Towards Citywide Inclusive Sanitation: *Engineering Design and Testing of a Novel Faecal Sludge Treatment Facility in South Africa – A Case Study Approach*

Mendy Zibuyile Shozi **[BORDA South Africa; shozi@borda-africa.org]**
Dr Samuel Getahun **[University of KwaZulu-Natal WASH R&D Centre]**

Brief overview

Citywide Inclusive Sanitation (CWIS) is an approach to urban sanitation, where all members of the city have equitable access to adequate and affordable improved sanitation services through appropriate systems of all scales (sewered & non-sewered), without any contamination to the environment, along the entire sanitation value chain. The South African government is committed to ensure that everyone has access to safely managed sanitation in line with the Sustainable Development Goal (SDG) 6.2 target. Sanitation services are provided through a mix of sanitation systems which include centralised and decentralised wastewater treatment systems (offsite), and non-sewered (onsite). To ensure sustainability of the environment transitioning to a circular economy within the South African water sector is required, which is in line with the Sustainable Development Goals (SDGs). Circular Economy, in the context of sanitation, focuses on the whole sanitation chain. In order to realise the full potential of the CWIS, implementing a circular sanitation economy approach which is embodied in CWIS principles.
Research question: How can the citywide inclusive sanitation and circular economy approaches be applied to manage faecal and wastewater sludge in South Africa to improve sanitation service delivery?

Aim

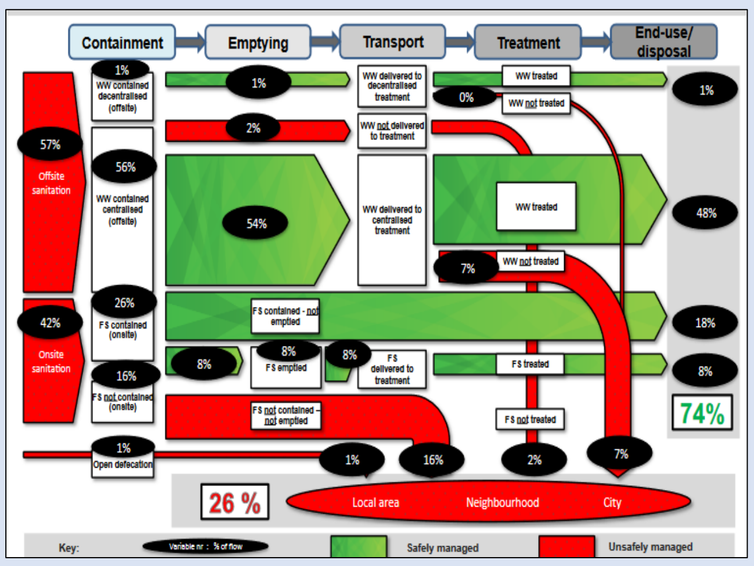
Produce the most effective guideline/tool for a CWIS Planning Framework development for South Africa, for improved sanitation service delivery, in line with achieving Sustainable Development Goal 6, by 2030.

Objectives

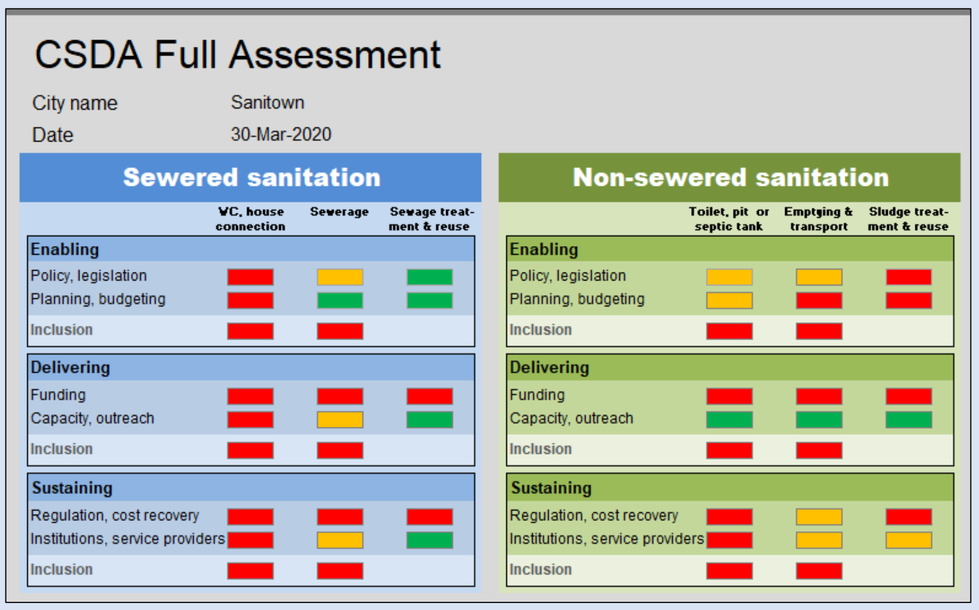
1. Conduct an extensive review of literature.
2. Produce updated basic and/or intermediate Sludge Flow Diagrams (SFDs) and City Service Delivery Assessments (CSDA) for eThekwini Municipality.
3. Quantify and characterise the quality of sludge produced by a commercialized and innovative on-site sanitation system in South Africa and assess the suitability of a FSTP or other treatment technologies for its management.
4. Quantify and characterise the incoming waste streams at an FSTP in Lusaka, Zambia.
5. Use the water-energy-food (WEF) nexus approach to identify potential resources to recover, as well as determine climate change impacts from potential greenhouse gas (GHG) emissions from faecal sludge management.
6. Produce technical engineering designs/ renderings of i) a faecal sludge treatment plant (FSTP), ii) FSTP and decentralised wastewater treatment plant (DEWATS) configuration, and iii) FSTP with co-composting/configuration (based on resource recovery of waste by-products) for South Africa, with eThekwini Municipality as a case study area.
7. Develop a novel policy brief, for improved sanitation service delivery in a city.

2. Excreta/Sludge Flow Diagram and CSDA

- Desk-based integrated assessment.
- An SFD provides an overview of **how** sanitation is working or not working in a city.
- A CSDA assesses **why** this is happening. It facilitates assessment of the enabling environment for CWIS.



- Field-based study for Durban, South Africa based on population of approximately 3.55 million (2015).
- Study was developed with the active engagement of local municipality.
- 74% of excreta is managed safely, with 48% coming from waterborne toilets on the central sewer network.
- Containment systems for the 42% on-site sanitation.
- One area of weakness in the estimations is regarding the proportion of WW that is not delivered to the treatment works due to overflow from blockages at pump stations.



- The CSDA is similar to other tools for reviewing the urban sanitation enabling environment.
- CSDA tool: Evidence-based project design work. CSDA graphics: The CSDA graphics, and recommendations based on the dialogue which they support.

3. Waste streams from on-site contained based sanitation in Durban, South Africa

- FS needs to be characterised for nitrogen, COD, BOD, solids, pathogen, nutrient, metals, faecal coliform, total coliform, helminth eggs, *etc*., so that the correct treatment method and/or technology can be used.
- The sludge from the container-based was sampled and analysed for a variety of parameters in order to characterize it.
- The polymer liner that goes in the toilet and encapsulates the sludge will also be analysed for potential reuse.
- Possible treatment options include a faecal sludge treatment plant (use of Manchinchi plant to optimise design)
- Resource recovery is at the heart if the characterization in order to generate income from reuse of the waste by-products.
- A techno-economic analysis would determine cost-benefit and large-scale commercialization.
- Greenhouse Gas Emissions from container-based sanitation will also be determined, in relation to WEF nexus.



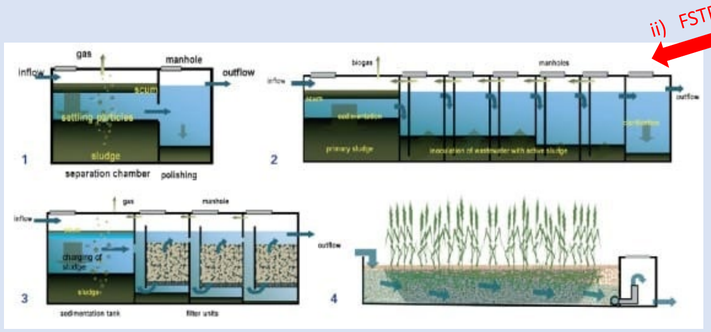

4. Waste streams from FSTP in Lusaka, Zambia

- Manchinchi FSTP in Lusaka, Zambia – operational and at over-capacity.
- Designed for 18m^3 pit latrine sludge and 95m^3 septic tank sludge – design based on limited data.
- General objective in the was the solid liquid separation.
- Incoming sludge streams, Effluent, and dried sludge yet to be analysed. Gas not measured yet.

6. Design a novel FSTP for South Africa

Using BORDA DEWATS tool, the different will be designed, based on data from previous objectives. Using CAD, 3D renderings will be developed.

i) **FSTP** – effluent to nearby WWTW.
ii) **FSTP + DEWATS** – the DEWATS would treat the effluent before discharge to environment or reuse.
iii) **FSTP + DEWATS + co-composting** – not directly feeding into one another as they both operate to treat sludge. Treatment choice will depend on desired end product.



Concluding remarks and Way forward

As the study is still in progress in the beginning stages, preliminary data will be presented, and the progress of the project and way forward will be discussed. With the hopes that input from other experts in the field, will dictate the way forward, should any gaps and opportunities be identified. There is no FSTP in South Africa, thus this research can be used to guide potential use for treatment of faecal sludge. In the country.
The results will add the body of literature in the field of citywide inclusive sanitation, particularly in South Africa where it is lacking. A much needed technical brief, along with the policy brief, will be published for the whole study. As well as identifying the synergies between greenhouse gas emissions which impact climate change, water, energy and food that may impact sustainability.

Global South Academic Conclave on WASH and Climate 2025
CWAS CRDF CEPT UNIVERSITY · CEPT UNIVERSITY FACULTY OF PLANNING · Gates Foundation · viega foundation