PhD Open Days

Conceptual approach for the modernization of sanitation systems in peri-urban slums. Exploring the interdependence of infrastructure systems in Chamanculo D – Maputo.

CLIMATE CHAGE AND SUSTAINABLE DEVELOPMENT POLICIES

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Methodology

In Maputo, on-site sanitation facilities are the main sanitation option, adopted by a significant part of Maputo residents. Only 9% of the residents have access to the public sewage system, 37% use septic tank, while the remainder are served by improved latrines (31%), pour flush latrines (12%), traditional latrines (10%) or open defecate (1%) (WSP, 2014).

The proposed approach is composed by five sequential phases and follows a "step-by-step" evolutionary framework, focused at a neighbourhood scale, aiming to improve sanitary conditions at each stage of the modernization process.

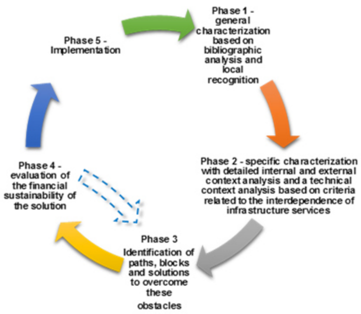


Figure 1 - Conceptual approach

Figure 2 – Chamanculo D - Maputo

Interdependence of infrastructure systems

In the second phase of the study, a detailed and specific characterization was performed with emphasis on exploring the interdependence of land occupation, water supply, storm water drainage, sanitation and solid waste management services in Maputo.

Block 19 (Q19) – Chamanculo D. Maputo – Mozambique

A specific household block (Q19) was chosen in the Northwest zone of Chamanculo D. This is an area with informal urban structure, very dense, mostly served by unpaved narrow pathways without drainage. The prevailing sanitation systems are latrines, with people having plain access to water in backyards. The primary collection of solid waste exists, although it is often hampered or even hindered by difficult access conditions.

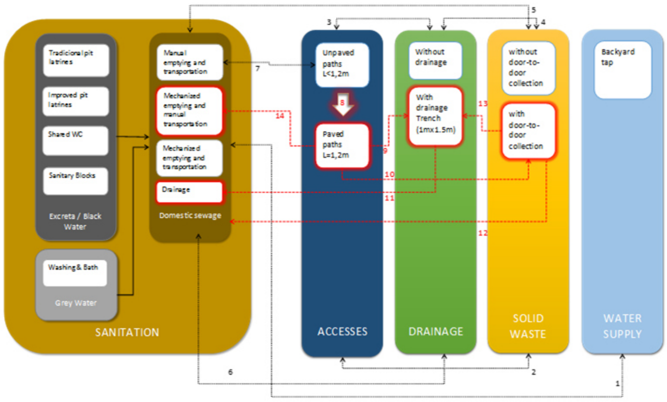
Using a classification matrix to identify the degree of relevance or dependency of system ***y*** relative to system ***x***, it was possible to identify priorities and potential blockage situations. Similar values of *Px* are obtained for drainage and accesses, being sanitation the most dependent system with a value of *Dy*=6. The drainage system and the access structure, despite having the same priority classification (*Px*), they also have levels of dependency between them. In fact, although classified with the same degree of priority the drainage system can be considered more dependent on adequate accessibility than the inverse. ($P_x = \sum_{y=1}^{x} P_{xy}$; $D_y = \sum_{w=1}^{n} P_{wy}$)

Table 1. Degree of dependency *Dy* and priority *Px* for Chamanculo D

	Land occupation and accesses	Water supply	Santation	Storm water drainage	Solid waste management	Total (P_x)
Land occupation and accesses	---	0	3	3	2	8
Storm water drainage	2	1	3	---	2	8
Solid waste management	0	0	0	0	---	0
Total (D_y)	2	1	6	3	4	ΣP_x=16

Mapping interdependencies

The current conditions for the different infrastructure systems in Q19 were mapped in Figure 3, showing the dependency and blocking relationships that are identified from 1 to 7. From these relations stands out the blockage associated with accessibility, on which all other systems depend on, except for the water supply. However, upgrading the whole block by providing it with adequate infrastructure considering the best practices and regulations for urban infrastructure planning and design would be impossible, first and foremost because of the lack of resources for such a project. But could it be possible that small improvements in the blocking factor would foster general upgrading, particularly in sanitation?
In this perspective, it was considered the possibility to formalize a network of paved roads (Figure 4), with a minimum width of 1.2 m, but ensuring the minimum intervention in the urban structure and land occupation. The (desired / desirable) cascade effect triggered by this intervention is also illustrated in Figure 3, with the new relations identified from 9 to 14. The unblocking trigger is identified with the number 8.



1 Population served with water supply. It influences the type of sewage produced, adding water to excreta and producing black water. Grey water discharged in backyards that hardly infiltrate.
2 Narrow and unpaved roads make primary collection difficult. The lack of primary collection fosters the accumulation of waste along roads, making circulation difficult.
3 Narrow and unpaved roads make it difficult to install a ditch or drainage channel that would be permanently obstructed. The lack of drainage degrades the pathways and hinders the circulation.
4 Lack of solid waste primary collection fosters the accumulation of waste, making drainage difficult. The absence of drainage hinders circulation and the possibility of primary collection.
5 Lack of solid waste primary collection encourages the accumulation of waste in backyards pushing them to be buried or descarted into septic tanks and pit latrines.
6 Lack of drainage encourages the accumulation and "mixing" of rainwater with grey water and black water.
7 Narrow and unpaved roads makes faecal sludge management operations of emptying and transportation impossible, implying that sludge is often burried or discharged wherever there is some space, often on backyards and pathways.
8 Unblocking trigger: paving and establishing paths with L = 1,2m.
9 Defined and paved paths enable the implementation of drainage ditches, even if narrow and with the need to be covered or partly covered.
10 Defined and paved paths make it possible to have door-to door primary waste collection.
11 A drainage system enables the drainage of rainwater, grey water and even the liquid phase from septic tanks and latrines.
12 Solid waste primary collection encourages the absence of waste in backyards and sanitation systems, promoting a more adequate functioning of these systems.
13 Solid waste primary collection encourages the inexistence of accumulated of residues in roads and drainage ditches, promoting a more adequate functioning of these systems.
14 Defined and paved paths make faecal sludge management operations of emptying ant transportation possible

Figure 3 –Interdependence and unblocking diagram

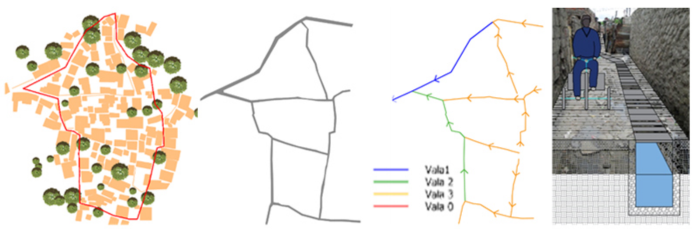


Figure 4 –Q19 structure, accesses, drainage network and sketch of possible solution

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