



Criteria for the assessment of sanitation technologies

by ttz, TUHH and NETSSAF consortium. Deliverable D04

NETSSAF Coordination Action



Project supported by the European Union under the 6th Framework Programme
 Start date: 1st of October 2006
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The following table contains a set of identified criteria sorted according to different aspects considered critical when using a holistic approach to assess sanitation systems. These include (1) health criterion, (2) environmental and resource criteria, (3) technical and operational criteria, (4) financial and economical criteria, (5) social, cultural and gender criteria. The objective is to include a comprehensive list of evaluation criteria to provide the decision makers with a complete overview of the existing aspects of sanitation systems.

The starting point for the development of the criteria was the list proposed by Bracken et al. (2004), in which five criteria were proposed as an expansion of the conventional triple bottom line usually accepted as the three pillars of sustainability –economy, society and the environment (Panesar et al., 2006).

For the purposes of this document, each criterion is accompanied by simple and easily interpretable indicator. The indicators will allow the planners and end-users to describe the technical, social, financial requirements as well as the impacts and the benefits obtained by the application of a sanitation system.

When dealing with a measurable aspect, for instance energy required, a measurement will be chosen with an appropriate unit. In this case, the planners will be able to evaluate different sanitation systems by comparing the value of the measurements. For instance, land required by system A is equal to 1,0 m²/pe, which is less than the land required by system B (1,2 m²/pe). To ensure that all relevant aspects of a sanitation system are covered, qualitative evaluation has been suggested as methodology to evaluate those indicators, which cannot be expressed quantitatively.

The final choice of sanitation system to be implemented will be the decision of the users and planners who will select from the given set of criteria, those parameters relevant to their community's profile. Furthermore, it is open for the decision makers to select a rating system that better suits their local framework.

Table 1.-Criteria for the assessment of sanitation systems

Health issues	
The risk of exposure to pathogens and non-pathogenic substances, that could infect members of communities, is classified in different groups according to the mode of contact. The degree of sanitation achieved by the sanitation technology is also considered in this section, assumed as an additional factor in health issues. This group of criteria also includes the health benefits; including hygiene, nutrition and improvement of livelihood achieved by the application of a certain sanitation technology. For details refer to section A.1.	
Criteria	Indicator for characterisation
<i>Exposure to pathogens and risk of infection related to all system elements including collection, transportation, treatment, reuse and final destination of products / wastes.</i>	
<ul style="list-style-type: none"> For communities of users and consumers 	Qualitative evaluation
<ul style="list-style-type: none"> For operators of the sanitation system 	Qualitative evaluation
<i>Health benefits due to food production, nutrition status, livelihood</i>	Qualitative description





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Impact to the Environment/Nature

This set of criteria involves the required natural resources for construction and running of the sanitation system, as well as the potential emissions to the environment (water, air and soil) that could result from the use of such systems. It also includes the potential gained benefits from reusing material, contributing to the cycle of nutrients and water. For more details on impact to the environmental, refer to section A.2.

Criteria	Indicator for characterisation
Use of natural resources – Construction:	
• Land	m ² /pe
• Energy	MJ/pe
• Construction materials	type and quantity
Use of natural resources- Operation and Maintenance (O&M):	
• Land	m ² /pe/yr
• Construction materials	type and quantity
• Energy from renewable resources	MJ/pe/yr
• Energy from non-renewable resources	MJ/pe/yr
• Total use on non-renewable resources	Non-renewable resource units
• Fresh water	m ³ /pe/yr
• Precipitation agents or other chemicals	Type and quantity/pe/yr
Emissions to the environment:	
- Discharge to surface water	
• BOD	g of BOD/pe/yr
• COD	g of COD/pe/yr
• Nutrients	g of N/pe/yr
	g of P/pe/yr
• Hazardous substances: heavy metals, persistent organic compounds, antibiotics/medical residues, natural and synthetic hormones	mg of Cd/pe/yr
	mg of Cu /pe/yr
	mg of Ni /pe/yr
	mg of Pb /pe/yr
	mg of Zn /pe/yr
	mg of Hg /pe/yr
	mg of Cr /pe/yr





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Criteria	Indicator for characterisation
	mg/pe/yr of persistent organic compound
	mg/pe/yr pharmaceutical residues
	mg/pe/yr hormonal substances
<ul style="list-style-type: none"> Salts 	g/pe/yr of NaCl
- Discharge to groundwater	
<ul style="list-style-type: none"> BOD 	g of BOD/pe/yr
<ul style="list-style-type: none"> COD 	g of COD/pe/yr
<ul style="list-style-type: none"> Nutrients 	g of N/pe/yr
	g of P/pe/yr
<ul style="list-style-type: none"> Hazardous substances: heavy metals, persistent organic compounds, antibiotics/medical residues, natural and synthetic hormones 	mg of Cd/pe/yr
	mg of Cu /pe/yr
	mg of Ni /pe/yr
	mg of Pb /pe/yr
	mg of Zn /pe/yr
	mg of Hg /pe/yr
	mg of Cr /pe/yr
	mg/pe/yr of persistent organic compound
	mg/pe/yr pharmaceutical residues
	mg/pe/yr hormonal substances
<ul style="list-style-type: none"> Salts 	g/pe/yr of NaCl
- Emissions to the air	
<ul style="list-style-type: none"> Emissions of climatic relevant gases (e.g. CO₂, CH₄, GHGs, etc) 	kg of CO ₂ equivalent/pe/yr
<ul style="list-style-type: none"> Emissions of acidifying gases (e.g. NH₃, SO₂ etc) 	kg mole of H ⁺ equivalent/pe/yr
Resources recovered	
<ul style="list-style-type: none"> Mass 	g/pe/yr of weight for each recovered product
<ul style="list-style-type: none"> Nutrients 	g/pe/yr of N
	g/pe/yr of P





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Criteria	Indicator for characterisation
	g/kg of S
	g/pe/yr of K
<ul style="list-style-type: none"> Energy 	MJ/pe/yr
<ul style="list-style-type: none"> Organic material 	g of total organic matter/pe/yr
<ul style="list-style-type: none"> Quality of recycled products (released to soil): heavy metals, persistent organic compounds, pharmaceutical residues hormones, etc. 	mg/pe/yr of persistent organic compound
	mg/pe/yr pharmaceutical
	mg/pe/yr hormonal substances
	mg of Cd/pe/yr
	mg of Cu /pe/yr
	mg of Ni /pe/yr
	mg of Pb /pe/yr
	mg of Zn /pe/yr
	mg of Hg /pe/yr
	mg of Cr /pe/yr
<ul style="list-style-type: none"> Area of common staple crop that can be fertilised 	m ² /pe
<ul style="list-style-type: none"> Water 	m ³ /pe/yr
<ul style="list-style-type: none"> Area of common staple crop that can be irrigated 	m ² /pe
<i>Accumulation of environmental burden in landfill</i>	
<ul style="list-style-type: none"> Nutrients 	g/pe/yr of N
	g/pe/yr of P
<ul style="list-style-type: none"> Organic material 	g/pe/yr
<ul style="list-style-type: none"> Estimated cumulative production of green house gases (CH₄, N₂O etc.) 	kg of CO ₂ equivalent/pe/yr
<ul style="list-style-type: none"> Hazardous substances: heavy metals, persistent organic compounds, antibiotics/medical residues, hormones 	mg/pe/yr of respective substance
<ul style="list-style-type: none"> Water (increases risk of leachate formation) 	m ³ /pe/yr
<ul style="list-style-type: none"> Volume on landfill 	m ³ /pe/yr





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Technical characteristics of the sanitation system and its operation

This set of criteria includes the technical characteristics of a sanitation system regarding the functionality and the ease with which the system can be constructed, operated and monitored by the own members of a community. Furthermore, it evaluates the robustness of the systems and the adaptability of its technical elements to the existing infrastructure. For details refer to section A.3.

Criteria	Indicator
Construction	
• System robustness	Qualitative description
• Robustness against drought, flooding, earthquake etc.	Qualitative description
• Possibility to use local competence for construction	Qualitative description
• Durability / lifetime	Yrs
• Compatibility with existing system	Qualitative description
• Flexibility / adaptability (to urban development, population growth etc)	Qualitative description
• Complexity of construction	Qualitative description
• Need of large scale infrastructure	Qualitative description
O&M	
• System robustness: risk of failure, effect of failure	Qualitative description
• Robustness to use of system: shock loads, effects of abuse of system	Qualitative description
• Availability of spare parts, parts for maintenance, etc.	Qualitative description
• Possibility to use local competence for O&M	Qualitative description
• Ease of system monitoring	Qualitative description
• Need of large scale infrastructure for operation	Qualitative description
• Complexity of O&M	Qualitative description



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Economical and Financial Issues

The economical and financial issues are related to the capacity of the communities to pay for the sanitation service, including both the construction of the facilities and maintenance of the system. This set of criteria also includes the economic benefits that could be obtained through the application of a sanitation system, including employment creation and enterprise possibility. For details refer to section A.4.

Criteria	Indicator
Construction	
• Input of own resources and labour in construction	Hours and quantities/pe
• Initial costs/ construction costs, total and annual costs	Costs/pe and cost/pe/yr
Operation and Maintenance	
• Annual costs for operation and maintenance	Cost/pe/yr
• Input of own resources and labour in operation and maintenance	Hours and quantities/pe/yr
Local economy	
• Employment creation	Number
• Business and income generation, enterprise possibility	Qualitative or quantitative
• Benefits from reuse	Generated income/pe/yr or increased production in kind/pe/yr
• Environmental and health costs	Cost/pe/yr or qualitative





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Social, cultural and gender aspects

The social, cultural aspects and gender aspects refer to "soft criteria", which are of utmost importance but difficult to evaluate. The criteria in this category shall evaluate the acceptance and appropriateness of the system, legal and institutional requirements, convenience, system perception and gender issues. For details refer to section A.5.

Criteria	Indicator	
<ul style="list-style-type: none"> Acceptance by the users/social acceptability 	Qualitative evaluation	
<ul style="list-style-type: none"> Willingness to contribute through work and or money for sanitation services (% of available income) 	Qualitative evaluation	
<ul style="list-style-type: none"> Convenience 	- comfort	Qualitative evaluation
	- personal security	Qualitative evaluation
	- privacy/dignity	Qualitative evaluation
	- smell	Qualitative evaluation
	- noise	Qualitative evaluation
	- attractiveness/ status	Qualitative evaluation
	- adaptability to needs of different age and handicapped, gender and income groups	Qualitative evaluation
<ul style="list-style-type: none"> Current and foreseen legal acceptability and institutional compatibility 	Qualitative evaluation	
<ul style="list-style-type: none"> Appropriateness to current local cultural context (acceptable to use and maintain) 	Qualitative evaluation	
<ul style="list-style-type: none"> System perception (complexity, compatibility, observability – including aspects of reuse) 	Qualitative evaluation	
<ul style="list-style-type: none"> Ability to address awareness and information needs 	Qualitative evaluation	
<ul style="list-style-type: none"> Positive/negative impact to women, children and elderly. 	Qualitative evaluation	



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