011
ecosan school toilets
Garla Mare, Romania

ECOSAN SYSTEM - APPLIED COMPONENTS	SOLID BIOWASTE	FAECES	URINE	GREYWATER	RAINWATER
COLLECTION		Separate collection in double vaults	Storage in urine tank		
TREATMENT		2 years of storage in the vault, 1 year of post composting	Applied purely or diluted after 6 month of storage		
USE		Fertilising in agriculture	Fertilising in agriculture		

1 General Data

Type of Project:
ecological school sanitation pilot project, in the framework of a safe drinking water project.

Project Period:
Start of planning: November 2002
Start of construction: August 2003
Start of operation: October 2003

Project Scale:
4 urine diversion toilets and 3 waterless urinals at a rural school with 200 pupils

Address:
Garla Mare, Mehedinti District, Romania

Planning Institution:
University of Technology Hamburg, Institute for industrial and municipal wastewater management (TUHH)

Executing Institution:
WECF, Women in Europe for a Common Future, Netherlands
M&S, Medium & Sanitas, Romania

Supporting Agency:
MATRA, Dutch Ministry of Foreign Affairs

2 Objective of the project

- Establishment of an affordable sanitation system to reduce groundwater contamination caused by nitrates and faecal bacteria from pit latrines.
- Raising public awareness with regard to the hygienic and health risks associated with poor sanitation and drinking water supplies.
- Provision of a secure supply of drinking water
- Provision of alternatives to expensive chemical fertilizers.
- Investigation of the feasibility of an ecosan approach in a rural context in Eastern Europe through a small pilot project

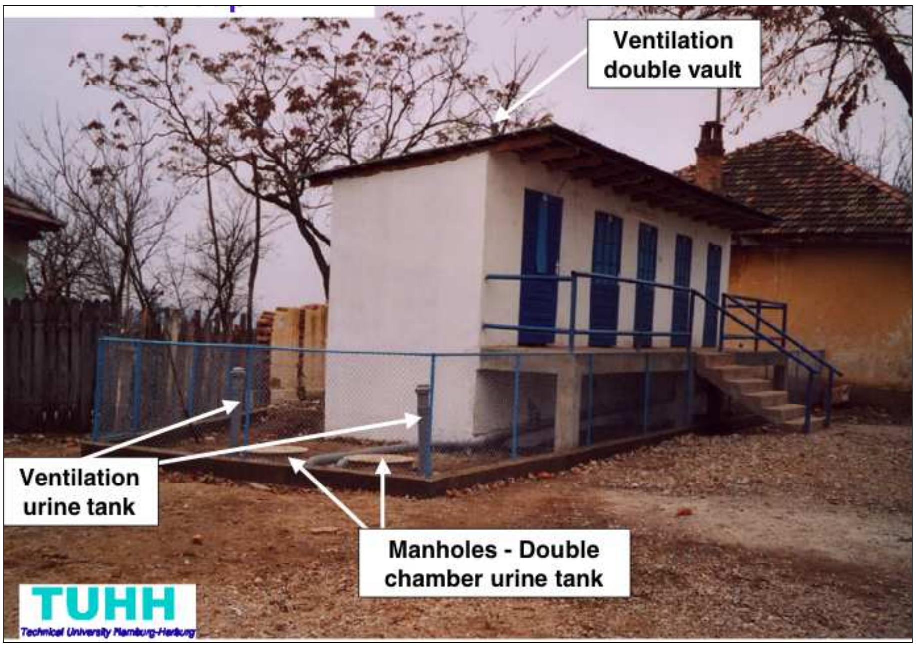

Figure 1: ecosan toilet building *(source: TUHH, WECF)*

3 Location and general conditions

In rural Romania 80% of the population are not connected to a central drinking water supply. These people get their drinking water mostly from shallow private wells. Mainly nitrates, faecal bacteria and pesticides however often pollute groundwater.

While the contamination caused by pesticides and some of the nitrates are a result of agricultural practices, the faecal bacteria and the rest of the nitrates are a result of the traditional and widespread use of pit-latrines, which infiltrate their liquid contents into the sub-soil, have a bad smell and are often built very close to household wells, resulting in some of the rural population having health problems as a result of using and consuming the polluted drinking water.

In the frame of the MATRA project "Safe Drinking Water", financed by the Dutch Ministry of Foreign Affairs, the village of Garla Mare (population: app. 3000) in south-west Romania was selected by the NGOs WECF and Medium & Sanitas in co-operation with the TUHH to be the location of a pilot project to address the problem of very high levels of nitrate (some wells >500 mg/l)

commissioned by
gtz ecosan program recycling oriented wastewater management and sanitation systems
Federal Ministry for Economic Cooperation and Development

and faecal bacteria (up to 2.4*105 total coliforms/ 100 ml) in rural Romania.

The rather high density of conventional latrines in people's yards was identified as one of the sources of groundwater pollution. In public meetings the citizens were informed about the disadvantages of latrines and the advantages of urine diverting toilets,

The village has no central water supply or sewage system. For their drinking water the inhabitants rely on 15 – 25 m deep private or public wells. 95 % of the villagers have a pit latrine in their yard, which is mostly unsealed and never emptied.

Figure 2: Former school latrine (source: WECF)

Garla Mare is a poor village with a very high level of unemployment. Approximately two thirds of the families have access to land, but most of the farmers operate on subsistence level,

Most of the population cannot afford chemical fertilisers, which leads to food scarcity in some seasons. The families would also not be able to pay for the operation and maintenance of a central water or sewage system if one would be installed. The continuation of the use of decentralised solutions was therefore seen as being the most appropriate approach in the village.

Figure 3 : toilet demonstration model *(source: WECF)*

Date of sample:		**10.12. 03**	**31.03. 04** t1: *stored for ca. 2 months*	**31.03. 04** t2: *active*	**12.07.06** *stored for ca.8 months*	**12.07.06** *active*
total N	[mg/l]	5190	4590	5290	6580	5320
total P	[mg/l]	261	286	342	348	377
total K	[mg/l]	470	n.m.	n.m.	1780	1630
pH	[-l]	9,22	9,25	9,25	9,27	9,51
El. conductivity	[mS/cm]	41,3	39,2	47,5	53,7	41,5
E. Coli	[CFU/10ml]	n.m.	0	0	n.m.	n.m.
Faecal streptococci	[CFU/10ml]	n.m.	$1,2´10^1$	$1,95´10^2$	n.m.	n.m.

Notes: n.m. = not measured, tank1: filled from 22.09.03-02.02.04; tank2: filled from 3.2.04

Table 1: Urine samples from Garla Mare *(source: WECF / TUHH)*

Pilot decentralised facilities were built at a primary school with approx. 200 pupils (aged 6-10 years) and 8 teachers. In the school yard was a well that had fallen into disrepair and was no longer in use. There was neither a drinking water supply nor hand washing facilities in the school. In the schoolyard, app. 15 m from the well, were bad smelling pit latrines.

The project should amongst other goals provide an affordable option to upgrade school sanitation.

It should serve as an example of how sanitary conditions in rural areas without any connection to sewage or central water supply system can be improved.
In addition the population should become aware of the advantages of urine diverting toilets regarding ground water protection and gain of excellent fertilizer.

4 Technologies applied

A toilet facility with 4 double vault urine diverting toilets, 3 waterless urinals and a small constructed wetland was installed.

For hand washing 3 washbasins were constructed and equipped with towels and soap. The resultant greywater flows to a gravel-sand bed that functions as a small constructed wetland.

To supply safe drinking water a multi-barrier filter was installed. An electric pump in the school well serves the hand wash basins and the filter with water.

The design of the dry double vault urine diverting toilets was done by the University of Technology Hamburg, that also supervised the construction. Pictures and posters of different toilet systems were presented during a public meeting and the preference for a squatting slab was figured out.

5 Type of reuse

To finally ensure the use of safe recyclate for agriculture, storage and treatment of the products will be supervised during the first 5 years of toilet-use by WECF and TUHH. Regularly samples of urine for analyses will be taken and assistance for urine application will be served.

Because of the large volume of the compost chambers it will take app. 2 years or more until one chamber is filled. Due to the long and cold winters it is planned to implement a post-composting phase of one year. Samples for micro organism analyses will be taken yearly. In 3 years the compost will be used by local farmers for fruit trees or crops. The water of the washbasins infiltrates the underground after passing through a gravel-sand bed.

According the Swedish guideline on storage time of urine, the urine is stored for at least 6 months and used by the local teacher and doctor, who are also farmers, as fertilizer on eggplants, tomatoes and corn. It is to be applied using 1 l Urine/ m² (equals 50 kg N/ ha) undiluted 4 weeks before the planting season begins. The result of the first trial was moderate, because the second necessary application was not carried out.

The analysis of the collected urine showed high amounts of macronutrients. The pH value was in all samples above pH 9; electrical conductivity was around 40 mS/cm. E.Coli were not detected in any sample. Faecal streptococci were one log lower in Tank 1 (after 8 weeks of storage) compared to the active tank. All analyses were performed according to German standard methods. The microbiological analyses were carried out in duplicate and the results were averaged. The results are shown in table 1.

To avoid any health risk by pathogenic transmission, urine should be used carefully, e.g. not on edible plants that are consumed raw.

6 Project History

The villagers were aware of the bad sanitary conditions in the school and other public buildings such as the dispensary or town hall. Due to that fact and the extremely polluted groundwater, the lack of adequate sanitation and the un-affordability of fertilizer for farmers the project leaders of WECF and M&S promoted the implementation of urine diverting toilets in the project.

Public meetings about the advantages and disadvantages of pit latrines and urine diverting toilets were organized.

The planning and realization of the urine diverting toilets was carried out in cooperation with the local authorities and the project committee, which was set up in the scope of the project “Safe drinking water”.

As there was no space to build toilets inside the school and villagers preferred to have the toilet outside, the new toilets were built outside in the schoolyard. To encourage the users and the caretaker to keep the toilets clean, care was taken to use pleasant, smooth materials inside the toilet building. Bricks from the old toilet structure could partly be used for the new toilet building.

7 Costs

Compared to centralised wastewater treatment incl. sewers the costs of this concept are much lower. The costs of the toilet were about 6300 Euro, one-third for the labour and 2 thirds for the materials. The material costs were rather high because of the high prices of e.g. bricks or concrete. The costs could decrease a bit by the construction of smaller compost chambers.

However the construction costs of a pit latrines are lower than for ecosan toilets, but the pollution of groundwater by latrines will cause long term external costs for example for drinking water treatment and water born diseases.

Costs for the different categories are shown in the following table:

category	costs (€)
brickwork	2125
completion in-/exterior	978
sanitary installations	1135
electric installations	78
Material	**4316**
labour	2025
Total	**6341**

8 Operation and Maintenance

- For teachers and pupils workshops on the use and maintenance of double vault urine diverting toilets were organised.
- A caretaker for O&M of the double vault urine diverting toilets and the multi-barrier water filter was contracted and intensively instructed. He will be paid during 5 years by the MATRA project “safe drinking water”

Figure 4: a workshop with teachers *(source: TUHH)*

- Education materials, leaflets and posters for the use and maintenance of the toilets and the filters were written and designed.
- The caretaker inspects and cleans the toilets daily. Tiles, and if needed the toilets are cleaned with soda water. The heaps in the compost chambers are weekly levelled and if needed covered with soil/ashes.
- The composting-chambers and the urine-tank have to be monitored by the caretaker. When one tank / vault is full (compost-vault up to app. 80%), the urine / faeces should be directed to the other compartment. Actually experience is that one 3 m^3 urine reservoir can be in use for 6 months, a 1 m^3 compost chamber for at least 3 years.
- It is recommended to cover the faeces with dry earth, ashes, sawdust or a mixture of these after defecation to minimise the water content and thus odour and flies.

9 Design information and technical specifications

For each toilet there are two easily accessible composting-chambers (vaults) with a sealed floor made from concrete. The vaults are used alternating in a 1 year rhythm. The volume of each chamber is 1,2 m² with a useful volume of 1 m². The floor of the compost vaults has a slope of 1 % to drain any leachate.

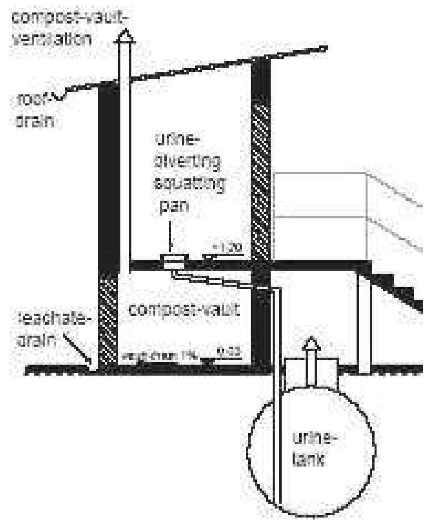

Figure 6: section of the toilet building *(source TUUH)*

Ventilation pipes with fly nets were installed from the composting-chambers to above the roof to avoid odour and flies. By the special design of the compost-chamber-dividing-walls only one ventilation pipe was installed for both chambers (compared to former designs where every chamber had one pipe).

The urine from the diverting-toilets and the waterless urinals is collected in a urine tank made of glass-fibre reinforced plastic (GRP), bought in Romania. This urine tank is divided into two chambers of 3 m3 each. The two compartments, similar to the composting chambers, are necessary for the 6

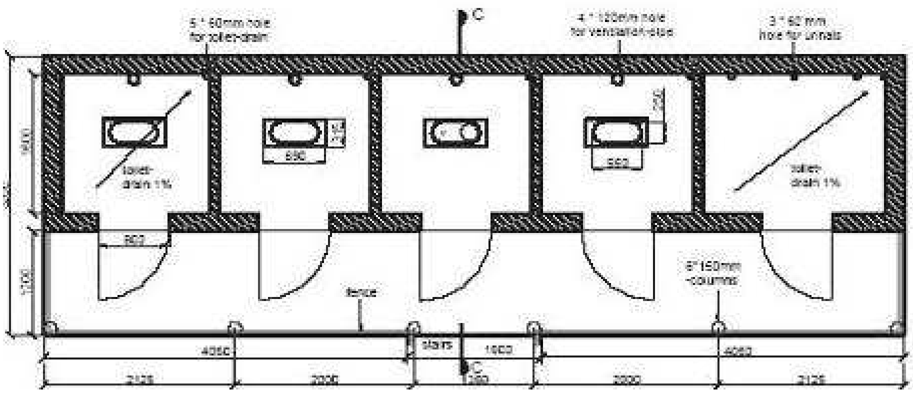

Figure 5: Plan of the school toilets *(source TUHH)*

months or longer resting time, during which most of the pathogens are killed or at least reduced.

The urine-pipe, from the slabs and urinals is guided to the bottom of the tank to avoid ammonia stripping and thus bad odour and nitrogen-losses when fresh urine is deposited into the tank. In this way the liquid does not come in turbulence and extra input of oxygen is avoided. In addition for each urine reservoir a ventilation pipe was installed. While a positive impact of these was not clear, the ventilation pipes were not installed in the follow-up ecosan toilets project in Ukraine.

Water from cleaning the squatting-pans and the toilet rooms along with the possible leachate from the compost-vaults is channelled to a small constructed wetland. So far no leachate from the compost chamber has appeared.

Plastic squatting-pans were selected instead of seating pans for hygienic reasons and since the children were used to squatting. The pans were elevated 10 cm from the floor for a more comfortable defecation-position and to avoid water from cleaning the toilet room floors from entering the compost-chambers.

The middle of the floor has one big hole to the collection chambers covered by the squatting pan. When one chamber is full the pan has to be turned round 180° in order to situate the faeces whole above the empty chamber.

Figure 7: faeces collection chamber *(source: WECF)*

A company from a nearby city under supervision of TUHH built the facility. Two students of the university of Bucharest were involved and reported back to the university on their experience. Although in the village hardly any construction material was available, as far as possible local labour and construction materials were used. Some second hand materials from the village were used for the construction.

10 Practical experience and lessons learned, comments

- A very crucial factor is the real understanding of the facility and its effects by the stakeholders. This was addressed in the workshops, which were held before the installation of the toilets, and by the easy to understand posters for the children.
- It is important to keep urine and faeces separate as most of the pathogens are contained in the faeces, while the urine (from healthy persons) is mainly aseptic. The possibility of cross contamination can however not be eliminated completely.
- It was shown that the installation of double vault urine diverting toilets is a low cost, very fast and easy to realise method to protect groundwater and thus improve health conditions.
- With proper education even 6 year old children understand the principle of urine diverting toilets as a part of ecological sanitation. Even in the critical first weeks of usage no problems occurred.

Figure 8: school girl in a ecosan toilet *(source WECF)*

- The new toilet system was accepted very well by the teachers and the pupils. In the village Garla Mare ecosan got an issue: in 2006 for the town hall and for 5 households double vault dry urine diversion toilets were constructed.
- Twice a year personnel of TUHH or WECF checks the condition of the toilets and filters, take samples of urine and discuss operating and maintenance of the utilities with the stakeholders once again. Some teachers of the school and the local doctor show interest in the process and results of the monitoring.
- A survey on e.g. the acceptance of the urine diverting toilets among pupils and teachers of the school was carried out after one year of experience. Only 3 % regarded the toilets unpleasant, 94 % are happy users, 87% of the pupils liked the school toilets much more then the latrines at home.
- Until the interviews there were no complaints about smell, but it seems that occasionally there are complaints about the urine smell. As a result of this several flow-off holes in the urinals were stopped until just one hole was left.
- Experiences learned, that good information on operation and maintenance of the ecosan toilets is crucial. During three years the toilets were well maintained, but after the retirement of the caretaker and the school director, the toilet facility was temporary not well cleaned and maintained.
- The chosen volume of 1m^3 the faeces vault was more then sufficient for the use of one year. Only after 2 years of usage, the second vault was taken in use.
- Although no quantitative analyses were carried out, in comparison with the not fertilized field, the size of the earns and harvest were clearly increased. the fertilizing effect of urine in corn cultivation was for the farmer very satisfying.
- In poor rural areas the transport and application of 3m^3 urine can be problematic. In the village only one car for transport and application of liquid manure was available. Because urine is a corrosive liquid the owner was reluctant to make available his car.

This pilot-project can serve as an example not only for other Romanian villages, but for many counties in the Eastern European, Caucasus and Central Asia region (EECCA), which are facing similar sanitary, groundwater and health-problems. The establishment of ecological sanitation is especially reasonable in regions with no central water supply and no sanitation system except pit latrines.

- In other WECF-projects in Bulgaria, Ukraine, Armenia, Uzbekistan, Kyrgyzstan and Afghanistan the same type of toilets for schools and private households are constructed or under construction.
- The project drew the attention of the wastewater department of the Technical University Timesoare, Romania, that sent students to visit the toi-

Figure 9 and 10: external view (front and back) of the public ecosan toilet in the yard of the town hall in Garla (*source WECF*)

lets to initiate a possible further co-operation

- The project drew the attention of international donors, like WB or Foundation Ensemble, and national authorities, like school inspectorates and mayors, and served as an example for improving school sanitation in a sustainable way.
- In 2006 a public urine-diverting toilet of the same type as the school toilet was constructed for the town hall in Garla Mare.

11 Available documents and references

Documents are to down load from website www.wecf.eu/publication or available by contacting WECF

Brochure: Dry urine diverting toilets; Principles, operation and maintenance, 2006, WECF (English).

Brochure: Sustainable development for all, Case study Garla Mare, Romania, 2006, WECF (English).

Brochure; From pit latrine to ecological sanitation; Results of a survey on dry urine diverting school toilets and pit latrines in Garla Mare, Romania, 2006, WECF (English)

Leaflet Ecological Sanitation and Hygienic Considerations for Women, 2005, WECF (English)

Ecological Sanitation and Associated Hygienic Risk, a WECF publication 2004 (English, Armenian, Rumanian, Bulgarian, Russian, Ukraine)

Poster: ecosan-closing the loop in wastewater management and sanitation, GTZ, translated by WECF and partner in Armenian, Romanian, Bulgarian, Russian, Ukraine.

Education materials on the use and maintenance of dry double vault urine diverting toilets, WECF (English, Armenian, Rumanian, Bulgarian, Russian, Ukraine)

Information on the use of urine and compost in agriculture, WECF (English, Armenian, Rumanian, Bulgarian, Russian, Ukraine)

Reducing effects of polluted drinking water on children's health in rural Romania, case study CEHAPE 2003, WECF (English)

Socio- Economical Gender Survey of Garla Mare, WECF, Kitty Bensvelden, 2003 (English)

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data sheets for ecosan projects

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