# Should ecological sanitation carry a health warning?

## Assessing the health risks of ecological latrines

### Introduction and scope

A primary benefit of sanitation is improved human health, achieved by breaking the transmission of pathogens to humans by the containment of faeces. This is essential to reducing the incidence of common illnesses such as diarrhoea, the cause of some 2.5 million deaths a year.

Sanitation involves human behaviour. Discussions around the health aspects of sanitation must therefore centre on the user, to ensure that sustained hygienic behaviours, enabled by sustained sanitation systems, ultimately improve human health.

Debates around the value and appropriateness of "ecological" forms of sanitation and latrines typically focus on the benefits to be gained from recycling excreta; capturing the nutrient value of human excreta, while reducing environmental pollution. The impact of an ecological sanitation system on human health – starting with the user – is less well debated. The result is a general misunderstanding and conflicting views about the implications of ecological forms of sanitation on the health of users and the wider community.

### Headline facts

- Ecological latrines ultimately return temporarily-contained faeces into the human environment.
- Ecological latrines only reduce the pathogen level in faeces to safe levels given sufficient storage times and proper management of the latrine.
- The health risks associated with ecological latrines vary according to the design of the latrine and practices of the users.
- The degree of risk varies; some forms of ecological sanitation are safer than others.
- Meaningful risk assessments, with a view to interpreting and understanding the relative and overall health risks, are essential to ensure that safer practices are encouraged.

*Box 1: What is ecological sanitation?*
Ecological sanitation (ecosan) works on the principle that urine and faeces are not simply waste products of the human digestion process, but rather are an asset that, if properly managed, can contribute to better health through improved food production and reduced environmental pollution.

At a household level, an ecological latrine is one of a variety of styles of dehydrating or composting latrine. The excreta is eventually decomposed or composted in or near the latrine, or perhaps collected and composted elsewhere. The urine is often collected separately, to aid the process by keeping the solid matter dry.

# Ecological Latrines and Health

Detailed classification of ecological latrines and information on their design and operation are available in the background report of this Briefing Note (Sugden, 2006) and in the WELL Factsheet on Ecological Sanitation (Smet and Sudgen, 2006).

However, understanding the design of an ecological latrine is less important than understanding the principles of its operation and maintenance, with the associated health implications of this for the user.

The extent to which any latrine risks human health and/or deters people from using the excreta depends on three basic factors:

- how the design reduces pathogens to a safe level;
- the degree of human activity (interaction) required to operate and maintain the latrine; and
- the way in which users/operators follow safe management principles.

All types of latrine and waste disposal system are potentially hazardous, particularly when their management systems break down. The safety of ecological sanitation should be viewed in this context, rather than in isolation from the human environment in which it operates.

Ecological sanitation is often considered to pose a health risk based on the transmission of disease associated with using excreta to fertilize crops. A review of these health aspects has found that:

- crop fertilization with raw excreta causes excess infection with intestinal nematodes, in both field workers and consumers of the crops;
- the fertilization of rice paddies with excreta may lead to excess schistosomiasis infection among rice farmers; and
- faecal matter used on grazing land can lead to cattle becoming infected with *Cysticerca bovis*.

The findings indicate that the risk of infection is from the use of incorrectly or poorly treated excreta. There is therefore a need for ecological latrines to form a barrier to the spread of disease and reduce pathogen levels as part of the treatment process.

*Box 2 : Summing up the safety factors*
The safety of ecological, or in fact, any form of sanitation, can be summarized as:

Good pathogen reduction in latrine + Good post-latrine handling + Good hygienic behaviour = Safe (ecological) sanitation

## Pathogen reduction in the latrine[1]

The following factors have a positive effect on reducing pathogens in ecological latrines:

- increasing the storage time;
- reducing the moisture content;
- increasing the pH of the contents of the pit/vault;
- increasing the temperature of the contents of the pit/vault; and
- encouraging the presence of other micro-organisms to destroy pathogens by predation.

**Table 1. Pathogen reduction for different ecological latrines**

| Latrine types | Significant form of pathogen reduction |
|---|---|
| Dehydrating latrine (with urine diversion) | Storage time, moisture content and pH |
| Composting latrine (without urine diversion) | Storage time and predation |
| Single pit Arborloo | Avoiding contact, storage time and predation |

[1] The epidemiological evidence base is available in the full background report (Sugden, 2006).

***Storage***: All designs of ecological latrines use a pit or vault to store excreta. Storage time has a significant impact in reducing pathogens to safe levels, making this one of the primary means by which ecological latrines reduce the level of pathogens in waste. The storage time depends on the pit/vault volume, the quantity of additives used, the number of people using the latrine and their diet.

***Moisture, pH and temperature***: In principle, pathogens die off upon excretion, as the environmental conditions outside the human host are generally not conducive to their survival. The moisture content, pH and temperature of the environment are all known to have an impact on pathogen reduction.

The ***ideal conditions*** to kill pathogens are reported as:

- low moisture content (<25%);
- high pH (>10); and
- high temperature (>36°C).

Ecological latrines use the following techniques to encourage pathogen reduction:

- providing sufficient *storage time* with suitably sized pits or vaults.
- reducing the *moisture content* by:
  - separating urine from faeces. Although this reduces the moisture content, it can still vary with the use of the latrine for bathing, 'wateriness' of stools, etc;
  - heating faeces with a solar drying plate, to evaporate moisture from the faeces; or
  - adding dry material such as ash, soil or lime to absorb moisture from the faeces.
- increasing the *pH* by adding dry wood ash or lime.
- increasing the *temperature* by:
  - heating the faeces using a solar drying plate; or
  - adding wood shavings or living material (such as leaves), to help the composting process to be as aerobic as possible.
- encouraging *predation* by the addition of soil containing a variety of micro-organisms capable of killing or consuming the pathogens.

It is important to note that the "ideal conditions" needed for pathogen reduction require good user management, and there will be variation in conditions within even a small project.

In a dehydrating latrine, while the pH may reach relatively high levels (above 9), the temperature and moisture content rarely reach levels to have a significant impact. In warm, humid climates achieving the correct moisture content becomes almost impossible. The main factor influencing the level of pathogen reduction is therefore storage time.

Even in a well-managed composting latrine, environmental conditions mean that the moisture content is not low enough to desiccate the pathogens, the temperature is not high enough to destroy them and the pH does not achieve the correct levels if soil and ash are added. Again, the main factor for pathogen destruction in a composting latrine is storage time.

Implications of such findings are that:

- minimum storage times should be one year; and
- until there is evidence that pathogens are consistently destroyed, ecological latrine users should be encouraged to bury the solids removed from the pit/vault.

Ecological latrines only reduce pathogens to safe levels given sufficient storage times and proper management of the latrine.

The reality of life in poor communities makes it difficult however, even with the users' best intentions, to ensure that sufficient storage and correct management occurs with all the ecological latrines that are built.

The safety of ecological sanitation is not dependent solely on the ability of an ecological latrine to reduce the pathogen level to a safe standard, but also the risk posed by post-latrine handling of the excreta and the hygienic behaviour of the household and wider community.

## Post-latrine handling

Independent of the latrine type, stored excreta from all ecological latrines (with the exception of the Arborloo) are intended to be taken from the pit and applied to land. How this process is carried out has a significant impact on the risks associated with using human waste as a fertilizer.

The removal and application process involves three areas of risk:

- those responsible for emptying the pit and applying excreta to the land become infected through direct contact;
- children and adults walk, work or play in the area where excreta is deposited or applied to land, and poor hygiene practices lead to contamination and infection; and
- contamination of crops, which is particularly important for crops that may not be cooked before eating, such as tomatoes or lettuce.

The risk of contamination to members of the community depends on how the removed excreta are applied to the land, as well as the amount of time people from the community spend on that land. When excreta are deposited near people's homes, or on land where people often congregate, the risk of contamination is increased.

A high risk of contamination occurs if the contents are spread by hand to the land and used as a top dressing. Exposed helminth eggs and pathogens will be a health risk to anybody walking on the land, although this risk will diminish with time as pathogen die-off is accelerated through the effects of sunlight and desiccation.

If excreta or excreta-derived products are applied to the field before planting crops:

- farm and sanitation workers should be adequately protected during the process;
- the excreta should be placed in trenches and covered with at least 25cm of soil; and
- root crops should not be planted directly over the trenches.

The degree of risk is also related to the growing time of the crop and survival time of the contaminating pathogen, either in the soil or on the crop. Only when pathogen survival times are shorter than crop growing cycles, is the potential risk posed to both crop handlers and consumers reduced. The high persistence and low infective dose for Ascaris (see Table 2) makes this pathogen the greatest cause for concern.

**Table 2. Survival rates of certain excreted pathogens in soil and on crops, at 20-30ºC**

| Common infections | Survival time in soil (days) | Survival time on crops (days) |
|---|---|---|
| Virus: Enteroviruses | <100 but usually <20 | <60 but usually <15 |
| Bacteria: Faecal coliforms | <70 but usually <20 | <30 but usually <15 |
| Helminths: Ascaris lumbricoides | Many months | <60 but usually <30 |

## Hygienic behaviour

One of the most effective methods of breaking the faecal-oral route and avoiding infection is through the simple act of hand washing with soap. If everyone who came into contact with excreta immediately washed their hands (or feet if walking barefoot), the risks presented by ecological sanitation would be significantly reduced. However, good hand washing is a difficult behaviour change to achieve effectively and it cannot be relied on to ensure safety to the user.

## Overall risk

Programmes promoting ecological sanitation are typically weak when it comes to assessing the health risks associated with post-latrine handling of the excreta. While much effort is placed on proving the safety of the treatment process in the latrine on 'technical' grounds, little effort is given to consideration of the whole process from a social, user-based perspective.

On the basis that the equation in Box 2 is correct and assuming that hygiene behaviours are not sufficiently well practised to provide a secure barrier to the spread of disease, the overall risk from ecological sanitation can be derived for different latrine designs in different settings, given the risks from pathogen survival and post-latrine handling.

A few typical latrine types and practices are included in Table 3 below. Similar assessments can be carried out to meet the requirements of other specific circumstances.

**Table 3. Overall risk associated with types of ecological latrine**

| Type of latrine and practice | Risk of pathogen survival in pit/vault | Post-latrine risk | Overall risk |
|---|---|---|---|
| *Well managed dehydrating latrine (with urine diversion), with 12 months storage* | | | |
| Peri-urban area growing maize on a plot 25 metres from any house. Contents dug into the land before planting. | Medium | Medium | Medium |
| Rural area growing maize in an isolated part of the village. Contents dug into the land. | Medium | Low | Low |
| *Composting latrine (without urine diversion)* | | | |
| Urban garden in a high density area growing tomatoes on a small plot of land. Contents dug into the land before planting. | High | Medium | High |
| Rural area growing maize in an isolated part of the village. Contents dug into the land before planting | High | Low | Medium |
| *Single pit Arborloo* | | | |
| Urban garden growing banana trees on full latrine pits. Pit is first covered with 25cms of soil. | Low | Low | Low |


## Summary

Circumstances in which ecological sanitation may offer an improved form of excreta disposal include:

- where a risk assessment method indicates a very low level of overall risk, e.g. correctly using an Arborloo;
- where open defecation is widely practised and households identify the fertilizer-producing qualities of ecological sanitation as the main reason for moving from open defecation to defecating in a latrine;
- at institutions, where good management and protection from human contact with excreta can be guaranteed; or
- in areas with traditional latrines where the track record of communal action provides the capacity to ensure safe post-latrine handling by ensuring adequate storage time, limiting human contact, good crop selection and safe handling procedures.

Conversely, in situations where there is high coverage of traditional latrines and no issues regarding groundwater contamination, there are no additional health benefits (in the sense of impact on communicable disease) to be achieved by adopting ecological latrines over any other form of improved sanitation.



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**This briefing note assesses the health risks associated with different stages in the ecological sanitation process – taken from the user's perspective.**

## Key references


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**Briefing Note compiled by Rebecca Scott of WEDC**

**Photographs by Bob Reed, Rebecca Scott and Steven Sugden**

**DFID Resource Centre in Water, Sanitation & Environmental Health www.Lboro.ac.uk/well**


**For further information, contact:**
**WELL**
**Water, Engineering and Development Centre (WEDC)**
**Loughborough University**
**Leicestershire LE11 3TU UK**

**Email:** WELL@Lboro.ac.uk
**Phone:** 0 (44) 1509 228304
**Fax:** 0 (44) 1509 211079
**Website:** http://www.Lboro.ac.uk/well/