Ecological Sanitation

The Challenge

Every year more than three million people die from water-related diseases, caused by lack of access to safe drinking water by more than one billion people and by lack of safe sanitation by nearly two billion people.

The sewer system that is being promoted as the answer to poor sanitation in urgan areas is based on the assumption of unlimited water resources and it is bases on the situation of western european cities in 19th century. Civil engineers were allowed by vast economic growth in the industrial centres to ignore the natural cycles of rural life and natural environments.

In other regions of the world and nowadays even in the countries that do have sewerage it appears that the sewer system is not a feasible or optimal solution. The main reasons are that construction and maintenance costs go far beyond the financial means of most communities and that water shortage does not allow for proper functioning of the sewer system. If a sewerage network exists in a South country, it primarily serves the rich. Large volume of drinking water are used to flush, large volumes of grey and black water require treatment. Costs which can only be afforded by a miniorty of affluent people. And it takes a large claim of the governments expenditure and the country's fresh water resources too. More and more people start to realise that sewerage causes structural loss of natural resources and nutrients and does not serve the nations population.

Asking the obvious questions

In case a community expresses the demand to improve its sanitation, one should ask two obvious questions. Do we have enough water to run through the sewers? And, do we have enough money not only to construct, but also to maintain a sewer system? In many circumstances, the answer to both or one of the questions will be negative.
Even if there is water and money available, issues like whether operation & maintenance skills are available and, whether the social stability, institutional capacity and climate conditions are favourable might have a negative effect on the decision for sewerage.

Often, pit latrines are not an (appropriate) alternative either. High population density, danger of groundwater pollution and difficult soil conditions can deny people this otherwise simple option.

Also encouraged by a raising awareness about the interdependent relation between food security and natural resource management, people question the 'drop and store' sanitation approach, because it is based on the assumption that human excreta is waste.

Sanitation paradigm shift

People are becoming aware that fresh water is rapidly becoming a scarce resource, and agricultural inputs such as fertilisers are limited even as fertile arable lands. It is clear that to sustain human existence, one must maintain and not exploit the environment.

For the nature waste can be seen as a resource. Human waste (average 500 litres urine and 50 litres faces) contains a significant percentage (80-90%) of the nutrients (NPK) needed to produce the annual food demand, 230 kg of cereal, per person.
At the same time it is known that mixing human excreta with water optimises the survival chances of pathogens that cause many diseases. In order to destroy pathogens one should optimise the conditions, as such high pH rate (no mixing with urine), good oxygen supply, low moisture and high temperatures. These conditions are created in an ecological sanitation (dry) environment. A parallel can be found in the principle that guides the integrated solid waste management: *Don't Mix!* The urine diversion toilets work along this principle.

Benefits of ecological sanitation

For people in water scarce countries the benefits of ecological sanitation are obvious. Individuals save water, the sanitation conditions will improve, high construction costs can be avoided. On a national and communal level, authorities realise the potential of water conservation, ground water protection, employment creation, increase food security and the reduction of wastewater management costs a ll benefits that can come by introducing ecological sanitation.
It has been proven that ecological sanitation and more precise that a urine diversion system has many advantages for individual households. The question that now has to be addressed is whether EcoSan can be the solution for an entire community. In other words, will urine diversion systems if applied on a communal scale and supported by a municipality become (even more) attractive to more individuals.

Communal ecological sanitation
WASTE wants to explore, develop and demonstrate the advantages of communal ecological sanitation in order to meet the ***global need to develop sustainable and affordable sanitation***, in order towards:
Demand reduction for freshwater through water conservation and reuse
Efficient use of resources (waste nutrients) in urban agriculture and landscaping
Decrease of wastewater flows through prevention of wastewater production
Influencing consumer demand by presenting people with an option for sustainable and economic efficient environmental sanitation
Integration of the use of ecological sanitation into municipal policy
Development of guidelines for ecological sanitation

The last two decades international water & sanitation experts and organisations have raised the question whether conventional centralised sewage management is *the* answer to the increasing sanitation problems and natural resource protection related to urbanisation. Increasing numbers of people in the field have acknowledged that the focus for the years to come needs to be on waste prevention and reuse. In the light of high infrastructure costs per capita, water scarcity, decrease of valuable land space and population growth in urban areas and increasing uncontrolled wastewater flows WASTE questions the sustainability of centralised sewer network solutions and wants to contr ibute development of decentralised sanitation approaches.

At this moment, many ecological sanitation options are available world wide developed by scientists and artisans - from simple self-made toilets to sophisticated systems with electronic sensors and regulators.
All these sanitation options are based on similar principles at the waste management hierarchy mentioned in the ISWM policy paper:
Separate 'waste' at source
Avoiding freshwater use for transportation of the 'waste'
Decentralised services provision (collection, recycling and storage)
Allow reuse of 'waste' as fertiliser and soil conditioner

Ecological sanitation will not only significantly reduce or even eliminate environmental pollution related to human excreta management; in the end it is cheaper than centralised sanitation. Large investments in sewer networks and wastewater plants can be avoided.
At the same time, this decentralised approach to waste management will enhance opportunities for micro and small enterprises (MSE) in the water and sanitation sector.

WASTE wants to find the answer to the question, whether EcoSan can be a solution for entire communities and neighbourhoods if it is adopted and supported with sufficient inputs.
Together with our partners, WASTE wants to study and demonstrate the application(s) of EcoSan systems on a communal scale with the aim to develop sustainable and affordable sanitation systems that are based on waste prevention, efficient resource management and promotion of markets for recycled resources even further.

Objectives	**Expected outcome**
Present (dis)advantages of the application of EcoSan on community scale	EcoSan will show better communal cost-benefit results than conventional sewage management
Encourage customer to select an comfortable and attractive environmental form of sanitation	EcoSan will satisfy the sanitation requirements of individual household
Integrate 'waste' collection of EcoSan sanitation in municipal collection service provision	EcoSan communal collection of 'waste' is fully integrated in municipal policy
Contribute to the detachment of waste generation from economic growth (new housing)	Decrease of land and energy requirements for waste(water) treatment
Contribute to the reduction in public investment for sanitation	Substitute capital intensive urban waste(water) management by cheaper means of sanitation
Contribute to the formulation of guidelines and regulations with regard to EcoSan	Draft recommendations for regulations and guidelines for EcoSan, and eco-incentives
Contribute to future decrease of Co2 and NH4 green house emissions produced by conventional wastewater treatment	Decrease the wastewater flow and production of sludge Reduction of energy use for waste management
Substitute mineral fertilisers by 'waste' nutrients (urine) close to or 'at source'	Arrangement of for reuse of its 'waste' on communal level, such as in urban agriculture
Allow recycling of better quality wastewater (grey water) close to or 'at source'	Arrangement of for reuse of its 'waste' on communal level, such as in urban agriculture

Increase the communal and individual interest in Eco San	Financial investment in EcoSan facilities by households, entrepreneurs and municipalities

Additional Advantages
Scarcity of good drinking water and unsustainable management of nutrients are problems that many countries face. Waste management must prioritise waste prevention, separation, followed by recycling and waste recovery. This has been true for solid waste management since decades. WASTE is convinced that the same principles can be applied to human waste (excreta). Thereby, WASTE challenges the conventional concept that centralised sewage collection and treatment must remain the norm and desire. The existing basic concept of mixing and transporting excreta with water, especially in water scarce regions, is seen as a point of discusion.

Water conservation, waste separation at source and recycling that are the principles of ecological sanitation will contribute to diversity of environmental options for meeting sanitation demands. In addition, it is expected that the overall costs of EcoSan are lower and the economic benefits higher than the current sewerage practice. EcoSan presents an opportunity to undo the relation between economic growth and the growth of wastewater flows.

Innovation
Many ecological sanitation options have been successfully tested and proven to be a feasible alternative for individual households. However, few projects, with exception of a large program in Guangxi, the southern province of China, are implemented on neighbourhood and communal scale. WASTE believes that the challenge, new problems, but also advantages of EcoSan will only become clear when a progress on a larger scale in urban communities based on the willingness of a municipality with R&D support and sufficient backing with financial incentives can be made.
The concept is clearly innovative as it presents a real alternative to the paradigm of conventional sanitation management. It focuses on ways to provide products and services using fewer resources and to prevent waste.

Employment for the poor
EcoSan will create additional employment in the water & environmental sector in manufactury , construction sector, private waste collection sector, recycling business and agriculture.
A positive stakeholder attitude towards EcoSan will enhance the development of an entire new product range and service provision. As a relative simple and inexpensive technology, development and dissemination of EcoSan will in particular be attractive for the MSE sector. EcoSan will require the involvement of many organisations and institutions, similar in scope and professionalism to the current centralised sewer management sector.

C-N emission reduction
EcoSan will contribute to water conversation, prevent water resource pollution, contribute to fixation of C and N and the future substitution of Co2 and NH4 green house emissions, allow reuse of valuable N, P and K as fertiliser, contribute to the efficiency and will enable further development of decentralised (grey, industrial and agricultural) wastewater treatments. Current energy demands for wastewater transport and treatment can be avoid. It is expected that the overall energy demand for a fully developed and applied EcoSan system will be

significantly decreased. EcoSan, as an alternative to conventional sewerage, will also make use of construction material such as sand, gravel, clay etc.

The Ecological Sanitation Option

This sanitation option is based on the principle: DON'T MIX
This principle takes in consideration the small volumes that a human being excretes and different character of human faeces and urine. The table below illustrates this.

Annual excretion by humans in relation to fertiliser requirement of cereal*

	Urine 300-500 litre	**Faeces 30-50 litres****	**Total**	**Fertiliser need for 230 kg cereal**
Nitrogen	3,1-5,6 kg	0,09 kg	3,4-5.7 kg	5,6 kg
Phosphorous	0,24-0,4 kg	0,19 kg	0,36-0,6 kg	0,7 kg
Potassium	0,6-1,0 kg	0,17 kg	0,72-1,2 kg	1,2 kg
Total N+P+K	**4,2-7,0 kg = 94%**	**0,27-0,45 kg = 6%**	**4,5-7,5 kg = 100%**	**7,5 kg**
Pathogens	4	15		

* volumes differ depending on climate, eating habits and other conditions
** completely dehydrated this would only be 3-5 litres

Looking at these figures *the sanitation problem presents a solution* that includes an advantage for sustainable poverty reduction and food production targets. It also highlights the question why we should use scarce water resources to dispose and mix a valuable resource, urine, with a health hazardous material, faeces, that hardly has useful contents.

The dry/compost sanitation option is particular worthwhile considering among communities:
That live in (semi)-arid regions, where water cost and scarcity do not allow sewer networks;
That cannot carry the financial burden of sewer investment, operation & maintenance and wastewater treatment;
That cannot technically sustain the operation and maintenance of a centralised wastewater management;
That live on hard (rocky) surface soils, or the areas with a shallow water table;
That lives in socially-politically unstable regions, or is temporary settlements.

However, also in countries where conditions allow the construction of centralised wastewater facilities increasing interest in alternative sanitation options can be noticed for environmental as well as financial reasons.

The dry sanitation option optimises the conditions that accelerate the destruction of pathogens by increasing oxygen supply (ventilation), temperature (dehydration), pH rates (diversion of urine and addition of pH-agent), retention time (st orage), but lower moisture (diversion of urine and avoidance of adding water).

The Ecological Sanitation Option, continued…

DON'T MIX is accepted throughout the world as the best sustainable principle of solid waste management. In the middle of the 19th century this principle was ignored when water-born sewer networks were introduced as the solution for the disposal of human excreta. Although only ten percent of households in the world are serviced by this system, and only again ten

percent of the waste(d) water collected via sewers is treated before discharged in the environment, it is considered and defended as ‘the ultimate solution’.

The application of the *DON’T MIX* principle in technical terms is simple, however, it would benefit tremendously from research efforts and practical improvements that were halted 150 years ago.

Urine diversion toilet facilities (various applications exist) allow for separate storage, collection and re-use and/or disposal of the human excreta. Consequently, household wastewater remains and can be treated using cost-effective and simple technology and re-used.

Therefore, the main burdens of dry sanitation are not technical, but lay in the social and cultural acceptance of an alternative waste management approach. However, application in various parts of the world teach us that these obstacles can be overcome by awareness building, incentives and *showing that it works*. In most parts of the world the advantages are obvious to everybody. These experiences also show that dry sanitation is not necessarily considered to be an option for rural poor families only. Although the practical application is much easier to realise in the country side, sophisticated dry sanitation systems can also found in semi-urban households.

Essential for the proliferation of decentralised sanitation is the change in perception among sanitary departments of municipalities. Decentralisation implies a different role for them. A major shift away from large infrastructure works towards a logistical approach. More co-ordination with the private service sector and private house owners. However, most communities do have /had similar recent experience in the solid waste sector. Best-practices of this sector, but also from the agricultural sector, can be applied and integrated in a decentralised waterless excreta management approach.

Other stakeholders challenged to readdress sanitation features are architects and builders. As faeces are most (cost)-efficiently disposed by gravity, the location of the toilet in the house will be more restricted, unless we can count on the creativity of architects and craftspeople. Again, recent experience teaches us that design and technology are not the major obstacles.

The main key towards the up scaling of this household sanitation approach is in the hands of local decision makers encouraged by the demand for improved sanitation from the community. The role of organisations like WASTE is to inform and advise people about this option and its advantages.