commonly used on-site facility in the studied countries. Yet, only South Africa, Botswana and Zimbabwe have a clear minimum standard for an improved pit latrine (VIP, BOTVIP and Blair VIP). Unfortunately, standards are not always applied consistently when these toilets are built.

It is commonly acknowledged that pit latrines could contaminate groundwater in certain circumstances. Yet, the literature gives disparate guidelines on the safe distance between a pit latrine and a water source (Graham & Polizzotto, 2013).

Pit latrines, even if it is a VIP that is not full yet, continue to be an unpleasant solution due to odour, flies and safety. In practice, eco-san alternatives, such as the urine diversion dehydration toilets (UDDTs) do not seem to resolve the issue of odour and flies (Roma et al., 2013).

The literature on faecal sludge management abounds with pictures of dirty and blocked toilets, but the literature does not indicate to what extent this problem is an engineering problem or an operation and maintenance problem. All over the world, from households to public spaces, thousands and thousands, probably millions, of cleaners, mostly women, have to clean toilets after they have been used. When users do not clean up their own urine and faeces spills on the seat and the floor, or faeces sticking to the inside of the bowl, someone has to clean up behind them. If no-one takes this responsibility, and disinfectant and cleaning materials are unaffordable or absent, any toilet, whether waterborne or a pit latrine, will smell and become unhygienic to use.

Nowhere in the literature have we seen this problem, which is also a gender one, being addressed directly.

The country reports do not make a link between open defecation and dysfunctional or unhygienic toilets. It is likely that open defecation will continue to be practised in Africa as long as there are toilets that are dysfunctional or unhygienic.

Focus areas:

- ✓ *A uniform standard for an improved pit latrine.*
- ✓ *Clear standards on the safe distance between a pit latrine and a water source.*
- ✓ *WASH campaigns that include educating children and adults (males and females) to be responsible and hygienic toilet users and cleaners.*
- ✓ *The sanitation value chain*

8.4 The sanitation value chain

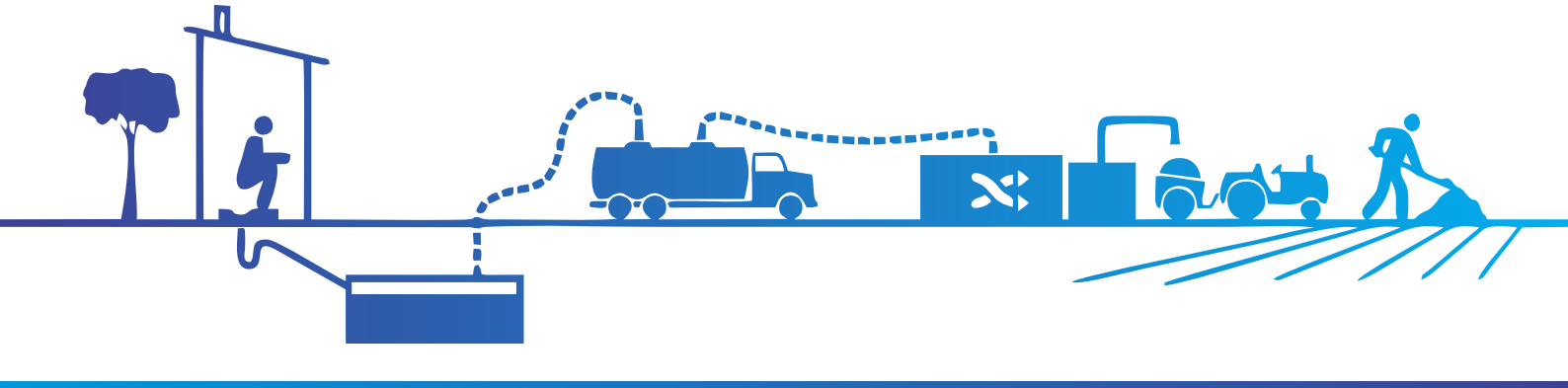


Figure 13. The sanitation value chain (Bill & Melinda Gates Foundation, 2010)

All along the value chain, current technology and faecal management practices present serious challenges:

8.4.1 Full pits

The time that it takes for pits to get full is a function of a number of factors that are well documented in the literature. The presence of solid waste in the pits is one of the main contributing factors. Education programmes might improve the situation, but unless the responsible authority removes solid waste regularly from informal settlements, it is unlikely that this problem will be resolved.

8.4.2 On-site disposal

On-site disposal (with or without treatment) of faecal sludge has not yet been resolved. The practice to close a full pit and dig a new one is only feasible on large stands, but this could increase the risk of groundwater contamination. On-site treatment and re-use, such as with the urine diversion dehydrating toilets, still has a long way to go to become acceptable, if ever.

8.4.3 Pit-emptying and transportation

Mechanical and manual pit emptying services remain challenging for a number of reasons, which are also well documented in the literature: exposure to pathogens, sludge remaining in the pit, access, the consistency of the sludge, mechanical problems with suction, cost, etc. Currently, if the owner of the toilet does not or cannot pay for the service, the service is not sustainable.

Some of the faecal sludge collected from pit latrines is legally added to the wastewater stream or taken to treatment facilities. Unfortunately, because of long distances to treatment facilities and cost, an unquantified but large proportion is illegally dumped in rivers, streams, the ocean or open spaces, creating a health hazard.

The figure below illustrates this for Dakar, Senegal.

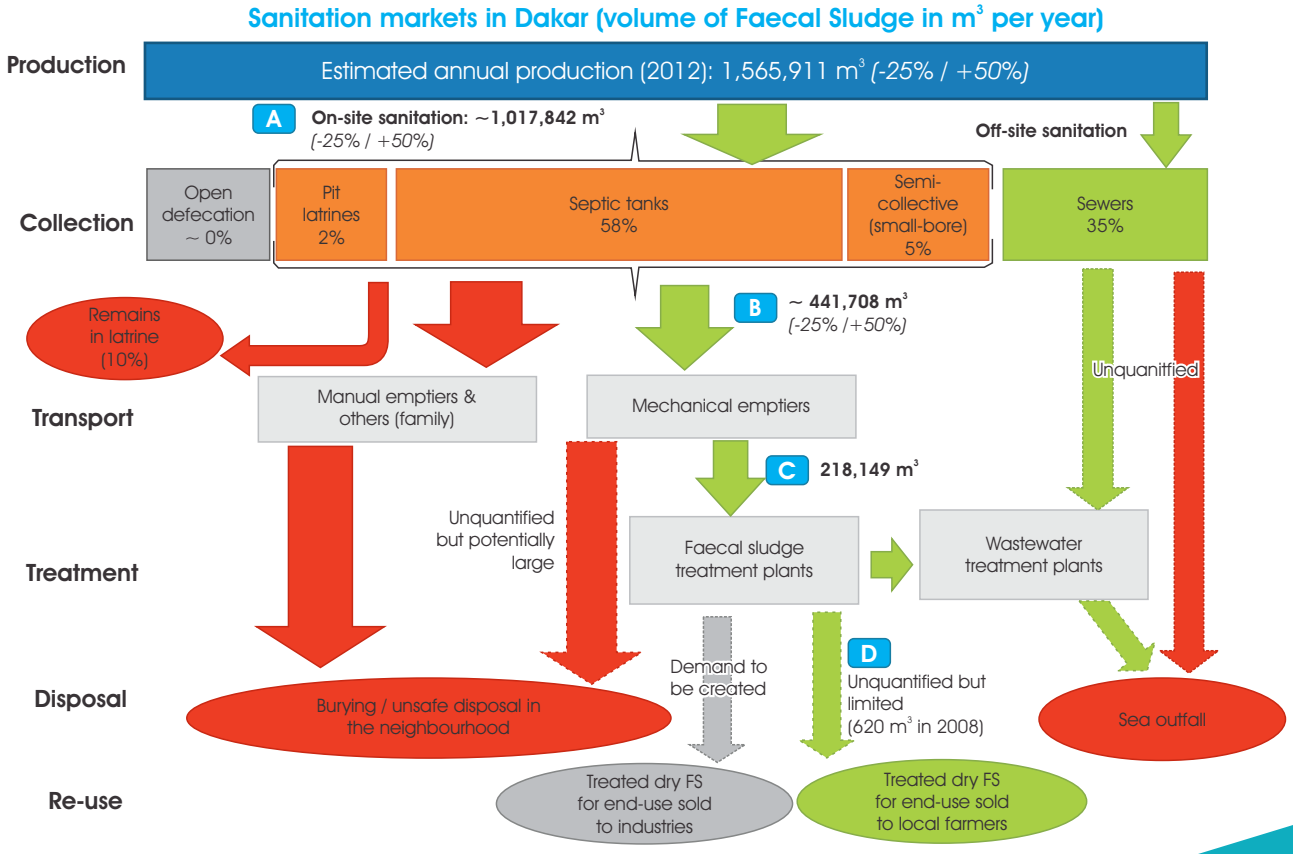


Figure 14. Unsafe faecal sludge disposal in Dakar (2012)[27]

8.4.4 Treatment, disposal and re-use

The literature points out that existing faecal sludge treatment plants and wastewater treatment plants in the studied countries are often dysfunctional. Large amounts of faecal sludge exacerbate the issues that these treatment plants have to deal with.

On the other hand, the country reports cite several examples of successful pilot projects with innovative faecal sludge treatment and re-use technology, for example, the biogas projects of the Umande Trust in Nairobi and the Dream Team in Zambia.

[27]Source: FaME project. http://www.slideshare.net/tremoletconsulting/fame-presentation-04112014-vf

Faecal sludge is a valuable resource that is still largely unexplored. For the future, it will be essential to research and develop further the potential economic value of faecal sludge for biogas or fertiliser or other applications.

Focus areas:

- ✓ *Solid waste removal services to informal settlements. Privatising recycling services might work.*
- ✓ *A cost effective and safe alternative for the pit to solve the problems with pit-emptying and potential groundwater contamination.*
- ✓ *Research and development of financially viable and scalable solutions for the re-use of faecal sludge. The cost-benefit calculation must reverse the money flow, i.e. pay toilet owners or collectors in money or by-products for faecal sludge.*
- ✓ *Supportive policy and legislation, and micro financing for the private sector to invest in these solutions.*

It is evident that these challenges and the areas to be addressed listed above call for an integrated management solution that can turn faecal sludge from waste to resource on a large scale.

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Please note that the abbreviations "*s.l.*" and "*s.n.*" stand for *without place of publication* and *without name of publisher*.

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