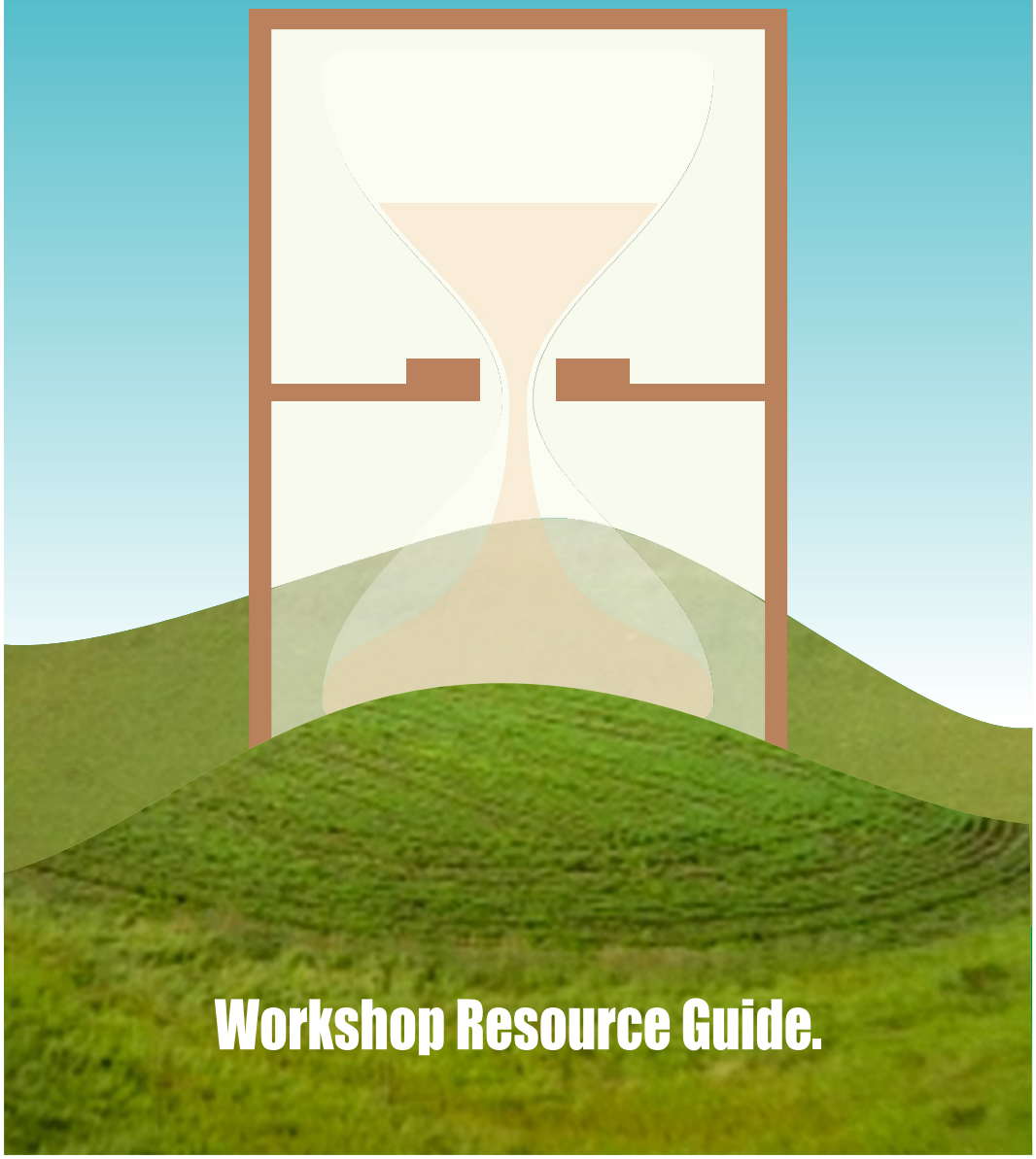
Regional Ecological Sanitation Workshop

15/17, Feb 2008, Bangalore



Workshop Resource Guide.

CapNet South Asia Regional Secretariat

Organises

Regional workshop

on

ECOLOGICAL SANITATION

15th, 16th, & 17th February 2008

Sponsored by

Cap Net

Arghyam
Safe, sustainable water for all

In collaboration with

WES-Net India
WATER AND ENVIRONMENTAL SANITATION

SEI STOCKHOLM ENVIRONMENT INSTITUTE

Cap-Net INDIA

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Contents

Background

South Asia and in particular the rural centers in South Asia are at a very crucial juncture. The water security and public health situation in most of the rural areas in South Asia is very poor due to inefficient ways of handling the existing as well as newly augmented fresh water supplies. The Urban centers are seen as water guzzlers by the Peri-urban and rural areas from where the water is diverted to cities. Uncontained and untreated excreta, does not only threaten the health for the unprotected rural poor but also causes damage to the entire rural economies with increased strain on health systems, and loss of productivity.

Given the huge scale of capacity development needs in the field of Ecological sanitation (a.k.a EcoSan), it is necessary to create resource pool of guides well versed with the concept so as to take up capacity building activities in a well networked manner.

It is in this context that CapNet South Asia Regional Secretariat feels that there is a strong need to address the sanitation issues and start building capacities and synergies in the region.

With this background, it is proposed that a 3 day Regional level workshop on eco-sanitation technologies and an initiation meeting of a network of guides be organized for developing capacities in understanding eco-sanitation and discussing the feasibility of forming a network of users across South Asia to take the debate forward as well as start individual actions for collective lobbying.

Rationale : As a matter of principle the problems that are not created do not need to be solved. And EcoSan does precisely the same. EcoSan generates opportunities that add value to human waste and possibilities of decentralized waste management are more amenable to citizen involvement all the while reducing pressure on public system. This can open up spaces for constructive engagement with local government on administrative matters, an area that is yet untapped. This workshop is an attempt to explore positive opportunities that are currently available at policy, project and program level and the need to exploit this phase.

Sanitation status

There are at least 2.6 billion people in the world without improved sanitation. Improved sanitation is defined by WHO as connection to a public sewer, connection to a septic system, a pour-flush latrine, a simple or ventilated pit latrine. Most of this 2.6 billion reside in rural Asia and Africa. But technically even access to "improved" sanitation does not solve the problem, as pit latrines which serve about 2.8 billion people usually fail to sanitize and contribute to ground water pollution. Also, septic systems and sewerage treatment plant often discharge in to the environment with little or no sanitization or nutrient removal, polluting the ground water table streams, lakes and coastal zones, helping to perpetuate the cycle of human disease and upsetting fragile aquatic ecosystems by nutrient overloading and eutrophication. The need to "close the loop" on nutrients indicates that a paradigm shift towards sustainable sanitation is necessary. The health risks associated with the current state of sanitation in the world require immediate action.

The millennium development Goal (MDG) targets to halve, by the year 2015, the proportion of people who do not have access to basic sanitation. More than 4 billion people will need to gain access to basic sanitation to meet the 2025 target of universal coverage.

Access to improved Sanitation - Urban (%)
Access to improved Sanitation - Rural (%)

	1990		1995		2000		2005	
Afghanistan	7	5	7	2	30	16	49	29
Bangladesh	55	12	54	18	53	27	51	35
Bhutan	...	...	65	70	65	70	65	70
India	45	3	49	9	55	17	59	22
Maldives	100	...	100	42	100	42	100	42
Nepal	48	7	53	15	58	23	62	30
Pakistan	82	17	56	26	89	34	82	41
Sri Lanka	82	64	93	75	96	85	98	89

Access to improved water source (%)
Access to improved Sanitation (%)

	1990		1995		2000		2005	
Afghanistan	4	3	4	3	21	19	39	34
Bangaladesh	72	20	73	26	74	33	74	39
Bhutan	...	...	62	70	62	70	62	70
India	70	14	76	20	82	28	86	33
Maldives	96	...	95	57	87	58	83	59
Nepal	70	11	77	19	85	28	90	35
Pakistan	83	37	86	45	89	52	91	59
Sri Lanka	68	69	72	79	76	87	79	91

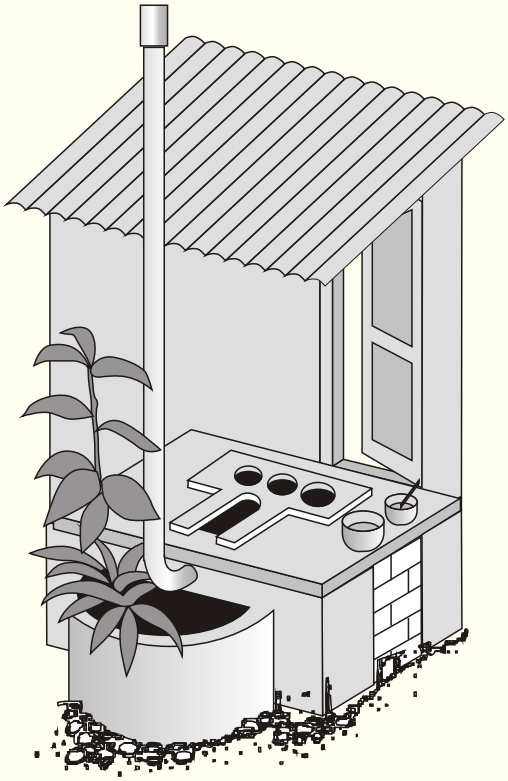
Source: World Bank Org

Introduction to Ecological Sanitation (Ecosan)

Ecological Sanitation can be viewed as a three step process dealing with human excreta : 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. It can involve soil based composting toilets in shallow reinforced pits, dry urine diverting toilets with storage vaults, urine diverting minimum flush toilets and even high tech vacuum systems. Cost effective ecosan can be adapted for developing and developed countries. It provides human health and environmental protection using affordable and appropriate technologies to match the needs of the entire world.

How it works

Ecological sanitation systems are designed around true containment and provide two ways to sanitize the human excreta - dehydration and decomposition. The preferred method will depend on climate, ground water table, amount of space and intended purpose for the sanitized excreta. Dehydration is the chemical process of destroying pathogens by eliminating moisture from the immediate environment. Drying materials like wood ash, lime and soil are added to cover the fresh excreta. Ash and lime increase the 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. 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 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, 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.



Fraction	General characteristics
1.Faeces	◨ Hygienically critical, potentially containing a series/ array of pathogens, leading to water-borne diseases (e.g.bacteria, viruses, protozoa, nematodes, worm eggs) ◨ Consists of organics, nutrients and trace elements ◨ Improves soil quality and increases its water retention capacity ◨ Average production ca. 50 kg/cap/a ◨ Consists mainly of organics submitted to decomposition processes and a minor proportion of nutrients
2.Urine	◨ Hygienically uncritical ◨ Contains the largest proportion of nutrients available to plants ◨ May contain hormones or medical residues ◨ Average production ca. 500 l/cap/a ◨ Consists mainly of nutrients available to plants and very little organics, therefore no need for stabilization
3.Grey water	◨ Usually of no major hygienic concern ◨ Volumetrically the largest portion of wastewater ◨ Contains usually almost no nutrients (simplified treatment) ◨ May contain a vast range of various substances ◨ Average production 25 100 m3/cap/a

The nutrient content of faeces and urine

Nutrient	Nutrients in Kg for crop production		
	Urine (500 1/year)	Faeces (50 1/year)	Total
Nitrogen	5,6	0,09	5,7
Phosphorous	0,4	0.19	0,6
Potassium	1,0	0,17	1,2
Total N+P+K	7,0 Kg(94%)	0,45 Kg(6%)	7,5Kg(100%)

Technology options

Composting toilets

Source separating dry system (achieved by ventilation & addition of bulleting material) Aerobic degradation of organic matter with a volume reduction of 70 to 90% onsite composting possible.

The systems can be

A.Single chamber continuous
B. Dual chamber
C.Single chamber with removable containers

A.Single chamber

continuous process

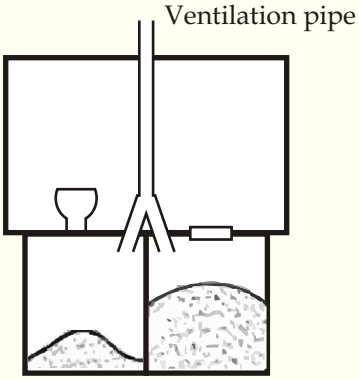
1. Fresh & mature materials are in the same compartment hence higher health risk.
2. Higher initial expense.

B. Dual chamber

1. Use of only one chamber at a time; the contents of the other vault matures undisturbed
2. Safe for person emptying
3. Needs more space

C.Single chamber with removable containers

1. The containers are removed when full and allowed to mature undisturbed
2. More compact and economical
3. Safe handling & storage needed.



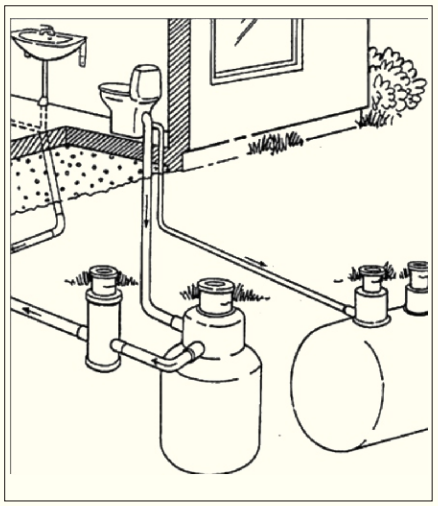
Dehydration toilets

1. Mainly suitable for regions with high average temperatures, avid conditions with short rainy seasons.

2. Reduction of moisture content or dehydration is achieved by combination of heat (solar), natural evaporation, proper ventilation and addition of absorption material
3. Usually double vaulted Systems

Urine diversion toilets

1. Separates urine at the source before it mixes with faeces.
2. Potential to recover majority of nutrient from waste water thus reducing pollution of surface/ground water
3. Minimizes hygiene risk



It can be a

Single flush system

which uses 0.5 lts water to flush urine and faecal material which is dry & is collected for further processing.

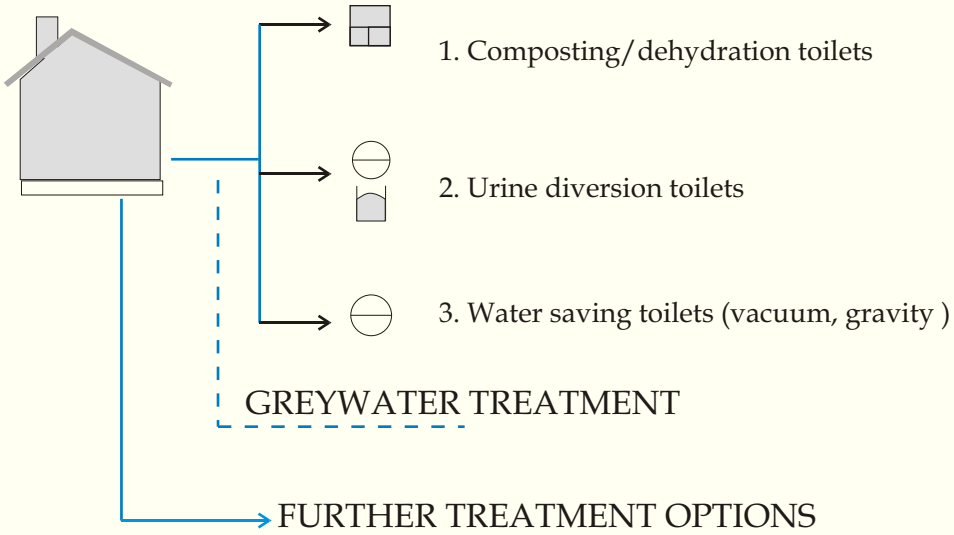
Dual flush system

In which, separate flushing is available for urine and faeces. Uses minimum water but needs a sewer system

Water saving vacuum toilets

They use 0.5 to 1.5 lts per flush and is a completely closed system. Used in ships, trains and aircrafts Need smaller diameter pipes than conventional gravity sewerage.

Collection



Treatment / Hygienization

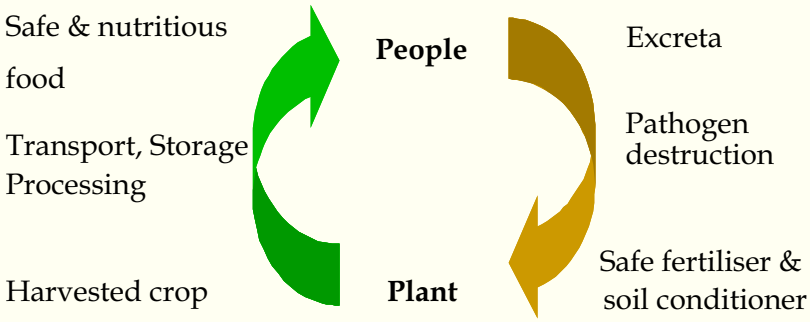
1. * On -site/off-site dry composting/+dehydration

2. * On -site/off-site dry composting
   * Storage

3. * On -site/off-site aerobic treatment liquid composting
   * On -site/off-site anaerobic treatment (biogas)
   * Drying and humification

Reuse of human excreta in agriculture

Ecosan system strives to close the nutrient loop between sanitation and agriculture, enabling an almost complete recovery of nutrients, organic material and water discharged in conventional sanitation systems. Closing nutrient loops and recycling organic material contributes to safeguarding soil fertility and improving its structure and water retention capacity, while providing a natural alternative to chemical fertilizers. In ecosan the term ' agricultural reuse' refers to a wide range of productive, ecosystem oriented reuse options, which include traditional agriculture for food crops, silviculture, horticulture, market gardening, aquaculture etc., It also includes reuse of grey water, organic content of waste water and energy.



- A family of four adults can produce an equivalent of around 30 kg NPK / year
- One person can provide enough nutrients for 200m^2 to 400m^2 agricultural production area, depending on soil & plant type
- Urine collected from one person during one day can be applied to 1 square metre of crop

Urine and faeces are complete fertilizers of high quality with low levels of contaminants such as heavy metals. They should be handled and treated according to hygiene guidelines.

Guidelines for safe use of human excreta, urine & waste water in agriculture

WHO Guide lines

1989 version : Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture.

2005 version : Guidelines for the safe use of wastewater, excreta and greywater.

EcoSanRes Guidelines

Guidelines on the safe use of urine and faeces in ecological sanitation systems

Guidelines on the use of urine and faeces in crop production

FAO Guidelines

FAO irrigation and drainage paper 47 : wastewater treatment and use in agriculture (1992)

New WHO Guidelines for the safe use of wastewater, excreta and greywater

Rules of wastewater, greywater and excreta in agriculture and aquaculture is practiced world wide on a large scale, however often without sufficient health protection measures.

WHO recognizes the importance of reuse of wastewater, greywater and excreta for sustainable food production and improved livelihood

WHO provides guidance on health protection measures for safe reuse.

WHO recognizes source-separation as a special and valid approach.

Definition : Disability adjusted Life Years (DALYs)

- DALYs are a measure of population health in terms of the burden due to a specific disease or risk factor.
- DALYs attempt to measure healthy years of life lost because of disability or death from a disease
- DALYs account for not only acute health effects but also for delayed and chronic effects.
- Different health outcomes (e.g. cancer & diarrhoea) can be compared and risk management decisions can be prioritized
- **Adopted protection level for wastewater / excreta use in agriculture in the new WHO guideline:**

  Tolerable additional disease burden

  <= 10^{-6} DALYs or 1 Daly per person and year

  = Only one of a million human life years expectancy will be lost due to the potential additional disease from wastewater /excreta reuse.

  = Same protection level as used in the WHO guideline for Drinking water.

"The social, ecological, economic benefits from well managed waste water & excreta reuse system far outweighs the possible risk due to the same."

Guidelines on the safe use of urine and faeces in ecological sanitation systems (EcoSanRes)

Focusses on the treatment and handling of faeces and urine, provides current information on risk management and assessment of source separation strategies technical and behavioural barriers against disease transmission, sanitation treatment methods, reuse in agriculture. The scope of guideline is limited to products from urine diversion devices and dry collection systems for faeces.

Recommendations for urine treatment and use

The main risks in the use of excreta are related to the faecal fraction and not the urine fraction. Technical constructions should be done in ways to minimize faecal cross contamination. At household level the urine can be used directly. Urine should, in large scale systems, be stored for one month at 20°C before use. A withholding period of one month between fertilization and harvest should be applied. Urine should be applied close to ground and preferably mixed with or watered into the soil.

Recommendations for faeces treatment and use

Faeces should be treated before use as fertilizer Primary treatment (in the toilet) includes storage and alkaline treatment by addition of ash, lime or urea. 1-2 cups (200-500 ml; enough to cover the fresh faeces) of alkaline material should be added after each defecation. Faeces should additionally be mixed into the soil in such a way that they are well covered. Faeces should not be used for fertilization of vegetables, fruits or root crops that are to be consumed raw, excluding fruit trees.

Recommendations for use of urine in cultivation

Urine is a quick acting Nitrogen-rich complete fertilizer. Best effects from prior to sowing, up until two thirds of the period between sowing and harvesting.

Recommended application rate and time should be based on the desired nitrogen application rate (based on local recommendations for chemical nitrogen fertilizers)

Rule of thumb : apply the urine from one person during one day (24 hours) to one square metre of crop (=300-400 m^2 per person and year)

Recommendations for use of faeces in cultivation

Faeces should be applied and mixed into the soil before cultivation starts. Local application in holes or furrows close to the planned plants allows for economic use. The application rate can be based on the current recommendation for the use of phosphorous based fertilizers (low application rate with little improvement due to the added organic matter)

Faeces can also be applied at much higher rates for improving structure and water holding capacity of the soil.

Pathogen reductions achievable by various health protection measures for wastewater use in agriculture

Control measure	Pathogen reduction (log units)
Wastewater treatment	1-6
Localized (drip) irrigation (low growing crops)	2
Localized (drip) irrigation (high-growing crops)	4
Spray drift control (spray irrigation)	1
Spray buffer zone (spray irrigation)	1
Pathogen die off	0.5-2 per day
Produce washing with water	1
Produce disinfection	2
Produce peeling	2
Produce cooking	6-7

"A combination of above measures will act as a multilevel barrier for pathogen transmission."

Onsite rain water harvesting technology

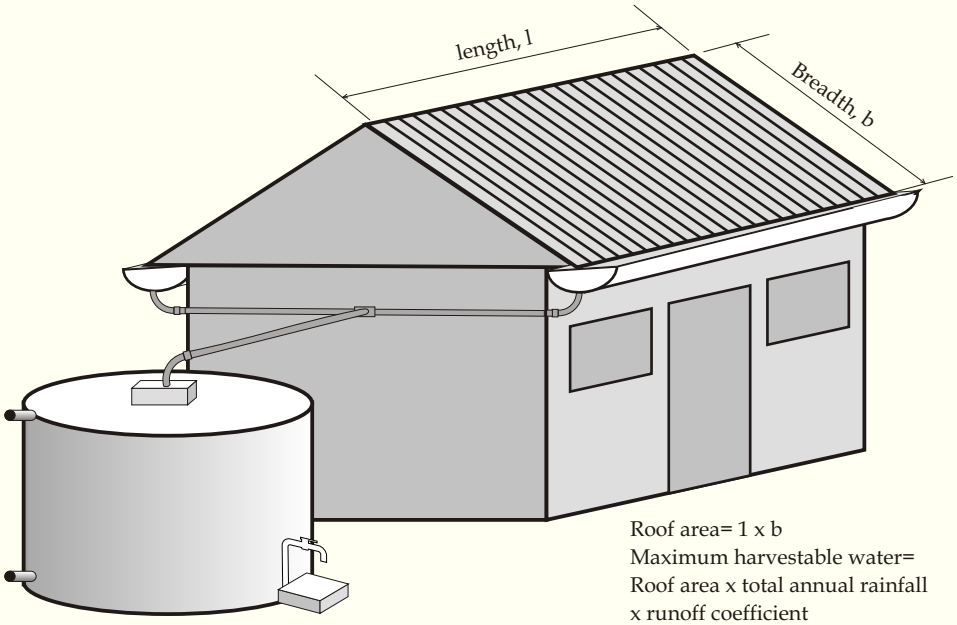
Around the world, the absence or scarcity of potable water continues to be a growing problem, especially in rural and remote areas of the developing countries. Although clean, fresh water may still be readily available in many other places, there are serious concerns about the increasing contamination of rivers,streams, lakes and ground water. Further more, wells that are being drilled deeper and deeper to extract ground water are resulting in ground water depletion in many continents.

Improvements are urgently needed in the conservation, collection, storage, treatment and reuse of water to meet the demands of an ever increasing population.

Collecting rainwater as it falls from the sky seems immensely sensible in areas struggling to cope up with potable water needs as well as contamination issues. Rain water is one of the purest sources of water as it contains very low impurities. Roof catchment with container storage is a practical way to collect rain water, largely because it is easy, low in maintenance and inexpensive, but household cleanliness is necessary. In regions where there is lack of water, roof catchment works, both as stand alone supply and as a supplement to a limited ground or surface water supply. Harvesting the rain is an old and traditional practice. Millions of rainwater catchment systems are relied upon in countries such as Australia, China, Newzealand , and Thailand as well as throughout Africa, south Asia, and South east Asia. Such a system is independent of any centralized or localized water system and helps to foster an appreciation of water as an essential and precious resource. A roof collection system can address both water quality and water quantity issues.

What is the potential for Harvesting ?

Sl.No	Rain Fall in mm (Annual)	From 10sq mtr.Roof area annually @90%collection efficiency in lts.
1	500	4500
2	1000	9000
3	1500	13500
4	2000	18000
5	2500	22500



Roof area= l x b
Maximum harvestable water=
Roof area x total annual rainfall
x runoff coefficient

On site treatment of grey water.

All house hold waste water, except toilet waste, is called grey water. This includes water from the kitchen, bathing, washing dishes and clothes. The amount of grey water varies from 20 lts to 200 lts/person/day.

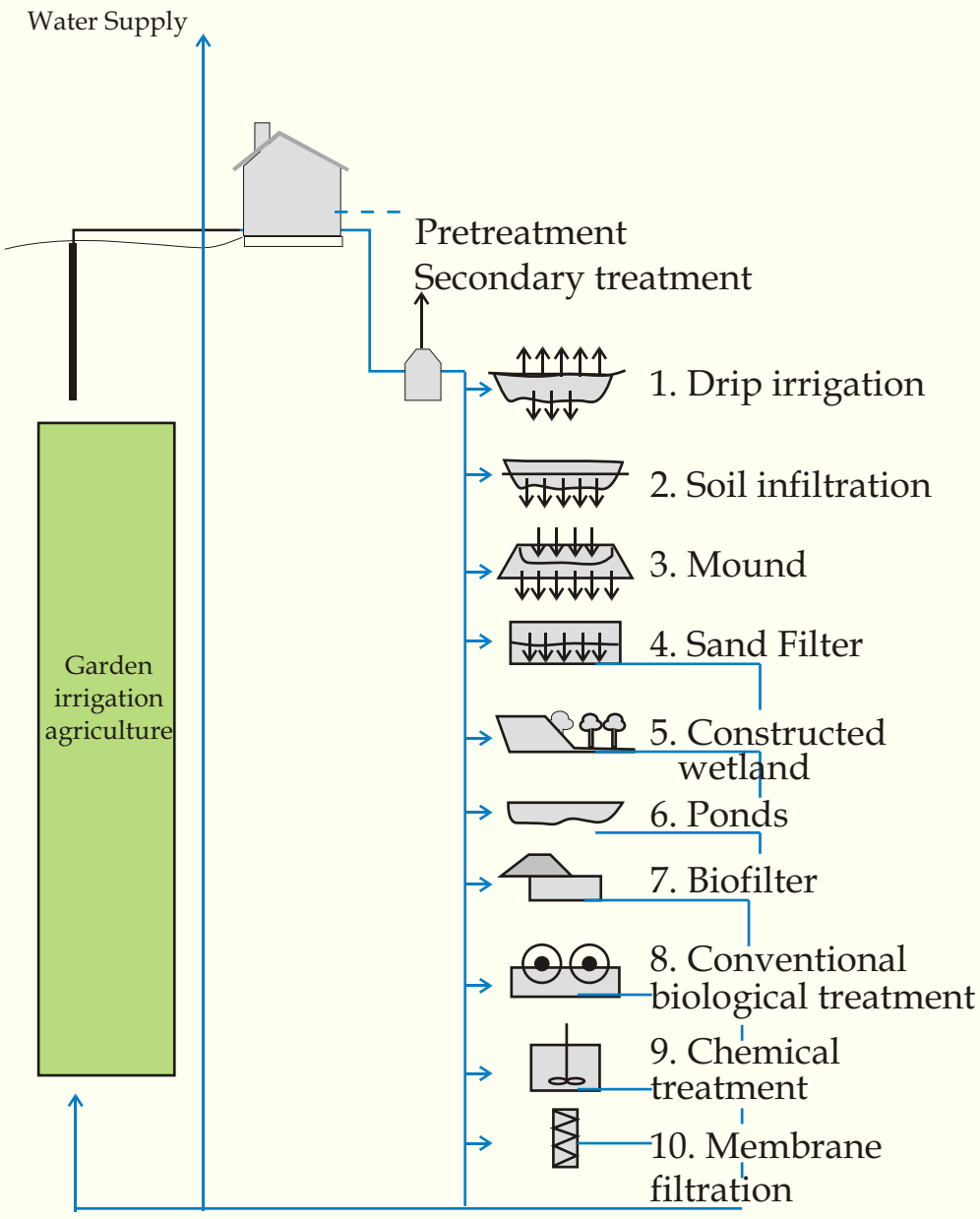
Grey water constitutes more than 90% of the water flow through the house. Composition of grey water varies greatly reflecting the life styles of the residents. Grey water physically contains high concentrations of easily degradable organic material such as fat and oil from cooking.The nutrient level in grey water is low compared to sewage. High concentrations of phosphorous is common due to cloth & dish washing detergents, but level of nitrogen is always low.It is free of pathogens, but grey water environment is favorable for bacterial growth which means that it needs to be treated before reuse. Also, untreated grey water easily turns anaerobic and thus creates foul odour.

Before treating grey water, simple pretreatment measures are taken to separate solid particles from the liquid by gravity, flotation and screens. On longer systems septic tanks, setting tanks, filter bags etc., are used for this purpose. If the system is small, grey water can be directly used on land where soil ecosystem will convert it into valuable plant nutrient.

If quantities are more the pre treated grey water is applied to soil through drip irrigation system, soil infiltration, raised mound filtration, sand filtration. Another option is to treat it in constructed wet lands, which is a shallow pond filled with porous media and vegetated with macrophytes. Flow is below the surface. Ponds are used when grey water is mixed with sewage.

Oxygen and Sunlight help in treating the waste water. Further more expensive and energy intensive technologies like bio filters, chemical treatment and membrane filters are available for grey water treatment. The treated grey water can be used in the garden for irrigation, discharged to surface waters or allowed to percolate into the ground to augment ground water .

Greywater Treatment Options



Pretreatment

Pretreatment is given to avoid clogging of subsequent treatment system

Solid liquid separation

By gravity, flotation, screens

Septic tanks, setting tanks, ponds, filter systems such as filter bags.

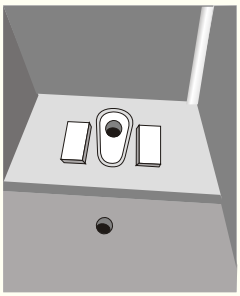
Technology Options

Features	Pros & cons
Drip irrigation	
Long flexible tubing with engineered openings or emitters Drop at slow rate to surrounding soil. Vegetation can absorb nutrients and help in cleaning grey water	+ efficient use of water - Higher initial cost - Choking of emitters due to organic film growth in pipes. + gravity flow no energy
Soil infiltration	
After leaving the pre treatment unit the effluent is distributed to the soil through open ponds or shallow trenches or infiltration basin. Suited for deep, well drained, well developed, medium textured soil	+ efficient treatment + inexpensive Not suitable in shallow water tables, sandy or impermeable soils - May offset the ground water quality + gravity flow, no energy
Mound system	
Similar to soil infiltration technique when existing soil is unsuitable for grey water disposal	

Sand filters	
Water is distributed on top layer and flows vertically down. Can be planted with a sand filter, often termed vertical flow wetlands Similar to infiltration	+ Plants avoid clogging of sand bed.
Constructed wet land	
Artificial shallow ponds vegetated with macrophytes usually sub-surface flow constructed wetlands Porous media used; sand, gravel, light wt aggregate crushed bricks etc 0.4 to 0.6 m deep systems are common in the tropics	+ Good reduction BOD and total nitrogen and phosphorus + good pathogen removal + can be gravity flow, no energy - Costs more than earlier systems
Ponds	
Used for sewage treatment also well suited for grey water treatment. Shallow man made basin through which grey water flows and has a retention period of several days	+ Good removal of BOD + Good reduction of Nitrogen and phosphorous + Robust & inexpensive - size & land requirement + can be gravity flow no energy
Bio filter	
Pre treated grey water is sprayed over a bio filter surface through a covered compartment Depth of bed usually 60 cms and light wt. aggregate & gravel in 2-10 mm size range.	+ good reduction BOD + good pathogen removal - Needs energy for pumping - More expensive
Conventional biological	
Treatment generally activated sludge treatment or fixed film sys-tems like trickling filters or rotating biological constructors are used.	+ compact setting & less space. + Efficient reduction of organic Matter

Rotating biological constructors are used. Since nutrient content is low treatment efficiency of systems also will be low.	- Requires more energy to operate & maintain - More expensive.
Membrane filtration	
Reverse osmosis using semi permeable membrane Micro, ultra and nano filtration	+ tertiary removal of dissolved salts, organic compounds, phosphorous, colloidal and suspended solids and human pathogens, including bacteria, protozoan cysts, and viruses.

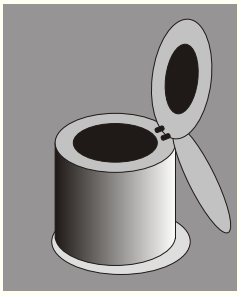
Urine diverting slab toilet, (used in China)



Urine diverting slab toilet, (used in India)

Single Flush Urine Diversion Toilet, (Used in Sweden)

Double Flush Urine Diversion Toilet, Sweden



Urine diverting insert to a Bucket toilet

Constraints & opportunities

In recent years there has been recognition that, when planning begins at local level and moves upwards, and when communities have more choice, there is greater chance of achieving sustainable Systems.
Community management of rural and small town water supply is now common in many parts of the world, on similar lines sanitation committees are also being framed.
Many of the constraints to implementation of ecosan are similar to the general aspects documented for the water supply and sanitation sector as a whole.Within this sector ecosan suffers because of lack of capacity and resources for implementation, weak institutions and seemingly universal lack of political will for sanitation and outdated legislation which is not harmonised with related legislations or overall development in the sector.

Codes & Regulations

As the concept of ecological sanitation is so new that not many cities or towns have any regulations relating to it. Existing regulations pertaining to water borne sanitation systems are not appropriate . New regulations will be required.

When ecosan is to be introduced on a large scale there is a need for specific regulations for the use of human excreta, urine and grey water as inputs for agriculture.
Such recognition is important because it is the starting point of ecosan to become the object of plans and programmes, financial incentive, tax exemptions, specific grants etc.

Today regulations are written so that they exclude systems that are not based on using water for human excreta.
The idea is to have regulations based on technology neutral functional criteria. It should state in qualitative terms the required performance of sanitation system to achieve societal goals. Some of the reasons for implementation deficit in relation to the existing regulations are:

- Outdated legislation: a legislation based on international recommendations without being adapted to the country setting
- New legislation / regulation has not been integrated into the daily implementation of the responsible authorities at different levels.
- Inconsistencies in bordering legislations / regulations / responsibilities of enforcement.
- Lack of personal financial resources / a knowledge capacity for the responsible authorities and actors, are possible effect of an incomplete decentralization process.
- Lack of public adherence to the legislation / regulation.
- It is important to remember that legislation might quickly become outdated if it is too specific and one needs to strive for a balanced situation between legislation and regulation.

Cultural and Religious aspects

Choices and behaviours related to sanitation are usually deeply rooted in a cultural understanding, more over, sanitation and related topics are often taboos. These fundamental aspects have to be considered when planning an ecological sanitation system. While planning an ecosan system three cultural considerations must be addressed

Psychological deterrents associated with the handling of human waste, which tend to be Universal

Gender issues which are both universal and local.

The influence of religion, which varies regionally despite universal doctrines associated with a particular faith. Cultural beliefs vary so widely in different parts of the world that it is not possible to assume that any of the practices that have evolved in relation to excreta and waste water use can be readily transferred elsewhere: Thorough assessment of the local socio-cultural context is always necessary .

It is vital to understand the psychological processes of waste treatment as much as the biological, chemical and physical processes of the system.

The psychology of waste treatment is understood by examining 3 elements

Attitudes towards excrement are universal
Behaviour regarding handling excreta varies from culture to Culture.
Motivations for using an ecosan system are many- hygiene, comfort, status, soil improvement, aesthetics, financial

Psychology
Universal negative attitude towards excreta. Behavioral acts of elimination and treatment vary worldwide. Motivations for use are diverse
Gender The physical and social demands for toilet varies between men and women and from culture to culture.
Religion Influence greater in eastern cultures and developing countries than western industrial countries. Spiritual association with purification

Political will

An enabling legislation and regulatory frame work do not alone produce the fulfillment of derived objectives of solving the sanitation problem. Without a political will and institutional capacity to enforce and implement the regulations from the national level down to local level the laws will remain beautiful words that do not call for action. Creating the political will to solve the sanitation problems at all levels in society is a major challenge. It is appropriate to ask if there will be more support and political will for ecological sanitation in a country than there is for conventional water and sanitation. The specific benefits of the closed loop approach must be communicated and promoted in such a way that the advantages of ecological sanitation, compared to other available sanitation systems and approaches as well as to the 'business as usual' alternative, become obvious to politicians and decision makers.

Political endorsement and support are a by element of policy development while political will is needed in implementation. Much effort must be devoted to political facilitation of policy reforms and then enforcement of policies for ecosan to be successful.

Financial aspects.

The introduction of ecosan system is bound to lower the total costs of urban sanitation as they need no water for flowing, no pipeline to transport sewage, and no treatment plants, and arrangements for the disposal of toxic sludge.
However, urban eco-san systems will involve costs of information, training, monitoring and follow up that are greater than corresponding costs for conventional sanitation systems.Initially the costs of building demonstration toilets, grey water system and ecostations, holding workshops and courses have to be borne by the govt. / funding agency. Subsequent scaling up costs could be covered by the local authorities and users. In practice, pilot peri urban sanitation programmes involving free or highly subsided demonstration models are likely to fail in the long run when false expectations have been raised regarding the cost of the system.

An urban ecosan system will generate additional costs that are not usually present in small rural ecosan projects, such as the safe handling, transportation, storage of urine and dehydrated or composted materials from many devices.

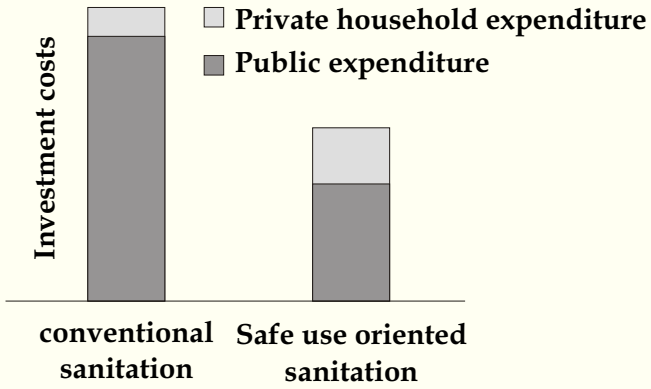
There will be significant economic return from the value of fertilizer produced.

Financing mechanisms

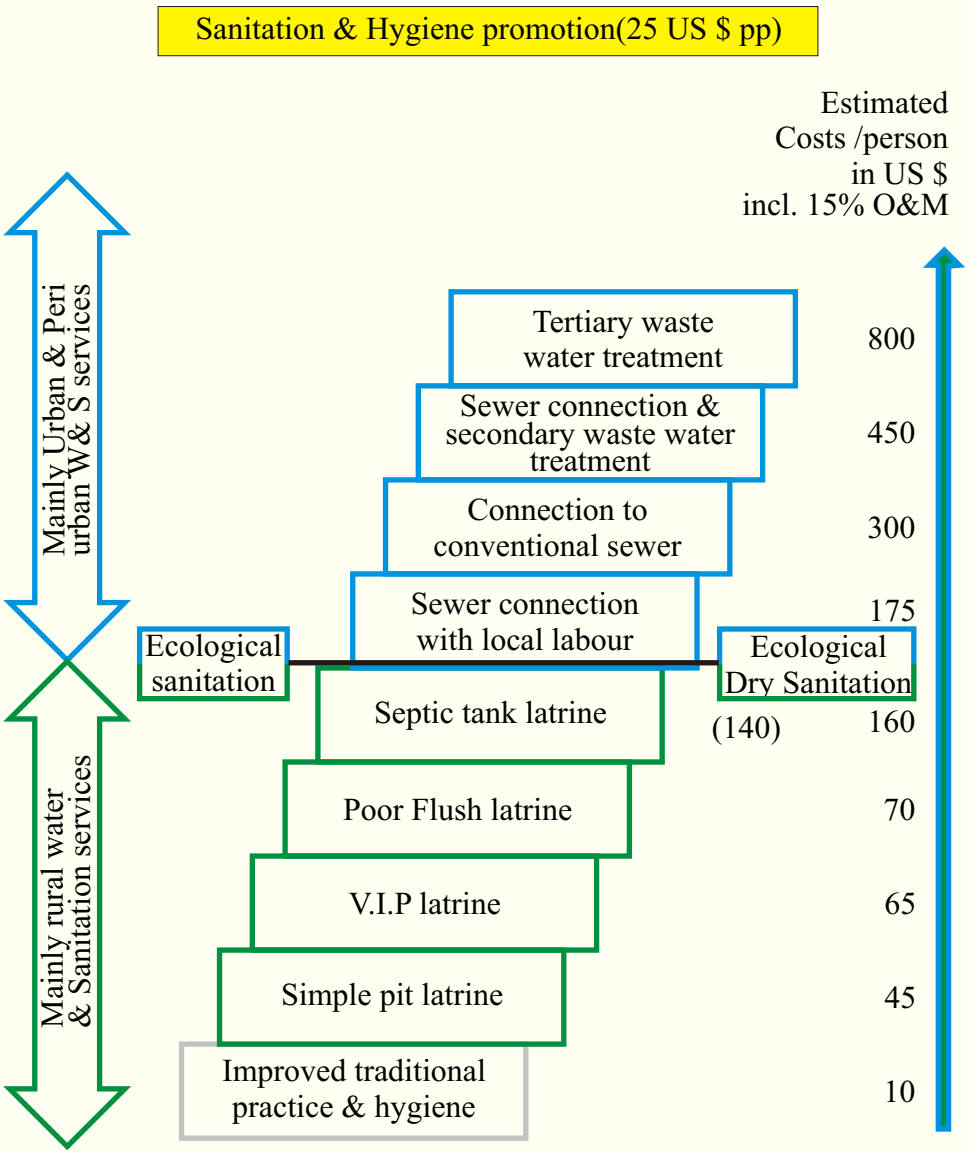
Appropriate financing instruments, putting particular emphasis on the possibility to finance the user's investment for on-site and neighbourhood systems and recognising those systems to recover and use excreta and grey water have a different cost structure from conventional sanitation systems. Innovative financing alternatives including start up funds, community based finance programmes, micro credit programmes and cost recovery mechanisms may therefore be required.

While developing financing mechanisms,allowances should be made not only for the investment, reinvestment, operation and maintenance of the system but also for the opportunity and environmental costs as well as the

external impacts on individuals and communities. Provision should be made for the financing of institutional capacity building, skill training, monitoring, assessment, policy and the development of an enabling atmosphere for sanitation. This includes awareness campaigns, hygiene promotion etc.



"Sanitation systems that recover and use excreta and greywater generally have a different cost structure than conventional systems. This needs to be recognised and practice oriented, research should focus on developing appropriate financing mechanisms to support private households in their decision to install them. As shown in the above figure, the total costs to install such systems tend to be lower than those for more conventional sanitation systems. This is mainly due to the decentralised, modular nature of source separating systems, which do not require large sanitary infrastructure, such as centralised treatment works, sewerage, or pump stations. In comparison to traditional decentralised sanitation (such as pit latrines for VIPs), they normally provide permanent solutions, and thus do not have to be replaced when full, representing a significant saving over time. However, although the overall costs are less, those to be covered by the private household may very well increase as a result of having to replace or transform domestic sanitary facilities (for example by installing a urine diversion toilet)."


Sanitation & Hygiene promotion(25 US $ pp)
Estimated Costs /person in US $ incl. 15% O&M
Mainly Urban & Peri urban W& S services
Mainly rural water & Sanitation services
Tertiary waste water treatment
800
Sewer connection & secondary waste water treatment
450
Connection to conventional sewer
300
Sewer connection with local labour
175
Ecological sanitation
Ecological Dry Sanitation
(140)
Septic tank latrine
160
Poor Flush latrine
70
V.I.P latrine
65
Simple pit latrine
45
Improved traditional practice & hygiene
10

Macro economic benefits

Investments in sanitation have a huge positive impact on the national economy
cost-benefit ratios averaging 5.5
WHO/UNICEF MDG Joint Monitoring Programme:
"access to safe drinking water and basic sanitation will bring dividend many times larger than the investment required."

Meeting the Sanitation Millennium Development Goal Target:
Costs estimations:
Between US$ 9 billion and US$ 15 billion
Payback estimation:
between US$ 65 billion and US$ 84 billion
Lower health care costs
Productivity gains.

Improved water supplies and basic toilets generate returns ranging from 3 to 4 times the original investment, depending on the type of investment and the country. For closed loop sanitation systems the return on investment is expected to be even higher.

The International Year of Sanitation - 2008

The United Nations Department of Economic and Social Affairs (UNDESA) is coordinating the International Year of Sanitation, in broad partnership with stakeholders including UN agencies, NGOs, the private sector and academia, to raise awareness and to accelerate progress on sanitation. An action plan has been prepared to outline the contributions and inputs of the United Nations agencies and partners to the International Year of Sanitation. The plan consists of activities both within and outside the UN-system to advance the implementation of sanitation related decisions.
The action plan includes activities to: raise awareness, release new and updated publications, advocate, monitor, access and commitments, advance

implementation, strengthen capacities, and evaluate costs and benefits.

The central objective of the International Year of Sanitation is to put the global community on track to achieve the sanitation MDG.

Sanitation is the foundation of health, dignity, and development. Increased sanitation access especially for poor people, is fundamental for reaching all the Millennium Development Goals.

The International Year of Sanitation aims to

Increase awareness and commitment from actors at all levels, both inside and outside the sector, on the importance of reaching the sanitation MDG, including health, gender equity, education, sustainable development, economic and environmental issues via compelling and frank communication, robust monitoring data, and sound evidence.

Mobilize Governments (from national to local) existing alliances, financial institutions, sanitation and service providers, major groups, the private sector and UN agencies via rapid collaborative agreements on how and who will undertake needed steps now.

Secure real commitments to review, develop and implement effective action to scale up International Year of Sanitation Objectives sanitation programmes and strengthen sanitation policies via the assignment of clear responsibilities for getting this done at the national and international levels.

Encourage demand driven, sustainable & traditional solutions, and informed choices by recognizing the importance of working from the bottom up with practitioners and communities.

Secure increased financing to jump start and sustain progress via commitments from national budgets and development partner allocations.

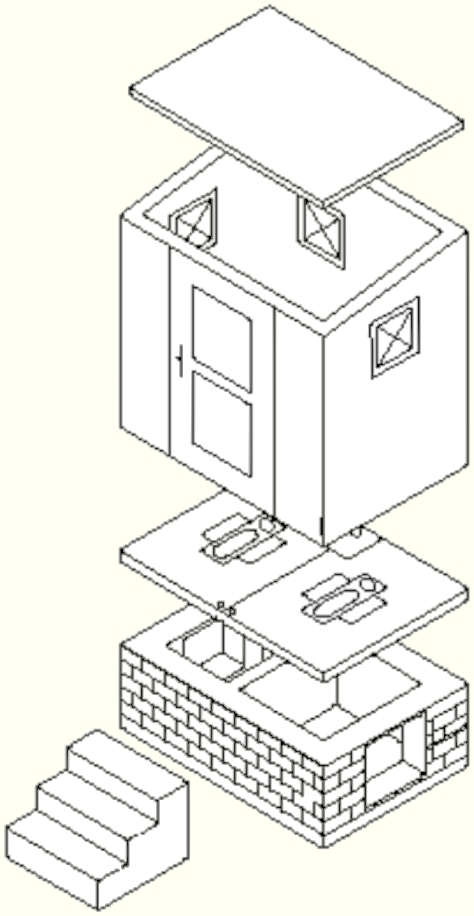
Develop and strengthen institutional and human capacity via recognition at all levels that progress in sanitation toward the MDGs involves interlinked programmes in hygiene, household and school facilities (such as toilets and washing facilities), and

the collection, treatment and safe reuse or disposal of wastewater and human excreta. Community mobilization, the recognition of women's key role and stake, along with an appropriate mix of "software" and "hardware" interventions are essential.

Enhance the sustainability and therefore the effectiveness of available sanitation solutions, to enhance health impacts, social and cultural acceptance, technological and institutional appropriateness, and the protection of the environment and natural Resources.

Promote and capture learning to enhance the evidence base and knowledge on sanitation which will greatly contribute to the advocacy and increase investments in the sector.

Exploded view of an ecosan system
(urine seperation and vent pipe not shown)



Opportunity

"Leapfrog the conventional centralised sewers - go straight to modern sanitation based on ecological principles."

References

1) Ecological sanitation, Uno Winblad & Mayling, Simpson - Hébert, Stockholm Environment Institute (SEI) 2004.
2) Jenssen. P.D, Greatorex. J.M & Werner. W.S, Sustainable 'waste water management in urban areas', University of Hanover, 2004.
3) Jenssen. P.D, 'Ecological sanitation - a technology assessment' (Ppt), 9th international conference 'Ecological Sanitation' Mumbai, India, Nov. 25, 2005
4) GTZ, 'Technical data sheets for ecosan components', Eschborn, Germany. 2005
5) Christine Werner, Florian Kingel, Ulrike Mosel, Sebastian Has, 'Vacuum Technology - collection and transport of sewage by means of low pressure' (Ppt) Pune W/S, 2005
6) WHO, guidelines for the safe use of wastewater, grey water and excreta , 2005
7) EcoSanRes fact sheet 1 to 12, Stockholm Environment Institute & Sida, 2005
8) Werner. W.S, 'Cultural aspects of ecosan' (Ppt) for mynetworks.org.
9) Christine Werner, 'International standard & guidelines, health and agriculture aspects'. Ecosan symposium, Syria, 2005.
10) Caroline Schanning and Axel Stenstrom, 'Guidelines on the safe use of urine and faeces in ecological sanitation systems'. Report 2004 - 2, EcoSanRes, 2004
11) Paul Calvert, 'Ecological solutions to flush toilet failures', Ecosolutions, 2004
12) UNEP (2004), financing waste water collection and treatment in relation to MDG & world summit on sustainable development targets on water & sanitation. Eigth special session of governing council global ministerial environment forum Jeju, Republic of Korea, 2004
13) Werner, ch,Et al., 'An ecosan source book for the preparation & implementation of ecological sanitation projects'. UNESCO/IHP and GTZ, Gmbh, 2006
14) Capacity building for ecological sanitation - ecosan resource material GTZ, 2006
15) S.Vishwanath, Rain water club, Personal communications

Acknowledgements

CapNet Global, Pretoria, South Africa

Cap-Net is an international network for capacity building in IWRM. It is made up of a partnership of autonomous international, regional and national institutions and networks committed to capacity building in the water sector. Cap-Net promotes the use of local institutions to plan and manage the delivery of capacity building services. Cap-Net works with international partners to improve local access to training materials, information and tools for integrated water resources management. Cap-Net is working with many networks of regional and national capacity building institutions. These partnerships provide the vehicle for a coordinated approach to the scaling up of capacity building support for sustainable management of water resources.

Arghyam Trust, Bangalore, Karnataka, India

Arghyam Trust is a public charitable foundation setup in 2001 with the vision **"Enough water, safe water ….always and for all"** . It seeks to drive strategic and sustainable efforts in the water sector that enhance equity in access to water for all citizens.

Arghyam seeks to support strategic and sustainable efforts in the water sector that enhance equity in access to water for all citizens with emphasis on sustainability - environmental, financial, social and technical - as the key desirable outcomes in all projects we support. Current project areas include Integrated Domestic Water Management, Rainwater Harvesting, Groundwater Management and Water Quality.

Wes-Net India, Delhi, India

WES-Net India is a learning alliance of stakeholders in the Water and Environmental Sanitation sector, including NGOs, UN agencies, private sector, consultants, government departments and donors. WES-Net's objective is to improve knowledge sharing and co-ordination within the water and sanitation sector - focused on achieving the Millennium Development Goals. WES-Net is also the Water and Sanitation Community of the UN's Knowledge Management Partnership Initiative. The solution exchange platform (e-discussions) enables WES-Net members to participate by rising and addressing issues which are shaping the water and sanitation sector in India.

CapNet India, Bhuvaneshwar, Orissa, India

CapNet India is a network for capacity building in Integrated Water Resources Management (IWRM). Dr.Smita Mishra Panda is the country coordinator for the past two years. She works through a core group representing academia, NGO and government organizations. CapNet India has country-wide membership of individuals as well as institutions, working in the area of water management. The broad issues in which capacity building has been undertaken by CapNet India are gender mainstreaming in IWRM, basic orientation on IWRM and its critique at zonal level (Area Water Partnerships) and network management. CapNet India has close linkages with other centers of capacity building in the government, University and non-governmental agencies that are focused on interdisciplinary approaches to water management.

SEI Stockholm Environment Institute

SEI is an independent, international research institute specializing in sustainable development and environment issues. It works at local, national, regional and global policy levels. The SEI research programmes aim to clarify the requirements, strategies and policies for a transition to sustainability. These goals are linked to the principles advocated in Agenda 21 and the Conventions such as Climate Change, Ozone Layer Protection and Biological Diversity. SEI has been engaged in major environment and development issues for a quarter of a century. It seeks to be a leader in the creation of a new field of sustainability science aimed at understanding the fundamental character of interaction between nature and society, and to contribute to the capacities of different societies to build transitions to more sustainable futures.

CapNet South Asia

CapNet-South Asia is the regional network of capacity building institutions in South Asia for institutionalizing Integrated Water Resources Management (IWRM) from a participatory, interdisciplinary and gender sensitive perspective for improved economic growth, enhanced social equity and increased environmental sustainability. Its secretariat is based at Hyderabad, India. The larger objective is to create, consolidate and institutionalize the facilities for conceptualizing, planning and operationalising Capacity Building for IWRM in South Asia.

Relevant web links:
Courtesy of GTZ & EcoSanRes Websites

International ecosan programmes and networks

EcoSanRes
International ecosan programme, sponsored by the Swedish International Development Agency (SIDA). Extensive ecosan information, publications, case studies, etc.
www.ecosanres.org

EcoSanRes discussion group
http://groups.yahoo.com/group/ecosanres

WASTE
Dutch NGO/consultancy group with international ecosan activities.
www.ecosan.nl

EcoSan Club
Austrian NGO with many international ecosan activities. Project information and publications.
www.ecosan.at

International organisations with ecosan activites

WSSCC
Water Supply and Sanitation Collaborative Council. Guidance on household-centred environmental sanitation.
www.wsscc.org

WHO
World Health Organization. Guidance on health aspects of wastewater and excreta reuse.
www.who.int -
http://www.who.int/water_sanitation_health/wastewater/en/Index.html

IWA
International Water Association. Specialist group on ecological sanitation.
www.iawq.org.uk

UNDP
United Nation Development Program
www.undp.org - http://www.undp.org/water/index.html

IEES
International Ecological Engineering Society. Newsletter, events, case studies, etc.
www.iees.ch

MyNetworks
e-learning and networking platform for ecosan, ecological engineering, etc.
www.mynetworks.org

WECF
Women in Europe for a Common Future implement ecosan projects in Eastern Europe.
www.wecf.de - http://www.wecf.de/issues/eco-sanitation.php

WaterAid
International charity dedicated to helping people escape the stranglehold of poverty and disease caused by living without safe water and sanitation.
www.wateraid.org -
http://www.wateraid.org/international/what_we_do/
where_we_work/mozambique

Biogas for Better Life, An African Initiative
Iniative which aims to improve the health and living conditions of women and children, protect the environment, and catalyze a new biogas related business sector in Africa.
www.biogasafrica.org -
https://www.biogasafrica.org/Pages/Default.aspx

GTO
German Toilet Organisation.
www.germantoilet.org

WTO
World Toilet Organisation.
www.worldtoilet.org - http://www.worldtoilet.org/hp/wto_hp.htm

GATE International e. V.
International NGO with experiences on appropriate technologies
www.gate-international.org - http://www.gate-international.org/briefs.htm

National ecosan programmes and networks

Ethiopia, SUDEA
Society for Urban Development in East Africa.
www.sudea.org

Luxembourg, CRTE
Resource Centre for Environmental Technologies.
www.crte.lu - http://www.crte.lu/mmp/online/website/content/water/76/index_EN.html

Mexico, Sarar Transformación
Ecosan reference and support centre.
www.laneta.apc.org/sarar/

Mexico, REDSECO
Red de Saneamiento Ecológico en México (Ecological sanitation network Mexico).
www.laneta.apc.org/redseco

Philippines, PEN
Philippine Ecosan Network. Discussion group.
www.groups.yahoo.com/group/ecosan-philippines

Zimbabwe, Aquamor
Peter Morgan's work on ecosan in Zimbabwe.
www.aquamor.tripod.com - http://aquamor.tripod.com/page2.html

Vietnam, VnEcosan.org
News, project information and a discussion forum on ecological sanitation in Vietnam.
www.vnecosan.org

Global Dry Toilet Club of Finland
Finnish association to promote the use of dry toilets

www.drytoilet.org

EcoSan Organisations

Agricultural University of Norway -http://www.ecosan.no/

UNDP - http://www.undp.org/water/

Sida (Sweden) - http://www.sida.se/

SARAR Transformacion SC (Latin America) - http://www.sarar-t.org/indexesp.htm

Espacio de Salud (Mexico) - http://www.laneta.apc.org/esac/home.htm

GTZ (Germany) - http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/8524.htm

Novaquatis EAWAG (Switzerland) - http://www.novaquatis.eawag.ch/english/general_e.html

Water Page (Africa) - http://www.africanwater.org/ecosan_main.htm

Aquamor (Zimbabwe) - http://aquamor.tripod.com/index.html

Sanitation Connection - http://www.sanicon.net/titles/topicintro.php3?topicId=17

WSP World Bank - http://www.wsp.org/

CITA (Mexico) - http://www.laneta.apc.org/esac/citaing.htm

International Ecological Engineering Society - http://www.iees.ch/news.html

Ecological Engineering Group

EcoWaters (formerly Center for Ecological Pollution Prevention) - http://www.ecowaters.org/

City Farmer - http://cityfarmer.org/comptoilet64.html

Mvula Trust (South Africa) - http://www.mvula.co.za/

Technical University Hamburg-Harburg -

Http://www.tuharburg.de/aww/

IWA Specialist Group on Sustainable Sanitation - http://www.tu-harburg.de/susan/

Eco-Solutions - http://www.eco-solutions.org/

The Hesperian Foundation - http://www.hesperian.org/

MAMA-86 Ukraine - http://www.mama-86.org.ua/main/news_e.htm

Mvuramanzi Trust (Zimbabwe) - http://www.mvuramanzi.org.zw/

CREPA (West Africa) - http://www.reseaucrepa.org/

Sustainable Sanitation and Water Renewal Systems (SSWARS), Uganda - http://www.sswarsuganda.org/

SCOPE India - http://www.scopetrichy.com/

Publications and Articles

Waterlines

Urban Agriculture Magazine (RUAF)

UNDP papers on ecological sanitation

Sida publication: Ecological Sanitation (in 5 languages)

Sanitation Publications (WSP-World Bank)

Divide and Spray - Sweden

Innovative Ecological Sanitation Concept Shows Way Towards Sustainable Urban Development,

Almut Hoffmann, Germany

Ecological sanitation: Protecting our environment,

Aussie Austin, South Africa

Ecological Sanitation Closing the Loop in Wastewater Management and Sanitation,

Uschi Eid, Germany

Ecological Sanitation: Closing the Loop

GTZ Ecosan Publications

Taking Care of Our Ecosan and the Reuse of Humanu andEcofert (Mvuramanzi Trust)

Acceptance Analysis of New Technology for Sustainable Water Management and Sanitation: A Case Study of Operating Farm Households in the Mekong Delta, Viet Nam (Florian Wieneke, University of Bonn)

The Dry Composting Toilet: An efficient, dignified, and healthy system for everyone (Lourdes Castillo Castillo, Mexico)

Market Place

Composting Toilets http://www.compostingtoilet.com/

Livus Multrum - http://www.clivus.com/

Wost Man Ecology - http://www.wost-man-ecology.se/

SanPlat - http://www.sanplat.com/

Separett - http://www.separett.com/

Terra Munda - http://www.mavab.se/g_nyheter/2001/nyhet_2.htm

Dubbleten - http://www.dubbletten.se/

Aquatron - http://www.aquatron.se/

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