

FSM

INNOVATION

**Sustainable FSM Services
through Integrated Use of Resources
and Innovative Technologies:
A Case Study of the eThekweni
Municipality (Durban) South Africa**

T. GOUNDEN AND N. ALCOCK

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EXECUTIVE SUMMARY

The vision of the EThekweni Water Services (EWS) is to ensure integrated use of resources through sustainable water management. This means providing water and sanitation services that are equitable as well as environmentally, socially and financially sustainable, and technically excellent.

EThekweni Municipality (City of Durban) has been forced to address sanitation challenges in a relatively short time span, due to a sudden increase in its geographic area of operation and a change from an infrastructure to a service delivery approach in the 2000s. This involved moving from 'first world' challenges of operating waste water treatment works and sewer networks to developing and applying a broader mix of technologies across the sanitation services chain.

During the sanitation development and scaling up process, the city has tested several innovative technologies and learned important lessons, including that 'one size does not fit all' for community sanitation. Sustained stakeholder engagement and education are critical for success and acceptance and continued academic research and assessment, will guide the implementation process and allow for re-imagining and re-development of the solutions.

The City places a high priority on gender equity including gender awareness within its own organization and in implementing sanitation programmes. Promoting gender equality is important for advancing the fundamental development goals of human rights and social justice, poverty reduction, economic development, and overall human development (UKZN Pollution Research Group, 2014).

Although gender is about men and women, the eThekweni Municipality's focus and is largely on

issues concerned with women's development and empowerment. Many women have experienced triple oppression, based on their race, class and gender. These derived from past policies and laws which deliberately favoured men. EWS has integrated gender into its work based on the leadership of the Municipality and the National Sanitation Policy.

EThekweni Water Services (EWS) has also learned that partnerships with research institutes and collaboration with the private sector greatly assist with meeting the objective of providing adequate and acceptable sanitation for all.

Finally, eThekweni is looking at developing new approaches, such as social franchising system to meet operation and maintenance challenges and technologies, such as recycling water, generating valuable products and operating off the grid to meet current challenges.

CONTEXT

Background

EThekweni Municipality (Durban) is located on the eastern seaboard of South Africa in the province of KwaZulu Natal, and covers an area of 2,297 square kilometres. In 2015 the population estimated from the 2011 census was 3.5 million people, and the GDP per capita USD 13,000 (2014). Approximately 55 percent of the land is designated as urban (30 percent peri-urban, 25 percent urban), and 45 percent as rural. Since the dawn of the new democracy in 1994, there has been significant influx of people to the city from rural areas, from other cities and from other parts of Africa. Population growth between 2001 and 2011 increased 1.13 percent, putting pressure on sanitation service delivery and other services. Most newly arrived people live in peri-urban areas and in the informal

settlements that are scattered throughout the city, often near potential work opportunities. Most informal settlements are situated on steep land or flood plains, which are high risk areas and pose further challenges to service delivery and infrastructure development.

According to a survey in 2011, there were 912,000 households within the municipality, of which 54 percent were formal, 34 percent informal or backyard shacks, and 12 percent rural. The diverse nature of the topology, the mix of urban, peri-urban, informal and rural households, and the inward migration rate pose a significant challenge to the city in terms of service provision.

Shit Flow Diagram analysis

EThekweni FSM interventions can be summarised using a shit flow diagram (SFD). The offsite and onsite services provided by eThekweni can be broken down as follows:

Onsite

- Urine Diversion Toilets
 - Burial on site
 - To Black Soldier Fly (BSF) plant
- Ventilated Improved Pit (VIP) Toilets
 - Burial on site
 - To LaDePa (Latrine Dehydration and Pasteurisation treatment system)
- Ablution Blocks on site (VIP)

- Flush toilets to septic tank
- Flush toilets to conservancy tank

Offsite

- Flush toilets to central sewer network
- Ablution blocks to central sewer
- Flush toilets to decentralised package plants.

The tables below provides the breakdown of sanitation services by dwelling type as well as backlog figures, and was used to generate the SFD (UKZN Pollution Research Group, 2014). The data used was secondary data from a desktop study and has not all been verified in the field or by surveys.

The key issues depicted in the SFD are as follows:

- 74 percent of the excreta is safely treated before disposal or reuse
- 26 percent is released unsafely into the environment
- 16 percent of onsite sanitation is not contained due to the use of informal pits
- 7 percent of the waste going through the waste water treatment works is considered not treated to effluent quality standards
- 18 percent of the population have UD toilets, and it is assumed that the waste is buried or treated at the BSF plant
- 8 percent of the population have VIPs, septic tanks or conservancy tanks, and it is assumed waste is treated safely.

Dwelling type	Total number of dwellings	Sanitation type per dwelling					
		Serviced with Urine Diversion Toilets	Within 200m of Ablution Block	Serviced with VIPs	Serviced with Septic Tanks & PPs	Serviced with Waterborne Sanitation	Backlog in Sanitation Service
Informal Settlements	265542	5194	111868			15533	132947
Informal Settlements - Formal Informal	3096				3096		
Backyard Shacks	48975					48975	
Rural - Traditional	103715	77059					26656
Formal houses not in Rural area (A1)	409210			35000	99282	274928	
Flats (B1)	110225					110225	
Formal houses in Rural area	5147				5147		
Total	945910	82253	111868	35000	105525	449661	159603
Percentage	100%	9%	12%	4%	11%	48%	17%

Dwelling type	Occupancy Rate
Formal house	3.86
Formal Flat	2.9
Informal single	3.6
Informal Backyard	3.9
Rural	5
Rural formal house	4.65

Dwelling type	Population Proportion per dwelling type					
	People with UD	People with ablation	People with VIP	People with Septic or Package Plants	People with Waterborne to central	People Unserved
Informal Settlements	18698	402725			55919	478609
Informal Settlements - Formal Informal				11951		
Backyard Shacks					191003	
Rural - Traditional	385295					133280
Formal houses not in Rural area (A1)			135100	383229	1061222	
Flats (B1)					319653	
Formal houses in Rural area				23934		
Total	403993	402725	135100	409113	1627796	611889
Percentage	11%	11%	4%	11%	45%	17%

Table 1: Breakdown of sanitation services and backlogs by dwelling type

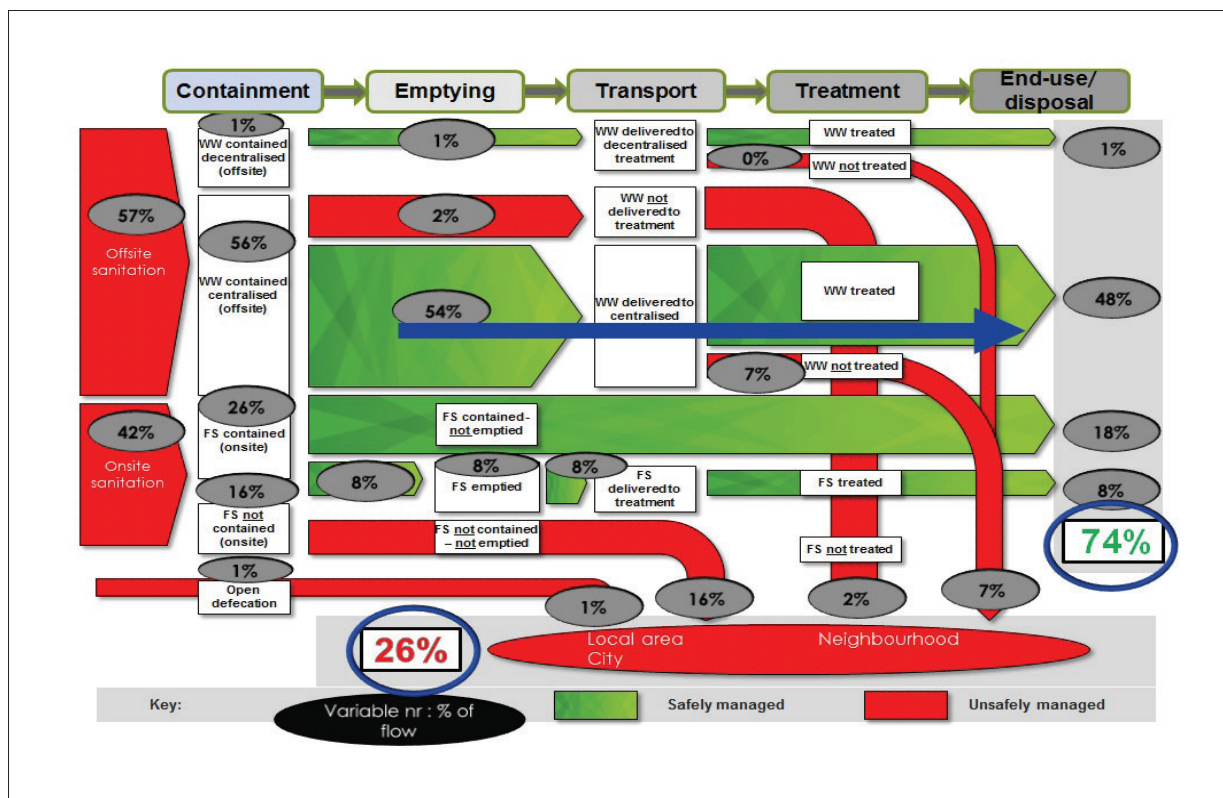


Figure 1: Shit flow diagram for Durban

FSM IN NATIONAL AND LOCAL URBAN SANITATION POLICY

History

Prior to the first democratic election in 1994, the City of Durban comprised several council areas servicing white, Indian and coloured areas under the former apartheid system. Black areas were governed by a combination of the provincial government and the KwaZulu homeland structures. Following the election, the former council areas were amalgamated with the former black township areas to form the eThekweni Unicity, which had one water and sanitation department. The boundary of the city was later expanded to include the sparsely populated rural areas, which had little or no services. Between 1994 and 2000, the municipality focussed on improving the operation of the waterborne sewer system in the former townships through upgrades and community education programmes.

The city also inherited approximately 35,000 VIPs in peri-urban areas where factors such as high density or topography prevented the construction of waterborne sewage.

In 2000/2001, a cholera epidemic broke out in the newly formed Metro region that affected more than 1,000 people and led to more than 15 deaths. The epidemic was particularly problematic in the rural areas, where no formal water and sanitation services were being

provided. An extensive programme to roll out a basic water and sanitation service was developed and then implemented. The services consisted of a ground tank system providing six kilolitres of free water per month and a urine diversion toilet for each household.

AN EXTENSIVE PROGRAMME TO ROLL OUT A BASIC WATER AND SANITATION SERVICE WAS DEVELOPED AND THEN IMPLEMENTED

The city also realised that the provision of housing to new residents living in informal settlements could not keep up with demand. A programme to provide community ablution blocks (CABs) with showers, toilets and laundry areas was developed and rolled out. This would ensure that each household had access to basic sanitation within 200 metres of their homes.

Institutional mandate

National policies and legislation focused specifically on sanitation, to guide the delivery services in an equitable and fair manner including the policy of free basic services for all (Department of Water Affairs and Forestry, 1994).

While the right to access to adequate sanitation is not expressly provided for in the Constitution of South Africa, it does contain clauses that imply the right to basic sanitation. In addition, the 2001 white paper on Basic Household Sanitation explicitly acknowledges that "...government has a constitutional responsibility to ensure that all South Africans have access to adequate sanitation...", and the Water Services Act of 1992 the primary legislation relating to water and sanitation in South Africa also refer to a "right to basic sanitation."

South Africa has a three-tier system of governance: national, provincial and local. Local government has the constitutional responsibility to provide water and sanitation services, while provincial and national government have a constitutional responsibility to set policy and support local government in a spirit of co-operative governance (DWAf, 2001).

The Water Services Act sets out the regulatory framework for institutions tasked with the supply of water and sanitation services, and provides for different water institutions to be established as follows:

- The water services authority (WSA), which is the responsible municipality
- The water services provider (WSP), whose role is to physically provide water supply and sanitation services to consumers.

Thus the eThekweni Municipality is the WSA and EWS is the WSP for the EThekweni Municipal Authority. EWS has the responsibility of providing water and sanitation services to more than 3.6 million people within the municipal area, which includes both urban and rural areas. This has given rise to a number of challenges, such as provision of basic water and sanitation services to communities outside the waterborne edge, a lack of awareness about how to use water supply and sanitation services correctly, illegal connections, blockages and vandalism (EWS, 2011).

The challenges facing the WSP in the provision of water and sanitation services are to:

- Manage the conflict between different users in different catchments
- Provide a means of providing access to services to those who are still without
- Maintain and improve services already supplied in a sustainable manner
- Provide measures to assist those who do not have the economic means to pay normal service charges
- Provide water services in support of all forms of economic development
- Address gender equity issues and services for other vulnerable groups.

These challenges need to be addressed in a manner that supports the preservation of ecosystems and in conjunction with an education and awareness programme to ensure proper use and management of water and sanitation systems.

Government policy provides for free sanitation for indigent households (the minimum level of service being a VIP latrine) and access to free basic water. Specific funding streams are available to municipalities for these services; however the details of delivery are left up to the local service provider.

The main strategic planning instrument for local government is in the Integrated Development Plan (IDP). The IDP is a single, cross sectoral plan intended to integrate and co-ordinate all developmental activities and associated budgets within the municipality and which includes the development of a Water Services Development Plan (WSDP).

The new National Sanitation Policy of 2016 has also provided some new areas of focus. These include:

- Prioritising hygiene and sustained end user education
- Sanitation must be people centred and demand driven
- Sanitation has economic value in the form of reuse of bi-products
- Sanitation services need to reflect the growing scarcity of water in a manner that does not undermine long terms sustainability and economic growth
- Long term operation and management planning needs to take place in order to ensure long term sustainability of the services
- Differences in needs and priorities of women, girls and boys and inequalities in access are taken into account during implementation.

Role of the private sector

EWS provides most of the sanitation services throughout the sanitation chain although private sector entities are used to collect and transport of faecal sludge from septic tanks, VIPs and urine diversion (UD) toilets. A number of decentralised treatment plants are privately operated. The private sector is also utilised for the construction of new UD toilets and Community Ablution Blocks (CABs).

Active regulatory aspects or gaps

EThekweni Water Services has an active approach to policy when developing a new sanitation technology. The approach is to first pilot the technology based on the research findings. New policy is then developed before rollout at scale according to the approved policy. Recently developed is the policy on UD toilets, which will be emptied by the municipality every two



Figure 2: Photographs showing emptying and transport of waste from VIP toilets

years free of charge rather than the onus being on the resident to empty the toilet. Adopting the principle that ‘good science makes good policy’, this decision was based on research by PRG into viable pathogens in UD content that pose a risk to householders who emptied chambers. An example of a new policy area being explored is in relation to control of private septic tank emptiers. EWS is exploring the use of a GPS tracker system to monitor septic tank emptiers in order to prevent unofficial dumping of waste in the environment. Gaps in regulatory aspects relate mainly to by-laws that restrict onsite sanitation where sewer infrastructure has been provided. There are also significant regulatory gaps in the area of reuse of waste.

ABLUTION BLOCKS PROVIDE SEPARATE ACCESS AND SERVICES FOR WOMEN AND GIRLS WITH ADEQUATE LIGHTING AND FEMALE CARETAKERS TO IMPROVE SAFETY

Gender policy and approach

Although gender is about men and women, the eThekweni Municipality’s focus is largely on issues concerned with women’s development and empowerment. This is because women have experienced triple oppression, based on their race, class and gender. This is also derived from the impact of past policies and laws which deliberately favoured men, thereby historically disadvantaging women. *“eThekweni Municipality hereby deliberately focuses upon this vulnerable group in order to honour its commitment*

to reducing poverty and facilitating development.” (EThekweni Municipality, 2015)

EThekweni Water and Sanitation have directly applied gender requirements of the municipality and the National Sanitation Policy through the following actions:

- At least 75% of all local project employment opportunities must be for women
- Ablution blocks provide separate access and services for women and girls with adequate lighting and female caretakers to improve safety.

SUMMARY OF FSM INTERVENTIONS

VIP Programme and LaDePa

EWS inherited 35,000 Ventilated Improved Pit latrines (VIPs) in the mid to late 1990s. This was the basic level of sanitation service provided to areas that could not be included in the waterborne system, due to high population densities, lack of formal cadastrals and difficult topography. After ten years, many of the VIPs were full or overflowing, giving rise to extreme public health hazards. EWS piloted an emptying service that was later refined. Policy was then developed before full rollout took place. Under this policy, toilets would be emptied free of charge every five years. Residents would pay for emptying within that period, which would be on request. The sludge removal was carried out by a managing contractor that used local subcontractors who adhered to strict emptying protocol and high levels of health and safety standards. Disposal was burial on site or sludge was processed at a decentralised pelletizer plant called the LaDePa. This machine, developed in partnership with technology partners, first removes solid waste, then dehydrates and pasteurises the VIP sludge and finally produces

pellets which can be used as a soil conditioner or fertiliser. The machine uses heat and medium wave infrared technology to destroy the pathogens.

Urine diversion toilet programme using BSF processing plant

In early 2000, during the cholera epidemic, EWS began exploring other sanitation technologies that could be used in the vast, sparsely populated rural areas

as well as the peri-urban areas to replace to the VIP toilet. The cost of emptying the VIP toilet was proving prohibitive due to difficult access to areas and the toilet itself. Following this research and prototype testing, the urine diversion double vault toilet (UDDT) was selected. As the sketch shows, the pedestal separates urine (a male urinal is also provided) from faecal matter. The urine is diverted to a soakaway, while

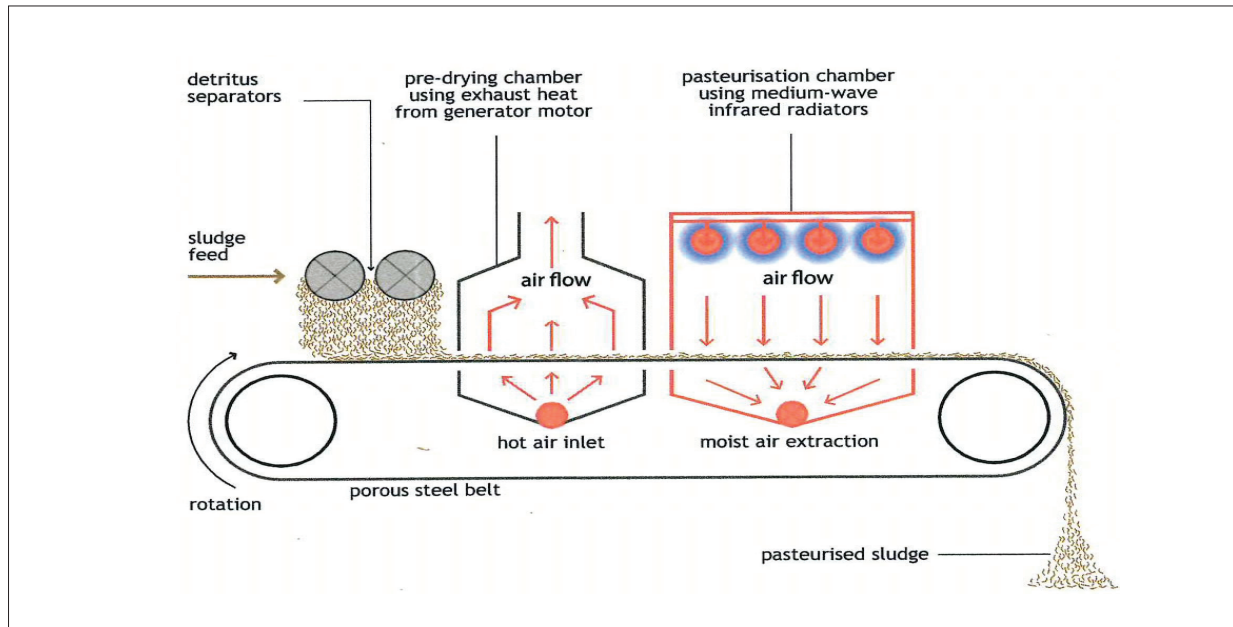


Figure 3: Schematic of LaDePa (Latrine Dehydration Pasteurisation) pelletiser which is used to process VIP waste at decentralised locations



Figure 4: Photographs of LaDePa components, inputs and products

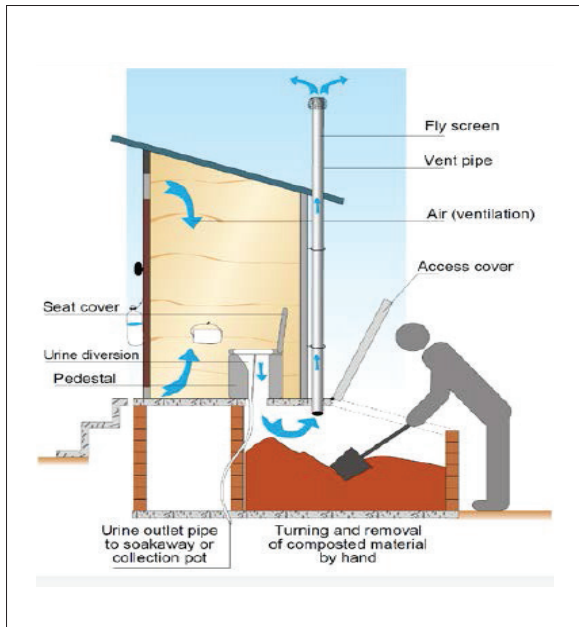


Figure 5: Schematic of a urine diversion toilet

the faecal matter collects in the chamber. When the chamber is full, the pedestal is moved to the second chamber giving time for the contents of the first chamber to decompose and for pathogens to die off. Residents are trained to empty and bury the contents of the chamber once fully decomposed. Access to the chamber is by means of two sliding back panels, which is much easier than breaking into a conventional VIP toilet. The UDDT is provided to the households

at no cost but the householder is responsible for emptying. The delivery programme started in 2005, and some 85,000 toilets have been developed to date (DWAf, 2002).

EWS partner, the University of KwaZulu Natal Pollution Research Group (UKZN PRG), have undertaken several research activities linked to the implementation and operation of the UDDT over the past five years. A number of challenges were identified:

- Some households were not emptying full and overflowing chambers
- Households felt that EWS should provide a free emptying service as they did for VIP toilets
- Pathogens were not breaking down during the decomposition process, so households were being exposed to health hazards during uncontrolled emptying
- Some peri-urban areas have densified and there is limited space for burial onsite
- Disposal at hazardous waste sites is prohibitively expensive (USD 65.00/ton).

EWS made a decision in 2014 to provide one free emptying service every two years. The appropriate policy was approved by the council. An opportunity to test and develop an emptying and disposal model through a private sector partnership was made possible through a grant from the Bill and Melinda



Figure 6: Photographs showing the components of a urine diversion toilet and emptying activities



Figure 7: Photographs showing various aspects of a black soldier fly plant used to process urine diversion toilet faecal waste

Gates Foundation (BMGF) that aimed to promote business partnerships in the sanitation sector. The programme consisted of an emptying programme followed by burial on site or transport to a processing site. The emptying, burial and transport programme is funded by the municipality.

The technology selected for the processing plant is Black Soldier Fly (BSF). The plant, which was built at a municipal wastewater treatment works, consists of receiving area, grow-out sheds, nursery and processing equipment. This was funded by BMGF. The end products are oil from larvae, animal feed and biochar. As the project is a pilot, "downstream" sale of products are still being finalised by the operator. However, the operator has existing relationships with agricultural buyers for sale of feed and industrial buyers such as Unilever for sale of oil. The plant was completed at the end of 2016 and is in the commissioning phase at present. It is being operated privately under a service level agreement (operating contract). The emptying contractor was appointed by tender and will start emptying toilets at the beginning of 2017.

Key institutional and regulatory issues are:

- The development of an innovative service level agreement between the municipality and the BSF plant operator
- Use of local labour and local contractor were made mandatory in the emptying tender document
- Detailed health, safety and environmental requirements were included in the emptying contract and in the BSF service level agreement.

Community Ablution Blocks (CABs)

A key third sanitation challenge faced by the municipality is the provision of services to residents

of dense informal settlements while residents wait for provision of new formal housing. Waterborne sewage and urine diversion toilets at a household level are not possible due to densities and topography. EWS piloted and later rolled out community ablation blocks (CABs), which provide services to approximately 75 households within 200 metres of the facility. Housed within a converted shipping container, the CAB provide the following facilities:

- Separate male and female toilets
- Showers
- Laundry areas
- Lighting
- Connections to sewer mains.

Each container is allocated a local caretaker who manages the facility. Of the 1,500 caretakers employed to date, more than 1,300 are women. EWS provides consumables such as toilet paper and cleaning material on a regular basis. EWS also attends to faults such as water leaks, toilet blockages and vandalism. Robust, non-valuable materials were used to reduce incidents of theft and vandalism.

Through EWS partner UKZN PRG, a number of research activities on the installation and operation of CABs were undertaken between 2012 and 2016. Key findings from these research activities included:

- High running costs due to slow response by the municipality to leaks and faults
- Inconsistent service provided by caretakers due to low levels of monitoring
- Some pollution challenges due to leaks and blockages
- Access is difficult (in some cases) due to topography
- Greater acceptance of the technology
- Significant reduction in open defecation



Figure 8: Photographs showing components of a community ablution block in an informal settlement

- Greater social cohesion where communities embraced toilet blocks as their own
- Reduction in vandalism.

Other planned FSM Interventions

The EWS response to these findings was to develop a social franchising system to manage the CABs. This system involves the appointment of a private managing company (franchisor) that appoints local CAB operator companies (franchisees). Women owned businesses will be targeted for the majority of these franchisee opportunities. The system allows for rapid response to faults, and procurement requirements and cost management would be transferred to the franchise system. However, EWS has not yet been able to obtain approval from municipal management to implement this approach.

EWS is also investigating decentralised waste water treated options including DEWATS for use at new housing projects that cannot be connected to the sewer network. DEWATS is an anaerobic baffle reactor, which has been piloted by the municipality

but approval for use at new housing projects is still being sought. The approval process, which includes conducting an environmental impact assessment (EIA) and obtaining a water use licence, has proved laborious and resulted in delays.

THE EMPTYING SERVICES ARE MADE POSSIBLE BY CROSS-SUBSIDISATION FROM WATER AND SEWERAGE SERVICE CHARGES FROM MORE AFFLUENT AREAS AND HOUSEHOLDS

FINANCIAL AND ECONOMIC ASPECTS

Both the VIP and the UD toilets were provided to residents free of charge. This was made possible by a municipal infrastructure grant provided by national government to municipalities, and the cost of installing

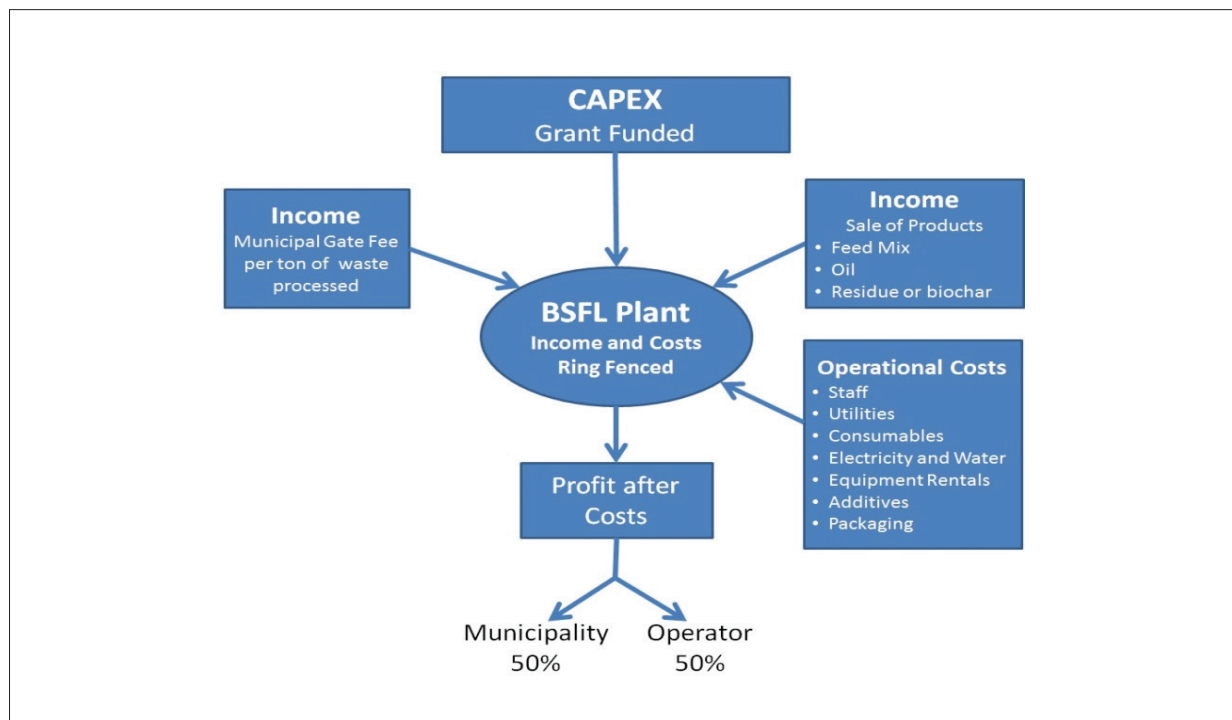


Figure 9: Schematic of the business model agreed on by the municipality and operator for the black soldier fly plant

Processing route	Cost/toilet USD
Removal, burial and tree planting	75.00/toilet
Removal, transport and disposal at hazardous waste site (average dist. 20kms)	97.00/toilet
Net cost of removal, transport and BSFL processing (assuming a profit share of USD 11.00 per toilet waste processed and a 100% capital cost subsidy)	51.00/toilet

Table 2: Costs of waste management from urine diverting toilets

Driver	Change
1994 new democratic dispensation	<ul style="list-style-type: none"> Improve sewer network in former townships
1996 new eThekweni municipality as amalgamation of townships, white and Indian council areas	<ul style="list-style-type: none"> Extensive education programmes in communities and schools on correct operation of sewer system
Free basic services policy	<ul style="list-style-type: none"> Rollout of VIPs
2000/2001 cholera epidemic	<ul style="list-style-type: none"> Rollout of basic water and UDs in rural and peri-urban areas
2000/2001 White paper – adequate sanitation for all	
2005 VIP – five-year emptying policy	<ul style="list-style-type: none"> Rollout of VIP emptying programme and development of LaDePa for processing of waste
Rapid urbanisation after 1994	<ul style="list-style-type: none"> Rollout of CABs in informal settlements
Political and social pressure for flush toilets in non-sewered areas	<ul style="list-style-type: none"> Testing of DEWATS Pour flush testing
Urine diversion research indicates health hazard when emptying	<ul style="list-style-type: none"> Development of UD emptying programme and BSF technology for processing plant
2014 Research indicates operation and maintenance challenges at CABs	<ul style="list-style-type: none"> Development of social franchise management system

Table 3: Drivers of change in the sanitation sector

a UD toilet through the municipal infrastructure grant is USD 860, and a VIP USD 461.

The emptying services (every two years for UDs and every five years for VIPs) are made possible by cross-subsidisation from water and sewerage service charges for in more affluent areas and households. Should households require emptying within the two and five years cycles, they can request this but must pay a removal fee. The cost of pit emptying a VIP toilet is an estimated USD 100, whilst UD emptying costs around USD 46.00 and is covered by the cross subsidy which is equivalent to the household pays if they need extra emptying.

Figure 9 illustrates the agreed business partnerships contained in the service level agreement for the processing of UD waste at the BSF plant (N Alcock et al., 2016)

The financial costing for the model for removal of UD waste and burial onsite, and transport and processing is shown in Table 2.

The costs for UD management are subsidized by the Municipality from the higher sewage and water charges in more affluent areas, meaning that there is no income through payment by users. The cost to the householder to desludge a septic tank and transport waste is approximately USD 65.00.

CAPACITY DEVELOPMENT

Capacity development is an integral component of EWS ethos both internally (staff) and externally (community and contractors). Internally, staff are mentored and coached on specialised areas of their work including being given opportunity for further education in their respective fields. Externally, work

opportunities on projects include members of local community (non- skilled) who are given on job training according to the Expanded Public Works guideline “to develop skills within communities through on-the-job and/or accredited training of workers and thereby developing sustainable capacity within communities” (EPWP,2016).

DRIVERS OF CHANGE

The drivers of change in the sanitation sector in eThekweni are summarised in Table 3 above.

LESSONS LEARNED

There have been many specific lessons learned from the implementation of the various sanitation technologies for target communities. However, several fundamental lessons have been learned across all programmes.

There is no ‘one size fits all’ approach. Different technologies are suitable for different situations and communities. Secondly, the attitudes and understanding of communities and political structures are instrumental in the success of any rollout. Without community engagement, support for and understanding of operation and maintenance will be lacking. Technologies need to be tested in laboratories and then piloted in communities before finalisation for rollout. Policy development based on the findings of the pilot must then be developed and approved. During rollout, ongoing research and evaluation must take place. Finally, based on any problems identified, the approach can be re-imagined and new approaches piloted.

The FSM sanitation model can thus be summarised in the cycle below. This development cycle is the key to achieving rollout.

A number of other key lessons learned are summarised below:

- **Rollout to city-wide services** needs to include comprehensive long-term community engagement and education
- **Need to shift from an infrastructure** to a service delivery approach
- **Need for safe management of excreta** throughout the sanitation chain
- **Need for facilitation of progressive realisation** built on what is already in place
- **It is important to consider operation and maintenance budgets** and not focus purely on building toilets
- **The role of the private sector** in bringing in innovation needs to be recognised
- **Policy makers and sector leaders** need to encourage calculated risk in order to continually improve service delivery.

OUTSTANDING CHALLENGES

Key outstanding challenges and the planned steps to address these challenges are:

New environmental policy is aimed at reducing or stopping burial of faecal waste on site. This means more waste from VIPs and UDs will need to be transported to decentralised processing plants. There is a plan to rollout three more LaDePa pelletizes at various locations in the municipality to process waste and derive income from sale of products. This potential income will reduce the costs associated with the transport of the waste.

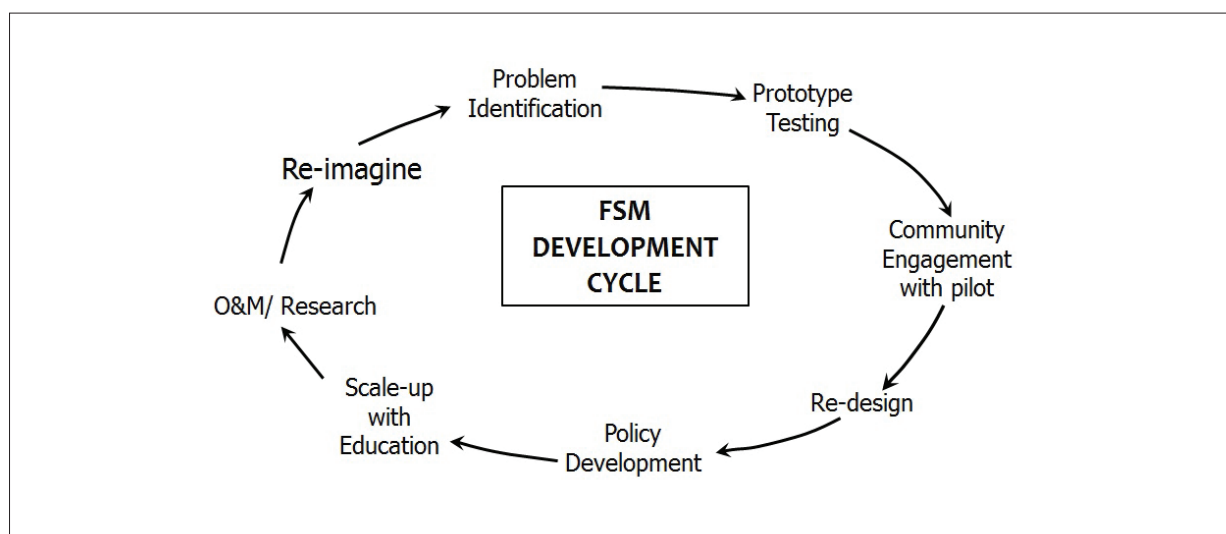


Figure 10: FSM development cycle

The operation of the BSF processing plant will be analysed this year. Should the plant be viable in terms of reducing costs through sale of products, additional plants will be planned and constructed within the municipality.

Improving the operational and proactive management of the caretakers in the CAB programme. The social franchising system (described earlier) aims to achieve more efficient and cost effective management and maintenance of the CABs and empowerment of women through franchisee opportunities.

The provision of flush toilets at new housing projects that cannot be connected to the existing sewer networks. Residents strongly aspire to owning a flush toilet. Two technologies are being piloted to try to meet this aspiration. First is pour-flush technology, which uses limited water (a scarce resource in the municipality) and waste is disposed of in a pit close to the house. The second is DEWATS or Decentralised Waste Water Treatment System. It is hoped to test this at a new housing project soon.

Exploration of new technologies that advance to the circular economy approach. Technologies that recycle water from effluent and grey water, derive valuable products from waste and operate off the electrical grid will be developed over the next few years.

The **municipal approval processes and delays** experienced during procurement for rollout.

Approval by Municipal management and procurement challenges have delayed the CAB franchising system, the rollout of UD waste removal, and the second VIP waste removal programme. New ways to address these challenges need to be sought. The most fundamental step would probably be to build relationships between officials and key politicians (decision makers).

Other challenges needing attention include:

- Creation of sustainable small-scale independent service providers to assist the municipality with improving service delivery efficiencies
- Exploring possible revenue generation from resource recovery and reuse of waste products
- Deepening the understanding of city leaders and politicians about the value proposition of FSM and that 'it's not all about flushing'
- Changes in procurement processes to allow for more local community involvement in projects
- Relaxation of by-laws and policies for onsite sanitation within urban areas.

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ABBREVIATIONS AND ACRONYMS

BSF	Black Soldier Fly
CAB	Community Ablution Blocks
DEWATS	Decentralised Wastewater Treatment
EWS	Ethekwini Water and Sanitation
LaDePa	Latrine Dehydration and Pasteurisation
UD	Urine Diversion
VIP	Ventilated Improved Pit

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