Manual

Safe and profitable toilets

A solution for health and wealth

Urine diverting toilets

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WECF

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What is WECF?

Moving people for a world in balance

Women in Europe for a Common Future is a network of over 100 organisations and individuals working for sustainable development, protection of human health and environment and poverty reduction, including empowering women. Our international network consists of members and partners in Western and Eastern Europe, the Caucasus and Central Asia.

What is in this manual?

WECF Sanitation projects

WECF supports its partners in 13 countries to build demonstration dry urine diverting toilets for private and public (schools) use in:

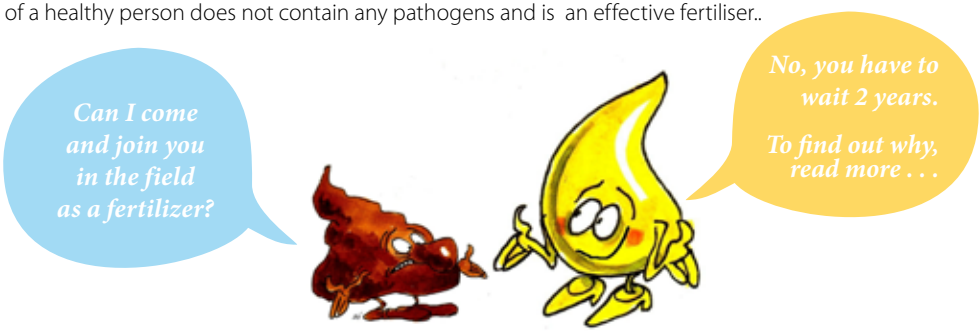
- *Afghanistan*
- *Armenia*
- *Azerbaijan*
- *Belarus*
- *Bulgaria*
- *Georgia*
- *Kazakhstan*
- *Kyrgyzstan*
- *Moldova*
- *Romania*
- *Tajikistan*
- *Ukraine*
- *Uzbekistan*

If you don't use this brochure, please give it to somebody else!

How toilets can be safe and save you money?

Safe toilets can prevent a lot of trouble

It is scientifically proven that sanitation and health are closely related. Toilets can even save lives! This is because there are millions of pathogens in the faeces. Pathogens are tiny living things that can spread diseases. Therefore it is important to treat our faeces before handling it. The urine of a healthy person does not contain any pathogens and is an effective fertiliser..



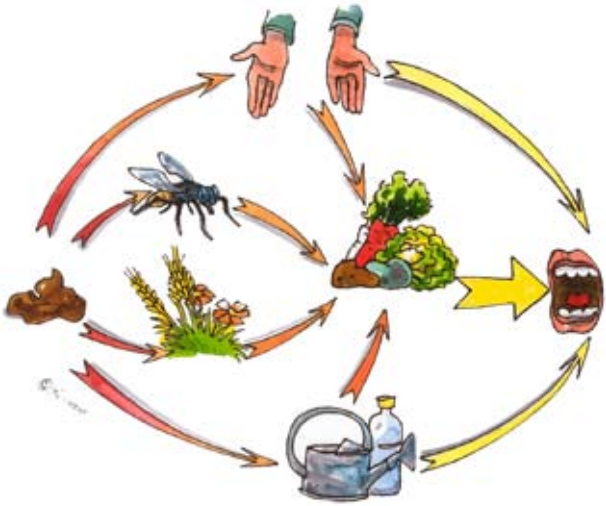
In many so-called ‚developed countries', where there are flushing toilets and sewage systems, people are starting to realise that these systems are very expensive to construct and maintain. Also, they use a lot of valuable water and pollute the environment, especially rivers.
Safe water is one of our scarce natural resources that we should use wisely!
This brochure describes how you can easily construct a toilet which is relatively cheap, doesn't use water and allows you to use the excreta as safe and effective fertiliser. This toilet does not smell or attract flies and is easy to clean. It can even be constructed inside the house. The time needed for constructing such a toilet is about 5 days. You can construct it from materials which you already have or find materials at your local market. The total costs may vary from 100 - 700 USD. This may seem like quite a lot of money but compare it to the costs of an unsafe toilet. And also the costs of visits to the doctor and medicines, time off work because of sickness. And the health of your children, which is beyond any price. A safe toilet will protect you from diseases like diarrhoea, hepatitis, cholera and, typhoid fever because pathogens in faeces will no longer contaminate your environment and drinking water and cause you infectious diseases. Moreover, you can increase your harvest by 1.5 to 6 times[4] or save money on artificial fertilisers such as NPK (Nitrogen, Phosphorus, Potassium) which are used by many farmers.
If you have 5 people in your family, you save one sack of fertiliser (50 kg) per year. Does the investment in a safe toilet seem more logical now?
If not, don't forget to include in your calculation the costs you will save for constructing your current toilet! Once you have built your safe toilet there are no additional costs and the toilet will last for at least 10 years.
We invite you to read this brochure on safe and profitable toilets carefully. If this information is not interesting for you, please give it to somebody else.

Why can the absence of toilets or unsafe toilets make people sick?

Faeces which end up in our mouth

Faeces contain millions of pathogens which can easily make us ill.

They can enter the human body via our hands, the food we eat or the water we drink. Flies can also bring the pathogens from the faeces to the food. Untreated faeces, which is disposed of in open areas, bushes or agricultural fields will contaminate the crops and water. But also pit latrines often leak pathogens into the ground water, which can contaminate drinking water as well.



These routes from faeces to human bodies can be blocked by several barriers:

1. Building a toilet that does not allow faeces and urine to leak or spread into the environment
2. Washing your hands with soap after each toilet visit
3. Storing food and water in clean places
4. Boiling water and cooking food for at least 5 minutes to kill pathogens

This brochure focuses on the principles of constructing and using a toilet that does not allow leakage into ground- or surface water, does not contaminate the fields and does not attract flies. BUT don't forget to implement additional hygienic measures to block the routes from faeces to human bodies.

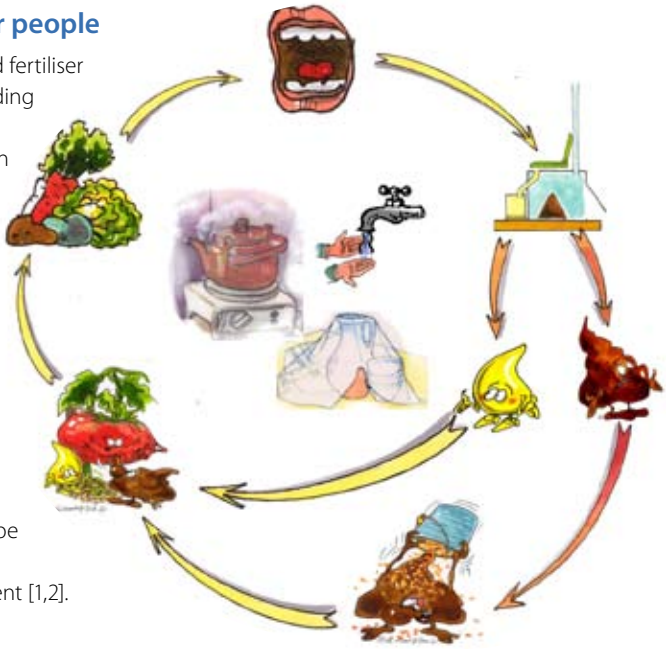
It is very important that you and your children wash your hands after visiting the toilet and before eating to prevent diseases in your family. And clean your nails!

The principle of Urine Diverting Dry Toilets

Safe use of waste as fertiliser and preventing contamination

Nutrients are anything that feeds plants, animals, or people

When farmers add compost and fertiliser to the soil, these are ways of adding nutrients. The cycle of nutrients starts with the crops we grow on the field, which we eat as food and afterwards end up as faeces and urine in the toilet. Now we apply the principle of a urine diverting dry toilet; the urine will be diverted from the faeces. The urine can be used as a fertiliser straight away. The urine from a healthy person does not contain pathogens. It has a lot of nutrients and can be used safely as an effective fertiliser without further treatment [1,2].



The faeces can also be used as a fertiliser, but not immediately

It has to be treated before use as a fertiliser in order to kill all the pathogens [1,2].
The urine can be stored in a tank.
This can be done by drying or composting.
In dry urine diverting toilets no water is used; on the contrary, water even harms its functioning. Instead, the faeces always has to be covered with ashes, sawdust or other dry organic materials*, to prevent smelling and to help the drying process of the faeces. After 2 years of uninterrupted drying and/or composting (no addition of fresh faeces), the dried/composted faeces can also be used to improve the soil. You will see how to keep the dry and fresh faeces separate later on in this brochure. When doing so, the rules on page 9, 12 and 13 should be followed. When you use it on your land you can gain more crop yields and the cycle starts again . . .

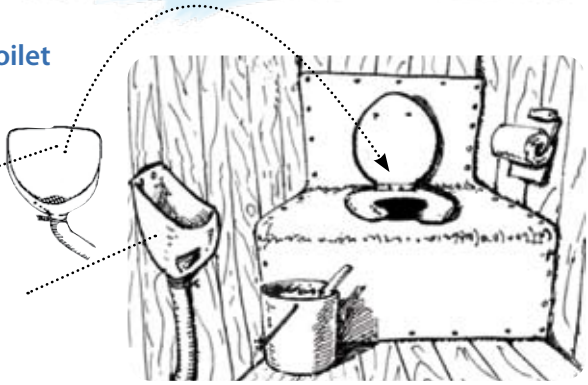
** Organic matter is what is left when plants and other living things die and decompose.*

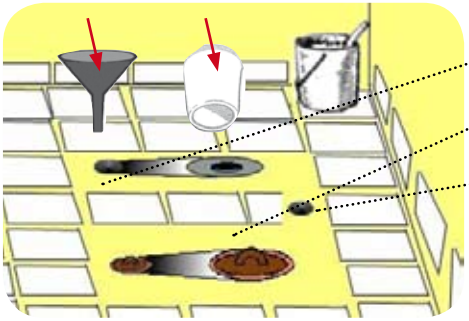
How to divert urine from faeces?

Many options are possible. Be creative!

One idea for a sitting toilet

Cut the bottom and side of a plastic jug. Attach it, upside-down, with the open side towards the back of the toilet. For men a waterfree urinal can be used.





Design: CAAW - PHAST, 2006

For the urine: Use a big funnel or make a hole in a bowl and build it into the floor.
For the faeces: Cut the bottom out of a bucket and build it into the floor.
For anal washing: an extra hole can be constructed like the one of urine.

Urine-diverting toilet seats or - slabs can be bought in some places. Contact WECF for the nearest provider.

Do´s

- ✔ *Be absolutely sure that no faeces can enter the urine hole*
- ✔ *Be sure that all urine flows into the collection tank*
- ✔ *Use water-resistant paint, tiles or linoleum at places where urine might fall*
- ✔ *Use a lid for the faeces hole*

Don´ts

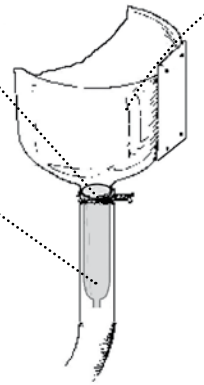
- ✔ *Don‘t use materials which can absorb urine*
- ✔ *Don‘t make the urine hole too big, as this will cause smell*

How to collect the urine?

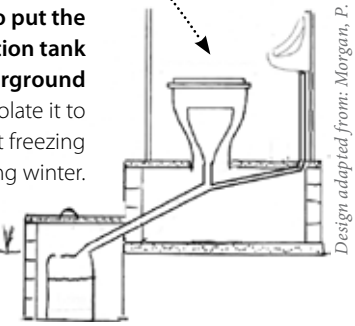
Urine goes down the pipe into a tank

Attach a tube or hose to the spout of the urinal (part), making sure there are no leaks.

You can use a finger of a rubber glove or a condom (with a hole) at the urine outlet of he toilet for extra smell prevention. In this case, the urine pipe must go straight down.



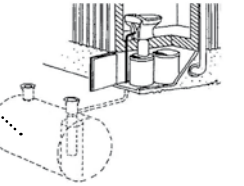
You have to put the collection tank underground and isolate it to prevent freezing during winter.



Design adapted from: Morgan, P. (2001)

A small urine tank is cheap and easy to empty.

A big urine tank doesn't need to be emptied as often but needs a pump to take the urine out.



Tip: The water from anal-cleaning can be channeled into the adjacent garden with plants which are not used for consumption.

Do´s

- ✔ *Make sure that the urine tank can be emptied easily*
- ✔ *Use a urine tank with strong walls*
- ✔ *Be careful in the choice of material for the tank. Plastic and concrete is okay!*
- ✔ *Make a proper connection between the jug and other urine pipes*
- ✔ *If the pipe is curved make sure it will not block*
- ✔ *Make a little ventilation hole in the urine collection tank so that urine can in and air can go out*

Don´ts

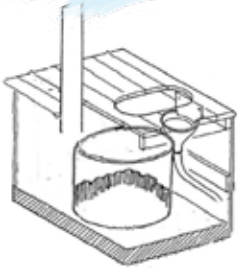
- ✔ *Avoid an upward or horizontal gradient of urine pipes (always slope downwards)*
- ✔ *Avoid sharp bends in the piping*
- ✔ *Don't construct the urine pipe under the faeces hole*
- ✔ *Don't use iron pipes or barrels because it will corrode (PP or PE is better than PVC)*

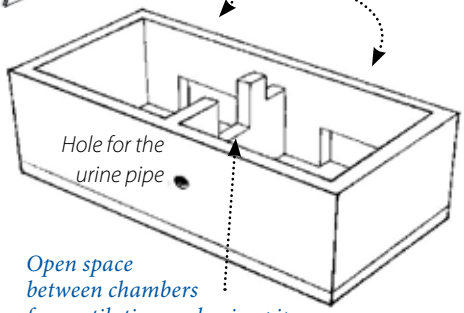
How to collect the faeces?

Single or double vault

Single Vault

Use a container to collect the faeces. When it is full, store the faeces in a dry place for 2 years or compost it. Place an empty container in the faeces chamber.





Design adapted from: Winblad, U. (2004)

Double vault

Build 2 chambers. Use the first chamber. When it is full, switch to the second chamber. After 2 years, the first chamber can be emptied and used again. A common size of 2 faeces chambers is: 1.5 x 1.5 x 0.6 meter with 2 openings of minimal 0.50 x 0.50 meter. The foundation should be a bit above ground level, so that no water can enter from below. Our tip: to use stones together with concrete to make the foundation. This saves concrete and thus money.

Tip: Construct the faeces chambers in the direction of the sun (south), so that the faeces get hot which makes the pathogens die more quickly.

Do´s

- ✔ *Use proper baked bricks for the faeces chamber(s)*
- ✔ *Be sure that the treated faeces can be removed after drying (make doors)*
- ✔ *Put 3 cm fine layer of ashes or sawdust on the floor before using a chamber This stimulates the drying process*
- ✔ *Insulate the faeces chambers doors to prevent heat-losses in the house*

Don´ts

- ✔ *Don‘t design the faeces chamber(s) too small*
- ✔ *Don‘t forget to leave a hole for the urine pipe*
- ✔ *Don’t make the doors too small so that the faeces can easily be removed*

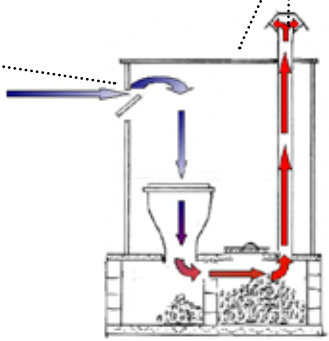
How to ventilate?

Install a pipe with a cover

A ventilation pipe allows the moisture of the faeces to escape. Air flows from a high to low pressure, from cold to warm.

Prevent water entering through the ventilation pipe, by covering it and make proper connections between the pipe and roof.

A window provides some fresh air.



Design adapted from: Morgan, P. (2001)

Source: http://www.red-ring.at

A wind driven or electric ventilator reduces the possibility of bad smell.

Do´s

- ✔ *The pipe should be as straight as possible*
- ✔ *Connect the two faeces chambers in such a way that only one ventilation pipe is needed*
- ✔ *Use black materials for the vent-pipe which absorbs heat more easily*

Don´ts

- ✔ *Don't make sharp turns in the ventilation pipe, it blocks the air flow*

How to convert faeces into a safe soil conditioner?

Drying or composting

Drying

The process of drying starts after the last input of fresh faeces.
After 2 years drying, the faeces has become a safe soil conditioner[2].
Covering the faeces with ashes, sawdust or other dry organic materials helps them to dry and prevents smelling. Pathogens die faster with ashes then with other organic materials. It is recommended to level the faeces heap from time to time so that fresh faeces is easy to cover.

Composting

Compost is plant matter and manure that has broken down and turned into a soil conditioner. Composting is especially handy for single vault toilets because a full container can easily be emptied on a compost pile. For this process you also have to cover the faeces with organic material, for example sawdust. The time needed to kill all pathogens depends on the temperature of the compost pile. In climates with long cold winters, it can take 2 years. The compost is also ready if the compost heap can be warmed up to more than 50 degrees Celsius for at least one week[3].

A compost heap is like a livingbeing: it needs air, water, and food[3]

Air: The more often you turn the compost, the quicker the compost will be ready.
Moist: Your pile should be as moist as a wrung-out sponge.
Food: Composting works best if there is a good mix of dead organic materials and fresh materials. Dead materials could be brown leaves and sawdust. Fresh materials are green weeds from the garden, leftovers from the kitchen (but no meat) and also the faeces and urine. Ensure that children do not play in the compost.

Tip: Be careful when handling faeces: Always wash your hands afterwards!

Where should I build a toilet?

Inside, attached or outside the house

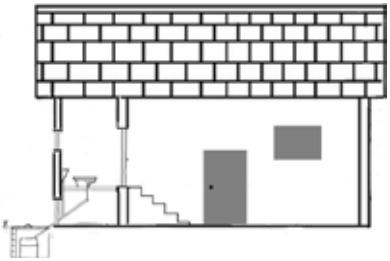
Inside the house

Advantages

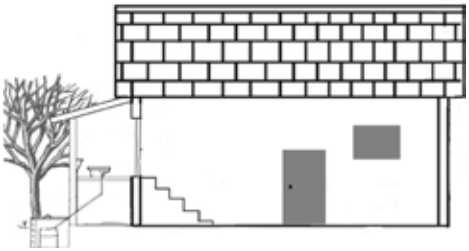
✔ No need to go outside;
✔ Warm and comfortable;
✔ No extra walls needed.

Disadvantages

✔ Space under the toilet is needed;
✔ Risk of smell when it is not constructed or maintained well;
✔ Wind driven or electric ventilation is recommended.



Design adapted from: Schiere, J. (1989)



Attached to the house

Advantages

✔ No need to go outside;
✔ Warm and comfortable;
✔ Doesn't need space in the house;
✔ Toilet can be reached from inside.

Disadvantage

✔ Have to construct a door in a outside wall.

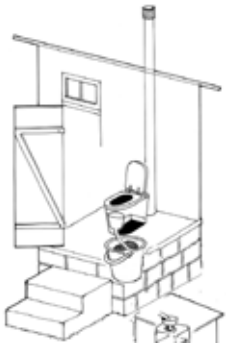
Outside the house

Advantages

✔ No risk of smell in the house;
✔ Easier construction; no alternation in the house needed.

Disadvantages

✔ Far from the house;
✔ Cold in the winter.

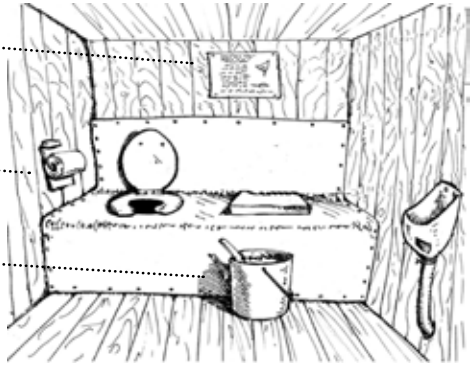


Design adapted from: Winblad, U. & Simpson-Hébert, M. (2004)

How to use and clean the toilet?

Keep the principles in mind

You should put some information in the toilet for visitors and explain to them how to use the toilet.
Toilet paper can be collected in a bucket or in the faeces chambers. This does not harm the functioning of the toilet.
Sawdust, ashes or other dry organic material have to be provided in a bucket. You can use a small scoop to cover the faeces.



A visit to a safe toilet should always be combined with proper hand-washing with soap. Therefore, don't forget to build a hand-washing facility near the toilet.

Prevent water from entering the faeces chamber. It will be cause a lot of smell.

Use vinigar/soda, a cleaning product, little water and a sponge to clean the toilet.

Do´s

- ✔ *Use ash, sawdust or dry soil to cover the faeces after every toilet visit*
- ✔ *Use only one chamber at the same time (in case of double vault)*
- ✔ *Cover the faeces hole with a lid*
- ✔ *Use rubber/plastic gloves when you clean the toilet*

Don´ts

- ✔ *Don't urinate in the faeces hole*
- ✔ *Don't throw rubbish into the toilet*
- ✔ *Don't defecate in the urine hole*
- ✔ *Don't throw ashes or sawdust into the urine hole*

Design: CAAW - PHAST, 2006

Source: www.gtz.de/ecosan Poster U D Philipines

How to use the urine to get higher crop yields?

Urine = NPK + other useful nutrients

An average person produces around 500 litres of urine per year containing 4.0 kg Nitrogen (N)[2], 0.4 kg Phosphorus (P)[1] and 1.3 kg Potassium (K)[2]. The urine and treated faeces of one person collected during one year, can fertilise 300 to 500 square meters of land[1,2].

Urine can be spread on the land without dilution just before sowing or planting.
The urine might be "too strong" for dry soils. In that case it has to be diluted several times with water. A tip is to apply the urine while you irrigate or when it is raining so that you don't have to dilute the urine with water yourself and the smell disappears quickly.

The urine should always be applied to the soil and not on the plants[1]. For young plants you need to dilute the urine more then for elder plants[1]. In general, crops with small amount of roots like carrots, onions and lettuce need more repeated applications of urine[1].

Every soil and every crop needs different amounts of nutrients. If you don't know how much to apply, try 1,5- 2,5 litre urine water per square meter per cropping season.
You will have the best results when the crops need it most.

That is during the early stages of crop development, thus not during winter. An option is to store the urine of this period in closed barrelsYou can do small experiments to find the optimal fertilisation.

Do´s

- ✔ *Keep at least 1 month time between fertilisation and harvest*
- ✔ *Apply urine close to the ground (to prevent evaporation to the air)*
- ✔ *Wash the harvested crops before consumption*
- ✔ *Urine of public toilets have to be stored at least half year*

Don´ts

- ✔ *Don't apply urine near fresh water- bodies*

How to use the feaces to improve the soil?

Dried or composted feaces = organic matter + NPK + other useful nutrients

One person produces about 50 litres of faeces per year containing about 14 kg organic matter and 0,5 kg Nitrogen (N), 0,2 kg Phosphorus (P) and 0,2 kg Potassium (K)[2]. Organic matter in the soil, enables it to retain water better. If you don't know how much to apply, try 1 - 2 kg dried or composted faeces per square meter per cropping season[2].

- ✔ *Dig or plough the treated faeces into the soil immediately upon application*
- ✔ *Keep at least 1 month time between fertilisation and harvest*
- ✔ *Be careful with handling faeces or composted faeced (especially fresh feaces). Therefore use personal protection (like gloves), take hygienic measures including hand washing and clean the used equipment well afterwards*
- ✔ *Wash the harvested crops before consumption*

Do´s

- ✔ *Don't use the faeces on the land before 2 years drying or composting*
- ✔ *Don't use faeces for crops which are eaten raw, excluding fruit trees*
- ✔ *Avoid any contact with treated - and especially fresh feaces*

Don´ts

How can I get more information?

On the internet!

Other organisations working on health and sanitation

- ✔ World Health Organisation (WHO) website contains a lot of information and statistics on water related illnesses. In 2006 the WHO publicised Guidelines for the safe use of wastewater, excreta and greywater. **www.who.int/water_sanitation_health/en/**
- ✔ Ecological sanitation research (EcoSanRes) is an international organisation. The website contains a nice collection of pdf-files, organisations and other links. **www.ecosanres.org**
- ✔ GTZ German agency for technical cooperation. The website contains a vast amount of information on Ecosan projects around the world. **www.gtz.de/ecosan**
- ✔ The Hesperian Foundation is a non-profit publisher of health materials seeking to empower communities and individuals to take more control of their own health as part of building a more just world. **www.hesperian.org**
- ✔ **www.sustainable-sanitation-alliance.org**

Other WECF publications on Ecological sanitation

- ✔ Urine Diverting Toilets in Climates with Cold Winters, Technical considerations and the reuse of nutrients with a focus on legal and hygienic aspects, 2007 . **http://www.wecf.eu/english/publications/2007/ecosan_cold_climates.php**
- ✔ Ecological sanitation and associated health risk, 2007. **http://www.wecf.eu/english/publications/2007/ecosan_hygiene.php**
- ✔ Sustainable Development for All, Reducing effects of polluted drinking water and inadequate sanitation on children´s health in rural Romania, 2006. **http://www.wecf.eu/cms/publications/2006/sustain_all.php**
- ✔ Dry Urine Diverting Toilets - Principles, Operation and Construction, 2006. **http://www.wecf.eu/cms/publications/2006/ecosan_reps.php**
- ✔ From pit latrine to ecological toilet, Results of a survey on dry urine diverting toilets and pit latrines in Garla Mare, Romania, 2006. **http://www.wecf.eu/cms/publications/2006/ecosan_pitlatrines.php**
- ✔ Posters, Benefits of Ecological Sanitation. **http://www.wecf.de/cms/publications/2006/poster_ecosan.php**
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[2] Deegner, S. & Samwel,M. (2005): Urine diverting toilets – Principles, operation and construction. WECF, Germany, Munich.

[3] WHO (2006): Guidelines for the safe use of wastewater, excreta and greywater. World Health Organisation.

[4] Morgan, P. (2003): Experiments using urine and humus derived from ecological toilets as a source of nutrients for growing crops. Paper presented at 3rd World Water Forum 16-23 March 2003.

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