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Assessment of climate resilience rating for non-sewered sanitation technologies using existing climate resilience framework

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Highlights:

- **Sanitation systems are vulnerable to impacts of extreme climate change related disasters and events**
- **In most instances the designs do not consider prevailing climatic conditions and non-resilient sanitation system exposes people to health hazards**
- **Non-Sewered Sanitation (NSS) technologies being demonstrated by Water Research Commisssion were assessed for climate resilience using an existing rating framework**
- **NSS technologies has a high rating for climate resilience and considered to be highly adaptable to climate change.**

Keywords: Sanitation; Resilience; Rating

INTRODUCTION

It is estimated that about 3.6 billion people worldwide (UNESCO, 2023) still do not have access to safely managed sanitation and most of these people reside in water-stressed or flood-prone areas, which is problem that is increasing around the globe as a result of climate change. Homes that have gained access to basic or safely managed sanitation risk losing them during climate related disasters or events. This will prevail until we consider and emphasize that the design, selection and implementation of sanitation systems, should take into account mitigation of potential risks and shocks related to climate change.

According to IPCC (Bates et al, 2008) sanitation systems will be increasingly vulnerable if the design standards do not account for changing climate conditions and non-climate-resilient sanitation system exposes the public to a health hazard. In the event severe flooding, damaged toilets and sanitation systems can spread waterborne disease across communities and settlements. In area affected by drought, non-resilient sanitation systems contribute to water stress or can stop functioning, causing people to settle for open defecation. The impact of climate change will result in regress on the progress made over the years in the sanitation sector, hence the need for

sanitation systems to be resilient to ensure universal access to safely managed sanitation for all as per the SDGs.

METHODOLOGY

Water Research Commission has prioritized research and innovation that links climate change and sanitation through the South African Sanitation Enterprise Programme (SASTEP). Through SASTEP, WRC is evaluating and demonstrating non-sewered sanitation (NSS) technologies that are off grid and promotes circular economy within sanitation value chain through water efficiency, water reuse and nutrients recovery from human waste.

The technologies were assessed for climate resilience using the ClimateFirst framework, which is a climate framework for improving resilience of sanitation technologies. ClimateFirst was developed by Institute of Sustainable Futures University of Technology Sydney (ISF-UTS) for the Bill and Melinda Gates Foundation (BMGF). The framework offers a process to consider how climate-related hazards can affect a sanitation technology and how the risks of these hazards can be reduced through technology design by incorporating climate resilient design features (ISF-UTS, 2023).

RESULTS AND CONCLUSIONS

The ClimateFirst framework has 6 climate resilient design categories each having 3 to 5 resilient design features to assess a sanitation technology as shown in Table 1 (ISF-UTS, 2023). The NSS technologies being demonstrated by WRC had 64-76% (16-19 out of 25) climate resilient design features in the climate resilient framework developed by UTS. Each NSS technology had at least one resilient design feature under all the 6 climate resilience design categories and thus all the NSS technologies were rated high in terms of overall resilience. These technologies could be considered when selecting sanitation systems that considers future climatic projections to ensure sustainable sanitation systems in the face of climate change.

Category	Resilience design feature
A. Avoiding exposure to hazards	1. Raising
	2. Burying
	3. Portability
	4. No/low Inputs
B. Withstanding exposure to hazards	5. Armouring and strengthening
	6. Oversizing
	7. Shapes that distribute pressure
	8. Circumvention
	9. Sealing and Barriers
C. Enabling flexibility	10. Adaptability
	11. Modular design
	12. Platform design
	13. Redundancy and diversity
	14. Signalling
D. Containing failures	15. Frangibility
	16. Fail-operational
	17. Decentralisation
E. Limiting consequences of complete failure	18. Safe disposal
	19. Reusable materials
	20. Fail-silence
	21. Repair speed
	22. Accessibility for rapid flaw detection and repair
F. Providing benefits beyond sanitation technology resilience	23. Reciprocity
	24. Hybridising
	25. Transformative capacity

Table 1: Climate resilience design categories and design features

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