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Planning approaches for sanitation systems in peri-urban areas: a case study from Tanzania

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The planning and improvement of sanitation systems represents a critical problem for low-income countries, in particular in rapid growing peri-urban areas. This paper illustrates the assessment of the Community-Led Urban Environmental Sanitation (CLUES) and the Sanitation Safety Planning (SSP) approaches, tested for the design of an improved sanitation system in peri-urban areas of Iringa Municipality, in Tanzania. The application in field of the two approaches permitted to evidence and analyse their strengths and weaknesses, and possibilities to increase their potentials with an integrated use. The experience, applied to a case study, aims to be an example of application for practitioners dealing with sanitation planning in context showing similar characteristics.

Introduction

Poor sanitation and accessibility to services remain critical problems in most countries of the developing world. According to results of the WHO/UNICEF Joint Monitoring Program (WHO/UNICEF 2015), it is estimated that about 2.4 billion people still lacks access to adequate sanitation facilities, particularly in sub-Saharan Africa and Southern Asia. In low-income countries, sanitation is usually centred on basic on-site facilities, and in many cases the collection, treatment and disposal of wastewater and faecal sludge are poor or inefficient. The rapid urbanization occurring in most towns and cities contribute to worsen the problem of adequate infrastructure and services especially in peri-urban areas. Human wastes contain dangerous pathogens that, when not properly managed, could be transferred into the human body, leading to potential diseases.

For many years, interventions to these problems approached top-down strategies: governments and aid agencies had subsidized latrines and sewer systems in order to increase the access, but the approach revealed to be weak leading to slow progresses (Mara *et al.* 2010). Recently the focus has been shifted towards participatory approaches aimed to meet user needs and criteria-based decision making methodologies for considering different aspects and perspectives (Lüthi, Panesar *et al*. 2011). At international level a great effort had been done in order to study and develop processes for designing improved sanitation systems, but many constraints still remain especially when they are applied in field.

This paper present a case study within which recent approaches to sanitation planning were applied, and it is aimed at investigating their adaptation to a specific context, challenges which remain to overcome in field and possibilities to potentiate their efficacy with a combined use. The research has been conducted within the project titled "Integrated environmental sanitation concepts for poor, underserved and peri-urban areas of Iringa Municipality", leaded by the NGO ACRA Foundation, under development in Iringa, Tanzania, and aimed at improving health conditions of poor communities in the peri-urban wards of the town, chosen as case studies.

Methodology and selection of approaches

The first step of the work involved a literature review of current trends in sanitation planning and of existing sanitation planning tools. Approaches internationally known and implementable in peri-urban contexts, were

individuated to be used within the project, and those satisfying following criteria based on project objectives were chosen, in agreement with Iringa Municipal Council (IMC) and other local and international partners: 1) address the safeguard of the human health and the environment; 2) promote resources reuse and recovery; 3) stakeholders and community involvement; 4) consider previous staff experiences on planning processes.

The Community-Led Urban Environmental Sanitation (CLUES) (Lüthi, Morel *et al.* 2011) and the Sanitation Safety Planning (SSP) (WHO 2015) methodologies were chosen to be tested within the case study in Iringa.

The CLUES approach was implemented according to the CLUES Guidelines (Lüthi, Morel *et al*. 2011). A skilled facilitator leaded the process carrying out steps 1 to 6 in the four peri-urban wards involved in the project. The planning process started with ignition and promotional activities, the identification of stakeholders and boundaries, and the creation of a community force (steps 1 and 2). A detailed analysis of the current situation (step 3) was carried out collecting data about the sanitation system in place, hereafter named S0. Data derived from literature, official documents and project reports. Field data were collected during a baseline survey by means of interviews and direct observations made with 718 households in peri-urban wards and during field visits to the municipal Wastewater Treatment Plant (WWTP). Experts and community workshops permitted to identify preferred and feasible technical solutions for designing an improved sanitation system (steps 4 and 5), hereafter named S1. Local action plans for the implementation of selected solutions were developed by stakeholders with the indication of tasks, timelines and responsibilities for each action (step 6).

The SSP approach was carried out, based on the SSP manual (WHO, 2015). The SSP team (module 1) has not been assembled yet. The approach was developed at a research level by authors to adapt the tool to the context for and facilitate the work of a team not experienced with risk assessment tools. The mapping of the current system S0and the characterisation of waste streams (module 2) required the collection of additional data about wastewater and faecal sludge management and reuse. Data derived from direct observations during pit emptying, and from interviews to stakeholders: health officers, local farmers, informal emptiers, engineers and employees of the Iringa Urban Water Supply and Sanitation Authority (IRUWASA). Analytical data were collected through water monitoring campaigns conducted at the WWTP and in wells located in the project area. Exposure groups and routes were identified in S0 for each step of the sanitation chain, as well as hazards, related hazardous events and existing control measures (module 3). A semi-quantitative risk assessment was carried out by means of a simplified matrix (Domini *et al*. in press) for evidencing high risks in S0. For each high risk, additional control measures were identified to reduce it. A tool for prioritizing control measures was finalised based on weighted criteria as cost, technical effectiveness, acceptance and potential (Domini *et al*. in press). Identified additional control measures were integrated in the design of the improved sanitation system S1 emerged from CLUES. Finally, an incremental improvement plan and a monitoring and verification plan were suggested for S1 (modules 4 and 5).

Strengths and weaknesses of the two approaches within the case study were analysed, highlighting their common or complementary elements, for evidencing the potentials of an integrated use enhancing their effectiveness.

Results

The CLUES approach

According to results of baseline assessment of S0 in peri-urban wards, 45% of household latrines resulted unimproved, meanwhile most of wells showed evidence of faecal contamination. Mortality of children under 5 years caused by diarrhoeal diseases was 16.7%. The 57% of respondent declared to use the mechanised emptying service offered by IRUWASA, the 20% to fill and cover the pit, whilst almost 23% of households rely on informal emptying. Faecal sludge is often reused in agriculture or disposed of in the environment after poor or no treatment. The community recognised poor latrine facilities and the poor management of wastewater and solid wastes as sanitation priority problems. Experts and community workshops supported the design of an improved sanitation system, which foresees the use of Ventilated Improved Pits (VIP), twin pits pour flush toilets, septic tanks, or fossa alterna (Fig. 1). The emptying and transport would be operated manually or mechanically, whilst sludge would be disposed of at the WWTP, or at a decentralised co-composting plant to produce compost for agriculture. The stabilised humic material obtained in the fossa alterna could be used as a soil amendment (Tilley et al., 2014).

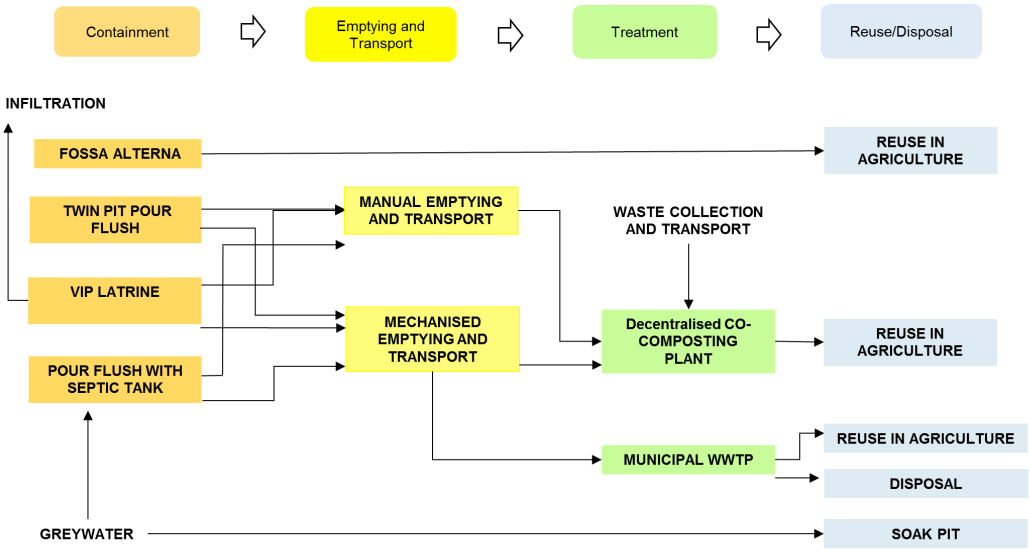

Figure1. Scheme of the proposed sanitation system S1

Main actions foreseen by action plans in the sector of sanitation were:

1. the realisation of household latrine prototypes, and training of ward health committees and community;
2. awareness increasing campaigns on correct hygiene behaviours in to communities;
3. the strengthen of sanitation groups at street level;
4. the organisation of sanitation competitions;
5. the revision and reformulation of sanitation bylaws and their promotion to community.

Great relevance was given to schools sanitation and hygiene.

The SSP approach

System boundaries concerned waste streams of wastewater, greywater and faecal sludge generated within administrative boundaries of four peri-urban wards, from generation to point of use or disposal. Hazardous and hazardous events for the system S0 were identified for each sanitation steps and their risk level was calculated. Of a total of 139 events, 42 gained a high or very high level of risks. High risks occurred in each step of the sanitation chain and concerned all exposure groups, principally vulnerable people, workers dealing with manual emptying, farmers reusing untreated faecal sludge and consumers of raw products. For each of them, additional control measures were proposed to be included in the design of the improved sanitation system S1emerged from the CLUES, in order to diminish the risk level. Main control measures to be endorsed along the whole sanitation chain were: 1) strengthen awareness campaigns for improving hygiene behaviour, such as regular cleaning and proper use of toilets; 2) specific trainings of emptiers, aimed at increasing awareness and improving practices in using appropriate PPE, tools and working procedures; 3) improved faecal sludge management technologies for manual emptying; 4) enforcement of law and regulations in the sanitation sector.

The resulting improved system S1 should be based on a multi-barrier approach focused on additional control measures. Those gaining high priority as emerged by the assessment, are summarized in Table 1 and would represent the basis for the improvement incremental plan.

Discussion and lessons learnt

Tested tools, as emerged from their application within the case study, showed to be useful methodologies for the planning of an improved sanitation system.

The CLUES approach

The CLUES approach demonstrated to be structured as a clear and systematic process, being concurrently flexible and easily adaptable to the targeted context. The approach is strongly participative in its nature and

was able to bring stakeholders together to develop a common understanding about environmental sanitation problems in the intervention area, and to discuss about possible solutions. Community members appreciated the approach and the importance given them to have the right to take part of the decision process. Local authorities and institutions had the opportunity to understand, facing the community and its needs, problems of which they were unaware.

Table 1. **Proposal of an incremental improvement plan based on high priority control measures.**

Control Measure	Comment	Long/Short term	Responsible	Due
Increasing awareness campaigns	Include cleaning, use of shoes in latrines, cooking, boiling water, cover pit hole, disinfection products	Short	IMC, NGOs	Immediate
Personal hygiene		Short		Immediate
Personal Protective Equipment (PPE)	Include use of dedicated clothes, training, tools and vehicles maintenance and washing	Short	IRUWASA, entrepreneurs	Immediate
Mosquito nets	Promotion of use of mosquito nets/ subventions	Short	IMC, NGOs	3 months before the rainy season

At institutional level, many challenges were encountered along the process and different levels of engagement were observed. At municipal level, a discontinuous commitment was observed, deriving from the change of leaders due to elections, but also from issues often affecting governance and institutions in African contexts, as the rapid turnover particularly of more motivated persons and difficulties in organization and coordination (Rodman 1968). Local leaders at ward level showed a higher commitment because they were elected and known by people, even if different levels of involvement were observed due to leadership and level of understanding of the process. A limit is represented by the fact that, a low commitment of authorities leads to weaken the whole process in that specific community.

Another issue aroused during CLUES implementation was the challenge of carrying out informed choices about the selection of options for the sanitation system. The community, but also local experts, demonstrated huge gaps in knowledge of technologies and environmental issues, and in understanding the link between health and hygiene. This fact could affect the technology choice. The importance and need of additional training and increasing knowledge of people and experts in the first phase of CLUES emerged.

Finally, the CLUES is a long process requiring a continuous follow up and multiple skills. Its implementation in four wards required time, and a wide effort in terms of human and economic resources.

The SSP approach

The use within the case study of the SSP demonstrated to be effective for identifying high risks and cost-effective interventions. SSP showed to be a strong tool for understanding risks for human health and the environment due to sanitation solutions currently in place and planned ones. With respect to CLUES approach, the SSP headed to a deeper assessment of the current situation. While the CLUES is demand-led and in its application in Iringa appeared to be oriented towards latrines users, SSP led to consider target groups and stakeholders in other steps of the sanitation chain, as farmers, consumers and workers of the emptying sector. Similarly, SSP is highly oriented towards enhancing benefits of recovery and reuse of resources, while CLUES, even if also endorses these issues, is susceptible to people priorities and decisions and could risk missing this goal if these concepts are not rooted in the community where the approach is used. Differently from CLUES, the SSP foresees the involvement of different stakeholders but does not specifically requires a broad community involvement, and it is not specifically designed for taking into account priorities and expectations of the community.

While the CLUES approach conducted community and local leaders to agree about spatial boundaries of the project, the SSP could stimulate the reflection on boundaries of the system.

The identification of control measures required for the risk assessment permitted to delineate the scenario of what was already in place and its effectiveness, for reasoning about what is possible to do, introducing

concepts of multi-barrier approach in risk reduction. The assessment of control measures supported the identification of cost-effective solutions representing an additional tool for understanding which solutions safeguarding public health could be implemented at first due to economic and time reasons.

SSP obliges users to reflect and examine aspects under a risk perspective that would not emerge using the CLUES alone. In the case under study, as an example, tools and equipment rupture during the latrine emptying step were aspects never emerged or discussed within CLUES meetings.

Both CLUES and SSP guide to the development of an action plan and of a monitoring and evaluation plan. However, the SSP goes a step forward: it foresees the design of a plan monitoring not only the implementation of actions and the correct functioning of the system, but the plan itself. Moreover, the SSP explicitly asks to determine actions to be undertaken in case of failure in the action plan implementation, which is important in the perspective of a continuous improvement of the sanitation system.

A limit of the SSP could be found in the risk assessment process, which could be not easy to perform for people not used to this kind of analysis. For the case study, a semi- quantitative risk assessment was chosen, and a simplified matrix were developed and adapted for the context. Nevertheless, a specific capacity building process would be necessary for performing this task.

Finally, the SSP methodology involves quantitative evidence of some aspects as, for example, pathogens concentration or diseases morbidity, which requires time and technical and economic resources in order to be obtained, particularly in developing context where these data are rarely available.

The impossibility of assembling and train a SSP team within the case study limited the appreciation of some aspects, nevertheless, we can conclude that the SSP represented, in the case under study, a strong support for the awareness increasing of stakeholders on health implications of sanitation systems.

Lesson learnt

In summary, we observed within the case study that the selected methodologies overlapped each other in some parts, while in others they were complementary (Table 2).

Table 2. Common and complementary aspects of CLUES and SSP as emerged in the case study

Common aspects	Complementary aspects	
CLUES + SSP	**CLUES**	**SSP**
	Process ignition / demand creation	
Define objectives		
Define boundaries	Physical boundaries	System boundaries
Stakeholder analysis		Identification of exposure groups
Detailed assessment of the current situation		Waste characterization / additional data on pathogens in water/dried sludge
	Prioritisation of community problems	
Assess / select and design options	Broad stakeholders involvement	Focus on health, risk assessment
	Technical options	Control measures
	Informed choice	Focus on recovery and reuse
		Assessment of control measures
Action plans for implementation		Actions in case of control measure failure
Monitoring and evaluation		Audits
		Develop supporting programmes and review plans

The CLUES approach guaranteed a strong participatory basis and stakeholder involvement. It supported the design of an improved sanitation system based on community priorities and on solutions feasible and suitable for the context, discussed with stakeholders. The SSP was complementary to CLUES in addressing specifically health risks and issues, assuring that all measures that are needed to control and reduce risks for health and environment were considered along the CLUES approach. It supported the analysis and inclusion of aspects along the whole sanitation chain, and the proposed improvement, monitoring and verification plans should be considered during the development of action plans foreseen by the CLUES approach.

Conclusions

The application of planning approaches to the case under study permitted to evidence their strengths and limits in peri-urban low-income contexts. The combined use of CLUES and SSP approaches is suggested for other projects or practitioners operating in context with similar characteristics, for addressing a wide stakeholder involvement in the planning process and supporting the awareness increasing about the relation between sanitation and health in the perspective of safeguarding the human health and the environment.

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