Contribution of Dry Sanitation to the MDGs and a Sustainable Development

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ABSTRACT

At present 2.6 billion people of the world's population have no access to adequate sanitation. The MDGs aim to halve the number of people without basic sanitation until the year 2015. The MDGs imply that sanitation technologies should agree with the principles of a sustainable development. Thus the "integrative concept of sustainable development" of the German Helmholtz Association (HGF) is applied to bring out the role of dry sanitation within a sustainable development. In contrast to other approaches using the ecological, economic and social pillars as frame for sustainable development, the integrative HGF-concept emanates from three constitutive elements: intra- and intergenerational justice, global perspective and anthropogenic view. This paper emphasizes the socio-cultural aspects of dry sanitation.

Millennium Development Goals

In September 2000, the leaders of 150 countries adopted the millennium declaration to attain a better and safer world for the twenty-first century. The overriding concern was to improve the situation of people living in extreme poverty. The summit identified eight development goals that need to be attained by the year 2015, the Millennium Development Goals – MDGs (see fig. 1).

One of the presented goals, the MDG 7, is to ensure environmental sustainability. In order to attain this millennium goal, three sub targets were defined within. In doing so the principles of sustainable development should be integrated into national policies or programmes. The ending of exploitation of environmental resources is defined as a basic step towards environmental sustainability. The more the international community set the target to halve the proportion of people without access to safe drinking water and basic sanitation by the year 2015. A further target within Goal No 7 is to achieve a significant improvement in the lives of at least 100 million slum dwellers (cp. [UN 2005]).

Millenium Development Goals (MDGs)

Goal 1	Goal 2	Goal 3
Eradicate extreme poverty and hunger	Achieve universal primary education	Promote gender equality and empower women

Goal 4	Goal 5	Goal 6
Reduce child mortality	Improve maternal health	Combat HIV/AIDS, malaria and other diseases

Goal 7

Ensure environmental sustainability

- Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources
- Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation
- Achieve significant improvement in lives of at least 100 million slum dwellers by 2020

Goal 8

Global partnership for development

Figure 1. The Millennium Development Goals.

In the following the MDGs are brought together with the principles of sustainable development. For this the “integrative concept of sustainable development”[1] of the German Helmholtz Association is considered.

Sustainable development

The core ideas of the Brundtland Report of the UN Commission on Environment and Development from 1987 and the Rio documents from 1992 (e.g. Agenda 21, Rio Declaration) provided the basis for the operative approach to sustainable development.

The integrative concept of sustainable development

From 1997-2002 the HGF[2] carried out the „integrative concept of sustainable development“. Other existing approaches used so far the “classical pillars” of sustainable development (economy, ecology, social aspects). In contrast the integrative concept emanates from three constitutive elements of sustainable development: *intra- and intergenerational justice, global perspective and anthropogenic view*. Following the “planetary-trust theory”[3] [Kopfmüller et al. 2001] derived three general

[1] Integrated concept of sustainable development [Kopfmüller et al. 2001]
[2] HGF = Helmholtz-Association of German Research Centres
[3] Planetary-trust (Edith Brown-Weiss 1989): Every generation is authorised to use the natural, social, economic and cultural heritage of the preceding generation. At the same time the present generation is dutybound to hold this heritage in trust for future generations.

sustainability goals from the pre-defined constitutive elements to allow an integrated view of all dimensions:

- Securing human existence
- Maintaining society's productive potential
- Preserving society's options for development and action

Furthermore each general sustainability goal was specified by five sustainability rules (cp. Table 1). The latter were defined as action-guiding principles or minimum requirements for sustainable development (cp. [Kopfmüller et al. 2001]). In the following the HGF-concept is used to consider the role of dry sanitation within the process towards sustainable development.

Table 1. General sustainability goals and substantial sustainability rules. (Source: Kopfmüller et al. 2001)

1. Securing human existence	***2. Maintaining society's productive potential***	***3. Preserving society's options for development and action***
1.1 Protection of human health	2.1 Sustainable use of renewable resources	3.1 Equal access of all people to information, education and occupation
1.2 Ensuring the satisfaction of basic needs (nutrition, housing, medical care etc.)	2.2 Sustainable use of non-renewable resources	3.2 Participation in societal decision-making processes
1.3 Autonomous subsistence based on income from own work	2.3 Sustainable use of the environment as a sink for waste and emissions	3.3 Conservation of cultural heritage and cultural diversity
1.4 Just distribution of chances for using natural resources	2.4 Avoiding technical risks with potentially catastrophic impacts	3.4 Conservation of the cultural function of nature,
1.5 Reduction of extreme income or wealth Inequalities	2.5 Sustainable development of man-made, human and knowledge capital	3.5 Conservation of "social resources"

The MDG No.7 aims at a sustainable development to ensure environmental sustainability. According to [BMZ 2006] the environmental sustainable development results from a sustainable use of resources. This demand corresponds to the substantial sustainability rules 2.1 – 2.3 defined within the HGF-concept (cp. Table 1). Thus the MDGs can be seen as a prerequisite for sustainable development but all in all only as one aspect within a multitude of requirements.

Dry Sanitation

At present 2.6 billion people of the world's population have no access to adequate sanitation. First of all adequate sanitation is necessary to achieve the MDG 7 (environmental sustainability including the sustainable use of natural resources) but sanitation is also constitutive to satisfy other MDG-elements, e.g. the supply of drinking water, combating diseases, poverty and hunger or environmental damage.

The role of sanitation within a sustainable development

The supply of “clean” drinking water is a crucial prerequisite to achieve the MDGs (cp. [Hoering 2005]). Hygiene and sanitation are therefore fundamentals for fresh water supply as well as for attaining the MDG No. 7 and a sustainable development in general. This implies that any sanitation technology has to cover the sustainable use of resources.

Concerning the use of natural resources the following demands are in accordance with the general sustainability goal No. 2 of the HGF-concept [Brandl et al. 2003; Lehn et al. 1996]:

(A) The loss of non renewable resources (coal, mineral oil, fertile soils) should be kept to a minimum and the benefit resulting from the use of these resources should be assured for future generations by developing new technologies based on renewable resources. This concerns particularly fundamental needs for life that are irreplaceable.

(B) The use of renewable resources (water) should not rise above the potential to regenerate and additionally a basic contingent has to be reserved for the needs of nature.

(C) Feeding with anthropogenic materials should not rise above absorption capacity of ecosystems.

(D) The use of a natural resource in one region must not affect the possibility to use the resource in another region (in the case of water: upstream downstream problem)

The conventional sanitation systems consume large amounts of fresh water for transportation. If countries face dwindling water resources or suffer water scarcity the adaptation of sanitation technologies is urgent (e.g. adaptation of technological water intensity). Especially in developing countries water scarcity is often accompanied by additional problems, e.g. the lack of economic resources to adequately treat (domestic) wastewater and to provide water and sanitation services. Therefore the sanitation technology has to be adapted to economic resources and human capital (in the following condensed with (E)). Thus an appropriate sanitation technology should satisfy the attributes given below and in Fig. 2.

Under the conditions of water scarcity water should be preferred for high quality utilisation (drinking, washing) and the water **use of a sanitation technology should be minimised.** Furthermore the production of **wastewater should be minimised** to avoid the feeding of (drinking) water resources with anthropogenic materials (e.g. untreated faecal elements) and to minimise wastewater treatment costs. The integration of a sanitation technology into material flow cycles can help to reverse disadvantages of conventional systems (e.g. the loss of nutrients, excessive feeding of ecosystems with anthropogenic matter). Besides, a sanitation technology can contribute to retrieval of resources, e.g. by urine separation (phosphorus retrieval) or compost generation (humus retrieval).

In what extend this applies to dry sanitation technologies is considered next.

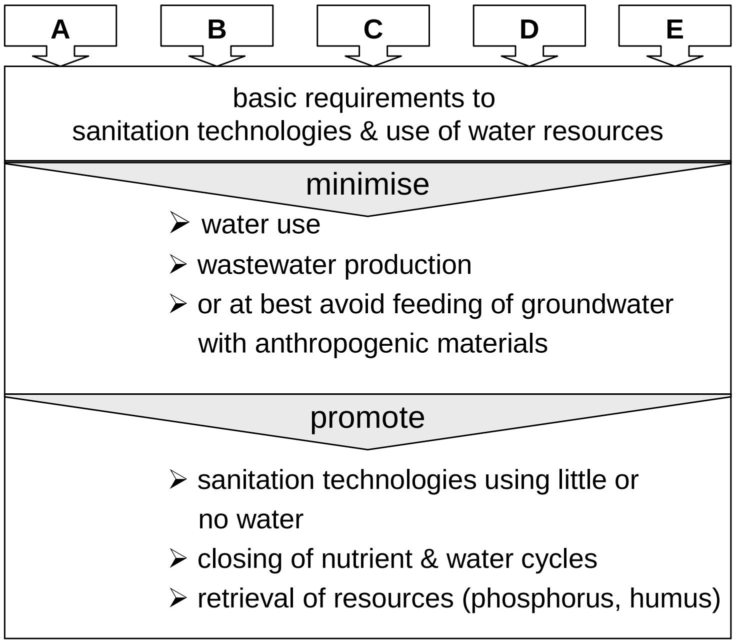

Figure 2. Basic requirements to sanitation technologies and water resources use as for water scarce regions (derived with the help of, [Cordova 2001], [Eiswirth 2000], [Wilderer 2002], [Werner et al. 2005]), (A)-(E) see text above.

What is dry sanitation

Dry sanitation is defined as the disposal of human excreta without the use of water as medium for transportation. After [Scott 2002] two types of dry sanitation can be distinguished:

- Dehydrating toilets: the urine is diverted away and the faeces are collected in a chamber or in two alternately used chambers. A hydrophilic, stench controlling or a pH-affecting material is added after each use (e.g. soil, ash, lime, sawdust). When full, the chamber is sealed for anaerobic microbial digestion (cp. [Kaltwasser 1982]). The most familiar example is the Vietnamese double vault toilet.
- Composting toilets: the faeces are also stored in a chamber or in two alternately used chambers (cp. [Kaltwasser 1982]). Other organic matter such as organic waste from the household, bark-mulch, straw or others is added. Under adequate temperature, airflow and moisture the faeces are broken down by different organisms, e.g. bacteria and fungi. Urine is drained away or collected separately.

Contribution of dry sanitation to the MDGs and a sustainable development

The benefits of dry sanitation and the contribution to the pre-decided sustainable development are described below (direct and indirect effects).

Theoretically dry sanitation

- **works without the use of water and therefore produces no wastewater**
  - ⇨ water use can be limited to basic needs. This is of special interest where water is scarce and the potential of water resources to regenerate is low. Especially rural households are less independent on central authorities or the supply of reliable canalisation and treatment systems.
  - ⇨ dry sanitation vastly helps to reduce the ground and surface water contamination or the wastewater load of receiving waters especially if adequate wastewater treatment can't be guaranteed. Thus, there is less risk of water-induced diseases.
- **can easily be used within nutrient-retrieval-systems (closing-the-nutrient-loop)**
  - ⇨ material flows can be separated "at the source". Retrieved nutrients can be reused in agriculture, gardens or for energy production
    - separated urine is rich in phosphorus and can substitute artificial fertilizer and thus allows to end the exploitation of limited natural phosphorus resources
  - ⇨ organic waste, human and animal excreta can be disposed within a composting technology or for energy production
    - if sufficiently sanitised the compost or dehydrated material can be applied to agriculture without any risk for health. The composted material supports humus accumulation and helps to maintain or even improve soil fertility. This makes possible an increased agricultural production and thus better income and nutrition for people. New income opportunities and better living conditions again can prevent rural exodus e.g. in agricultural dominated areas.
    - dehydrated or composted solids can be utilised in biogas plants. Generated power can returned to households.

Dry sanitation is a simple energy-saving technology that can principally be implemented regardless of whether what wealth. Additionally it is flexible enough to be adjusted to individual design expectations. Decentralised on-site treatment is possible just as collection for centralised treatment.

Nevertheless there are some disadvantages of the technology that should not be disregarded. Looking to the described benefits dry sanitation seems to be more advantageous as technology for decentralised use in rural areas or for detached houses with a garden or agriculture. In dense populated areas or in houses with many units the functioning of the technology might be more difficult to realise. If on-site treatment is not possible there might be costs for service-companies and maintenance of the system, e.g. costs for storage or transportation of excreta. Besides, pharmaceutical residuals in faeces may affect soil and food quality. Moreover the dry toilet technology requires accurate use (adequate compost temperature or digestion duration, sealing of collecting facilities, etc.) and therefore sufficient know-how of the users or inspection by skilled personal at regular intervals.

Another sensitive issue might be the conflicts between technological characteristics and cultural habits or beliefs about defecation. For example in Muslim culture urine and faeces are considered "impure", excreta are regarded as waste not as a resource (cp. [Nawab et al. 2005]). Thus, Islamic religion prohibits the contact with faeces or the reuse of faeces for cultivation (cp. [Kaltwasser 1982]). Depending on the cultural background anal cleansing preferences might be a further obstacle for dry toilet implementation. Exemplary Muslims prefer a wet anal cleansing and within a dry sanitation project in Pakistan people refused cleansing in a separate place (cp. [Nawab et al. 2005]). The more such toilets or the on-site storage of faeces might be considered as a sign of poverty, underdevelopment or regression – both for people dreaming of higher living standards and for people familiar to very high living standards.

The implementation of (dry) toilet systems therefore requires mutual agreement. On the one hand people possibly have to change attitudes or to overcome inhibitions. On the other hand toilet systems should be adapted with due respect to the local conditions and traditions.

Figure 3 shows the positive and negative effects of dry sanitation in relation to the three HGF-sustainability goals.

	possible effects of dry sanitation		
	indirect	direct	indirect
	general sustainability goals (HGF-concept)		
	securing human existence	**maintaining society‘s productive potential**	**preserving society‘s options for development and action**
positive	• reduced risk of water induced diseases • implementation is almost independent from income of users • support of autonomous households • improvement of nutrition	• no contamination of ground and surface water with faeces • no water use for wastewater transport • recycling of bio-waste and dung possible • humus accumulation possible >> soil fertilisation • retrieval of (phosphorus) resources is possible	• reduction of rural exodus and therefore conservation of cultural diversity • contribution to social health
negative	• income is possibly crucial for service and maintenance >> inequalities	• harmful residuals in faeces and lack of know-how may impair quality of natural resources	• change of cultural habits is possibly required • function of systems might be dependent of willingness of people to change attitudes or to overcome traditions

Figure 3. Positive and negative aspects of dry sanitation pertaining to the general sustainability goals.

SUMMARY

Dry sanitation appears to be an adequate technology to meet the requirements for environmental sustainability. Obviously it is a technology that can advantage the achievement of the MDGs at all. Especially in water scarce regions dry sanitation seems to fulfil a multitude of additional sustainability-criteria that are defined within the HGF-concept for an integrative sustainable development. Although some aspects (that might call for modifications of the basic technology) have to be reviewed in special cases, e.g. cultural acceptance of the technology or functionalism in urban areas, dry sanitation can definitely contribute to sustainable development in high degree.

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