EVALUATING ECOLOGICAL SANITATION - A SOCIOTECHNICAL APPROACH

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Introduction

At least half of the population of the world has no access to proper sanitation, and the trend is that the number of unserved people is increasing. A key sanitation element is the safe disposal and treatment of human excrement. Feces are the principal carrier of pathogens and contain few nutrients, urine is relatively free of pathogens in healthy people and contains most of excremental nutrients. How are the numerous ecological systems evaluated? The success of any sanitation system meeting its goals. Here we investigate ecological sanitation as solution to at least parts of these problems by systematically presenting technical, economical and sociocultural issues in order to evaluate by screeing.

Toilet/handling systems

Ecological toilet systems/material handling can be devided in dehydration toilets, composting toilets, pit latrines and digesters (polyethylen biogas digesters).

Urine contains about 95% water and feces about 80% water. Most of the nitrogen, phosphorus and potassium is contained in the urine, whereas the organic matter (mostly carbon) is contained in the feces.

Table 1. Mean nutrient content (%) in human excreta and nightsoil [a]

	Urine	Feces
Nitrogen (N)	88	12
Phosphorous (P)	67	33
Potassium (K)	71	29
Organic matter [b]	50	50
Carbon (C)	25	75

[a] % of total nutrient content [b] the amount of organic matter in urine equals that of feces due to the large amount of urinal urea

Important excreted pathogens are viruses, bacteria, protozoa and helminths and their associated diseases. All of these diseases are endemic in many areas of tropical countries, but prevalence varies depending on region, continent, type of settlement (rural, urban), climate and other factors such as agricultural practice, eating habits, culture and society.

The health risk of excrement is generally reduced when the waste is kept in a as small volume as possible. This means that mixing of human waste with water contributes to a spreading of the pathogens.

Table 2. Optimal process factors*

Factor	**Compost toilet**	**Dehydration toilet**	**Pit latrine**
Water content	25-70%	<25%	<70% ?
Temperature	>0ºC: biological activity >42 ºC: pathogen removal by heat	> 0 ºC	> 0 ºC

pH	6-8	>9	No limits
C/N-ratio	20-30	No limits	No limits
Storage time **	>6 months, or when hygienic	>6 months, or when hygienic	> 1 year
Additives needed	Yes	Yes	No

* Factors in process chamber ** Measured from when the tank is full

Table 3 Other factors describing toilet systems

	Compost toilet	**Dehydration toilet**	**Pit latrine**	**Urine diversion**
Volumes	Large-small	Medium-small	large	Large-small
Climate*	No demands, but special design may be needed if very humid or very cold	Temperate to warm arid to humid	Above 0ºC	Above 0ºC **
Odor nuisance	Low-high	Low-high	High	Positive effect on odors
Pathogen control	High if working ok	High if working ok	Low	Positive effect on pathogen removal
Complexity in operation & maint.	High, training should be considered	Medium, training is required	Low	Low
Ground water level	No demands, but secure against flood	No demands, but secure against flood	Continuously below pit level	

* ambient ** can be used below zero with some technical precations

Culture

Culture plays an important role in the evaluation process because it influences the acceptance (or rejection) of a sanitation system. This does not imply that cultural patterns are immutable and improved technologies should be designed around a fixed set of beliefs; rather, that culture influences behavioral change. The following section identifies three cultural influences that affect the acceptance (or rejection) of an alternative sanitation system: psychology, gender, and religion.

Economy

The costs for ecological sanitation is lower than for conventional sanitation (Winblad et al., 1998). This is particularly important for developing countries where public institutions face stringent financial limits. Sanitation projects can financially either be externally supplied or self-supportive, or a combination of both. They can focus on the number of people being served for the money (cost/benefit), on internal economical or political aspects of the supplant (i.e. recycling a portion of the supplied finances), or also on economical and political aspects of the receiving part (i.e. favoring groups of people). Projects can have components of all 3 of these aspects but from a viewpoint of solving the sanitary problems at hand the cost-benefit should be the option with priority.

Existing reports on economy imply that costs of sanitation vary from basically free systems that impose large risks for pollution, to about USD 100 or more for one household system of acceptable quality, depending on a number of factors.

Conclusions and recommendations

Based on the characteristics of ecological sanitation defined in this and other projects, it is concluded that composting toilets, dehydration toilets and in some cases, pit latrines meets the criteria for ecological sanitation, see below.