

# 63. Using human waste

Human and animal excreta has been used since ancient times as a fertilizer and soil conditioner. In Europe and North America it has been virtually replaced by artificial fertilizers, but in many other parts of the world it still plays a major role in the provision of soil nutrients.

Waste recycling is promoted for both economic and environmental reasons, but the use of fresh excreta carries considerable health hazards. This Technical Brief introduces the main issues one needs to consider to both control the process and optimize the benefits gained from using human waste, whilst minimizing the threat.

## Using excreta as a resource

Human excreta is a rich source of nitrogen and other nutrients necessary for plant growth.

In many ways it is better than artificial fertilizers. It:

- encourages the formation of humus (decomposed vegetable matter) which is essential for optimum soil structure and water retention;
- contains trace elements (chemical fertilizers do not) which help protect the plant from parasites and disease;
- promotes the development of small organisms (microbes) which convert the minerals to forms that the plants can use; and
- improves the soil structure, making it easier to cultivate and to resist the effects of erosion.

The Chinese rely greatly on human excreta (sometimes known as 'nightsoil') as a fertilizer. Over 90 per cent of the quantity collected is used in agriculture.

Excreta was, and still is, recycled in a variety of ways. Table 1 lists the most common.

### Urine

Urine has been used as a resource in many parts of the world for centuries.

When diluted with water it makes an excellent liquid fertilizer. Until quite recently it was used in Europe for household cleaning, softening wool, hardening steel, tanning leather and dyeing cloth. The Greeks and Romans used it for colouring their hair. African farmers use it for fermenting plants to produce dyes, and the Chinese pharmaceutical industry uses it to make blood coagulants.

### Health risks

The transmission of disease through the use of untreated excreta can be widespread. Parasitic eggs and cysts may remain viable in soil, water and on plants for many months, creating a hazard for farmers and customers alike.

The primary aim of a sanitation project is to prevent the spread of disease. Where excreta is to be used as a resource, therefore, it is essential to introduce methods for protecting the users from the diseases it contains. Some of the main features of compost latrines designed to do this are described overleaf.

**Table 1. Common excreta-recycling practices**

<i>Practice</i>	<i>Countries where used</i>
Soil fertilization with untreated excreta	China, Japan, Korea, Taiwan, Thailand
Composted excreta used in agriculture	China, India
Excreta fed to animals	China, India, Melanesia, Nigeria, Sri Lanka
Compost latrines	Central America, Vietnam, Europe
Biogas production	China, India, Korea,
Fish food	China, India, Korea, Malaysia, Indonesia
Aquatic weed production	Vietnam, South-east Asia



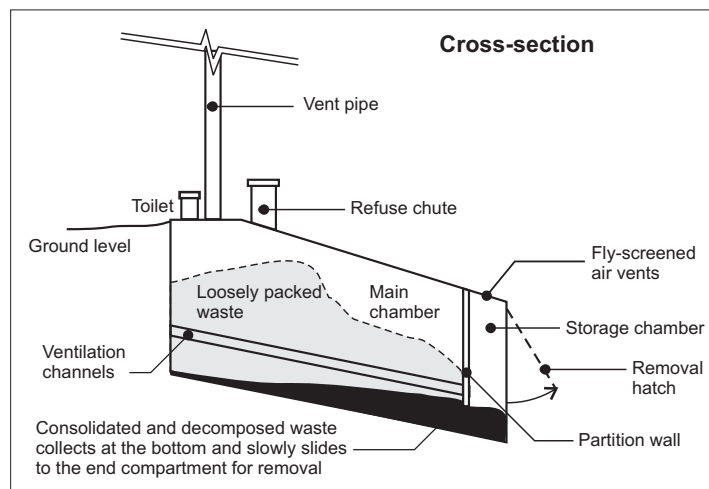
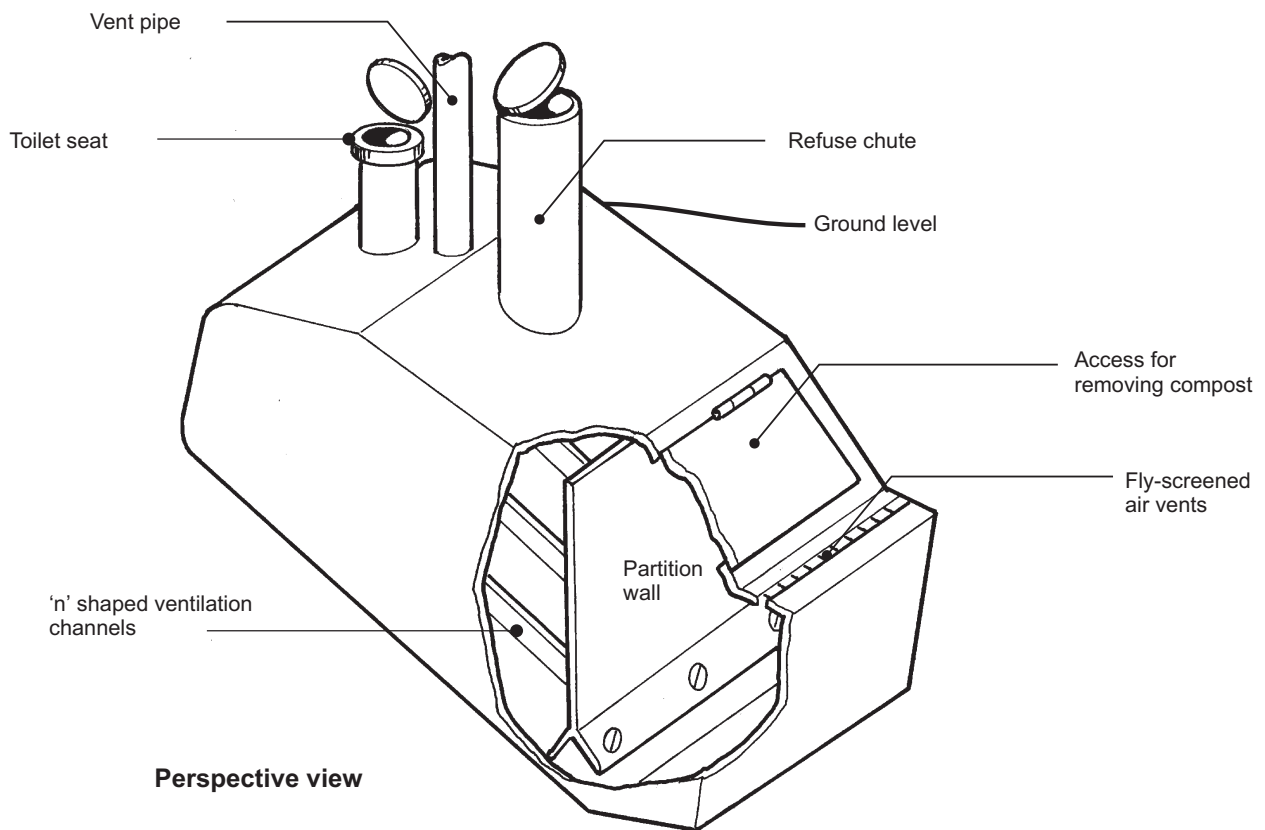
# Using human waste

## Compost latrines

Composting is the process of biologically breaking down solid organic matter to produce a substance (compost) which is valuable as a fertilizer and soil conditioner. Excreta is mixed with other matter to reduce the moisture content, adjust the chemical balance of the mass and improve the texture.

Given a large enough organic mass and the presence of oxygen, the breakdown process will release energy. This energy will be partly used by the bacteria to reproduce, and will be partly converted to heat. If sufficient heat is generated, the temperature of the mass can rise enough to kill pathogens. The wastes generated by a single family are not enough to support such a large increase in temperature and, therefore,

the process cannot be relied upon to destroy pathogenic organisms, particularly parasitic worms and cysts. Any latrine based on this process must contain other features to prevent the spread of disease. Decomposition can also take place in the absence of oxygen (anaerobically). It is slower and does not produce any rise in temperature. It may also produce a strong odour.



**Figure 1. Continuous composting toilet**  
(Latrine superstructure not shown)

## Aerobic latrines

Aerobic composting latrines must:

- keep the waste material open and relatively dry so that air can circulate freely;
- separate new wastes from old; and
- contain the wastes for long enough for any pathogenic organisms to be destroyed.

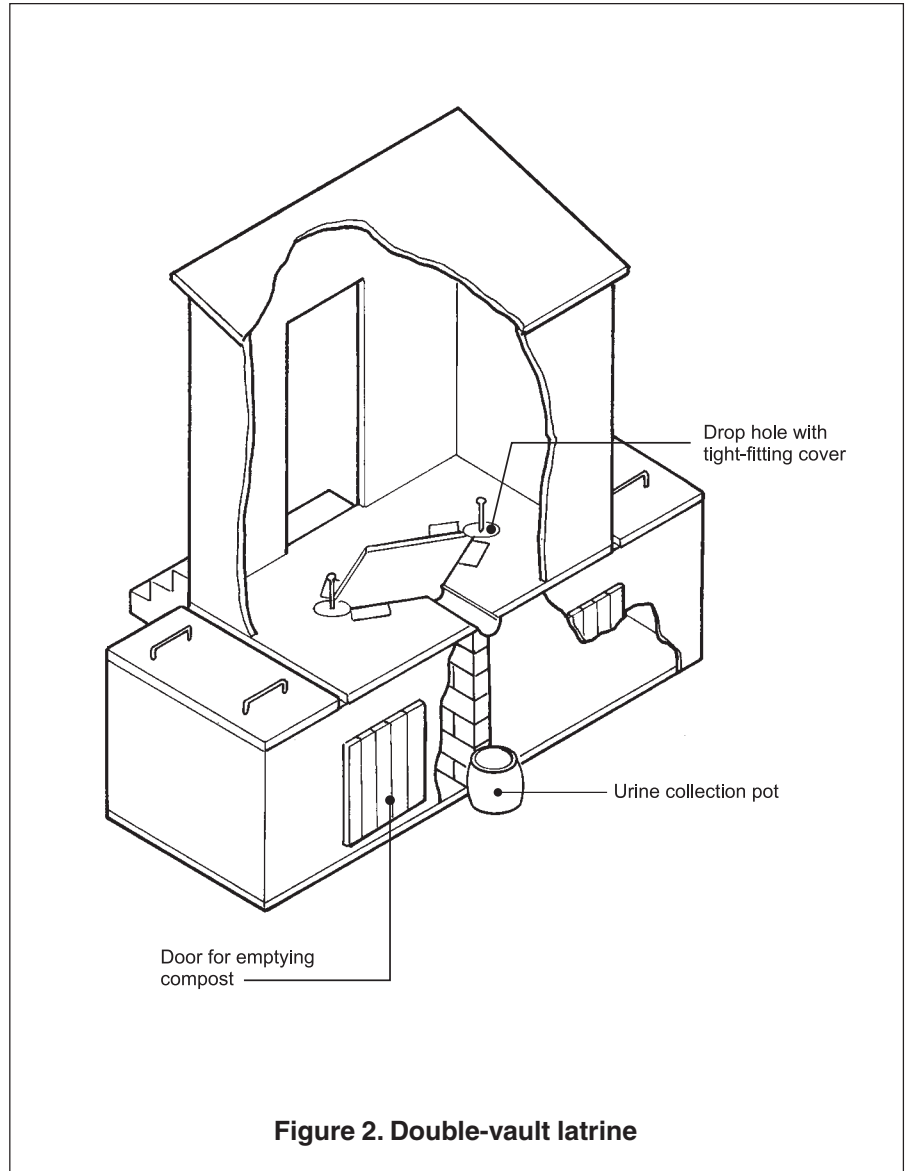
The most common design is based on a unit developed in Sweden, called the 'Multrum'.

Excreta and other wastes are added to a 3m-long receptacle which slopes away from the inlet (Figure 1). The latrine is fitted with a suspended floor made of channels shaped like an 'n' which draw air in through the storage chamber, through the decomposing mass and out via a ventilation pipe. The mass gradually slides down the suspended floor as it decomposes. Eventually it collects in the storage chamber from which it can be removed. The main chamber holds the material for about a year to ensure that the pathogens have died. The compost moisture content and chemical balance are controlled by adding vegetable waste and sawdust or ash. The process is continuous, with the weight of new material helping to push the decomposing compost towards the storage chamber.

The latrines have proved successful in small communities in industrialized countries, but it is usually necessary to install a fan on the ventilation pipe to increase ventilation, thereby controlling odours and flies.

Attempts to introduce them in other parts of the world have failed. Problems were experienced with over-use, too high a moisture content, and failure to add enough vegetable waste. These problems led to foul-smelling, unpleasant latrines which were shunned by users.

The main problem seems to have been that the users did not consider the end-product worth the effort. Family composting latrines are expensive to build, and produce only small quantities



**Figure 2. Double-vault latrine**

of compost. Many people prefer to purchase chemical fertilizers (which are often subsidized by the State) rather than work with human excreta.

## Anaerobic latrines

It is easier to produce anaerobic (without air) than aerobic (with air) conditions. A moist mass of excreta and other wastes will naturally compact, which will in turn exclude the air and turn the mass 'anaerobic'. Anaerobic latrines usually work on a batch system. Excreta, vegetable waste (to control the chemical balance) and ash or sawdust (to control the moisture content) are deposited in a sealed container (Figure 2). Urine is collected separately. When the container is full it is sealed and another container can

be used. When the second container is full the first container can be emptied and re-used.

There is some dispute as to how long the compost should be stored before it is used. Some people believe that it should be stored for at least two years while others recommend as little as 10 months. The longer the wastes are stored, the more pathogens will be destroyed.

Batch-composting toilets have had mixed success. Failure has generally been the result of poor understanding of the process or lack of interest in the final product. Controlling the moisture content has often caused problems, particularly in communities where water is used for anal cleaning or people bathe in the toilet cubicle.

# Using human waste

## Biogas

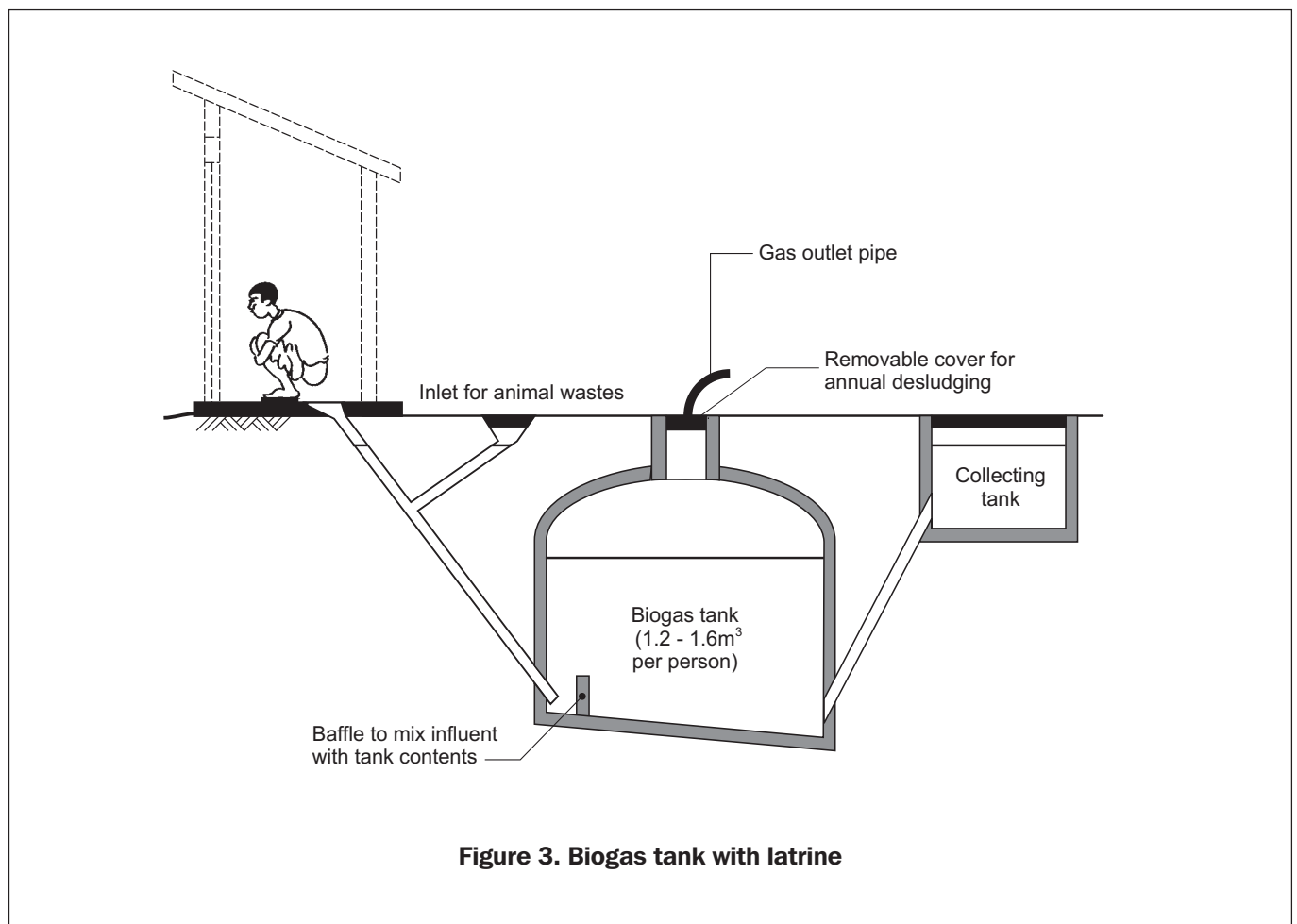
If human excreta is combined with animal and agricultural wastes, and water, it will give off gas as it decomposes. Given the right temperature and mix of wastes, much of the gas will be methane, which is flammable. The mix of gases produced is called 'biogas'. Biogas plants have been incorporated into domestic latrines in a number of

countries with mixed success. The plants are used widely in China where the gas produced is used for cooking and lighting. Plants similar to the one shown in Figure 3 take excreta and pig wastes mixed with water.

Biogas plants typically store the wastes for about 30 days. This removes some of the pathogenic organisms but by no means all. It is better to store the excreta for a period

prior to or after putting them in the biogas tank.

Biogas plants can be expensive to build and difficult to operate. Poor maintenance leads to loss of gas production and blockage of the digester tank with solids. They are only appropriate in communities with a commitment to recycling organic wastes and where there are few alternative power sources. ■



### Further information

Franceys, R., Pickford, J. and Reed, R., *A Guide to the Development of On-site Sanitation*, WHO, Geneva, 1992.  
Pickford, John., *Low-cost Sanitation: A survey of practical experience*, IT Publications, London, 1995.

Prepared by Bob Reed and Rod Shaw



WATER AND ENVIRONMENTAL HEALTH AT LONDON AND LOUGHBOROUGH (WELL) is a resource centre funded by the United Kingdom's Department for International Development (DFID) to promote environmental health and well-being in developing and transitional countries. It is managed by the London School of Hygiene & Tropical Medicine (LSHTM) and the Water, Engineering and Development Centre (WEDC), Loughborough University.

<http://www.lboro.ac.uk/well/>

MIT OpenCourseWare  
<http://ocw.mit.edu>

EC.715 D-Lab: Disseminating Innovations for the Common Good  
Spring 2007

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.