Using GRASP method for developing options of sanitation systems for an informal settlement in Lima

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I. Introduction

- Only a small percentage of fecal sludge generated in Lima's semi-informal settlements is safely managed
- The semi-informal settlement of Quebrada Verde is yet to benefit from any urban sanitation programs

→ This research aims at promoting a sustainable wastewater reuse concept by providing recommendations on the most appropriate sanitation systems that could be used for inputs into decision-making processes using the GRASP procedure considering resource recovery.

Fig 1: Quebrada Verde (lowland, dry season)

II. Methods

The GRASP procedure [1, 2]:

1) technology appropriateness assessment (TechApp)
2) system builders (SanSysBuilder)
3) option selector (OptionSelector)
4) mass flows quantification (SanSysMassFlows)

→The appropriateness assessment principle is to find out which a set of sanitation system (SanSys) matched to the local condition of an area.

→The appropriateness of 42 technologies for the given case study was assessed using 18 attributes developed within the sustainable sanitation objectives.

→The output only tells us whether the technologies are appropriate to be applied in a case and does not intend to replace experts' knowledge for a detailed design.

Table 1: Potential technologies list grouped by its functional group

	Technologies
User Interface	Urine-diverting dry toilet; dry toilet; pour-flush toilet; cistern-flush toilet
Collection and Storage	Urine storage tank; dehydration vault; faeces storage chamber; single pit; twin pits; composting chamber; vermicomposting; septic tank; fossa alterna
Conveyance	Motorized transport of urine; human-powered transport of urine; motorized transport of dry material; human-powered transport of dry material; conventional sewer; solids-free sewer; condominial sewer
Treatment	Urine bank; sludge drying bed; faeces drying bed; anaerobic baffled reactor; anaerobic filter; sequencing batch reactor; trickling filter; activated sludge; co-composting; biogas reactor; waste stabilization pond; const. wetland
Use and/or Disposal	Application of urine; application of faeces; application of compost; application of processed sludge; biogas combustion; leach field; soak pit; irrigation; surface solid disposal; surface water disposal

III. Results

- The appropriateness assessment resulted in 265,185 valid SanSys options, comprises of 57,188 UDDT and 7,111 dry toilet systems; and 100,443 systems each for pour-flush and cistern-flush toilets.
- These valid options were characterized in 17 system templates (STs) based on a total of 19 STs as previously defined [1].
- Higher recovery ratio potentials were observed for SanSys with urine diversion, biogas production, and the system combining anaerobic filter and co-composting for the treatment.

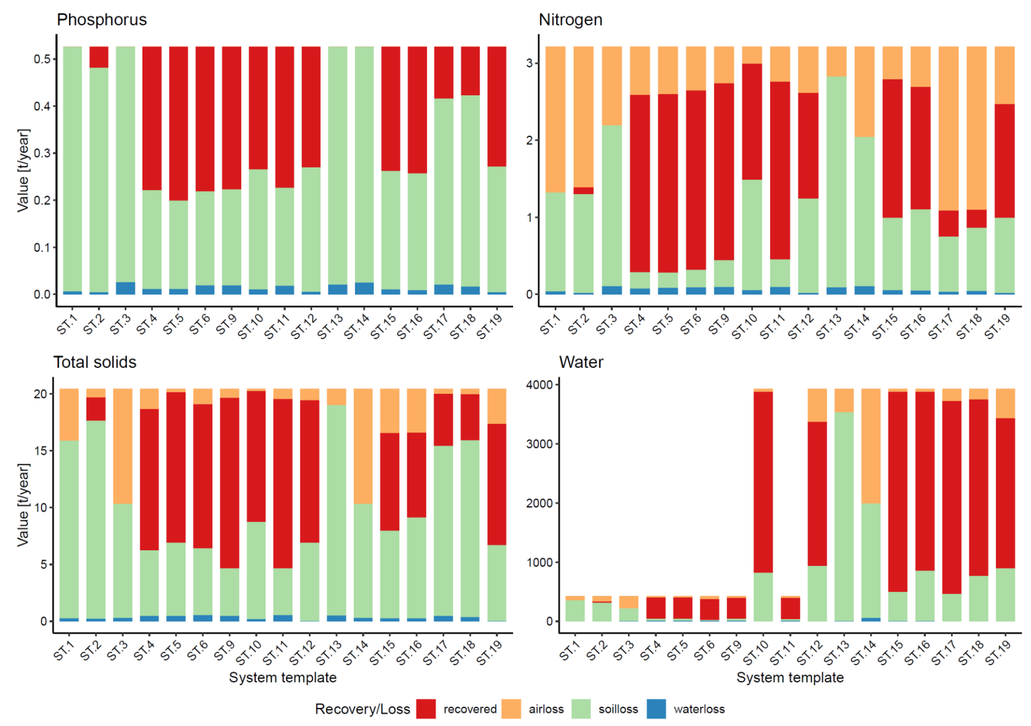

Fig 2: Stacked bar graph of mass recovery and losses in ton/year. ST 1-9 and 11 are systems with dry sources, ST 10-19 are systems with a pour-flush toilet

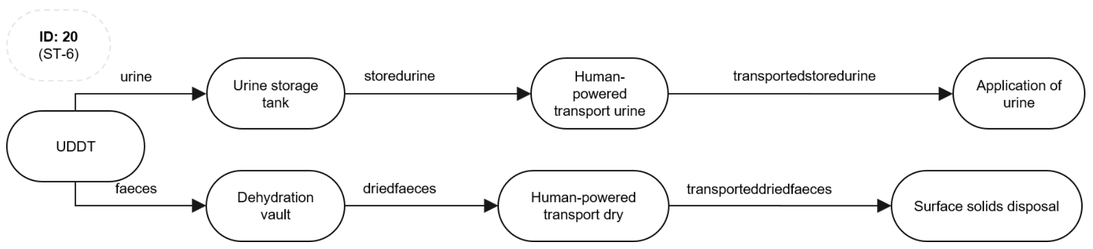

Fig 3: An example of selected SanSys with higher resources recovery potentials

IV. Conclusions

- The SanSys appropriateness assessment is context-specific. The case of Quebrada Verde can be replicated in other areas with similar profiles.
- The result shows which SanSys options have the greatest energy and water recovery potentials. These are recommended to be considered in the decision-making processes.

[1] Spuhler, D., Scheidegger, A., and Maurer, M. (2019). A generic model to quantify nutrient, water, and solids flows of a broad range of sanitation systems considering uncertainties. Submitted to Water Research.

[2] Spuhler, D., Scheidegger, A., and Maurer, M. (2018). Generation of sanitation system options for urban planning considering novel technologies. *Water Research*. **145**: 259–278.

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GRoW GLOBALE RESSOURCE WASSER

GEFÖRDERT VOM

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