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Participatory Decision Making for Sanitation Improvements in Unplanned Urban Settlements in East Africa

Astrid Hendriksen[1], Judith Tukahirwa[1], Peter J. M. Oosterveer[1], and Arthur P. J. Mol[1]

Abstract

Solving the problem of inadequate access to sanitation in unplanned settlements in East Africa needs to combine social and technical dimensions in such a manner that they fit the local context. The modernized mixtures approach offers an analytical framework for identifying such solutions, but this approach requires effective methods for participatory decision making. This article intends to contribute to filling this gap by identifying and further elaborating an appropriate multicriteria decision-making tool. The multicriteria decision analysis methodology, Proact 2.0, offers an adequate solution as it creates the possibility to connect knowledge, experiences, and preferences from scientists, experts, and policy makers with those of the end users. We show in particular that users not always prefer the most optimal sanitation system, defined from an "expert" point of view. This article concludes that using Proact 2.0 can lead to substantial improvements in decision making in the field of sanitation in unplanned settlements in East Africa.

Keywords

multicriteria decision analysis, Proact 2.0, user involvement, participatory decision making, modernized mixtures, sanitation, East Africa, unplanned settlements

[1]Wageningen University, Wageningen, Netherlands

Corresponding Author:
Astrid Hendriksen, Environmental Policy Group, Wageningen University, Hollandseweg 1, P.O. Box 6706 KN, Wageningen, Netherlands
Email: astrid.hendriksen@wur.nl

Introduction

The United Nations declared 2008 to be the international year of sanitation by explaining,

> Improving sanitation represents one of the best options to really accelerate health, social, and economic development. Sanitation is not the topic of the Millennium Development Goals (MDG) or of the International Year of Sanitation because it is a problem, but because it is a solution and yet sustainable solutions for dense urban slums remain elusive. (United Nations, 2008)

Today more than 2.6 billion people still lack access to adequate sanitation facilities. At current rates of progress, the world will not achieve the Millennium Development Goal sanitation target: "Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation," which equals a reduction by almost 1.4 billion people. However, realizing this MDG does not mean the end of the sanitation challenge. Even then some 1.4 billion people will still not have access to improved sanitation facilities (WHO/UNICEF, 2010). Moreover, in less than 30 years, these numbers are set to double because of the rapid urbanization (United Nations, 2005).

Poor sanitation and solid waste management are among the key factors not only affecting the health of urban dwellers but also contributing to high poverty levels in developing countries. The worldwide focus on sanitation generated by the UN's year of sanitation has definitely led to increased attention for making sanitation facilities available to the urban poor. However, the challenge does not merely lie in the quantitative expansion of sanitation facilities in slum areas. It does also lie in ensuring that these facilities fit the conditions of the slums. In the past too, often newly constructed sanitation facilities were ignored by the urban poor, the potential users, because they did not fit their daily lifestyles, their religious beliefs, their cultural habits, or their economic capacity. Filling the sanitation gap is therefore not only a matter of constructing more toilets, water points, and sewerage systems but also to make sure these infrastructures fit with the practices, concerns, and capacities of their users (Black & Fawcett, 2008; Isunju, Schwartz, Schouten, Johnson, & van Dijk, 2011; Schouten & Mathenge, 2010; Lenton, Wright & Lewis, 2005).

Hence, both the technical and the socioeconomic dimensions of sanitation solutions need to fit the local context. The modernized mixtures approach (Oosterveer & Spaargaren, 2010; Scheinberg & Mol, 2010; Spaargaren, Oosterveer, van Buuren, & Mol, 2006; Scheinberg, Spies, Simpson, & Mol, 2011) offers an analytical framework for identifying and designing infrastructure solutions (among which sanitation) that are adapted to the specific local contexts, through more flexible combinations of sociotechnical system elements at multiple levels of scale. It is not the characteristics of the technical (sanitation) system that are the starting point; the characteristics of both the social contexts and technical systems themselves are combined in an optimal way. This is why the modernized mixtures approach differs from the modern, grid-based centralized systems in the developed world as well as from decentralized on-site systems that are common in developing countries. Hence, the modernized mixtures approach represents a new paradigm that helps us to overcome conventional dichotomies in system design, such as those between large- and small-scale systems, advanced and low technological systems, centralized and decentralized systems, and consumer exclusion and involvement (cf. Spaargaren et al., 2006). This is attractive when designing a sanitary system in unplanned settlements (van Buuren, 2010), where sanitation systems have to be adapted and designed to fit specific local circumstances and context, instead of implementing existing ill-fitting turnkey systems. To do so, however, the modernized mixture framework has to be complemented by approaches and tools for bringing, especially, social characteristics and dimensions into the design and implementation process as well. Many of these characteristics are only to be found among the multiple specific stakeholders related to new sanitation systems and cannot be standardized. Hence, assessing different sociotechnological solutions to sanitation problems on multiple criteria should allow for the active involvement of different stakeholders.

This article therefore aims to contribute to the further operationalization of the modernized mixtures approach by developing and testing a multicriteria decision analysis method with a strong user involvement to close the gap between technological innovation and user acceptance. To put it more specifically, how can potential users of sanitation facilities living in urban slum areas be involved in the design and decision-making process to realize sanitation facilities that are of good technical quality and will also be accepted by them because these facilities fit their specific social-economic and cultural situation?

With this objective, this article starts by further developing the argument that user acceptance of sanitation facilities is fundamental to achieve a sustainable impact, which makes participatory decision-making methodology an essential component of the system of design and implementation. The section on participatory decision-making method reviews different participatory multicriteria decision-making methods and then identifies and, furthermore, revises a method that may be expected to offer promising perspectives for concrete application. The next section reports on the testing of this method, Proact 2.0, in the practical conditions of Katanga, a slum area in Kampala, the capital of Uganda. Finally, we conclude on the perspectives of Proact 2.0 as a participatory multicriteria decision-making tool to identify sustainable sanitation facilities that bridge the gap between technological optimization, financial limitations, environmental conditions, and user acceptance.

Stakeholder Involvement in Modernized Mixture Approach

Lack of sanitation is among the main causes of health problems among urban dwellers in African cities and is widely considered to contribute to poverty (Tukahirwa, Mol, & Oosterveer, 2010, 2011). Hence, for many years, initiatives from a variety of local, national, and global actors have been taken to increase levels of access to sanitation in the poorer urban communities in African cities. In recent years, following the emphasis on sustainability, a number of innovative sanitation alternatives—the ecosan toilet being the most recent one—have been installed by technological experts, often following initiatives from NGOs and CBOs. Yet increasingly there are indications that the urban poor tend to ignore these innovative sanitation systems, blaming NGOs and CBOs—and other sanitation promoters—for being led by their own ideas and agendas instead of solving the concrete problems of the urban poor. This resulted in many failed initiatives aimed at the introduction of ecosan toilet systems (see Kaggwa, Kiwanuka, Okurut Okia, Bagambe, & Kanyesigye, 2003). Such results reflect a broader tradition, where sanitation facilities were identified and implemented on the basis of expert assessments, ignoring the users' perspectives and the local social conditions (Pahl-Wostl, 2002). Such "expert-based" or "expert-led" approaches stress the importance of sanitation optimization from a technological and/or economic point of view and result in a one-directional flow of recommendations from experts to governmental and NGO/CBO decision makers. Hence, sanitation solutions are often defined by experts and imposed on local communities, although these communities may not necessarily perceive the solutions as beneficial as the experts for social, cultural, or even economic reasons. It has been widely recognized, but not yet widely applied in practice, that decision making on sanitation improvement for the urban poor should involve community members; that is, households that are the ultimate users of proposed sanitation solutions. The consequence of this is quite radical: Recognizing the importance of user and stakeholder involvement means that technological optimization can no longer be the dominant criterion in decision making and a trade-off between public acceptance and technical quality (Beierle, 2002) may be necessary. Hence, more varied and flexible responses to the present sanitation challenges are required, particularly in the context of African cities where financial resources are limited and the pressure for finding rapid solutions are high.

The modernized mixtures approach (Oosterveer & Spaargaren, 2010; Spaargaren et al., 2006; Scheinberg & Mol, 2010) offers a conceptual framework for identifying more adequate solutions to the current sanitation problems in the context of urban Africa. This approach is developed to identify sustainable urban environmental infrastructures by combining various levels of scale with different degrees of involvement of end users, of separation or mixture of water and waste flows, of level of technological advancement, and of centralization of infrastructure and decision making, all to establish better connections between the possible infrastructural solutions and the social-economic context where they are applied (Oosterveer & Spaargaren, 2010). For this, the modernized mixtures approach argues for the inclusion and integration of technical and social-scientific knowledge when designing sanitary solutions in specific settings. Hence, views and contributions from experts, decision makers, and end users need to be included and combined into (hybrid) solutions. The rationale behind this approach is the need for creating a "fit" between different potential sanitation options and the prevailing (perceived) socioeconomic, ecological, and technological circumstances. Involved users are invited to identify preferred sanitation solutions among those that are realistically (i.e., technologically and economically) feasible in their particular user-context. This implies that each community may identify a specific sanitation solution, as the specific user-context may differ. Using this modernized mixtures framework means, therefore, promoting a modular approach to sanitation problems rather than aiming for a one-size-fits-all solution.

The modernized mixtures approach has determined three key criteria to design and assess adequate sanitation solutions, including ecological sustainability, accessibility (particularly of the poor), and technological flexibility (van Vliet, Spaargaren, & Oosterveer, 2010). Ecological sustainability refers to the environmental profile of sanitation solutions, in terms of minimizing pollution (e.g., waste), minimizing natural resource use (e.g., water), and reusing valuable resources (nutrients). Accessibility relates to the extent to which all households in poor communities can make use of sanitary infrastructures and are not prevented from doing so for financial, physical, or sociocultural reasons. Technological flexibility points at how sanitation systems function and "behave" in times of economic, political, and climatic variability, extremes, and instability. Although entailing a promise for designing more sustainable sanitation systems, the modernized mixtures approach is in need of further elaboration particularly on how stakeholders can participate in designing and assessing sanitation options and systems in concrete situations. Hence, we need to extent this modernized mixture framework with a methodology of participatory decision making on sanitation.

Participatory Decision-Making Method

Nowadays, stakeholder support is recognized as essential for successful implementation of many (environmental) policies and programs. Since Arnstein described the "ladder of participation" in 1969, it is known that significant degrees exist in stakeholder involvement and participation and that the extent of their influence during decision-making processes is a crucial factor in determining their future stakeholder (Arnstein, 1969; Beierle, 2002; Jonsson, Andersson, Alkan-Olsson, & Arnheimer, 2007; Kasemir, Jäger, Jaeger, & Gardner, 2003). This general argument is not different for sanitation policies and programs. Also in sanitation knowledge, experiences and ideas of specialists and official decision makers should be coalesced with those of the community, the users, who are affected by sanitation system (Addo-Yobo & Njiru, 2006; Irvin & Stansbury, 2004; Jonsson, 2005; Kasemir et al., 2003). This means that the focus of experts in sanitation policy making has to change from a preoccupation with only scientific expertise to one with wider contributions to accommodate the needs and demands of different stakeholder groups. At the same time, involving local community members in sanitation planning need further elaboration. The main problem is that involvement of end users in decision-making processes can add considerable complications, as their knowledge experiences and preferences do not automatically synchronize with the most optimal sanitation solution(s) from an "expert-based" (technological-economic) view. Most users do not have the expertise to judge which innovations in sanitation are technologically feasible for their community. In addition, there is not one single best sanitation solution that fits all stakeholder groups equally, as they often differ in economic means, social preferences, and cultural practices. Hence, end users are often portrayed as incapable of overseeing the full complexity of technical innovations and as providing their input only on the basis of private interests (Devas & Grant, 2003; Williams et al., 2001). Recognizing the importance of incorporating an end-user perspective in decision making on sanitary infrastructures should not make us naive regarding the capacity and capabilities of end user to (co-)decide in such processes. However, it does mean that the established procedures need to be carefully reconsidered to give end users a place in the process of planning and decision making.

Hence, we are in need of methodologies that give experts and local stakeholders a justified role and position in planning and decision making on sanitation.

Participatory Sanitation Planning Tools

Over the last decades, many participatory decision-making tools have been developed, some specifically for sanitation policy but many others destined for more general use in environmental decision making. Netssaf (2008) provides the most encompassing recent overview of various frameworks for participatory planning tools in the domain of sanitation. Table 1 presents the summary of this inventory and shows that these tools all divide the planning process in a different number of phases.

The different participatory sanitation planning tools with multiple stakeholder involvement as presented in Table 1 all have their specific characteristics and focus. The Participatory Hygiene and Sanitation Transformation (PHAST) approach is designed to promote hygienic behavior, sanitation improvements, and community management of water and sanitation facilities, building on people's ability to address and resolve their own problems. Decision making with PHAST is, among other things, based on the principles that "those who create decisions will be committed to follow them through" and "every community understands its own situation best." Community involvement is believed to result in higher levels of effectiveness and sustainability than could be expected from externally imposed solutions (WHO & UNDP/World bank Water & Sanitation Program, 2000). The PHAST approach relies heavily on extension workers, who organize workshops for the community and guide community members through the different steps of the sanitation planning process. Although the focus is on hygienic behavioral change, this approach also stimulates improvements in the sanitary conditions of these communities by encouraging them to set up their own systems for monitoring community behavior based on the criteria they identified themselves.

What the PHAST approach has in common with the open planning of sanitation systems and the household-centered environmental sanitation planning approach is a stakeholder analysis, which is included in the first phase of problem identification. All three approaches emphasize that the probability of success will increase if the users

Table 1. Participatory Sanitation Planning Tools With Multiple Stakeholder Involvement

Participatory Sanitation Planning Tools				
PHAST	Open planning of sanitation systems	Household centered environmental sanitation planning approach	Sanitation 21	Multicriteria decision analysis systems
Phases				
Problem identification	Problem identification	Request for assistance	Institutional mapping	Problem definition, goals and objectives
Problem analysis	Identification of boundary conditions	Launch of the planning and consultancy process	Interests/ objectives	Definition of criteria
Planning for solutions	Terms of requirement	Assessment of the current status	External factors	Definition of alternatives
Selecting options	Analysis of possible solutions	Assessment of user priorities	Capacity	Definition of preferences
Planning for new facilities and behavior change	Choice of the most appropriate solution	Identification of options	Sanitation elements	Decision making
Planning for monitor and evaluation		Evaluation of feasible service combinations	Management	
Participatory evaluation		Consolidated plans for study area	evaluation	
		Finalizing of consolidated plans		
		Monitoring, evaluation, and feedback		
		Implementation		

Source: Netssaf (2008).
Note: PHAST = participatory hygiene and sanitation transformation.

are seen as participants in the planning process and therefore they need to be involved right from the start. All three approaches claim that involving the users of sanitation facilities in every step of the planning process is essential for a successful end result. During the Terms of Requirements phase in the Open Planning of Sanitation Systems approach, a distinction is made between primary and practical functions. Primary functions can be environmental protection or resource conservation and practical functions can relate to reliability and affordability. After identifying the criteria for these two functions, at least three alternative solutions should be compared before a final choice for a particular sanitation system can be made by all stakeholders (Schönning & Stenström, 2004). The household-centered environmental sanitation planning approach combines PHAST and the Open Planning Sanitation Systems in a 10-step planning process.

Sanitation 21 aims at closing the gap between households and urban sanitation systems. The focus of this decision-making tool is an analysis of the different technical options that are relevant within a sanitation system that covers all levels of the urbanized area, including households, neighborhoods, districts, the city, and beyond. Multicriteria decision analysis (MCDA) constitutes an approach that is nowadays used in environmental projects to support multiple stakeholder involvement. It provides an ordering of alternatives—from the most preferred to the least preferred ones—based on different technological, economic, social, and ecological criteria. The involvement of multiple stakeholders is crucial in MCDA, but it can be organized in different ways, such as focus group meetings, workshops, interviews, or surveys. This methodology is widely applied during participatory decision-making processes on complex problems (Chowdhury & Rahman, 2008). MCDA methods aim at supporting complex decision-making processes by providing a framework for collecting, storing, and processing all relevant information from experts and end users. The core of the MCDA method is a decision-making model, which is a formal specification of how to combine different kinds of information to reach a shared solution (Lahdelma, Salminen, & Hokkanen, 2000).

A MCDA methodology can be—and has been—used to identify a single most preferred option, to rank different options or to distinguish acceptable options from unacceptable ones (Nigim, Munier, & Green, 2004). Compared with conventional decision making and different alternative participatory decision-making tools, the advantage of using the MCDA methodology is its contribution to increased transparency in judging and deciding on alternatives, to enhanced stakeholder participation, and to better optimized solutions by applying and combining several criteria in the decision-making process. The method is also easily adaptable to specific local conditions (Netssaf, 2008). Another advantage of the MCDA methodology is the possibility to connect expert-knowledge, knowledge of authorities, and user-knowledge to make a decision that is most likely acceptable for all stakeholders. This is particularly important in the field of sanitation where decisions have substantial consequences: Selected sanitation options remain present for a long term and affect many people, whereas mistakes are not easily remedied because of the costs involved. It is for these reasons that among the different participatory tools for planning on sanitary infrastructures MCDA gains a growing popularity.

Proact: A Multicriteria Decision Analysis Method for Sanitation Policy

Proact (Hammond, Keeney, & Raiffa, 1999) is a MCDA method that matches very well with the goal of initiating a multiphase stakeholder dialogue to arrive at decisions in the field of urban sanitation. The Proact method consists of five phases: the problem analysis, the setting of objectives, the selection of alternatives, the assessment of

Table 2. Phases and Stakeholder Participation in Proact

Phases in Proact 2.0 stakeholders	Problem analysis	Objectives	Alternatives	Consequences	Trade-off
All stakeholder groups	X	X	X	X	X

Source: Hammond et al. (1999).
Note: X = participation of this particular stakeholder group is important.

the consequences, and the trade-offs between different alternatives. The problem analysis phase focuses on the identification of the problem and on the determination of the decision-making context. Scientists, experts, policy makers, and users need to develop a common understanding of the problem, of the decision that has to be made, and of the criteria by which such decision is to be judged and evaluated. If an issue is not understood or considered to be important by one of the stakeholders, it will be difficult to get this stakeholder involved. By the same token, it is important to engage a wide group of stakeholders as early as possible, particularly in analyzing and defining the problem. The objectives are to be set to reach a common understanding of the problem. Subsequently, the problem definition leads to the formulation and selection of alternative solutions and to a decision on the various criteria to be considered when comparing them. The criteria for decision making on alternative sanitary solutions typically consist of indications for technical feasibility, cost-effectiveness, social impacts, and various environmental impacts. It is important that all stakeholders have the opportunity to actively participate in this phase to allow inclusion of all different perspectives and points of view in the process (Lahdelma et al., 2000). All alternatives are screened by assessing the consequences for each of them. In the trade-off phase, these alternatives are ranked in the order of preference and scored against the criteria that were set in an earlier phase. Each of these criteria has been assigned a particular weight within the final decision-making process as a reflection of their relative importance. The weight and the scores on the criteria are combined for each alternative to derive their overall value. Finally, the best alternative can be determined.

According to Hammond and colleagues (1999), applying Proact means involving all stakeholder groups throughout the decision-making process. Table 2 emphasizes that Hammond and colleagues do not make any distinction between the roles of different stakeholder groups in the different phases of the process.

In other models, however, distinctions are made between the roles where different stakeholders can and should play in the various phases of a MCDA: Stakeholder groups are assigned different responsibilities in distinctive phases of the process than others, such as experts, planners, or decision makers, are. For instance, Lahdelma et al.

Table 3. Phases and Stakeholder Participation in Environmental Multicriteria Decision-Making Processes

Phases in MCDA stakeholders	Define alternatives and criteria	Make measurements	Choose decision aid	Provide preference information	Form draft solutions	Make final decision
Decision makers	X		(X)	X		X
Interest groups	X			(X)		
Experts	X	X				
Planners	X	(X)	X		X	

Source: Ladehlma et al. (2000).
Note: X = participation of this particular stakeholder group is important; (X) = participation is less important. MCDA = multicriteria decision analysis.

(2000) make a difference between four stakeholder groups and each of them is involved in two to four of the six different phases (see Table 3).

Van Buuren and Hendriksen (2010) follow Ladehlma et al. (2000) by making a distinction between the different stakeholder groups and their contribution in different phases of the planning process on sanitary infrastructures. However, they consider especially the phases of problem analysis and objectives vital in the decision-making process, although these phases are absent in the sanitation planning process of Ladehlma et al. Therefore, van Buuren and Hendriksen designate this multicriteria decision analysis methodology, Proact 2.0, so to underline the continuities and innovations compared with the previous use of this method. Van Buuren and Hendriksen combine the division of the Proact phases according to Hammond et al. (1999) with the division of the stakeholder groups as developed by Ladehlma et al. (see Table 4).

Proact 2.0 considers the involvement of all stakeholder groups important especially in the first phases of the planning and decision-making process: problem analysis and the formulation of objectives. In these phases, it is essential that the problem is considered from as many different angles as possible and that all stakeholder groups agree on a number of common objectives. However, in the phase of elaborating alternative solutions, there is no need to involve the end users or the policy makers/local authorities. During this phase, scientists and experts on sanitation are much better placed and equipped to determine the feasible options in a given context. When all feasible options are identified, end users have to select their personally preferred option among them. For policy makers, this will lead to a better understanding of the eventual positive and negative commitment of end users for certain options, which is important in the final decision-making process. Hence, in including stakeholders in decision-making processes on improvements in sanitation, adjusting their participation to the different phases in the multicriteria decision analysis process is vital to optimize both the process and the contributions from stakeholders.

Table 4. Phases and Stakeholder Participation in Proact 2.0

Phases in Proact 2.0 stakeholders	Problem analyses	Objectives	Alternatives	Consequences	Trade-offs
Scientists	X	X	X		
Technological experts	X	X	X		
(Local) policy makers	X	X			X
Users	X	X		X	

Note: X = participation of this particular stakeholder group is important.

The Proact 2.0 method offers practical support in optimizing user involvement to reach feasible and sustainable sanitation improvement. Two phases are particularly important in realizing this: problem analysis and consequences.

Identifying and involving all stakeholders at an early phase of the policy process help to build up mutual trust and allow for a common understanding of what the problem is and how it should be defined, although it also facilitates the joint formulation of objectives against which alternative solutions should be assessed. These objectives should be defined in terms of social needs rather than in the technical solutions to be put in place (van Vliet, 2006). When the consequences of all feasible alternatives are discussed, users are also to be actively involved. As the end users should benefit from the new sanitation improvements, it is crucial that they are involved in discussing all options before deciding on their final preference. This phase of discussing consequences of all feasible alternatives should be based on a deliberative approach to decision making, whereby participants listen to each other's arguments and preferences and generate group choices after due consideration of each possible option. In contemplating on and arguing for what they consider to be the best solution, participants (different groups of end users) ought to try to convince one another by offering arguments that are acceptable by others. Even if this phase of deliberative participation does not result in one clear recommendation, it can still serve as a stage where user values become discernable and identifiable (Forsyth, 2007; Fung & Wright, 2001).

To evaluate the practical use of the Proact 2.0 methodology developed in this manner, we have applied this method in sanitation upgrading in Katanga slum in Kampala, focusing especially on the phases of problem analysis and consequences.

Testing Proact 2.0 in Katanga Slum, Kampala

Katanga village is one of the major informal settlements in Kampala. Its growth can be attributed to its location close to the central business district allowing for easy access to informal jobs. It is one of the many informal settlements where the majority of the urban poor in Kampala are accommodated. It is common knowledge that among the multiple problems related to poverty in these areas, sanitation is one of the most prevalent ones (Figure 1).

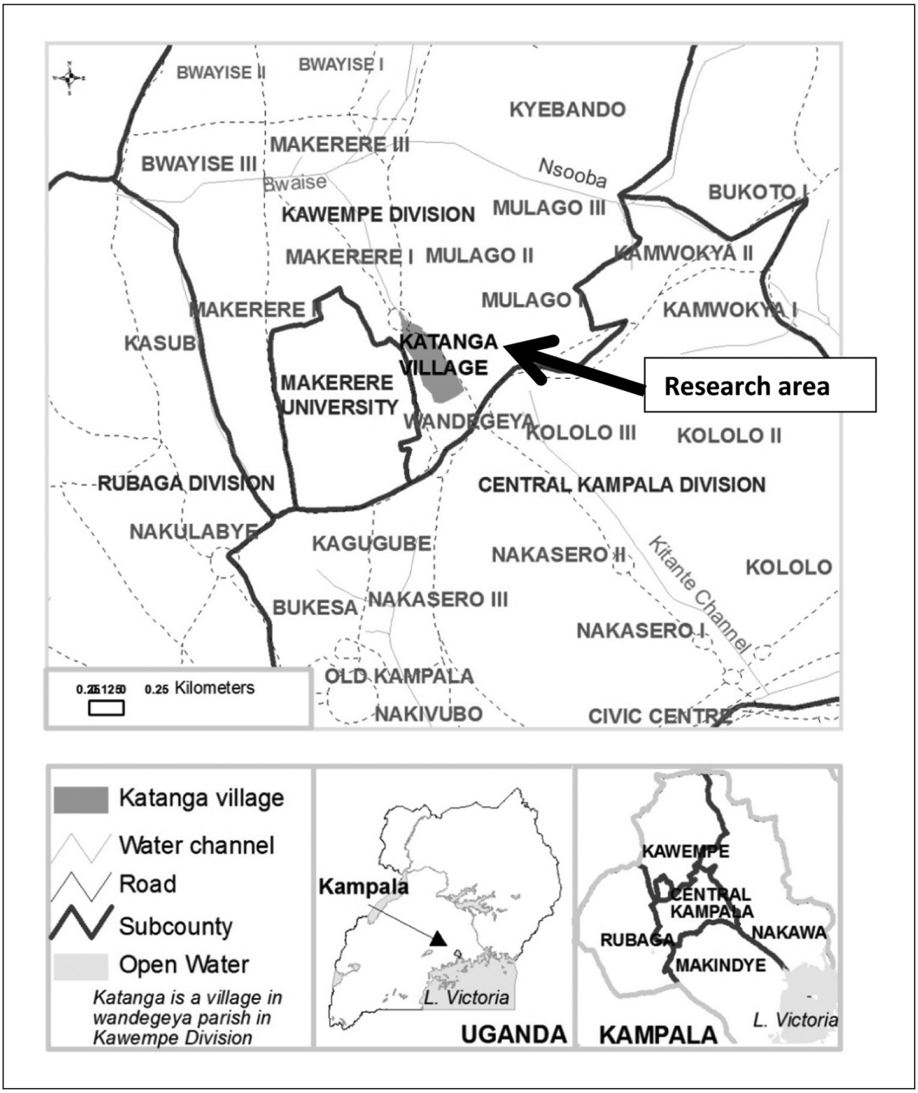

Figure 1. Administrative map of Central Kampala, Uganda

Previous efforts made by local NGOs and CBOs to improve the sanitation situation among the urban poor had not resulted in sustainable solutions (Mabasi, 2009; Okot-Okumu & Oosterveer, 2010). A number of innovative and ecologically sustainable options had been established, such as ecological sanitation (ecosan) toilets and composting plants to improve their health and environmental conditions. For instance, in

Katanga, several ecosan toilet blocks had been installed, allowing the separation at source of urine and feces. This separation facilitates the reuse of valuable components from urine and feces and reduces water loss. Hence, it protects public health, prevents pollution, and returns valuable nutrients and humus to the soil. From a technological and environmental sustainability point of view, ecosan toilets are therefore an attractive solution. Yet in Katanga slum, local leaders explained that these ecosan toilets are used by only a very few poor households because the majority of the potential users are convinced that these ecosan toilets are not hygienic. As a result, most human waste is still disposed of indiscriminately, together with solid waste, leading to all the hygienic problems coming along. Here the expert dilemma is felt: knowing solutions without knowing the problem (see van Buuren & Hendriksen, 2010). The decision to introduce ecosan toilets was made by technical experts on technical grounds, and its failure underlines the necessity of involving end users in the process of developing and implementing alternative solutions.

To translate this aim in concrete practice, the Proact 2.0 methodology was tested here and two workshops were organized for the different stakeholder groups involved in sanitation upgrading in Katanga. The first workshop was organized with the participation of representatives from all stakeholder groups engaged in sanitation around Katanga. The first workshop was jointly organized by environmental scientists from Makerere University, Kampala, and Wageningen University, the Netherlands, who together work on viable options for improving the sanitation situation in Uganda and as such have an overall picture of the different organizations involved in sanitation activities in Katanga slum. Hence, experts were invited from the Uganda Water and Sanitation Network, an umbrella organization working toward achieving universal access to safe water and improved sanitation by coordinating and informing their member nongovernmental and community-based organizations on sanitation. Representatives from the Kampala city council which is mandated by the local government act 1997 to provide numerous services including sanitation upgrading attended the workshop. In addition, local policy makers and local leaders living in Katanga were invited. During this first workshop, 12 stakeholders with a variety of expertise were asked to discuss the present situation to develop a common understanding of the problem. The second workshop was organized to screen the different feasible alternatives for their user preference and acceptance. Hereby, local leaders and inhabitants of Katanga were invited.

Screening: Selecting Feasible Alternatives for Sanitation Improvement

During the first workshop, scientists and technological experts gave presentations on sanitation problems and solutions to inform policy makers and local authorities. Subsequently, all stakeholder groups interacted to define the problem, to formulate alternative solutions and to identify the various criteria that should be considered when comparing alternatives. Technological, social-cultural, economic, environmental, and health criteria were included. Taking alternative solutions into consideration and comparing them are essential as there are usually several options technologically and economically feasible, but there may also be local conditions that rule out certain options. The process of distinguishing feasible and unfeasible options for sanitation in Katanga was called *screening*. This screening process was carried out together with a group of diverse technical experts. During the screening phase, these specialists took into consideration the defined set of criteria as well as site-specific conditions of Katanga slum. The implementation of this phase in the decision-making process by implying only experts was in line with Proact 2.0: Not all stakeholders have to be involved in all phases of the decision-making process. Nonexperts in sanitation technology cannot be considered capable of making the complex technological decisions needed for identifying feasible options for sanitation, and expert knowledge is indispensable for making an informed selection in this stage. However, in order not to become trapped or locked in specific technological trajectories, it proved to be essential to have sufficient diversity in this expert group. Too often, individual experts have their own technological preferences based on their specific training, knowledge, institutional affiliation, or on other interests. It is vital that screening technological alternatives is an open process among distinct technological experts and expertise.

As a result of this screening process, several feasible alternatives were selected for improving the sanitation situation in Katanga slum. Some of the pro-poor onsite sanitation technologies were not suitable for this context. For instance, as unplanned slum it was not easy accessible for emptying facilities. Field observations in Katanga revealed that pit latrines, often promoted by NGOs, were technically not suited to the local environmental conditions. The areas where these toilets had been constructed were marshy and hence had a high water table. As most of the latrines were constructed without protection from the groundwater, this created a serious health risk. At the same time, conventional pit latrines, an assorted collection of facilities with poorly understood health impacts, were still the main sanitation technologies the urban poor had to rely on. Therefore, despite the serious problems, the pit latrine was included among the feasible options to be investigated by stakeholder.

The other feasible sanitation options identified by experts were the double-pit latrine, the waterless system with the alternating pit, the pour flush sanitary system, and the urine diverting dry toilet (better known as ecosan). The double-pit latrine is an improved version of the single-pit latrine. A second pit is added to allow continued use, while the stored fecal material can settle and later be used as a soil conditioner. The waterless system with alternating pit collects, stores, and treats excreta in the pit itself so the generated compost can be removed and transported for use or be manually disposed of. In pour flush systems, treatment of sludge is on-site but the system can also be connected to an anaerobic biogas reactor where gas can be produced for use when cooking. The last identified feasible option was the urine diverting dry toilet, which separates feces and urine to allow feces to dehydrate and to recover urine for beneficial use.

Table 5. Background Variables Participants Katanga Workshop

Age in years	Gender	Education	Marital status	Number of children	Religion
≤20 = 25%	Male 55%	Primary school 25%	Single 55%	0 = 30%	Muslim 63%
21 ≤ 40 = 60%	Female 45%	Secondary school 55%	Married 37.5%	1-4 = 50%	Catholic 18%
41 ≤ 60 = 15%		College 20%	Divorced 5% Widow(er) 2.5%	5-10 = 20%	Christian 11% Protestant 8%

User Acceptance

Many failures of initiatives to improve sanitation conditions in urban slums can be attributed to a large extent to the lack of in-depth understanding of slum life (Isunju et al., 2011; Jenkins & Curtis, 2005). Therefore, during the second workshop, the stakeholders were invited to further screen the different feasible alternatives on their end-users preference and acceptance. Hence, not only the local leaders as the representatives of the Katanga communities, but also inhabitants living in Katanga were invited.

A group of 50 inhabitants of Katanga was invited to participate in a 1-day workshop, and they were challenged to screen the five technical options for sanitation improvement that resulted from the first workshop and the screening process. The participants were selected on diversity and representativeness. Table 5 lists some key data on the background of these participants.

The participants were split into five diverse subgroups to discuss the feasible sanitation options. Each subgroup was assigned one potential sanitation improvement and was asked to consider this option by doing a SWOT-analysis, without any pregiven criteria for such an assessment. The results from each subgroup were presented to all participants and followed by a plenary discussion on their conclusions. During this part of the workshop, the principle of deliberative decision making was followed, whereby participants were able to listen to each other, invited to exchange and discuss arguments, and encouraged to bring up different points of view.

Discussing the different alternatives during the workshop resulted in an interesting overview of the different criteria used by the participants when assessing options for improving the sanitation situation in Katanga. With regard to the single-pit latrine, negative arguments dominated the discussion. Users considered the single-pit latrine a primitive option, not hygienic, a potential danger for infection, not safe for pregnant women, scary for children, without access for emptying when filled up, a dump place for waste, and only suitable as a temporary solution for underdeveloped areas. Most of these negative arguments were also expressed when discussing the double-pit latrine, but some positive considerations were mentioned as well. Both the single- and the double-pit latrines fit into the local conditions and are cheap to build. The double pit is considered less primitive as it does not get blocked, is less polluting because of the process of natural decomposing, and, when used well, is easier to keep clean. An active discussion followed after the presentation of the waterless system with alternating pit. All arguments were nullified by the fact that a waterless sanitation facility is unacceptable for Muslims and this applied to the ecosan option as well. Other arguments against the introduction of ecosan systems were that the construction is expensive, leads to an easy spreading of diseases, produces a bad smell, users need shoes for entering it, and because urine and feces should be diverted, it is impossible for females to make use of such toilets. The discussion about the pour flush toilet system was the most balanced in terms of strengths and weaknesses. It was considered to fit in every place and easy for use by everyone; it saves space, is long lasting and hygienic, and is seen as a dream because every family would like to have its own toilet. Yet it is expensive to build, requires special care to be kept clean, is rapidly blocked, and is not easy to maintain.

The choice to include a SWOT-analysis when asking end-users to assess feasible options seems to provide an effective basis for open discussions on their respective advantages and disadvantages and gave extensive insights in the end-user expectations, ideas, hopes, and fears. The aim of the SWOT-discussion was not to come to a consensus among users but to bring all considerations, experiences, values, and user behavior-patterns to the fore to establish commitment, understanding, and a broader perspective. This was important because during the plenary discussion, the policy makers and local authorities were also present. This broad exchange of views resulted in better and more complete insights in the diversity of user views and arguments related to the different sanitation alternatives. The plenary discussion constructed a list of criteria that Katanga inhabitants consider relevant when assessing sanitation improvements classified in five main categories (see Table 6).

These main categories, namely, technological, economic, social/cultural/religious, environmental, and health, cover the broad range of social, economic, and technological considerations that end users deem relevant when judging sanitary infrastructures. After consensus was reached on these categories, further refined into 15 specific criteria, all participants were asked to individually rank the different feasible options for sanitation improvement in Katanga in their order of preference. This approached allowed the ranking to be better based on arguments than would have been the case without group discussions, SWOT presentations, exchange of arguments, and criteria construction. After the individual ranking, the option that was identified by the users together as the "best" was determined and communicated to all participants and also to the other relevant stakeholder groups (see Figure 2).

These results show that most of the users chosen the pour flush as first, the single pit as second, and the double pit as third preferred option when they applied the technological and economical selection criteria. When they categorized social/cultural/religious criteria, they opted again first for the pour flush, whereas they ranked the single pit together with the double pit and the waterless system as the second preferred option. When applying the environmental and health criteria, the end users preferred

Table 6. End-User Criteria for Selecting Feasible Options for Sanitation Improvements

	Feasible options sanitation improvement				
Criteria	Single pit	Double pit	Waterless system with alternating pit	Pour flush	Ecosan
Technological					
Easy construction					
Safe					
Fits in the area					
Economic					
Cheap to build					
Maintenance costs					
Water costs					
Social/cultural/religious					
Convenient					
Safe					
Accessible					
Environmental					
Contamination					
Natural decomposing					
Little space					
Health					
Hygienic					
Healthy					
Use of water					

the pour flush toilet with the double pit rated as second and the single pit as third preferred option.

Evaluation: Lessons Learned

The Proact 2.0 methodology seems to fit extraordinarily well within the framework of the modernized mixtures approach. Where the modernized mixtures approach focuses on the integration of sociotechnical systems and the relationship with their users in a specific context, Proact 2.0 seems to be capable of closing the gap between technological innovation and user acceptance by identifying various stakeholder groups and making a distinction between these stakeholder groups and their contribution in the different phases of the planning process on sanitary improvements.

The Proact 2.0 methodology proved a useful multicriteria decision analysis method for multiple stakeholder involvement in decision making on sanitation improvement in Katanga. Compared with the original Proact method, two major adaptations made the revised, 2.0 version more realistic and feasible. The first major adjustment was the

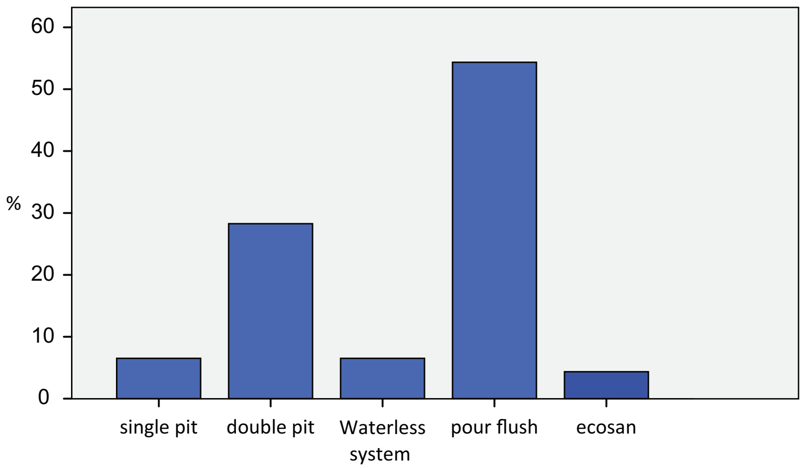

Figure 2. Preferred options for sanitation improvement (in percentages)

insertion of the screening phase, whereby most stakeholder groups were left out due to their limitations in technical expertise when assessing technological innovations. By relying on qualified, independent experts and ensuring sufficient diversity in technological expertise, a lock-in effect, whereby only few alternatives would be considered, was prevented.

The second major adjustment was introduction of the SWOT analysis of the feasible options by the end users only. Considering the consequences of these feasible technical alternatives for sanitation improvement in Katanga proved the most important phase for end-user involvement. Open discussions, where users expressed their considerations and views, resulted in a better understanding among users and between users and policy makers, ultimately helping in better decision making. During this second workshop, only users participated, but in the end they presented and discussed their conclusions to the policy makers at a plenary session. It would have been of more added value if the technical experts and scientist would also have attended this session. The results from the SWOT analysis proved very relevant because disagreements between users and between users and experts often have little to do with the technology per se but rather with the importance of user considerations, such as convenience and religious habits. Increased insights in end-user views allow for a better understanding of why the adoption of a technological improvement in practice differs from what experts expect (and/or hope).

During the trade-off phase, users ranked the feasible sanitation options individually, often only as “best” and “worst” options. Interestingly, there was no visible and identifiable connection with the list of criteria they developed before, so the individual ranking provided little additional information about user views. For example, during the discussion about pour flush toilet systems, the users concluded that a pour flush toilet is an expensive option and not easy to maintain. Still, the individual ranking showed that users ranked the pour flush toilet system as cheap to build and with low maintenance costs. Confronted afterward with their ranking, the users explained that they wanted to make very clear that the pour flush toilet system was their number one choice. After the plenary discussion about the consequences of each option, no new information was brought up. Therefore, user involvement proved most relevant in the phases of problem analysis and of formulating and identifying consequences, whereas technological expertise was crucial in the screening phase.

Conclusions

Current improvements in sanitation facilities for the urban poor are facing a number of challenges, including lack of user acceptance of innovative technologies, but this factor tends to be ignored by technical experts and municipal decision makers. Providing effective sustainable sanitation solutions in slum areas requires, however, in-depth understanding of life and preferences among the inhabitants of these informal settlements. This can best be achieved by engaging the future end users in the decision-making process on improving sanitary infrastructures. Realizing this would result in identifying feasible sanitation options that are more sustainable, more flexible, and more accessible for the poor because technological and social dimensions are combined and end-user expectations taken into account. This article developed Proact 2.0 as a methodological tool to make the participation of different stakeholders feasible and most effective in particular phases of the decision-making process. Compared with other multicriteria decision analysis methods, Proact 2.0 differs because end-user involvement proves most important in the phase of problem analysis and in the phase of the consequences as technological expertise is crucial in the intermediary, screening phase. Proact 2.0 has shown to be a useful method for participatory decision making on improving sanitation facilities because it (a) combines the information, knowledge, and "expertise" from experts, policy makers, and users; (b) balances these various sources of input to ensure that none dominates; and (c) excludes stakeholder groups from phases where they have little to contribute, making the participatory process more efficient and feasible.

Applying Proact 2.0 will result in information gathered from different stakeholders during the different phases of the decision-making process, and this may be expected to contribute to realizing options that will effectively improve the sanitation situation of the urban poor. This is fully in line with the objectives of the modernized mixtures approach, and therefore the Proact 2.0 methodology succeeded in adding the appropriate methodological mixture to the modernized mixtures approach.

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Bios

Astrid Hendriksen is working in the field of research methodology at the Environmental Policy Group, Department of Social Sciences at Wageningen University, Wageningen, the Netherlands.

Judith Tukahirwa is PhD researcher at the Environmental Policy Group. Her research is on the role of nongovernmental organizations and community-based organizations in public–private arrangements in African urban sanitation and waste management.

Peter J. M. Oosterveer is associate professor at the Environmental Policy Group, Department of Social Sciences at Wageningen University.

Arthur P. J. Mol is chair and professor in Environmental Policy, Department of Social Sciences at Wageningen University, director of the Wageningen School of Social Sciences, Wageningen University and professor in Environmental Policy, Renmin University, Beijing, China.