

# Using Innovation as a Catalyst for Sanitation Service Delivery



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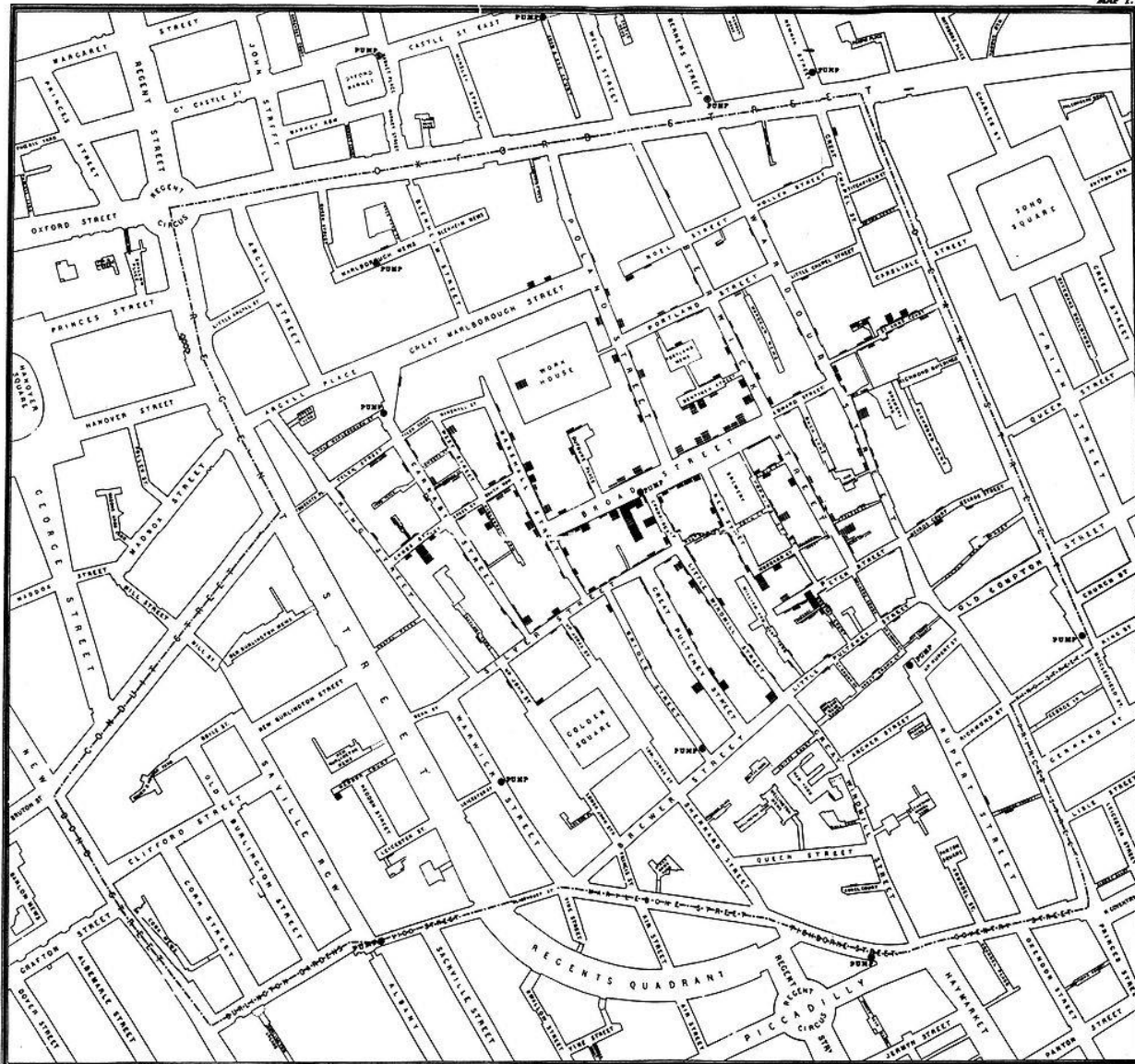


# Sanitation: Barrier to Disease

WEDC, 2004



Faeces



C.F. Oxley, Ltd. Southampton D.P. London

SCALE 30 INCHES TO A MILE.



*the Middle Ages,  
wood cut*

# Sanitation – Cinderella of Services

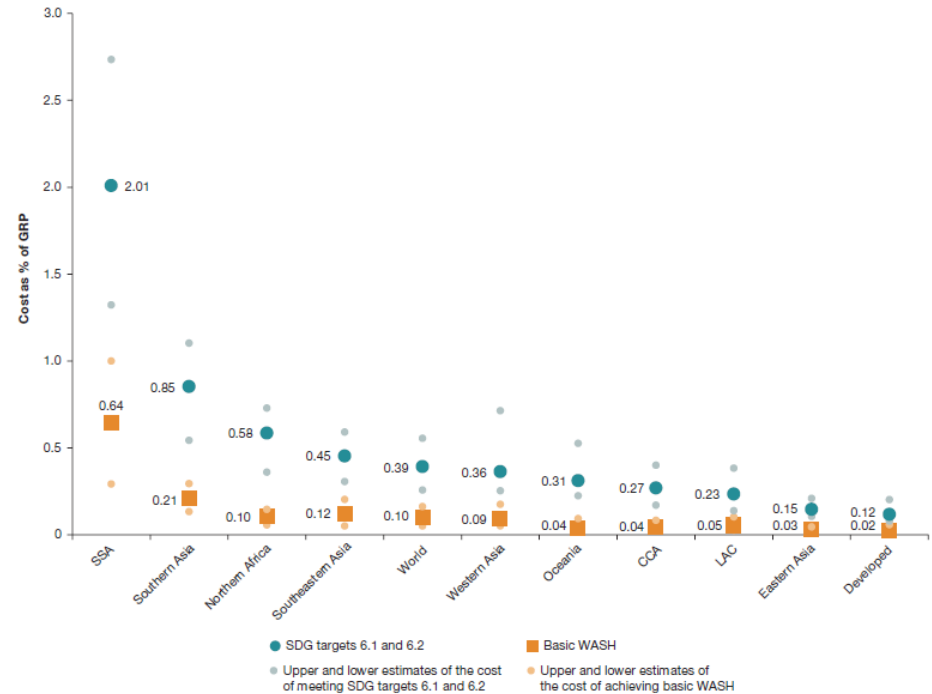


# Sanitation Statistics - Africa



- Sanitation the most off-track MDG
- Progress 24% to 30% access to improved facility from 1990-2015
- 70% of Sub-Saharan Africa lack access
- 19/27 highest OD countries in Africa
- Widespread OD countries have highest under-5 mortality, malnutrition and poverty
- Greater capital is needed for SSA due slow progress (WSP - Hutton & Varuhese, 2016)

**FIGURE 2: WIDE VARIATION BETWEEN WORLD REGIONS IN CAPITAL COSTS AS A PROPORTION OF GROSS REGIONAL PRODUCT**  
 Costs of Basic and Safely Managed Services as Percentage of Gross Regional Product (GRP) by Region, with Uncertainty Range



Note: WASH = water, sanitation, and hygiene; SDG = Sustainable Development Goal; SSA = Sub-Saharan Africa; LAC = Latin America and the Caribbean; CCA = Caucasus and Central Asia. See table 2.2 for details on upper and lower values on variables varied in sensitivity analysis. Gross regional product is based on the aggregated GDP of countries in each region. An economic growth rate of 5 percent is assumed across all regions.

Source: WSP (2016)

## Sanitation Makes Cents

“An overall estimated gain of 1.5% of global GDP and a US\$ 4.3 return for every dollar invested in water and sanitation services” (WHO, 2012 and 2017)

# Current Binary Technology Paradigm

## Conventional WWTW

Conventional linear design approach  
Full flush is “gold standard”  
Resource intensive (Capital, Sewers, Water, Energy, etc.)  
Challenging to meet urbanisation & pop growth  
Expensive & beyond reach of developing countries  
Established technologies (discharge regulations, guidelines, policies, etc.)

## On-Site Sanitation

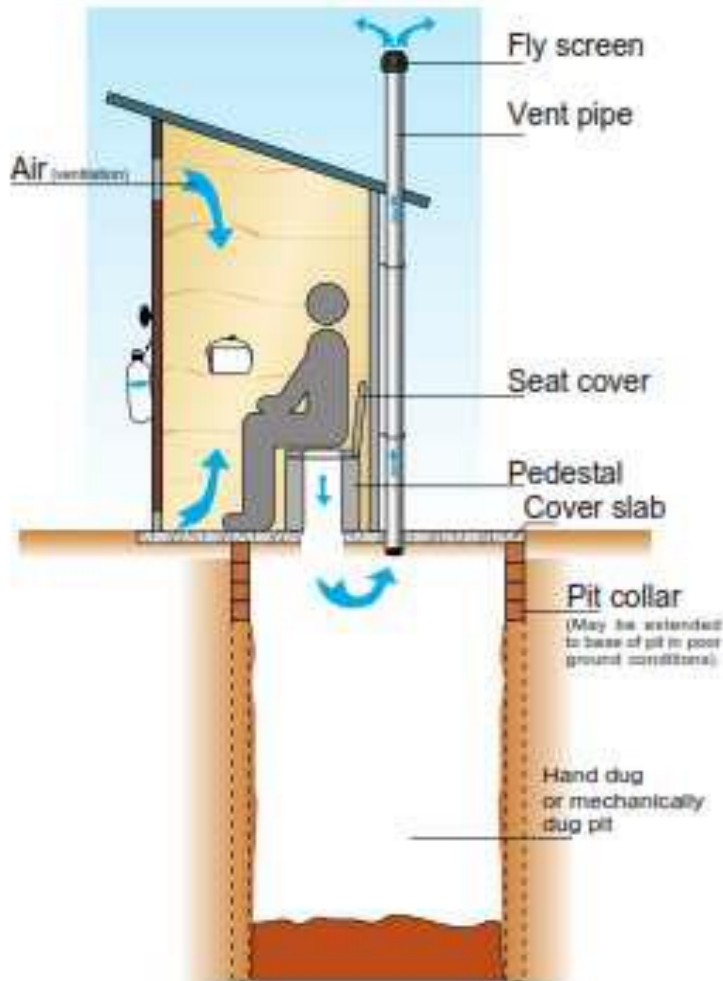
Most prevalent tech in SSA  
Viewed as “temporary” solution  
Less resources  
Can be scaled at urbanisation rates  
5-50% cheaper (than activated sludge)  
Faecal Sludge Management – lack of policies & standards, disposal routes unknown, O&M overlooked.



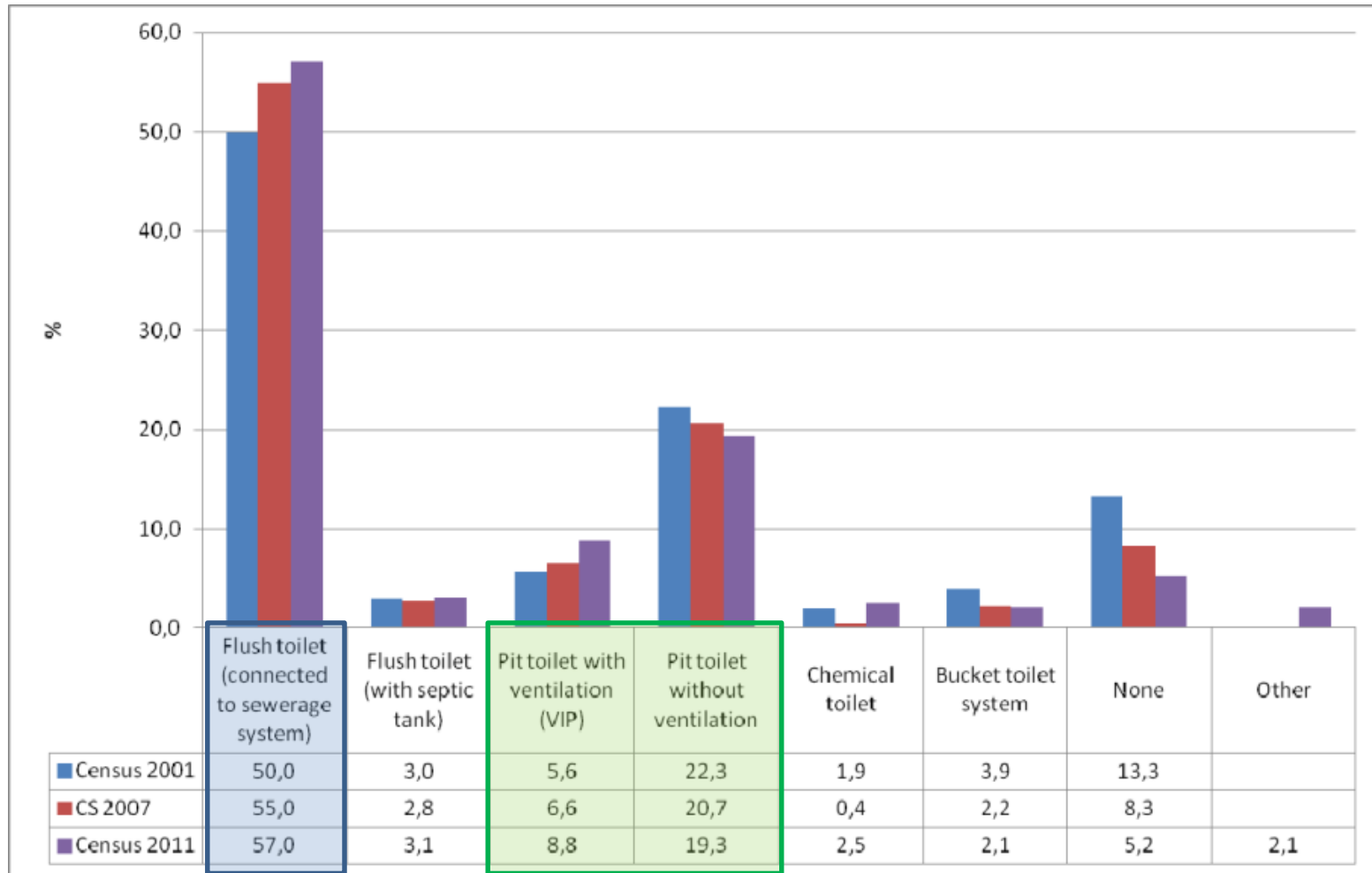
**Solution???**

# Introducing the VIP (Ventilated Improved Pit) Latrine Toilet

- ❖ Ventilated Improved Pit (VIP) latrine has been the government's minimum standard sanitation technology.
- ❖ Designed to reduce disease transmission and smells.
- ❖ Improve on stability of pit latrine structure.
- ❖ Has concrete slab and vent pipe
- ❖ Nearly 10% of South African population serviced by VIP toilets



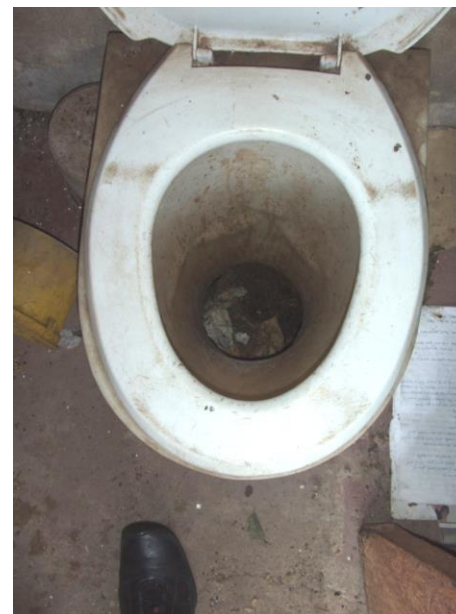
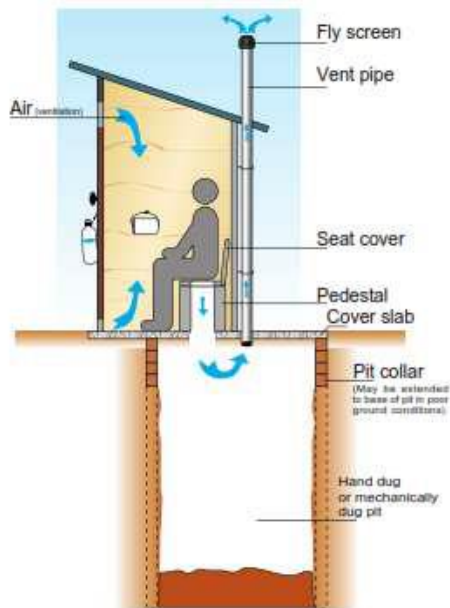
# SA National Statistics: Sanitation



Statistics South Africa (2011)

# Post Implementation Challenges

- ❖ Large infrastructure programmes to build VIP latrines in South Africa
- ❖ Around 30% of South Africans rely on VIP and derivatives
- ❖ Tipping point being reached – pits were filling but many municipalities did not O&M budget, policies & procedures for management
- ❖ SALGA (2009) survey showed 60% facilities conducting reactive maintenance while 40% had inadequate maintenance capacity.
- ❖ Limited technical know to empty & disposal pit contents







**Mechanical emptying a problem!**



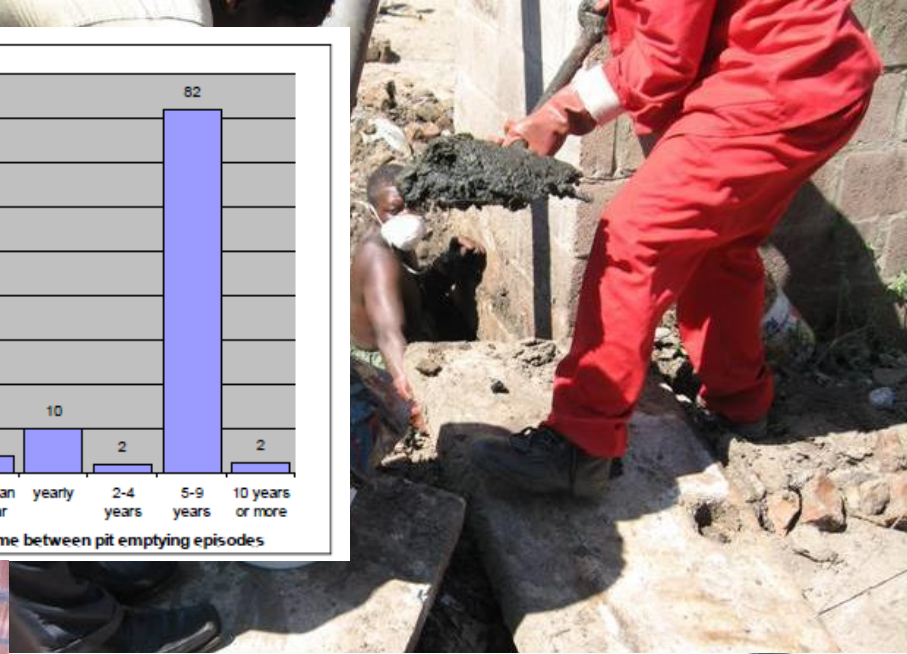
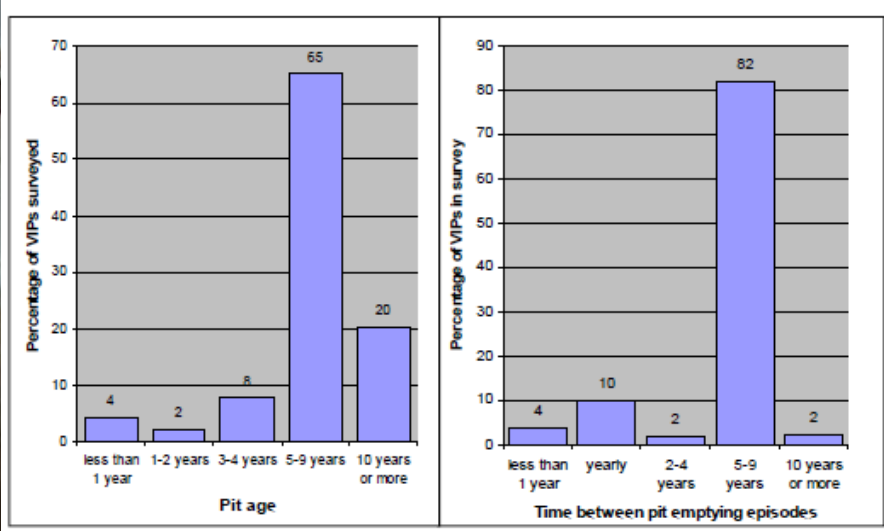
**Disposal can be a problem!**

**Access can be a problem!**

# Lack of Answers: Research Needed

- Why were pits are filling-up much faster than their design life?
- There is conflicting advice on what should be put into pits (additives, etc.) and do these work?
- Undesirable non-degradable objects (why & how much?).
- Is emptying of pit contents hazardous?
- How can we optimise pit emptying?
- How can we dispose of the sludge?
- Pollution plumes from on-site units?

**LACK OF UNDERSTANDING OF HOW VIP LATRINES FUNCTION & WORK  
KNOWLEDGE GAP IDENTIFIED  
SCIENTIFIC DATA REQUIRED TO MANAGE THE CHALLENGE!**



Large-scale infrastructure programmes to build VIP toilets since end of 1990s  
*Many of the toilets were full or nearly full*  
*Pits filling faster than design rate*  
*Lack of Planning, Strategy and Solutions for Sludge Management*

# The Service Delivery Issue



**IN DIRE STRAITS:** Bulugha Farm School, situated just outside East London, is one such school that had to make do without proper toilet facilities. The school, which has 250 pupils enrolled, made use of a single pit latrine while other pupils were forced to relieve themselves in the bushes  
PICTURE: MARK ANDREWS

## Commission set to investigate school sanitation problem

By ZISANDA NKONKORE  
Education Reporter

**T**HE Human Rights Commission (HRC) is to investigate schools in the Eastern Cape after it was found that

"Given the billions of rands made available to fund Eastern Cape education every year, it is unacceptable that almost one in five of the 5 694 public schools doesn't have the most basic facilities

lets at the school since it was built.  
"This really affects us negatively because even the six pit toilets we have are not in a good condition and some of them should not even be in use," Maki said.

The screenshot shows the top section of the Sowetan newspaper website. It features the newspaper's name 'Sowetan' in a large, bold font. Below the name is a navigation menu with options for 'Menu', 'Home', 'Search', 'Weather', 'Traffic', and 'Radio'. There are also several small thumbnail images and headlines, such as 'M-Net will have Cliff back', 'Minister Zulu spent R689,000 on business trip', and 'Gareth Cliff versus M-Net: Watch the full judgment'.

## We were sick of poor sanitation: SJC

By Sapa | Jul 25, 2014 |

Social Justice Coalition (SJC) members refused to leave the Cape Town civic centre last year because they wanted to make a statement about poor sanitation, a magistrate's court heard on Thursday.

"Members had felt frustrated because we had been engaging with the city for two years," SJC general secretary Phumeza Mlungwana testified.

"The decision was that we needed very strong action to get the mayor's attention."

Mlungwana and 20 other members were arrested in September last year after singing and dancing at the stairs of the Cape Town civic centre without giving the city notice. Some of them had chained themselves to the stair railings, forming a human chain.

They had wanted to speak to mayor Patricia de Lille about the frustration at the city's perceived inaction over proper sanitation in informal settlements like Khayelitsha.

They were charged with convening a gathering or alternatively, convening or attending a prohibited gathering.

The group pleaded not guilty on the basis that their actions were not criminal.

Their lawyer Michael Bishop had applied for them to be discharged on Thursday, but this was refused.

Mlungwana said the SJC had fought tirelessly since 2008 to promote rights envisaged in the Constitution, accountability and active citizenship.

They decided to focus on sanitation after receiving numerous complaints about a lack of maintenance and consultation.

The SJC had been excited when De Lille committed to a janitorial service for informal settlement toilets at a sanitation summit in 2011.

Mlungwana said the implementation failed because of a lack of policy. The city eventually started stalling and "playing hide and seek".

The SJC's executive council decided last year that they would go to the civic centre and not leave until they had handed over a letter of demands.

"We chose 15 people because we didn't want to apply for the picket and wanted to stay within the law," Mlungwana said.

She will resume her testimony on October 7.



The screenshot shows the BusinessReport website. The main article is titled "Sanitation needs to improve to stop flinging of human waste". The article is dated March 17, 2015, at 08:00am, by Keith Bryer. The article text discusses the challenges of providing affordable housing with hygienic human waste disposal in Cape Town, particularly in informal settlements. It mentions that the city does not have the money and the central government has other priorities. A photo shows a row of communal toilets in an informal settlement. The website also features a search bar, navigation menu, and a sidebar with a PPS logo and "Most Viewed" / "Most Commented" sections.

**Sanitation needs to improve to stop flinging of human waste**

March 17 2015 at 08:00am  
By Keith Bryer

Comment on this story

**FLINGING** human waste around may be a bizarre way of making a service delivery protest, even if the complaint centres on portable toilets in Cape Town informal settlements, but it does highlight a huge problem facing every city in the developing world – ours not excepted. We are, after all, a developmental state.

What our city authorities face is this: how to provide, low-cost affordable housing with hygienic human waste disposal fast enough to accommodate the thousands fleeing rural areas for the city.

Cape Town has a particular problem. Most of the areas where recent arrivals choose to place their shelters are low-lying, not quite below sea level but low enough for the water table to be very near the surface.

Water table

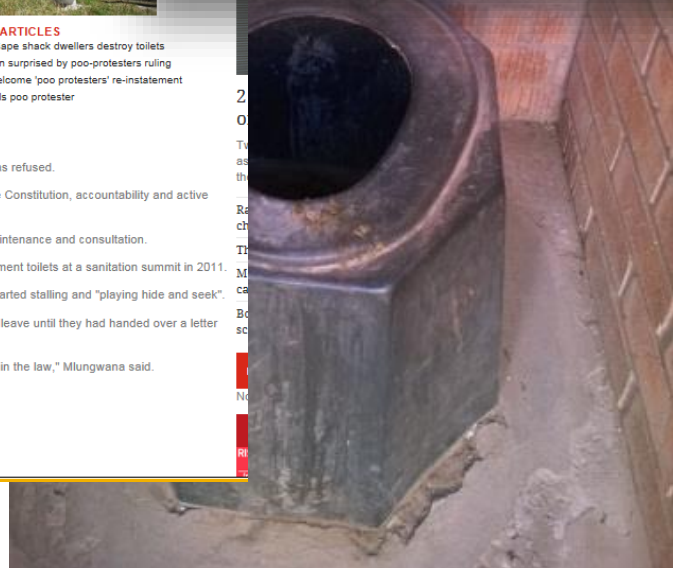
What a high water table means, especially during a Cape winter, any sewerage pipes that are not anchored (at huge cost) come floating to the surface, breaking in the process. The city does not have the money and the central government has other priorities.

An obvious – but not easy – solution is a waste disposal system that does not use water or need a network of underground pipes and a sewerage works. In other words, what is needed is a solution that is not the traditional way of doing things.



Communal toilets are seen at an informal settlement in Cape Town. The writer says authorities are faced with the challenges of providing hygienic human waste disposal fast enough to accommodate thousands migrating to the city. Photo: Courtney Africa

The advertisement for PPS (Professional Project Services) features a circular logo with the letters 'pps' inside. Below the logo, it says "FOR PROFESSIONALS SINCE 1941". At the bottom, it states "PPS is an authorized Financial Services Provider". There are also sections for "Most Viewed" and "Most Commented" with some partially visible text.



# Similar Challenge in SSA



18-Jun-18

The name

# Making Informed Decisions based on Science



## Investigation into Pollution from On-Site Dry Sanitation Systems

Report to the  
Water Research Commission

by

Simon Lorentz<sup>1</sup>, Bruce Wickham<sup>1</sup> and David Still<sup>2</sup>

<sup>1</sup> Centre for Water Resources Research, University of KwaZulu-Natal

<sup>2</sup> Partners In Development, (Pty) Ltd



Figure 3.2

However, sludge jammed the sprocket teeth and prevented the rolling elements of the chain from seating properly on the sprocket. As a result, the chain was forced to follow a larger arc around the base sprocket, increasing the tension in the chain and eventually causing the mechanism to lock. It was thought that a more consistent chain speed and higher power source (as compared to manual turning) might overcome this issue, so a small (0.125kW) motor was mounted on to the drive shaft to move the chains. Though this drove the chains smoothly and consistently when out of the sludge, as soon as pit sludge was introduced the system would again lock up. Additionally the drive system was quite dangerous as there were many moving parts (chains, scoops, sprockets) which the user could get caught on.

Guiding the chains around a bend proved to be complex and costly, with chains frequently jamming when coming into contact with the waste. After further discussions with Steve Sugden, a sprung scraper was added to remove waste from the scoops which allowed the entire design to be simplified significantly: the bend in the chain was eliminated and only a single chain was needed and the cog was removed from the bottom of the mechanism.



Figure 3.3 Current prototype of Gobbler with single chain and sprung scraper

WRC Report No. 2115/1/15  
ISBN 978-1-4312-0671-1

April 2015



# Key Outputs from Research

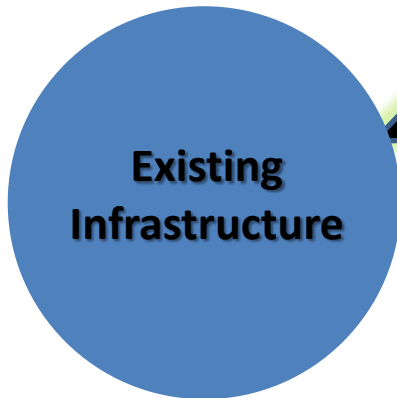
- Lack of technical capacity & solutions to deal with faecal sludge.
- Pit additives did NOT significantly reduce the rate of sludge accumulation rates.
- Pit latrines behave as storage vessels.
- Detritus can significantly increase O&M.
- Faecal sludge poses a significant health risk.
- The cost of managing faecal sludges is high and comparable to the costs of installing new latrines.
- Study localised: Need for technical & competency in SSA.



# Emerging Issues

- Urbanisation and Population Growth
- Availability of resources:
  - Capital, Water, Energy, Technical Skills
- Sustainability of technical options:
  - Resource requirements
  - Inappropriate technology choice
  - O&M requirements
- Faecal Sludge Management (FSM):
  - Viewed as temporary solution
  - How to handle and dispose faecal sludge
  - O&M costs neglected in budget
  - Not included in sanitation policies
- Suitable technology alternatives that takes into account user acceptance and available resources
  - Need for technical solutions that bridge gap between full flush reticulated sewerage & latrines

# WRC Strategic Programme



## New Management Approaches

- New O&M models
- Training Sanitation Supply Chain
- Sanitation as Business Approach

## Technology Upgrades

- Latrine upgrades
- Beneficiation of waste

## Bridging & Technological Approaches

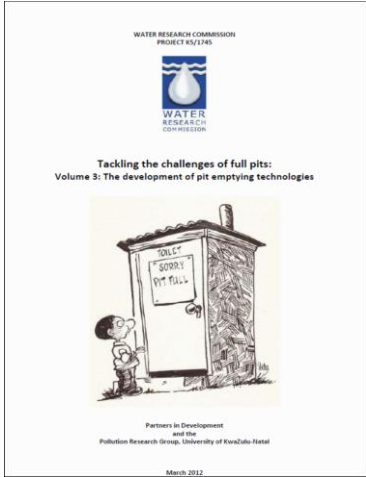
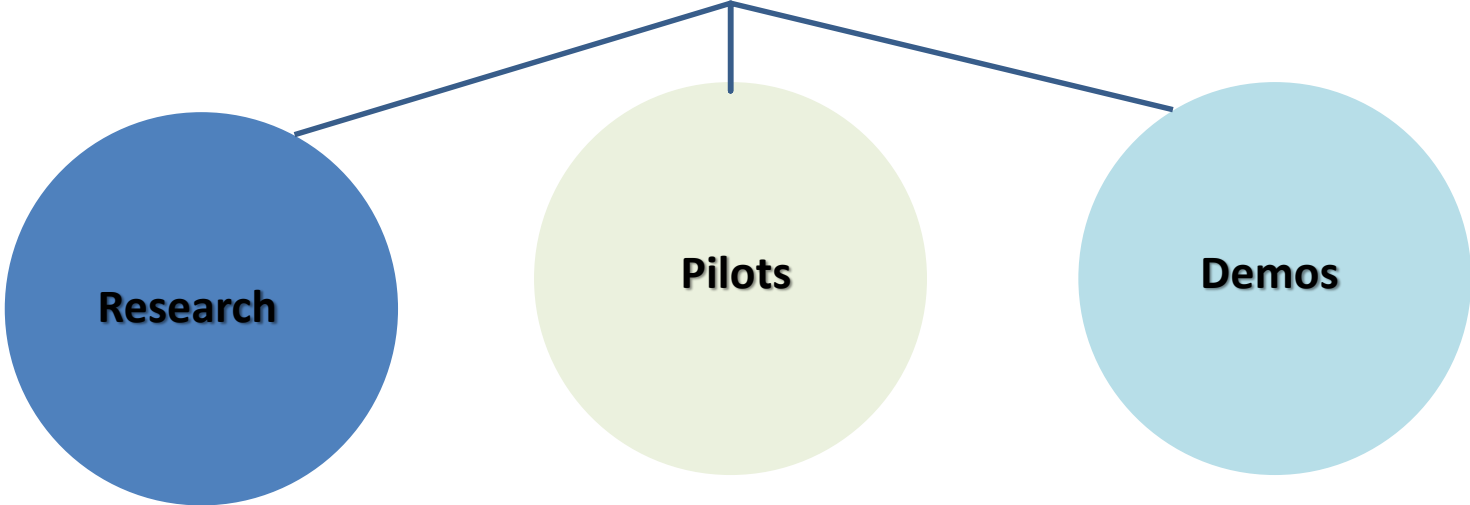
- Decentralised WWTWs
- Low Flush Toilets
- Beneficiation of waste streams

## Game changing technology

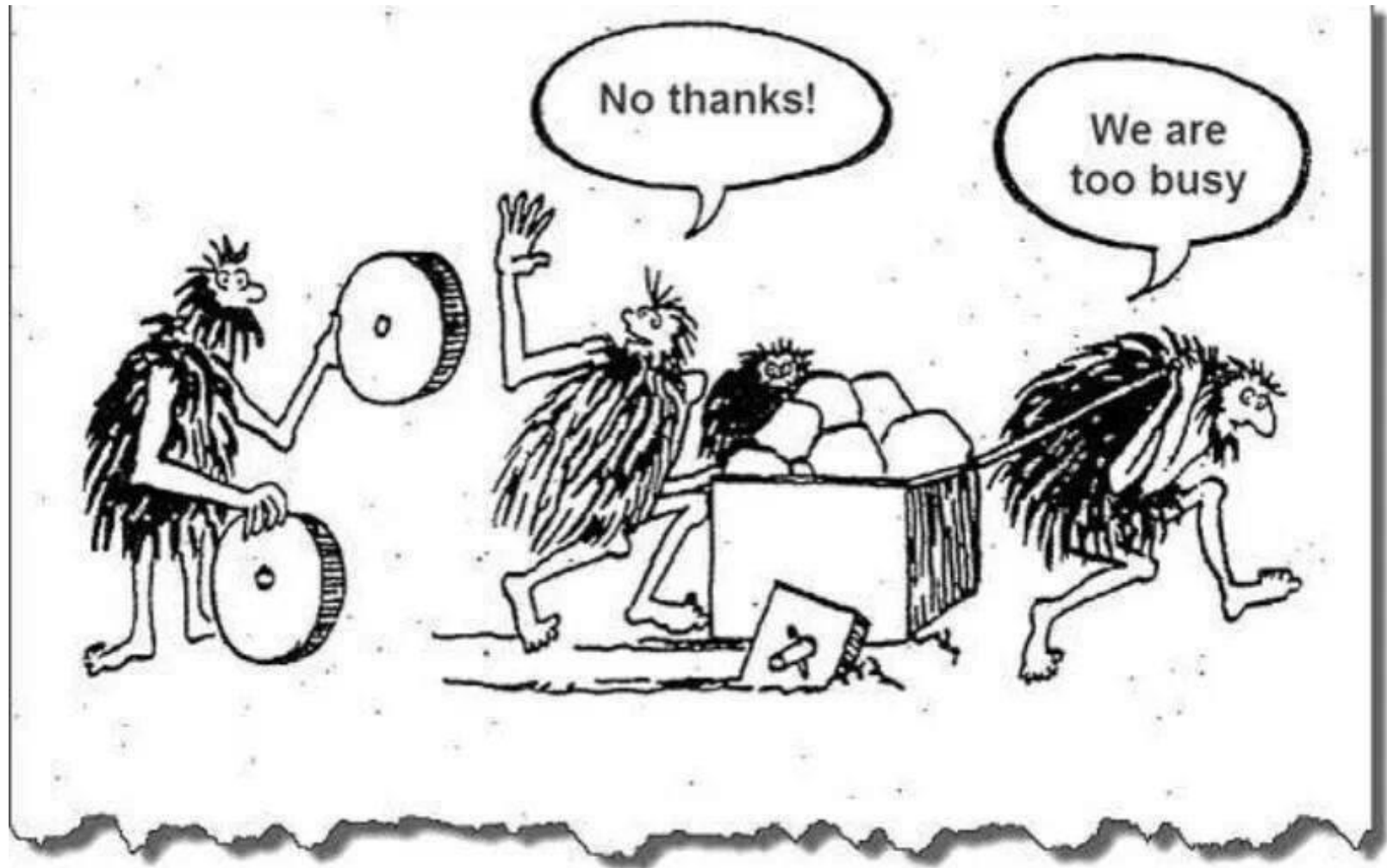
- Off-grid, no / low water, beneficiation of waste, commercial business model



# WRC Research and Development Programme



# Addressing the Challenges Through Innovation



# What is the Extent?



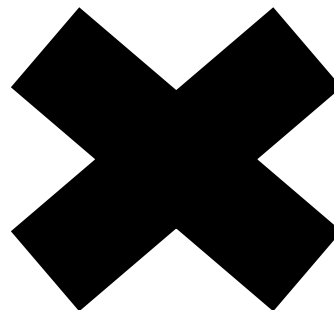
**blue drop**  
CERTIFICATION  
drinking water quality  
REGULATION



**green drop**  
CERTIFICATION  
waste water service  
REGULATION



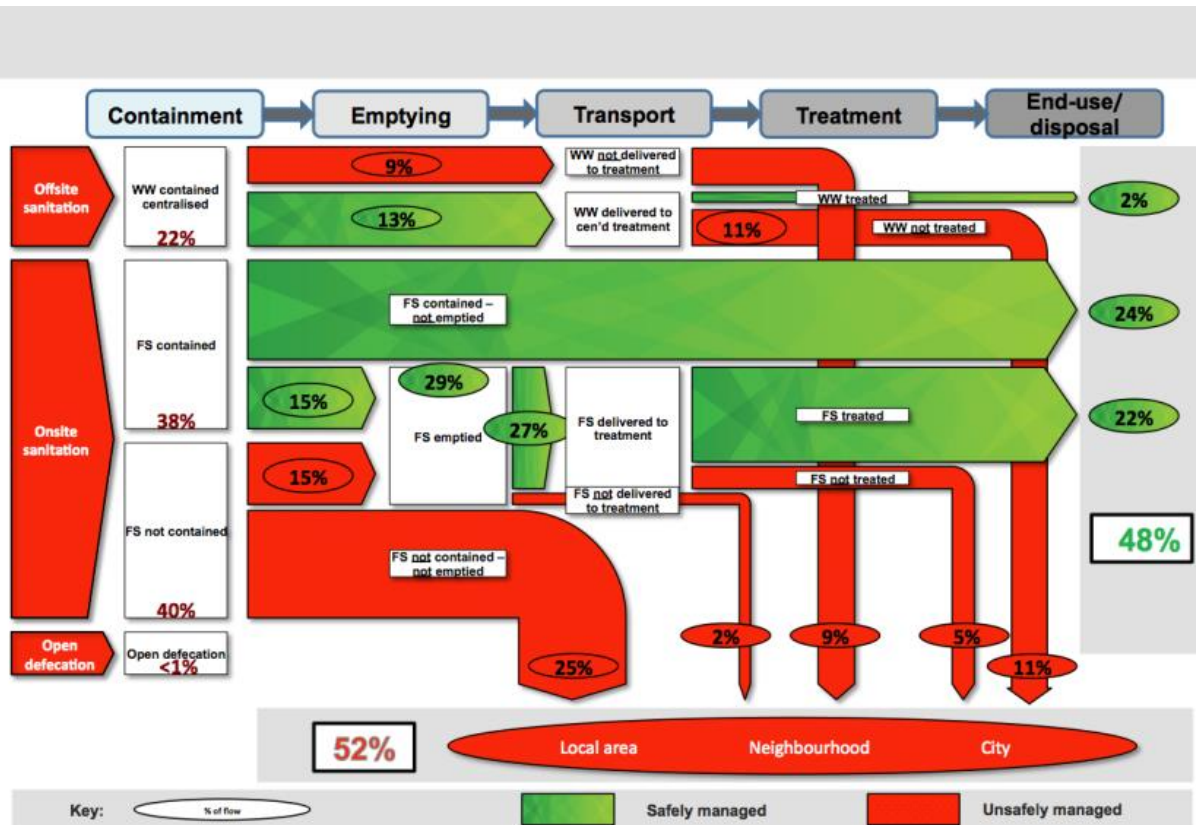
**No brown drop**



# Planning: What is Baseline?

## Shit Flow Diagrams

Shit Flow Diagrams – Visual Tool to How Much & What Happens to Excreta



- Standardised tool developed by World Bank
- Tells how much and what is / is not treated
- Tool for informing sanitation planning
- WRC catalysing national SFD initiative in 2017

# Managing What We Have Better



# Business-Driven Approach

- Ensures property ownership among users
- Promotes proper maintenance and operation of sanitation facilities
- Creation of localized jobs/ business
- Reduces dependency on donors / government
- Promotes sustainability
- Ensures development of technologies that are specific to local problems since human centered design is emphasized.

## **“Uber”-fication of Pit Emptying Services**

Structure pit emptying services  
SMS for emptying sent to pit emptying businesses  
Bid war attracts minimum bid & keeps costs low  
In Senegal pilot, price dropped from \$150 to \$90 per year

## **Social Franchising for O&M**

Uses franchising principle for social good  
Promotes high-level of services  
Encourages local business development  
Access to highly trained personnel  
Financial cushion & admin support for procurement & contracting

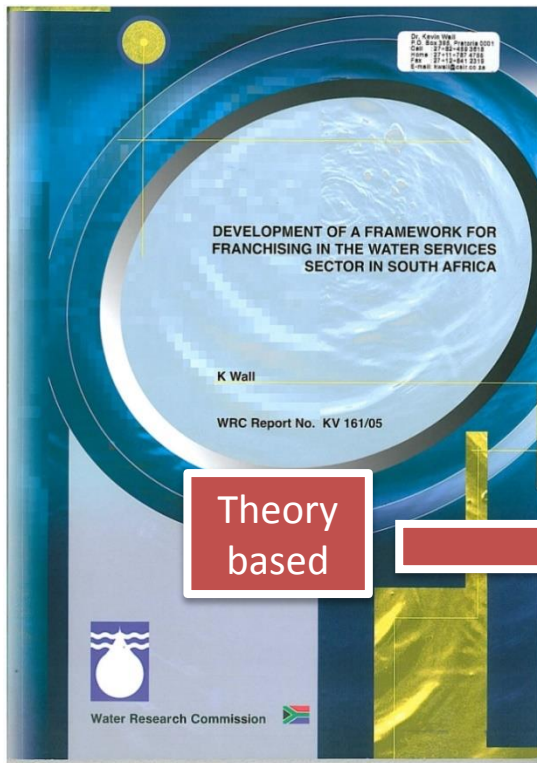


# New Supply Chains



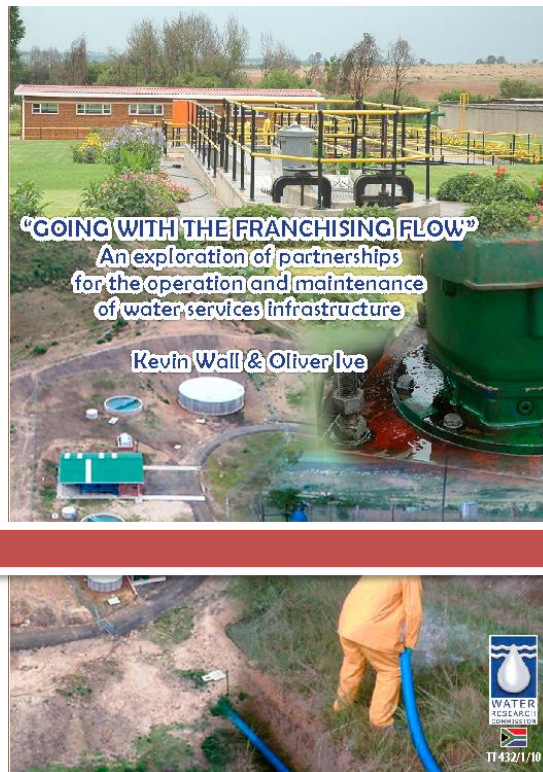
# Social Franchising

Development of a Framework for Franchising in the Water Services Sector in South Africa  
Kevin Wall, 2005

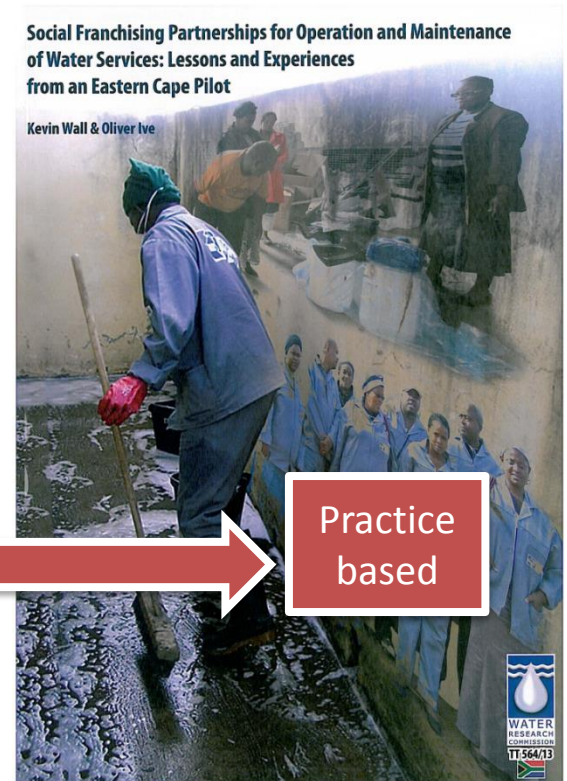


Theory based

“Going with the Franchising Flow” An Exploration of partnerships for the operation and maintenance of water services infrastructure  
Kevin Wall & Oliver Ive, 2010

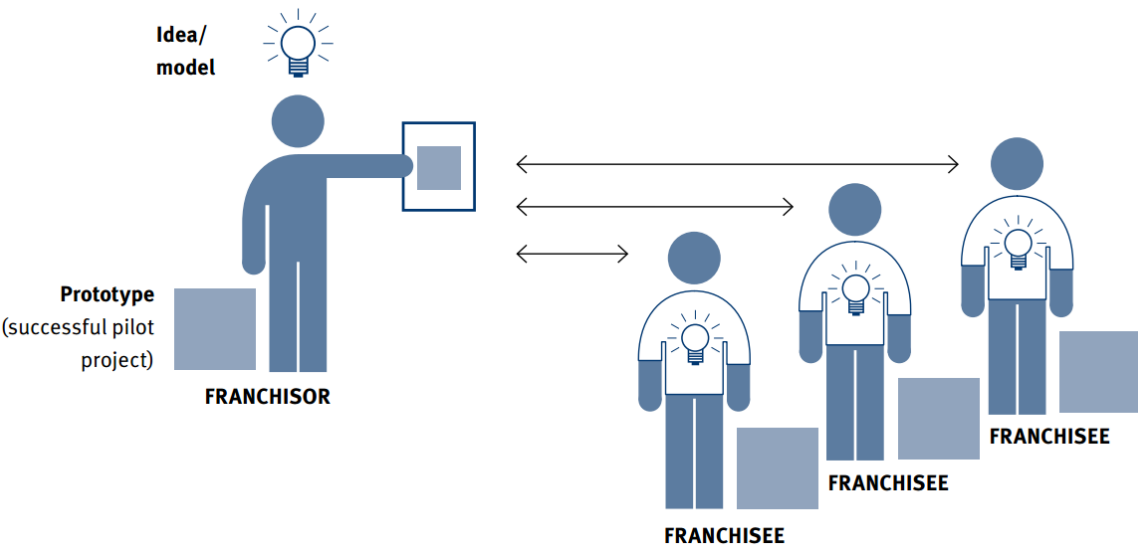


Social Franchising Partnerships for Operation and Maintenance of Water Services: Lessons and Experiences from an Eastern Cape Pilot  
Kevin Wall & Oliver Ive, 2013



Practice based





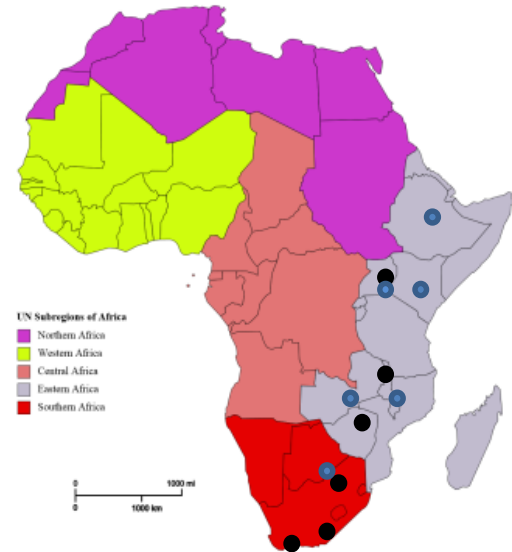


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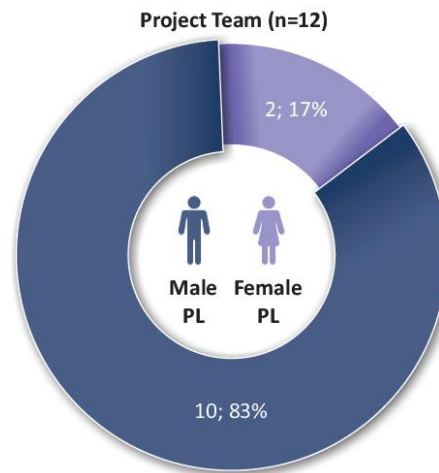
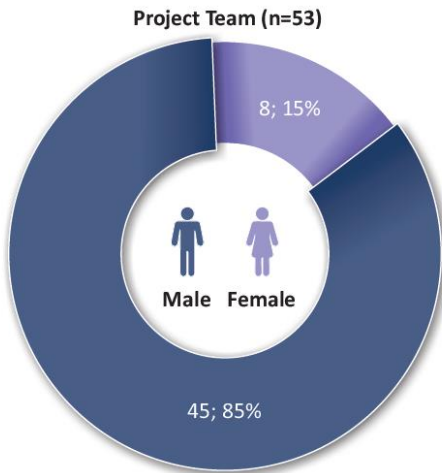
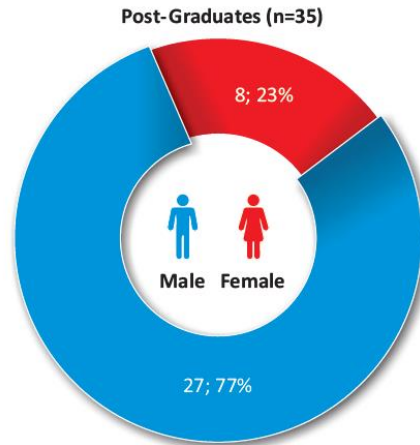
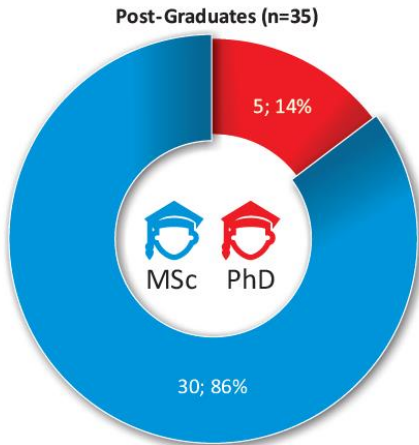
# SRFA: Capacity Building

- ❑ **Develop technical capability for Faecal Sludge Management in Sub-Saharan Africa**
  - New Researchers & Project Leaders
  - MSc & PhD
- ❑ **Stimulate localised innovation & solutions**
  - Alignment with SDG Goals 6 and 17
  - Dedicated funds to African-based researchers & innovators
  - Drive research output
- ❑ **Increase FSM knowledge base**
  - What is the baseline?
  - How do latrines behave? And how do they compare to other regions?
  - Guide local policy and decision-making
- ❑ **WRC 45-year model used to manage research teams**
  - Deliverable-based targets
  - Reference Group
  - Network

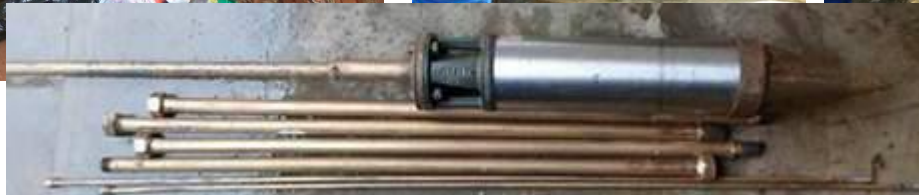


# Capacity Development

Target: 20 Researchers, 8 MSc, 3 PhD



# Innovations - Sampling



# Innovations - Upgrades





# Innovations – Collection & Transport



18-Jun-15

File name

# Innovations - Emptying



# Innovations - AD



18-JUN-18

File name

# Innovations - Beneficiation



# Innovations - Beneficiation



18-Jun-18

File name

37

# Gap Technologies – Sanitation Ladder



## Pour Flush

Flush betw 1-3l  
No cistern = no leaks  
Can handle newspaper  
Water seal to limit smells  
Less trash = easier emptying  
Greywater can be used for flushing



## Low Flush

Flush betw 1-3l  
Cistern for convenience  
(leak-free version available)  
Reduce flushing water use



## ArumLoo

Micro Flush (less than 2l)  
Ceramic bowl  
Tested according to international stds  
Optimised flow patterns

**Over 800 units installed in South Africa**

# The Oakford Development

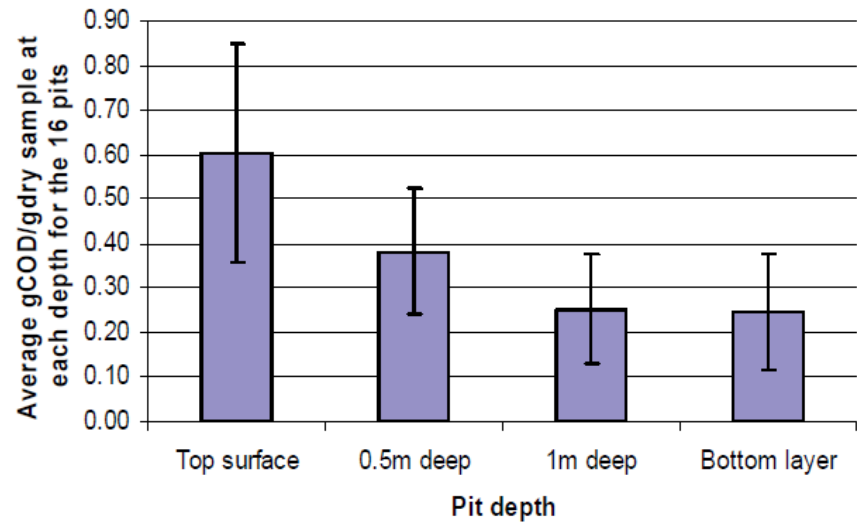
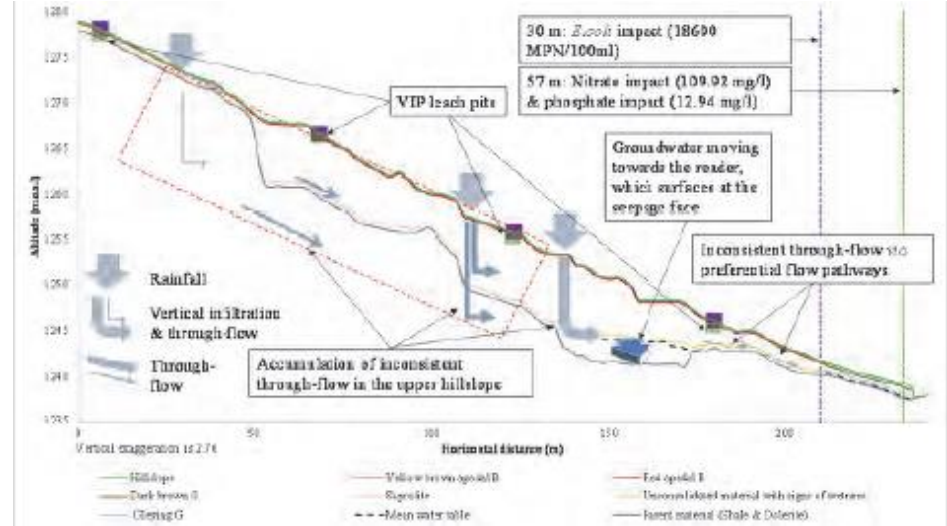


# Innovations for Optimising Sanitation Businesses





# Fundamental Science



# Sanitation Functionality Assessment Tool

- Protocol for establishing technical market claims
- Decision support - many new tech use hybrid processes to treat waste - require scientific evidence
- Promote self-regulation



**PC305 – Non-Sewered Sanitation ISO**

# Next Generation of Systems

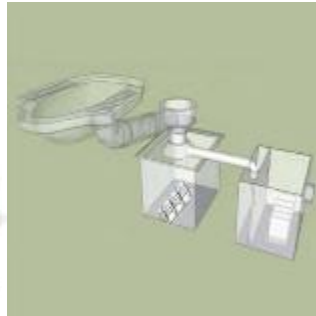
## Technologies

RTI International



Combustion  
Electrolysis

AIT



Hydrocyclone  
Pasteurization

WEDC



Carbonisation

Caltech



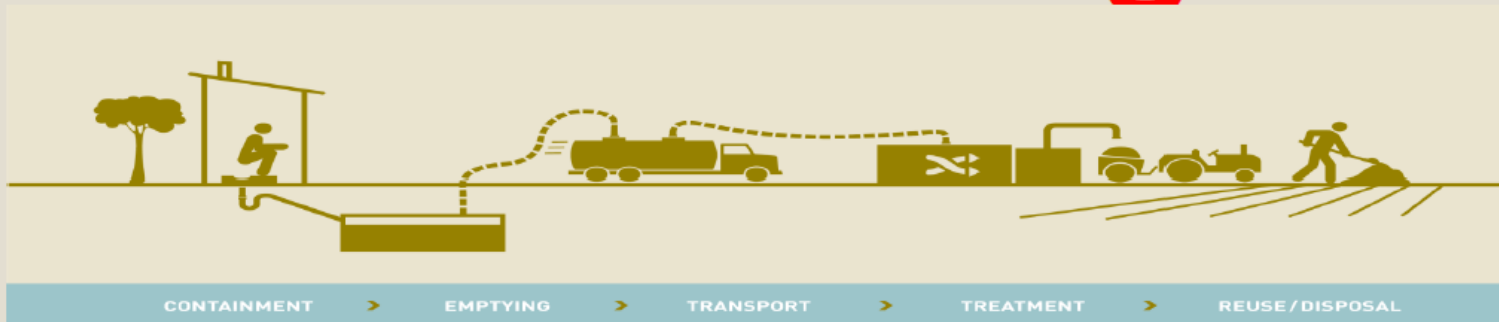
AD +  
electrochemical  
cells

Fundación Terris



Auger  
Composting

# Game Changers



## Sanitation Value Chain





Slide: Doulaye Kone (2015)



# Off-the-Grid Solutions

COMMISSION





## What is the EFT platform? (1)

- Researchers around the world have been working on developing reinvented toilets
- A need has been identified to provide a safe space to test the early engineering concepts under the control of the technology developers





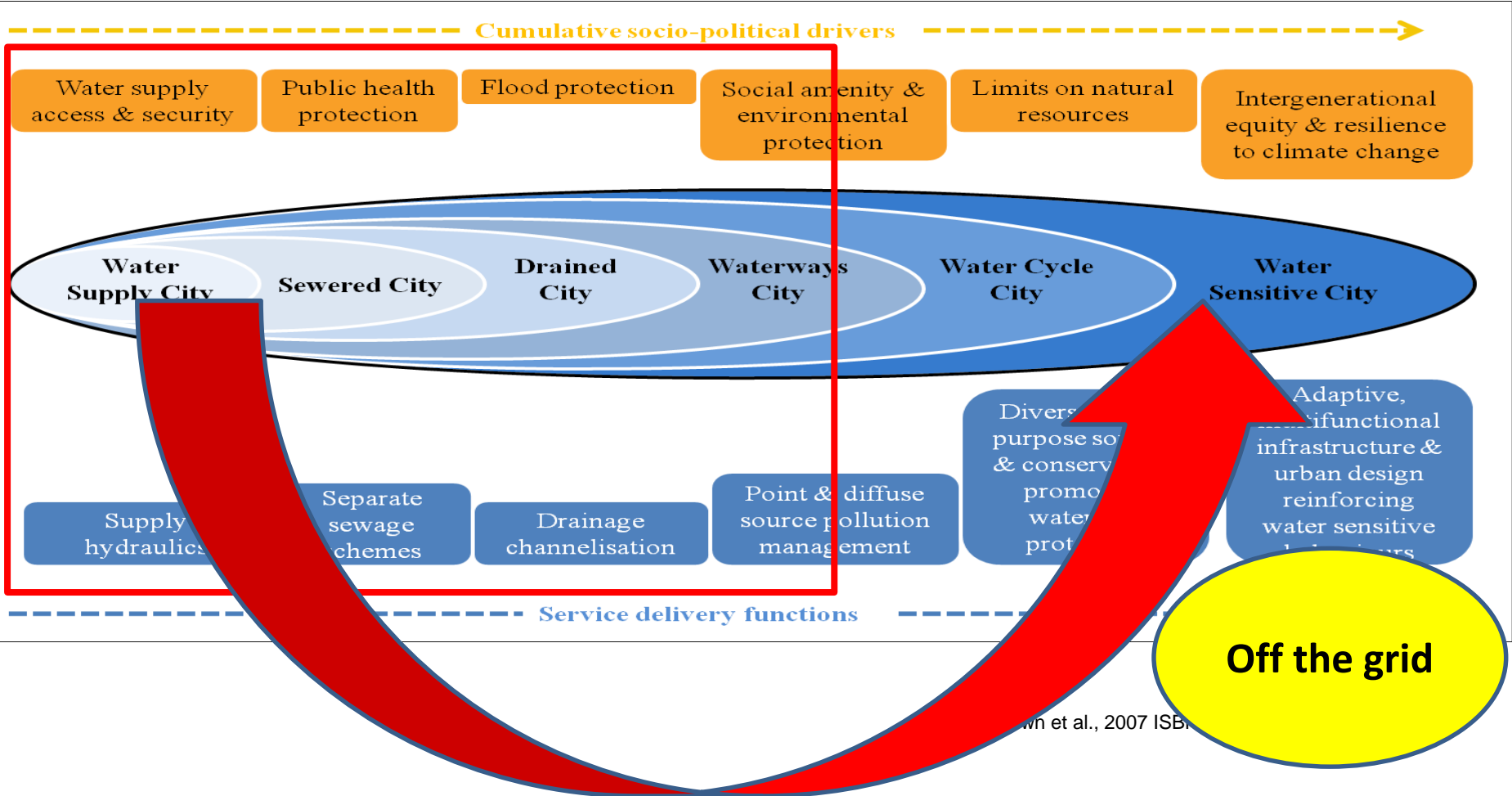


## Challenges — Installation

- Access to deliver toilets
- Things we didn't design for!
- Security – what else do we need to provide?
- Communication to users



# LEAPFROGGING OFF THE GRID SANITATION



... et al., 2007 ISBN

# Acknowledgements

- ❖ Amanz'abantu PTY Ltd
- ❖ Bill & Melinda Gates Foundation
- ❖ CSIR
- ❖ The Department of Science and Technology
- ❖ The Department of Water & Sanitation
- ❖ eThekweni Municipality
- ❖ Isidima Design & Development
- ❖ Partners in Development
- ❖ Sanitation Research Fund for Africa (SRFA) grantees
- ❖ University of KwaZulu-Natal