The Main Features of Ecological Sanitation

The need for safe sanitation

Pathogens and parasites found in human excreta, if ingested, can result in a variety of illnesses, including diarrhoea leading to malnutrition. If left untreated these illnesses can result in poor growth, iron deficiency (anaemia), vitamin A deficiency, and leave the body's immune system weakened and susceptible to more serious infections. Not all pathogens and parasites result in death, but the resulting malnutrition creates persistent poor health and a predisposition to disease and death from other causes.

The limitations of present day sanitation

Conventional sanitation is currently offered by two models: pitsan (pit toilets) or flushsan (flush toilets). Although conventional sewage systems transport excreta away from the toilet user, they often fail to contain and sanitize (due to inadequate or non-existent treatment facilities), instead releasing pathogens and nutrients into the downstream environment. This is considered the "linear pathogen flow" (Winblad and Simpson-Hébert, 2004). These systems mix faeces, urine, flush water and toilet paper with grey water, storm water and industrial effluents, usually overtaxing the design capacity of the treatment plants, if such a facility exists, as very few communities in the world are able to afford fully functional sewage systems. Simply put, flushsan has a dismal track record because all sewage systems contaminate the environment. Far more common than flush sanitation is the pit toilet, primarily because it is inexpensive and requires little or no infrastructure. This method fails to contain and sanitize excreta since pathogens and nutrients seep into the groundwater. Deep pit latrines also fail to recycle since the excreta is too deep for plants to make use of the nutrients. Pits are prone to periodic flooding, causing them to spill their contents. In general, pits are smelly, are often infested with flies, and in most parts of the world are poorly maintained and continue to be a source of disease and pollution.

Ecosan defined

Ecological sanitation can be viewed as a four-step process dealing with human excreta: source-separation, containment, sanitization and recycling. The objective is to protect human health and the environment while reducing the use of water in sanitation systems and recycling nutrients to help reduce the need for artificial fertilizers in agriculture. Ecosan represents a conceptual shift in the relationship between people and the environment; it is built on the necessary link between people and soil.

Ecosan is a real option

An essential step in the process of sanitation is the containment of pathogens that can cause disease. Human faeces contain bacteria, viruses and parasites, which, if not properly treated, can result in spreading of disease. Without containment and sanitization, a vicious circle develops where the pathogens in excreta are released back into the environment, re-infect people through consumption of contaminated water or food, and are then excreted again, only to begin the cycle over. Ecological sanitation systems are designed around true containment and provide two ways to render human excreta innocuous: dehydration and decomposition. The preferred method will depend on climate, groundwater tables, amount of space and intended purpose for the sanitized excreta. Dehydration is the chemical process of destroying pathogens by eliminating moisture from the immediate (containing) environment. Drying materials, like wood ash, lime and soil, are added to cover the fresh excreta. Ash and lime increase pH which acts as an additional toxic factor to pathogens if the pH can be raised to over 9.5. The less moisture the better, and in most climates it is better to divert the urine and treat it separately. Figure 1 shows a dry, double-vault urine-diversion toilet, a model being used in China, India, Vietnam and Mexico. It takes an average family 6 months to fill one of the vaults. Then the second vault is used. The first vault is emptied following an additional 6 months of sanitization and the material is taken to a soil compost. Urine is never mixed in this toilet but continuously diverted into a separate container and later used in diluted form as plant fertilizer. The dry ecotoilet meets all necessary health and environmental protection criteria and goes well beyond what conventional approaches can offer (Stenström, 2002; Schönning and Stenström, 2004), saving water and preventing water pollution. It produces no smell, does not attract flies and is an affordable solution inside and outside of dwellings throughout the world.

Soil-composting toilets make use of the process of decomposition, a biological process carried out by bacteria, worms and other organisms to break down organic substances. In a composting environment, the com-

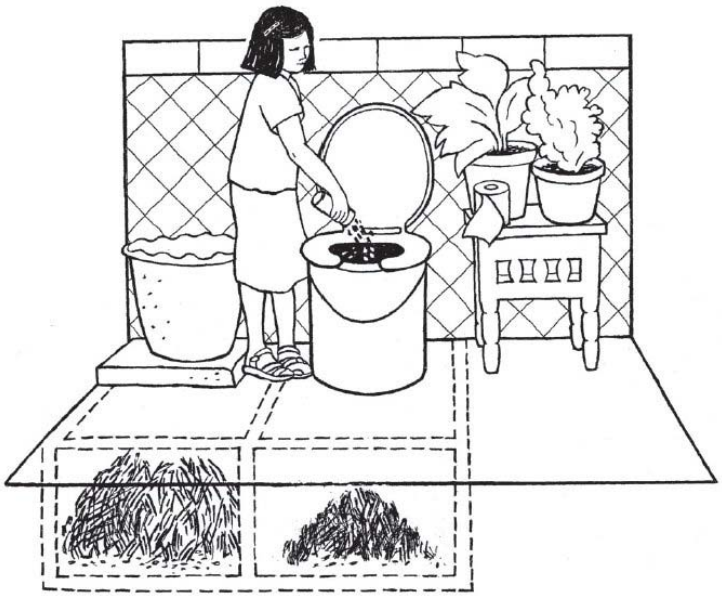

Figure 1: Double-vault urine-diverting dry ecotoilet in use in China, Vietnam, Mexico, and India

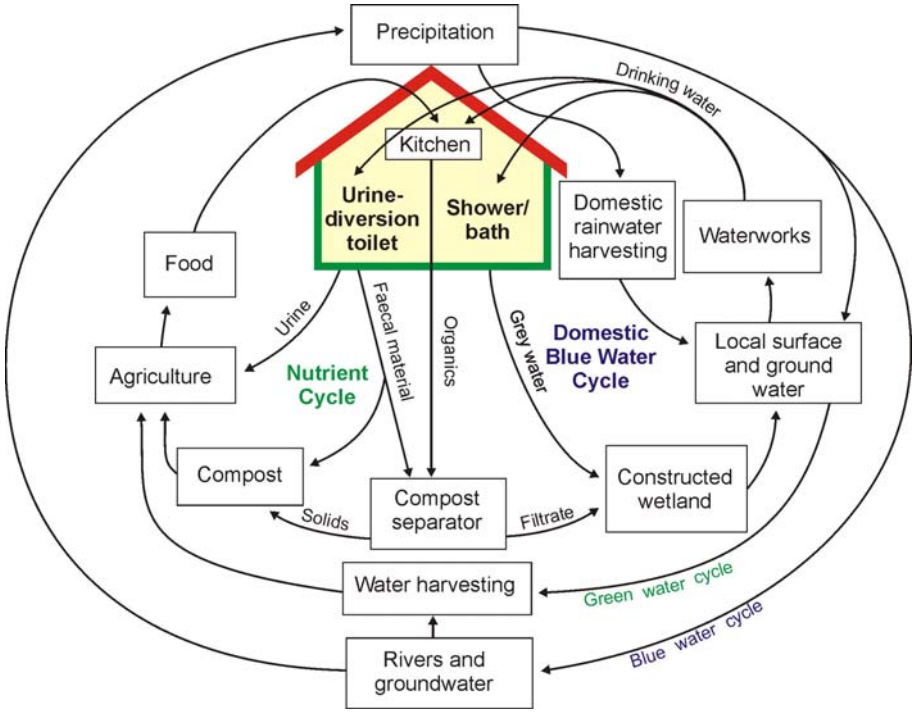

Figure 2. Complete household ecosan and eco-water use
Modified from Oldenburg, M. (Otterwasser)

petition between organisms for available carbon and nutrients continues until the pathogens are defeated by the dominant soil bacteria. Soil-composting toilets are constructed using shallow, reinforced pits where soil and ash are added after each use. Toilets such as the Fossa Alterna and Arbour Loo (Morgan 2005) have been successfully tested in Mozambique and Zimbabwe. The Fossa Alterna uses two alternating pits with a similar frequency of alternation as the double-vault dry toilet. Once sanitized and composted, the contents are removed and used in agriculture. The Arbour Loo is a single shallow pit which receives soil additions after each use and a tree is planted in the pit when it is full.

Recycling

The recycling of nutrients from urine and faeces is one of the key benefits of ecological sanitation. The N, P and K found in urine is a valuable fertilizer and the high organic content of faeces makes the composted product – humus – an excellent soil conditioner. In addition, it is important to recover and reuse these nutrients toward sustainable ecosystems to reduce the drain on natural reserves and lessen the dependence on artificial chemical fertilizers.

Average daily production and nutrient content of urine and faeces

	urine	faeces
Per person	1.2 litres	150 grams (wet wt)
Nitrogen (g/ppd)*	11	2
Phosphorus (g/ppd)	1	0.6
Potassium (g/ppd)	2.5	0.6

* (Grams/person per day)
Source: Del Porto and Steinfeld (1999)

Some countries and cultures have been recycling human excreta for agricultural purposes for thousands of years, especially in China and Southeast Asia, but often excreta have not been properly sanitized therefore propagating disease. By implementing ecosan, we can safely recycle nutrients without risking people's health and polluting the environment.

Ecosan for grey water treatment and composting of household organics

The ecological sanitation approach can be broadened to cover all organic material generated in households such as kitchen and food wastes. If these organic materials are sorted within the home, rather than mixed with solid waste and dumped, they become valuable recyclable materials once composted. Grey water can be treated using biological filter systems, evapotranspiration beds and "constructed wetlands", and rainwater harvesting can be implemented to harness water for personal hygiene and irrigation. Figure 2 illustrates all the options in a fully functional ecosan household.

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