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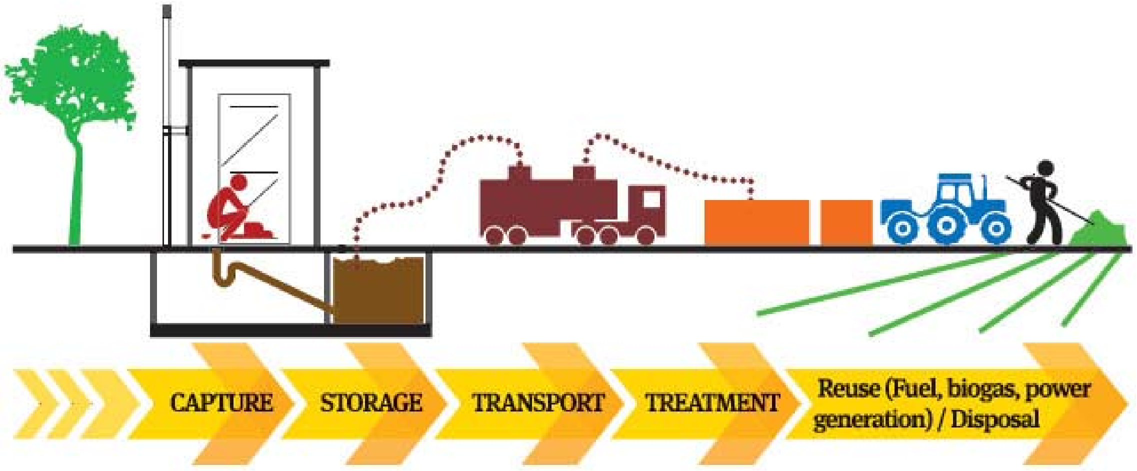
Economic Assessment of Fecal Sludge Management and Sewer-Based Sanitation System in Maputo, Mozambique

John Laurence Esguerra

PhD Candidate

Linköping University, Sweden & University of Antwerp, Belgium

Sanitation System



Adapted from Global Health Hub, 2012 .

- 2.5 billion people worldwide lacks basic sanitation
- Sanitation options: Sewer-Based (SB) and Fecal Sludge Mgmt (FSM)
- WASH services remain at 60-80% population coverage
- Neglect of proper sanitation has economic consequences

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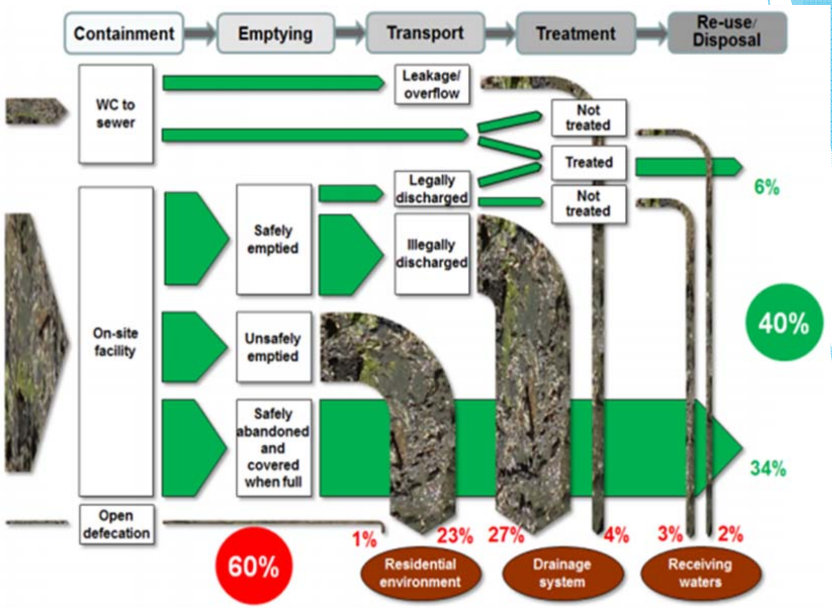
Maputo City



- The current sanitation system is 10% SB and 90 % FSM and is not fully functional.
- There is an impending Maputo City WASH Master Plan for 2050 that is SB based.

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Research Aim

To do an <u>economic assessment accounting both the technical and social costs</u> for the comparison of possible scenarios for the provision of sanitation services using the case study in Maputo, Mozambique.

- ✓ How will the sanitation system of Maputo develop from 2015 to 2025?
- ✓ How can economic assessment be done considering both technical and social costs of sanitation?
- ✓ What are the technical and social costs—in total, in relation to the different cost bearers, and in relation to the sanitation process value chain?

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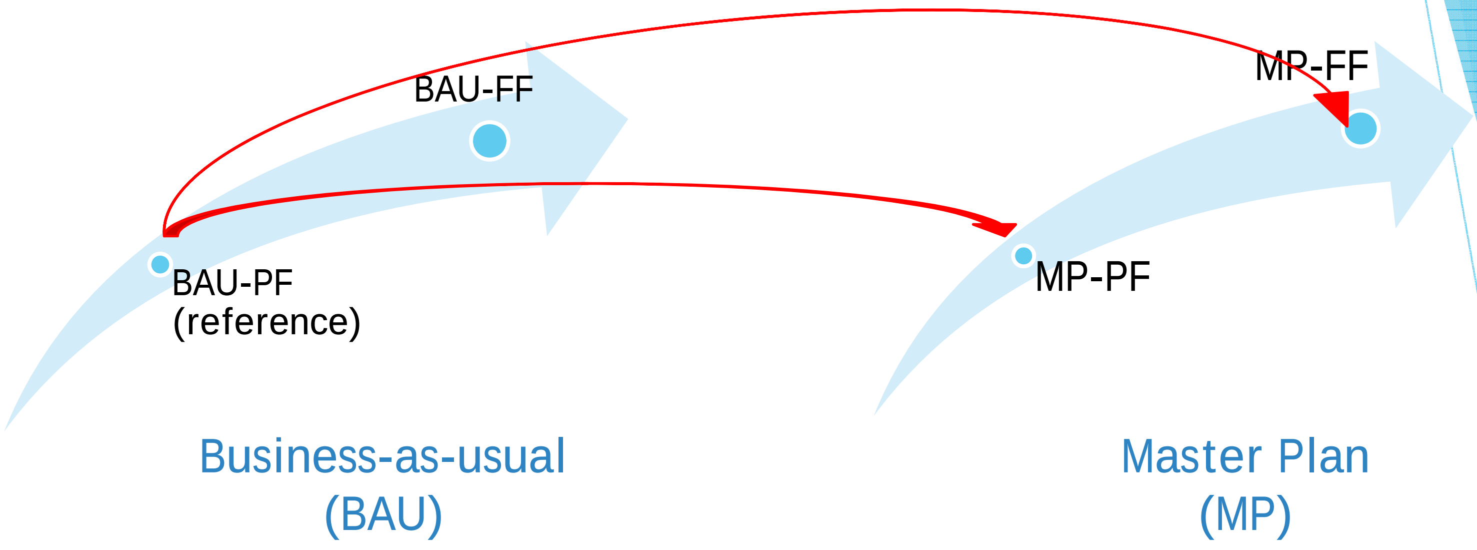
Scenario Development



	Sanitation System (Technology)	Service Level (Wastewater flow)
BAU-PF	10% SB, 90% FSM	partially-functional
BAU-FF	10% SB, 90% FSM	fully-functional
MP-PF	80% SB, 20% FSM	partially-functional
MP-FF	80% SB, 20% FSM	fully-functional

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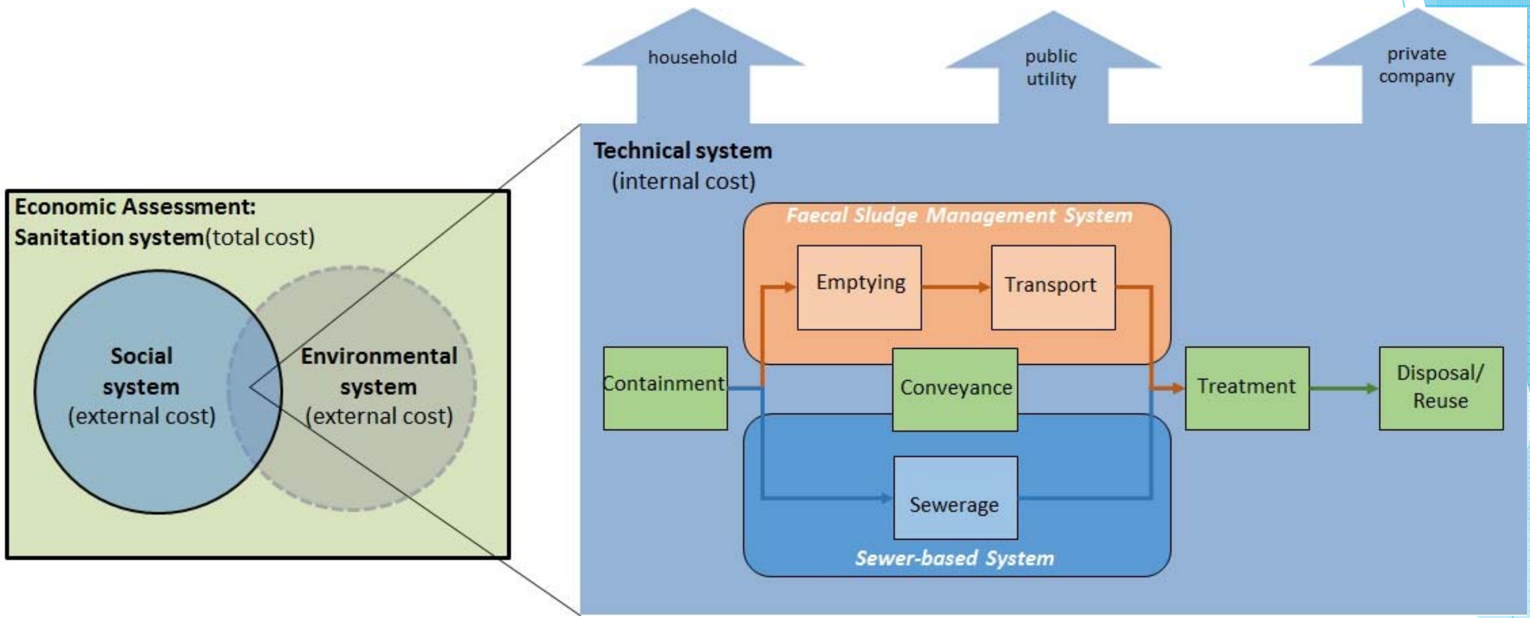
Costing Model



$$Total\ Costs = PV_{technical\ costs} + PV_{social\ costs}$$

- Technical Cost: Life Cycle Costing (Swarr et al., 2015; Fonseca et al., 2011)
- Social Cost: Cost of Poor Sanitation & Risk Reduction Approach (ESI, 2015)

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R&D: Technical Costing (1)

- **BAU-FF is 1.5 times cheaper than MP-FF.**
  - Cost component

    CapEx > OpEx > CapManEx

  - Sanitation process

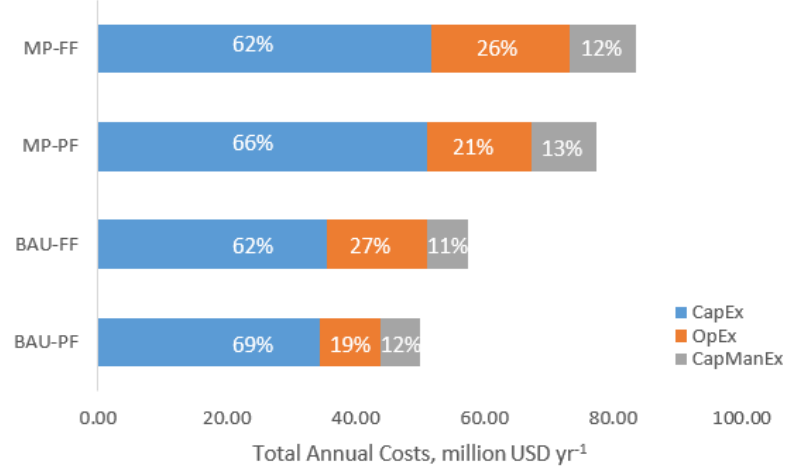
    Containment > conveyance > treatment > disposal

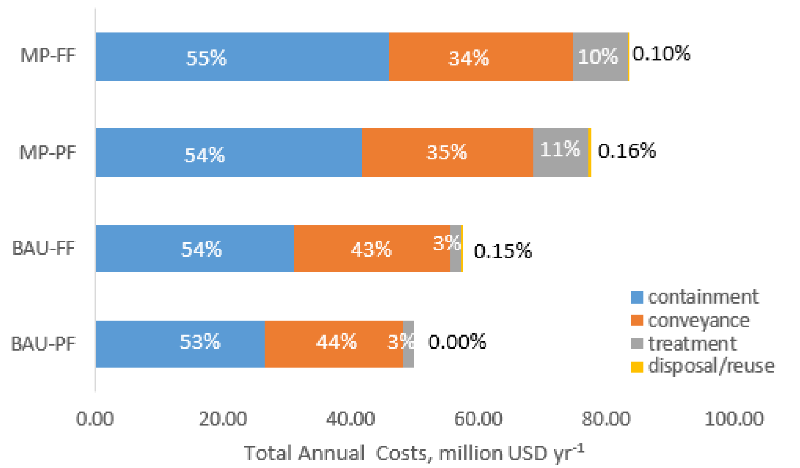
  - Costs bearer

    Household>DAS>E&T

- Scenario improvement from BAU-PF:

BAU-FF is 4.5 times cheaper than MP-FF.





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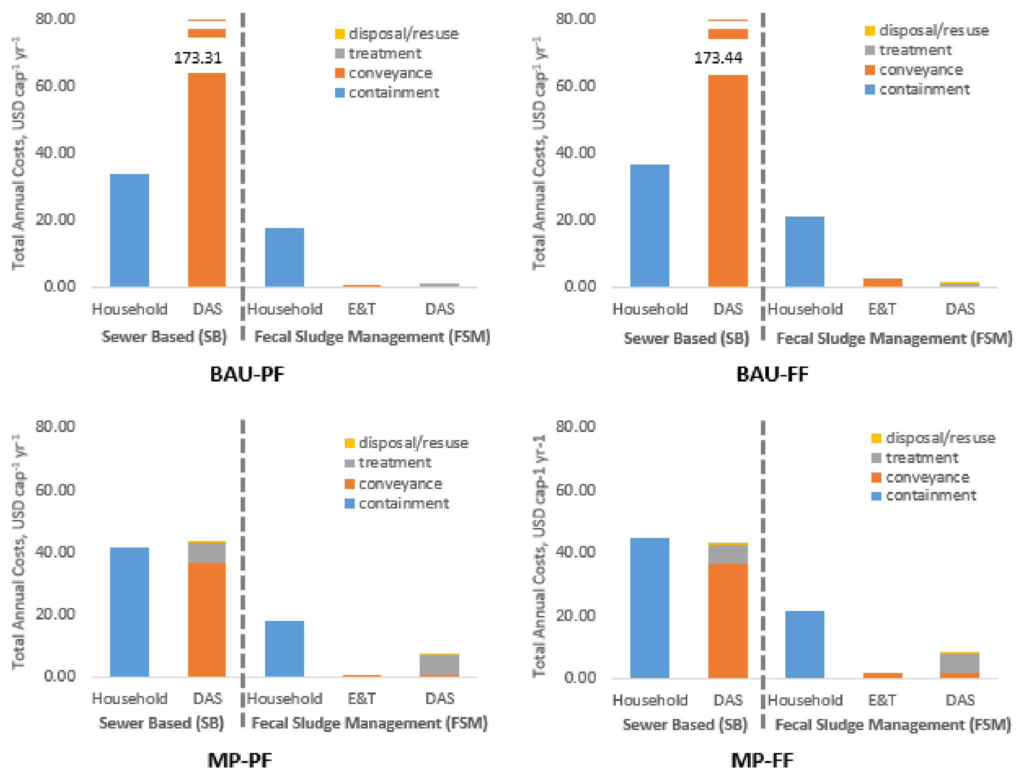
R&D: Technical Costing (2)

- **FSM system is cheaper by 2.8 up to 10.7 times than SB system.**

- On equity:
  - For BAU, DAS is the main cost bearer but serving only the 9% of the population in SB system.
  - For FSM, costs borne are at par for household and DAS in SB system.



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Combined Costing

In terms of technical costs required and social costs averted,

- BAU-PF→BAU-FF requires 4.5 times cheaper technical costs than BAU-PF→BAU→FF, but resulting on the same averted social costs

Scenario Improvement	Technical Costs Required, million USD yr^{-1}	Social Costs Averted, million USD yr^{-1}	Cost Effectiveness
BAU-PF → BAU-FF	7.51	0.34	**0.046**
BAU-PF → MP-FF	33.55	0.34	**0.010**
BAU-PF → MP-PF	25.74	0.15	**0.006**

- Unwanted scenario improvement, BAU-PF→MP-PF requires 3.4 times more expensive technical costs than BAU-PF→BAU-FF, but results to only 0.4 times social costs averted

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Conclusion

- FSM based sanitation system is cheaper than SB-based
- In contribution analysis, CapEx dominates in terms of cost components, containment in terms of sanitation process, and household in terms of cost bearer.
- The social costing method used differentiates the social cost averted for partially–functional scenarios but not for the fully-functional ones.
- The preferable scenario development is BAU-PF→BAU-FF, accountable to its mainly FSM character.

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EXTRAS

Methods: Technical Costing (1)

- Framework: Swarr et al. (2011)
- Sanitation-specific operationalization: Fonseca et al. (2011)

$$PV_{technicals\ costs} = PV_{CapEx} + PV_{OpEx} + PV_{CapManEx}$$

- Function: To provide wastewater sanitation service
- Functional Unit:100% of the population provided with wastewater sanitation service in 2025

Methods: Social Costing (1)

- Approach: (i) Baseline BAU-PF, cost of poor sanitation

  (ii) Other scenarios, risk reduction

- (i) Cost of Poor Sanitation

$$\boldsymbol{PV_{social\ costs} = PV_{HCC} + PV_{MPC} + PV_{MC} + PV_{FC}}$$

HCC – health care cost
MPC – morbidity related productivity cost
MC – mortality cost
FC – funeral cost

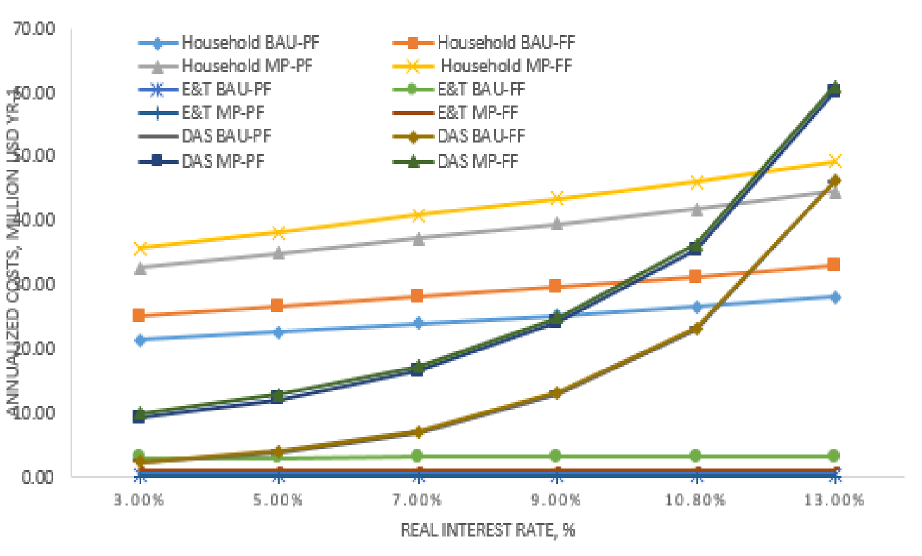
- (ii) Risk reduction approach
  - Scenario improvement: Risk reduction from intervention (ESI, 2015)

$$Social\ costs_{scenario\ X} = Social\ costs_{BAUPF} x \sum [\%coverage\ x(1 - risk\ reduction)]_{facility\ i}$$

R&D: Technical Costing (3)

Sensitivity Analysis

- **Interest rate:** breakeven point at 11.5-12% for household and DAS
  - In this study, 10.8% is used.
  - Others, 3-6% (Whittington et al., 2008), ~10% World Bank, 11% WHO (Carlevaro & Gozales, 2010)
- **Lifespan:**
  - Doubling for containment, reduction costs at 10-12% (5.75-8.69 million USD yr^{-1})
  - 50→30 yrs for sewerage, additional costs only at 1-2% (0.81-1.00 million USD yr^{-1})



R&D: Social Costing

- 1.46 million USD yr^{-1} can be an underestimation, only 1.18% of reported 124 million USD yr^{-1} nationwide (WSP, 2014)
- But,
  - magnitude of over a million USD yr^{-1} is a significant cost
  - i.e. if each household member will be sick with diarrhoea at least once a year, it already takes 4.2% of the minimum annual household income
  - 5% is the estimated maximum income share to be spent for water and sanitation

Combined Costing (1)

- In terms of total costs per scenario,
  - Lower technical costs, higher social costs
  - Social costs is between 1.33-2.85% of the total costs

Scenario	Technical Costs, million USD yr^{-1}	Social Costs, million USD yr^{-1}	Total, million USD yr^{-1}
BAU-PF	49.94	1.46	51.19
BAU-FF	57.46	1.12	58.41
MP-PF	75.68	1.31	76.80
MP-FF	83.49	1.12	84.45