A framework for assessing the climate resilience of decentralised sanitation technologies

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Achieving SDG6 in a Changing Climate

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Challenges

Increasing threat of climate change and uncertainty to sanitation technology

Risks to public health and the environment from sanitation failure in low and middle income countries

No guidance for assessing the climate resilience of decentralised sanitation technology

With Bill and Melinda Gates Foundation (BMGF) support, UTS-ISF has developed a framework to assess the resilience of BMGF reinvented toilets and conventional, **decentralised** sanitation technology.

Research Approach

1 **Literature review**

Of 50+ sanitation and non-sanitation literature

2 **Analysis: resilience design features**

i) Design features that support resilience ii) Climate hazards that impact sanitation technology

3 **Framework development**

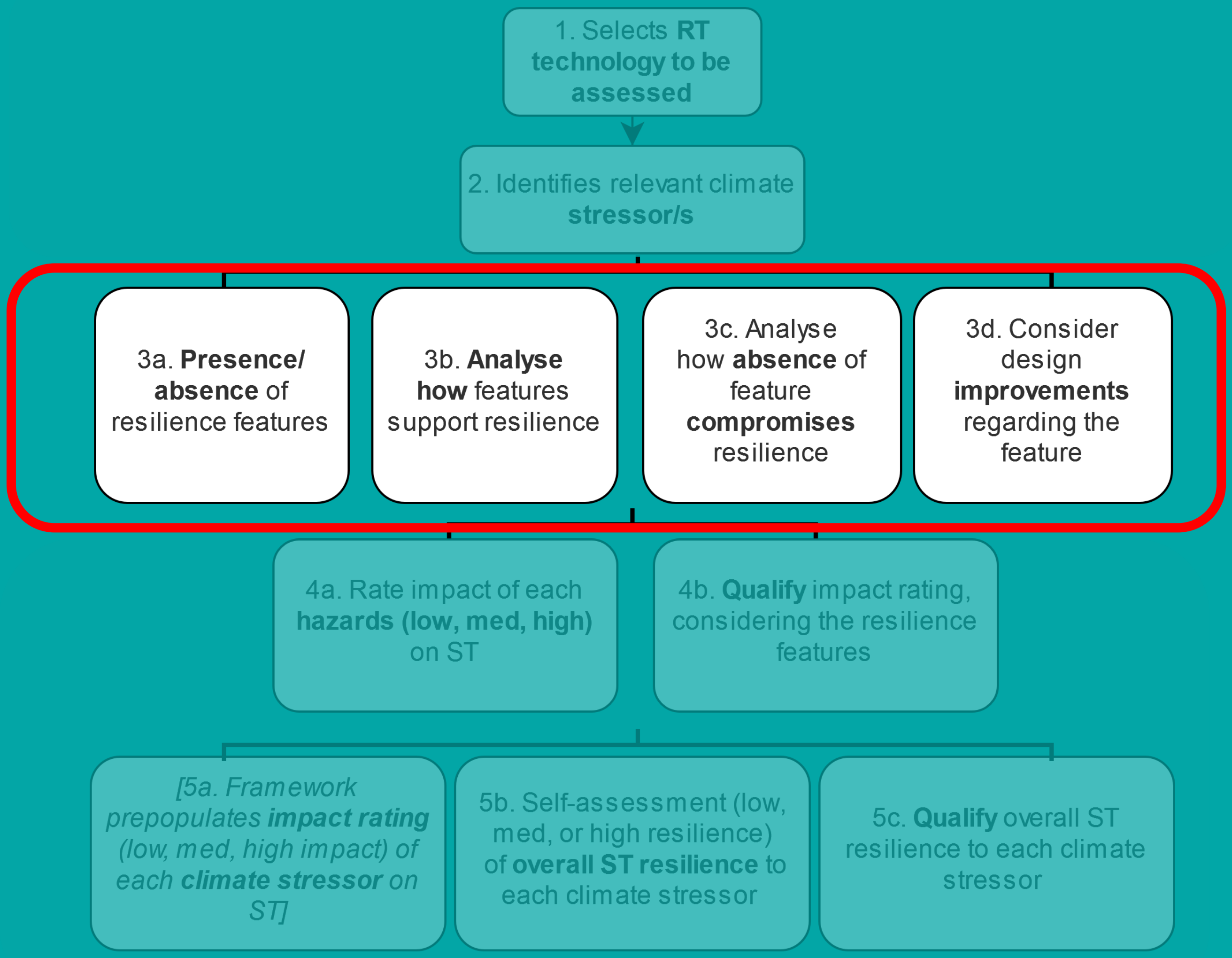
Excel-based, assess the presence/absence of design features, and resilience of sanitation technology to the climate hazards.

4 **Framework testing**

3 x Gates Reinvented Toilets; 3 x conventional sanitation technology (activated batch reactor, septic tank, container-based solution)

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

Assessment process



Assessment example: container based solution

Design Features

This section assesses the ST design features that contribute to resilience in response to CIDs and associated hazards. An example response is in Row 5.
The team should: 1) Assess the relevance of each ST design feature to the CID, and toggle "yes" or "no" in columns C to K as needed. (E.g. the framework considers 'sea
drought, so default is bolded in "no". If the team disagrees, this should be toggled to "yes") 2) Toggle "yes" or "no" in column L if the design feature is included.3) Complete
relevant. Features can be broken into sub-systems if relevant. Note. Section 7, "Benefits beyond resilience" is optional

Design Feature	Relevant CID (toggle default answers as needed): Floods	Precip. Pat.	High Sea Lvl	Fire Weather	Severe Wind	Droughts	Air Temp	Extreme Heat	Uncertainty	Is this design feature integrated into your ST? (toggle yes/no as needed)	Summary descriptor of the ST design feature/s that contributes to the ST's resilience (max 15 words per feature)	How does this design feature support the ST's climate resilience?	If the desi… this … *Note. Optio…*
Example entry: Sealing and barriers	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Non-return valve on holding tank Sealable entry door to treatment area Sealed electrical equipment Eaves and insulation on superstructure.	Holding tank non-return prevents backflow into toilet in flood. Sealable treatment area door prevents flood inundation. Electrics are sealed and can sustain temporary flood inundation. Roof eaves & insulation mitigate high temps by protecting equipment and supporting thermal comfort in toilet area.	In floods, the … risk to treatme… toilets in case…
environment beyond making the technology unavailable for use.											The toilet contains a small amount of human waste	The ST is unlikely to create a continual publich health risk if technology is destroyed	n/a
6. Facilitating fast recovery Features that enable the ST to be quickly rebuilt or restored if they are damaged, disrupted or destroyed by a climate hazard.													
Repair speed The technology, its components, processes, or its operations can be quickly replaced, rebuilt or restored if destroyed or disrupted so that performance downtime or degradation is minimised.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Materials are locally available The ST is supported by a supply chain Spare containers are provided to users	The materials are easy to patch/fix with local materials if damaged by a climate hazard. Plastic containers/funnels can be sourced from local suppliers or the ST supplier. Additional containers can be used if one fails.	Ferro cemen… to timber on…
Accessibility for rapid flaw detection and repair Components or processes of the technology can be easily accessed for examination and repairs.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	The toilets are above ground and all components are easily accessible	Inspection of flaws is simple/fast, repairs can also be quick. See comments above.	n/a
7. Providing benefits beyond resilience (*optional step for framework users*) Beyond providing a sanitation service when disturbances occur, resilient systems may provide other benefits. These benefits are secondary in importance to the resilience of the ST and usually non-essential. Features that contribute to this category are those that enable the ST to provide other benefits to people or to other systems.													

Outcomes for the sector

Critical reflection of climate change impacts on sanitation technology.

Prompts new design features to improve resilience

Assessment of the technology, and comparison with other technologies

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Scan the QR code for a full list of resilient design features