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Exploring Sustainability of Sanitation Systems: Social-Cultural Acceptability Analysis of Technology Options for Kampala's Peri-Urban Areas Using Multi-Criteria Decision Analysis

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Abstract: In a bid to improve peri-urban sanitation, several sanitation interventions using different technological solutions have been tried to replace the common Simple Pit Latrine (SPL), but with limited success due to lack of acceptability of the options by the users. Enhancing acceptability and hence sustainability of excreta management facilities requires an objective consideration of the peri-urban specific social-cultural aspects of service provision (community organisation, culture, settlement and others). Objective measurement of acceptability as a sustainability dimension, however, necessitates a Decision Support Tool (DST) that can link the design based technology attributes (excreta handling required, convenience and others) to the acceptability criterion indicators. As part of an on-going study, this study examines the development of such a DST using Multi-Criteria Decision Analysis (MCDA) techniques. First, the technology options were characterised and then using a case study of Kawempe Division (Kampala city), the field indicators situation and their relative importance (weights) were determined. These variables were then used to assess the acceptability index score of each technology option and its sensitivity to indicator variations using a HIVIEW program-based model. Ironically, model analysis results show that the acceptability index score for the common SPL is quite high (73%) compared to other options (VIP latrine-64%, ecosan systems-58% and non-conventional sewerage-40%). This could partly explain the limited success of the interventions that use these other technology options like the ecological sanitation systems.

Key words: Acceptability, criteria, excreta management, indicator, MCDA, peri-urban, sanitation, sanitation technology, sustainability

INTRODUCTION

Whereas inadequate and improper excreta management is one of the major problems facing Kampala City in general and the peri-urban areas in particular, lack of sustainability of the technological solutions employed presents an even bigger challenge to the sanitation sector managers and planners. The range of options used in the peri-urban areas of Kampala is quite narrow (pit latrines, septic tanks and buvera). About 80% of the people use latrines that are 'filthy due to inappropriate usage, poor construction, filling quickly due to overloading and inappropriate location and therefore unsustainable as sanitation systems in the peri-urban context[1,2]. This challenge has been recognised by various agencies, governments and local and international organisations and several measures have been devised to address it. Goal 7 of the eight Millennium Development Goals (MDGs) as set by the Millennium Declaration of the UN and specifically Target 11 and the Poverty Eradication Action Plan (PEAP) of the government of Uganda stress the importance of this issue. In the Kampala Sanitation Strategy and Master Plan[2] terms of reference, sustainability was clearly stated as the main objective.

Good decision-making during the sanitation technology selection process offers part of the solution to this sustainability challenge[3]. This, however, calls for objectivity, consistency and comprehensiveness in the appraisal process of the available excreta management technologies against the key dimensions of sustainability. The ad hoc and largely subjective approaches currently used in deciding the technological solutions for the peri-urban area interventions cannot lead to sustainable solutions. Available literature indicates that social cultural acceptability is one of the key dimensions of sustainability to be considered[4-6], yet the socio-cultural issues are rarely adequately addressed. Defines sustainable technology as that technology that does not threaten the quantity and quality of the resources, social component inclusive.

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The questions that remain unanswered in the technology selection process, especially for the social component, are how one can assess the performance of the mtechnology options on all the relevant social criteria; and how such performances can be combined into a measurable index reflecting socio-cultural acceptability and hence sustainability[7]. These questions remain unanswered for lack of well-tried and tested tools for measuring sustainability.

This study is a result of an on going study aimed at providing an insight into the sustainability of different excreta management systems for the peri-urban areas of Kampala. The study is focused on the social - cultural part of the non-physical demand drivers or what is commonly referred to as the software aspects[3,8]. This information, when combined with an objective assessment of the technical, financial, legal/institutional and environmental aspects will be used to develop a Decision Support Tool (DST) for exploring the sustainability index of excreta management technological solutions for Kampala peri-urban areas. The MCDA techniques will be used.

STUDY AREA

Thirteen (13) parishes from Kawempe Division, one of the five divisions in Kampala City Council (KCC), which is the political equivalent of Kampala District, was selected for study (Fig. 1). The parishes selected depict the typical peri-urban characteristics of Kampala urban area, namely:Unplanned development, poor environmental sanitation, diverse and mixed developments, prevalent poverty, harsh physical conditions and an apparent neglect by the authorities. The population is characterised by a mixture of high, medium and low-density settlements. The terrain is diverse, ranging from low-lying swamp areas of river valleys, through the gentle slopes of Mbogo Hill, to the relatively steep hills like Makerere. Each parish is divided into several local administrative zones.

Land use in the area is comprised of mixed development, though the areas close to the main roads are mainly commercial while those further away are predominantly residential. The parishes further away from the main economic activity centres like Kikaya, Kawempe I and Kanyanya have a rural character with some agricultural activities. There is some small-scale industrial activity within the commercial areas, but the gazetted industrial area is located further north in Kawempe I Parish and also along Gayaza road at Kanyanya. Generally the area is made up of unplanned developments, deficient in most of the basic urban services like sanitation, drainage, solid waste management and roads. The housing situation is a mixture of shanty temporally structures, semi-permanent units and some isolated permanent ones for the high and middle income classes. The total area under study is about 2,171 hectares (Table 1).

MATERIALS AND METHODS

Data collection: Both desk based study and field surveys were carried out. The aim of the desk based study was twofold, identification and determination of the sustainability criteria and indicators and appreciation and characterisation of the possible technology options. A critical review of the contemporary planning approaches was carried out-Strategic Sanitation Approach-SSA[9] Household Centred Environmental Sanitation-HCES, 2001). Emphasis was put on the post water and sanitation decade (post 1990) era with a focus on how technologies were selected for the peri-urban communities.

Thereafter, a field survey was carried out in the case study area using various instruments, namely: questionnaires, transect walks with field observation, key informant interviews and Focus Group Discussions (FGDs). A general household survey questionnaire was administered to 558 respondents (about 1% of households) using 5 trained research assistants to establish the general sanitation planning context. The questionnaire design was aimed at capturing the general sanitation situation and socio-cultural information concerning community organisation, the concerns and beliefs, perceptions and opinions on the existing excreta management systems and policies and the population characteristics among others. A second questionnaire was administered to various stakeholders (developers, residents, local leaders) with a view of capturing specific information on the socio-cultural sustainability indicators. This questionnaire allowed for in-depth exploration of reasons for some of the conditions and/or behaviour.

A third questionnaire was administered to experts and key stakeholders (10 in total) to establish the importance weights associated to the decision parameters by the decisionmakers. The ranking was used to enlist the importance weight. In depth discussions with key informants (officials) were held both for weighting of decision parameters and information gathering. The key informants included officials from National Water and Sewerage Cooperation (NWSC), KCC [Kampala Urban Sanitation Project-KUSP and Kampala Ecological Sanitation Project], Plan International, Ministry of Health (MoH) and some consultants and experts from Makerere University. Observations and physical measurements of aspects associated with pit latrines (size of pit, height

Fig. 1: Map of kawempe showing population density by parish

above ground for raised pits, distance from residential houses) were done. The socio-economic data analysis was done using a Statistical Package for Social Scientists (SPSS).

Acceptability index assessment: A HIVIEW program-based MCDA model for assessing acceptability index was developed using an analytical study based on 'value focused thinking', a form of multi-criteria analysis technique. Then performances of the options against indicators were established to gauge how well alternative technologies would achieve the objectives/values or overcome the barriers. This was done by judging the favourableness of each option in working in the conditions of the planning context,the state based on literature survey and expert information.

Under given conditions, the acceptability index was determined by evaluating the function below using the HIVIEW program based MCDA model based on linear additiveness assumptions[10,11].

Socio-Cultural Acceptability (SCA):

$$= f(aI_{s1}, bI_{s2}, \dots, nI_{sn})$$
$$= aI_1 + bI_2 + \dots + nI_n$$

Where: a, b, …, n are the relative sub-criteria weights associated to the different indicators and $I_{11}, \dots I_{2n}; I_3, \dots, I_n$, are the indicator- scores. (Indicator is a lower order criterion)

RESULTS AND DISCUSSION

Desk based survey

Social/Cultural indicators: The main concern regarding social-cultural issues is the practices that influence the design of the 'social' components of a sanitation system such that its acceptability or 'fit' within a community is ensured. It relates to the cultural and behavioural implications of the society in which the system operates[9]: thus acceptability (social-cultural 'fit') is the higher-level socio-cultural criterion in sanitation planning[12]. However, for effective and objective decision-making, that criterion was operationalised by breaking it down into sub-criteria (indicators) [any variable/component of the sanitation system used to infer the status of a particular criterion[7,13]. From various researches and current sanitation planning approaches aimed at enhancing sustainability and using a top-down approach, the important social/cultural indicators were grouped under three sub-criteria as given in the decision tree in Fig. 2. Their description and unit of measurement are given in the HIVIEW model constructed.

The selection of the indicators was done with a focus on measurement of sustainability at the household and immediate neighbourhood level. Thus factors external to this were left out like efficiency of implementing agencies. The indicators also reflect the critical social/cultural issues that affect the effective and efficient operation of sanitation systems in Kampala peri-urban areas. An assessment of the relative performance of the different technologies against each of these indicators in a given planning context, gives an insight into the level of acceptability of that option and therefore an indication of the relative sustainability level expected. These indicators were viewed as mutually preference independent[11,12].

Technology characterisation: Technology characterisation involved development of a detailed

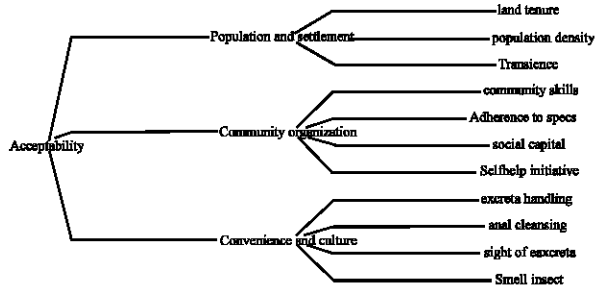


Fig. 2: Decision tree for social-cultural acceptability

description of each technology to reflect its expected performance (sanitation consequence) according to its design attributes in relation to the decision indicators. This helped to show how options differ from one another in the ways that matter as required of an MCDA analysis[12]. For effective characterisation, it was also recognised that a complete excreta management process for an area involves five important stages, namely, defecation/deposition requiring a receptor device, collection, treatment, disposal and resource reuse or recycling[13]. These stages may be accomplished using one technology or a combination of separate technologies depending on the design, situation and scale of operation. Thus some options were given as a combination of more than one technology.

For the social cultural sustainability dimension, the characterisation of the likely workable technologies for the Kampala peri-urban areas, according to the different stages of the excreta management process, is given in Table 2. The table gives the technologies for the receptor and the collection stages, which were the focus of this study.

Field Results

Field indicator situation: Data was collected from the case study area (13 parishes in Kawempe Division) in order that the planning context situation (the state) could be established along the social-cultural sustainability indicators as given in decision tree in Fig. 2. Table 3 gives the summary of the contextual findings according to the analysis of the information got from the field regarding each decision parameter.

The degree of favourableness was determined by judging the likelihood of an option's being able to work in the observed state based on the known design attributes of the technology option (as given by the DBASTs) and its performance in similar settings else where in the world.

Weighting of criteria and indicators: The results of the responses from four experts and six key stakeholders regarding the importance weight associated with the

Table 1: Population and household data in selected parishes-Kawempe division

	Area	No.	Population		Density	Household		
Parish	(ha)	Households	Male	Female	Total	per/ha	size	1% hh
Makerere II	88.100	3.743	6.159	6.295	12.454	141	3.3	37
Mulago III	91.500	3.845	7.095	7.116	14.211	155	3.7	38
Mulago II	57.600	4.071	7.049	7.236	14.285	248	3.5	41
Makerere I	70.600	1.899	3.442	3.503	6.9450	98	3.7	19
Bwaise III	72.200	3.001	5.055	5.840	10.895	151	3.6	30
Makerere III	70.300	4.104	6.792	7.546	14.338	204	3.5	41
Bwaise II	99.200	4.387	7.787	9.042	16.829	170	3.8	44
Bwaise I	120.70	4.092	9.248	9.740	18.988	157	4.6	41
Kyebando	295.60	8.540	16.311	17.419	33.730	114	3.9	85
Kikaaya	411.00	3.489	7.006	7.592	14.598	36	4.2	35
Kanyanya	272.50	4.685	9.023	10.035	19.058	70	4.1	47
Kawempe I	349.00	8.526	16.728	18.716	35.444	102	4.2	85
Kazo-Angola	173.10	3.961	7.125	7.8390	14.964	86	3.8	40
Total	2.171.4	58.343	108.820	117.919	226.739	104		583

(Source: Kawempe division development plan 2003/4-2005/6)

Table 2: Expected technology performance according to design attributes

	Socio-cultural Indicators										
	Convenience/ culture				Community organisation /attitudes				Population/ settlement		
	Smell/insect nuisance	Faecophillic support	Anal cleansing sensitivity	Sight of excreta	Self-help possibility	Adherence to specs sensitivity	Social capital required	Community skills required	Land tenure formality needed	Transience sensitivity	Population density served
Technology	1	2	3	4	5	6	7	8	9	10	11
Receptor device											
Simple pit latrines (SPL)	5	3	1	3	5	1	1	1	1	1	1
VIP latrine (VIP)	5	4	1	3	3	3	1	1	1	1	1
Aquaprivy (AP)	4	5	2	3	3	3	1	2	2	2	2
Ecosan dry (Esdry)	1	5	5	2	3	5	4	2	2	2	2
Ecosan wet (Eswet)	2	5	4	2	3	5	4	2	2	2	2
Pour flush toilet (PF)	1	3	4	2	3	4	2	2	2	2	2
Collection device											
Vault / cartage (VC)	4	5	2	4	3	3	2	2	2	2	2
Septic Tank (STK)	3	5	3	3	1	3	2	3	2	2	2
Settled sewerage (STS)	1	2	3	3	2	5	3	4	3	4	3
Simplified Sewerage (SS/C)	1	2	3	2	1	5	3	4	3	4	3
Conventional sewerage (CS)	1	1	3	1	1	4	5	5	3	4	4

[Source: Extracted from SANEX 2002; Kalbermatten et al, 1982]
Key to performance rating: 5- very high, 4- high, 3- medium, 2- low, 1 – very low; 0 – not applicable

criteria and indicators and those from the community are given in Table 4. Information from the experts and key stakeholders was combined with that from the community that was generated through the FGDs held. The results show that the social-cultural issues were considered to be the least important (18%) of the dimensions of sustainability. The relative normalised weights were converted to cumulative weights by the model (last column in Table 3), which in this study is similar to the second last column because this was a small model. Cumulative weight gives the overall weight contribution of the criterion to the whole model[11,14].

From the ranking of the indicators, it was evident that almost all the 11 indicators matter, as shown by the Combined Normalised Weight (CNWt) of the rankings (ranging from 5 to 11%). Social capital was the least important (5%), but all the others scored 7-11%. The most important were faecophilic tendencies, community skills and transience with 11% each.

Model output: The Hiview model was used to analyse the information captured regarding the degree of favourableness, under the basic assumptions of linear additiveness of the scores. The inputs to the model were degree of favourableness score of each option on the decision elements and the combined normalised weight associated with each decision element at the different levels[11].

Option scores against the indicators: The field findings as summarised in Table 3 were linked to the socio-cultural indicators and the technology design attributes in Table 2 such that the expected performance of each option could be determined for each indicator along a degree of favourableness scale. The direct measurement technique was used[11,14]. The score of each option on the indicator was determined by guided qualitative judgement on how favourably the option under question was likely to perform using a six point scale inserted in the constructed HIVIEW model as a drop down menu. The option's score against each indicator was judged as the level of favourableness of its performance under the conditions in Table 3. These scores were converted into preference values by a discrete value function (inbuilt in

Table 3: Field preferences/conditions observed (state)

Indicator	Field preference or condition observed	Technology choice implication: Favoured	Unfavoured
Smell/insect nuisance	Manifested as very serious concern for majority (68%). Desire to have odourless insect-free facility high; try to find local solutions by smoking or use chemicals.	AP, PF, All sewerage, Ecosan dry, Ecosan wet	SPL, Vault
Sight of excreta sensitivity	Strongly resented by majority. Expressed discomfort with sight of other people's excreta other than own child.	PF,	SPL, AP, vault, ecosan dry/wet
Anal cleansing method	Wipers mostly using any soft paper other than toilet paper (64%). Most of them happy with habit.	SPL, AP, Vault	PF, STK, all sewerage, ecosan dry/wet
Excreta handling sensitivity	Faecophobic mostly (73%). Majority very reluctant to handle human excreta.	all sewerage	SPL, AP, PF, vault, STK, Ecosan dry/wet
Self-help initiative	Majority initiate and provide most of the inputs within their means. Little support is expected from outside	SPL, AP, PF, vault, ecosan dry/wet	STK, all sewerage
Adherence to design specifications	Majority rarely follow design specifications and many do not take trouble to know	SPL, Vault	AP, PF, all sewerage, ecosan dry/wet
Community skills availability (capacity)	Very low (70% secondary education or less, 82% no upgrade knowledge). Therefore some skills available, but not for advanced systems.	SPL, AP, PF, Vault	STK, All sewerage
Social capital level required	Very low indeed, organising beyond household very hard. Some local cooperation in form of CBOs, but largely informal and not binding to many	SPL, AP, PF, Vault,	All sewerage, ecosan dry/wet
Security of land tenure	Most developments lack formal land titles, but recognised by local authority, local leaders.	SPL, AP, PF, Vault	STK, all sewerage
Transience characteristics	High, majority of people indicated possibility of moving (57%). Many are certain to move when resources permit	SPL, AP, PF, Vault, ecosan dry/wet	All sewerage, STK
Population density	High for most parishes (9 out of 13) [102-248 persons per ha]	All sewerage, STK,	PL, AP, PF

Table 4: Summary of weightings of criteria/indicators by experts and community representatives

Main sustainability criteria: Criterion	R Wt	Social-cultural sub-criteria: Sub-criterion	Social-cultural indicators: Indicator	ANRE	ARNC	C N Wt	C Wt
C1-Social-cultural	18	Community/culture	Smell/insect nuisance	8	11	10	10
C2- Legal/Institutional	25		faecophobic tendency	11	11	11	11
C3- Technical appropriateness	32		sight of excreta	10	8	9	9
C4-Affordability	25		Anal cleansing	11	10	10	10
Total	100	Community organisation	Self-help initiatives	11	8	9	9
			Adherence to specs	4	10	7	7
			Social capital	7	3	5	5
			Community skills	11	11	11	11
		Population and settlement	Land tenure	8	9	9	9
			Transience	11	11	11	11
			Population density	8	8	8	8
		Total	Total	100	100	100	100

(C Wt-cumulative weight, CNWt-combined normalized weight; ANRE-average normalised ranking experts; ANRC-average normalized ranking community)

the model). For the options that lie in between the most suitable and least suitable, a linear function relationship was assumed[10]. This analysis could be done for the entire area or a portion of it, say a parish.

Acceptability level index: The acceptability level index was defined as a measure of the social-cultural 'fit' of the technology option within a given social setting. For each technology option, it is the weighted average overall score on all the socio-cultural indicators. It was determined by getting the scores of each technology option on each indicator multiplied by the cumulative weight of the criteria and then summing the products using the formula acceptability index assessment. The results as computed by the HIVIEW model are in Fig. 3.

The technology option with the highest acceptability index score among the defecation devices was the Simple Pit Latrine (SPL) at 73% followed by the VIP latrine 64%, while the vault performs worst (41%). For the collection technologies, the Septic Tank (STK) performs best with 44% but the other options follow closely-vault and conventional sewerage at 41% and non-conventional

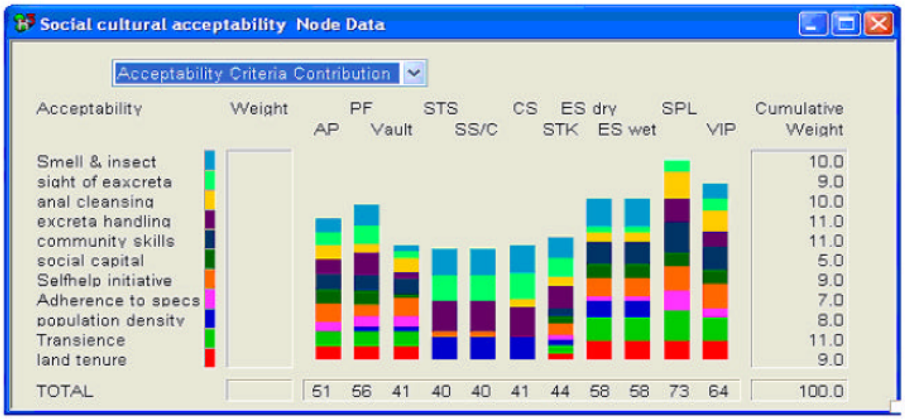
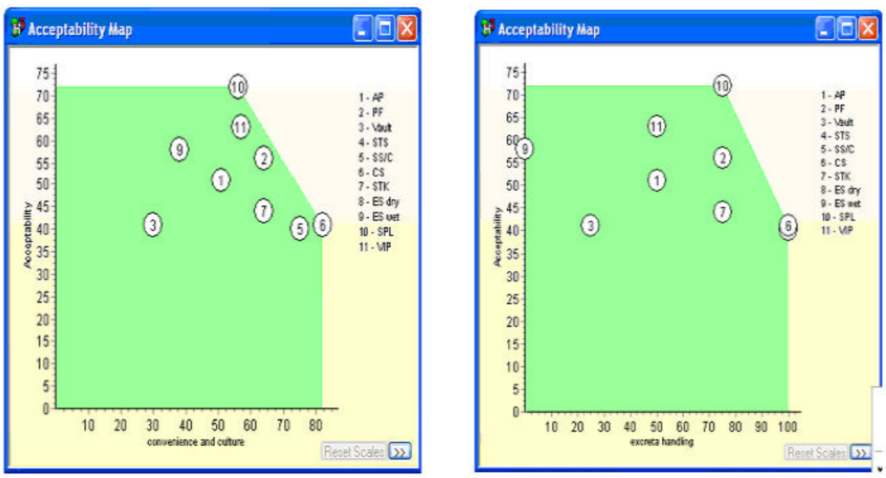


Fig. 3: Acceptability index for technology options



(a) (b)

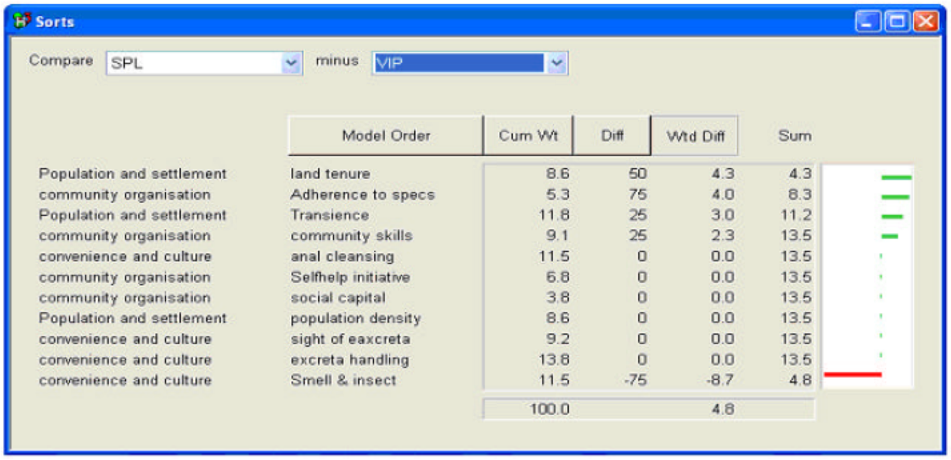
Fig. 4a: Mapping for convenience and culture against acceptability, Mapping for excreta handling against acceptability

sewerage systems (STS and SS/C) at 40%. The results from the model analysis concur with the recommendations of the KSMP (2004) recommendations, namely that shared/communal latrines were for the moment the most suitable for the densely populated areas. In the more stable communities, they recommend low cost sewerage system that could later be upgraded to conventional sewerage.

Further analysis of the model results: The results were further analysis for sensitivity to examine the robustness of the same and also cater for uncertainty of the variables. The three tools available within Hiview program were used, namely mapping, sorts and sensitivity analysis[14].

Mapping: Mapping allows the plotting of the values for any node or criterion against any other[14]. In the model developed, the maps were generated for the sub-criteria nodes and also for some criteria. In all the plotted cases, it was confirmed that the SPL was the most 'acceptable' option given the existing states. The maps also showed the options that were dominated by others on each criterion or sub-criteria using the efficient frontier concept. Two of such maps given in Fig, 4a and 4b show that regarding culture and convenience, SPL and the sewerage systems (CS, STS and SS/C) dominate the other options. This is because the favourableness score for these options on the criteria smell and insect nuisance, excreta handling and sight of excreta were high.

Sorts analysis: In the model developed, the sorts analysis allows the decision maker to compare the performance of any two options on each of the criteria and to examine the strengths and weaknesses of any option. It is an exploration of differences between options and can thus stimulate creative thinking on what positive interventions could be made to achieve the desired goal of the objective function, in this study, enhancing acceptability of an



Sorts

Compare SPL minus VIP

	Model Order	Cum Wt	Diff	Wtd Diff	Sum
Population and settlement	land tenure	8.6	50	4.3	4.3
community organisation	Adherence to specs	5.3	75	4.0	8.3
Population and settlement	Transience	11.8	25	3.0	11.2
community organisation	community skills	9.1	25	2.3	13.5
convenience and culture	anal cleansing	11.5	0	0.0	13.5
community organisation	Selfhelp initiative	6.8	0	0.0	13.5
community organisation	social capital	3.8	0	0.0	13.5
Population and settlement	population density	8.6	0	0.0	13.5
convenience and culture	sight of eaxcreta	9.2	0	0.0	13.5
convenience and culture	excreta handling	13.8	0	0.0	13.5
convenience and culture	Smell & insect	11.5	-75	-8.7	4.8
		100.0		4.8	

Fig. 5: Comparison of SPL and VIP

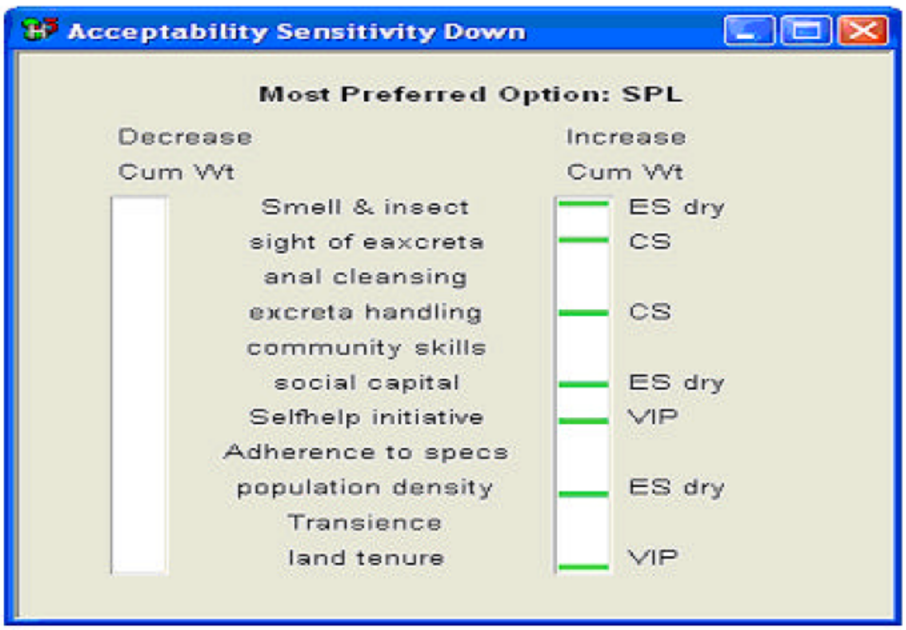


Fig. 6: Sensitivity down for acceptability index

otherwise poorly acceptable option. This tool thus informs the decision making process and therefore allows the decision makers to make the most desired decision and not necessarily the best by objectively considering trade-offs that can be made.

Figure 5 gives the comparison between Simple Pit Latrine (SPL) and the VIP latrine. It shows that SPL performs better than VIP on land tenure, adherence to specifications and transience. The later on the other hand does better on smell and insect nuisance only. The two options almost tie on the other indicators and their weighted score difference is 4.8. The FGDs held confirms this conclusion because most respondents who used the VIP latrine gave reduced smell as the main reason for choosing the VIP latrine. A similar analysis for the SPL and the ecosan dehydrating option (ESdry) shows that the former performs better on excreta handling, anal cleansing, adherence to specs, community skills and transience. The ecosan is better regarding insect nuisance and smell and population density.

The analysis of SPL option strengths gives community skills, transience, anal cleansing and excreta handling as the main ones. The main weaknesses were smell and insect nuisance and population density. Examination of the intermediate nodal scores showed that strengths were given by high scores on highly weighted criteria. This could partly explain the difficulty promotion of the Ecosan project for the peri-urban areas has encountered, given that the promotion was supposed to make the community abandon the traditional SPL and use

Fig. 6a: Smell and insect nuisance sensitivity up analysis

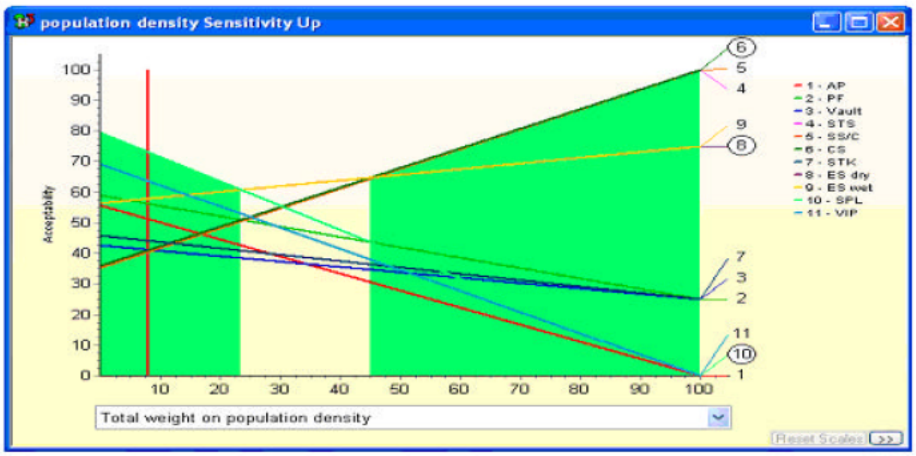


Fig. 6b: Population density sensitivity up analysis

the ecosan system, yet the former seems to have more advantages for the peri-urban planning context. The intervention would require effective consideration of the weaknesses of ESdry, namely faecophobism, anal cleansing habits, adherence to specifications of usage and sight of excreta (given by sorts analysis) in form of effective sensitisation.

Sensitivity analysis: Sensitivity analysis highlights areas in the model that would influence the overall preference ordering of the options in achieving the desired objective, in this study socio-cultural acceptability and hence operational sustainability. It is used to examine the extent to which differences of opinion and vagueness in scoring and weighting leave the overall ordering of the options unchanged. It also allows for consideration of variability in the state. This is one of the strengths of the MCDA approach to decision making[11], namely that even with a weak information base, analysis can proceed and later subject the result to extensive sensitivity analysis to identify sensitive areas.

Sensitivity down: The Sensitivity Down function allows for the display of a summary of the weight sensitivity for all the criteria below the selected node in the decision tree and it is most helpful to display this information for the root node (acceptability index in this study) in order to get a summary of sensitivity throughout the whole model. This function calculates/gives which criterion/indicator weights are sensitive; how much change leads to new preferred option; and what the new preferred option becomes. In the model, colour codes show the changes: red very sensitive (<5 points), yellow-less sensitive (5-15 points) and green-rather insensitive (>15 points).

The goal sensitivity analysis at the acceptability index level showed that the SPL remains the most acceptable option for defecation stage unless there is a large increase in the cumulative weight of most of the indicators (shown by green bar): Land tenure, self-help initiative, population density, social capital, excreta handling habits, sight of excreta and smell and insect nuisance. The preference would mainly change to ESdry (Ecosan Dry). This result concurs with the findings of KSMP[2] where most residents in peri-urban area preferred ecosan toilets for convenience and other social reasons. However, no amount of change in cumulative weight would cause change of preference for the anal cleansing habits, community skills and adherence to specifications because these were the major strengths of this option compared to the others. This observation is important for Kampala peri-urban sanitation planning given that the state along these indicators is likely to remain unchanged for a long time[2]. If sanitation improvement is to be achieved using options other than SPL, then effective promotion measures may have to be taken to address these decision elements in the social setting to enhance acceptability.

Sensitivity up: The Sensitivity Up tool helps to display, in graphic form, the sensitivity of the overall results to a change in the weight of a selected criterion or node over the entire range of 0 to 100. The graph demonstrates how the overall weighted preference values for all the options vary with the cumulative weight on the selected criterion/node. For instance, Fig. 6a shows that ecosan options would become the most acceptable at a cumulative weight slightly above 20. The analysis for the population density criterion was more interesting. The most acceptable option changes from SPL to ecosan systems at a cumulative weight slightly above 20, but at about 45% cumulative weight, the preference becomes sewerage systems (Fig. 6b). This is again in agreement with the proposal by the KSMP[2]. Senility up analysis of other indicators confirms the big increase in cumulative weight required to change the preferred option from SPL to others as observed in the sensitivity down analysis.

CONCLUSION

- For Kawempe peri-urban area, when all current social-cultural decision parameters pertaining to the sanitation system are considered using the MCDA model analysis, the simple pit latrine (SPL) is the option with the highest relative acceptability index (73%) followed by VIP latrines (61%) for defecation stage.
- Sensitivity analysis of the results further showed that the SPL remains the dominant option under a wide range of weight variations, which implies that great effort was required to address the weaknesses of the other options to successfully promote them to an acceptable level equal to or better than that of the SPL.
- Promotion of ecosan systems is the immediate more viable alternative to the SPL as indicated by the sensitivity analysis in Figure 6b, considering population density and smell and insect nuisance as important factors.

RECOMMENDATION

- The viability of SPL as the excreta management option for the peri-urban areas is questionable on health and environmental grounds, despite its being the most acceptable under the current social cultural context. Great effort has to be made in form of sensitisation, capacity building (skills development) and social mobilisation (social capital development) such that acceptability of the other options like ecosan and sewerage systems could be enhanced.
- Kampala peri-urban area should be divided into sanitation zones based on the prevailing socio-cultural characteristics of each sanitation area. Then using this DST, an insight into the acceptability levels of the different technology options could be assessed, weaknesses and strengths against the relevant criteria identified and appropriate intervention measures employed. This would inform the decision making process in a comprehensive and objective manner.

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