GTZ Supported Ecosan Projects in India

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Abstract
To promote the ecological sanitation approach in India, the Indian Innovative Ecological Sanitation Network (IIESN) was established through a joint effort supported by the GTZ, local partners in India and other international partners. IIESN is expected to develop innovative and socially accepted ecological sanitation systems for India and explore operational, institutional and economical models for the implementation of those ecological sanitation systems.
Current activities include the implementation of several demonstration projects in different areas of India. The projects comprise e.g. ecofriendly public toilets, school and individual toilets. The flexibility of the ecosan approach allows its incorporation in various local situations and adapted to the local reuse opportunities. Technologies of the demonstration projects comprise urine separating dehydration toilets, waterless urinals, urine storage, greywater treatment and black- or brownwater treatment with anaerobic digestion and constructed wetlands. Reuse options are the use of urine, dried feces and sludge for fertilisation, use of treated water (greywater, kitchen wastewater, anal cleansing water, black- or brownwater) for irrigation and beautification and use of biogas for cooking,

Keywords:
India, pilot projects, ecosan, wastewater treatment, biogas, composting toilets, urine separating dehydration toilets

INTRODUCTION

To promote the ecological sanitation approach in India, the Indian Innovative Ecological Sanitation Network (IIESN) was established through a joint effort supported by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, local partners in India and other international partners. IIESN is expected to develop innovative and socially accepted ecological sanitation systems for India and explore operational, institutional and economical models for the implementation of those ecological sanitation systems.
Current activities of GTZ and its partners in IIESN include the implementation of several demonstration projects in different areas of India. A selection of those projects will be presented below.

PUBLIC ECOSAN TOILETS IN SLUM AREA IN BANGALORE

The Indian NGO ACTS and seecon GmbH established an eco-friendly public toilet centre in Rajendra Nagar Slum, Bangalore, and a co-composting site for faecal matter at the ACTS Rayasandra Campus. At that time the majority of households in Rajendra Nagar Slum, a huge slum with inhabitants of different caste, religion and race, did not have their own toilets and residents had access to only one functioning communal toilet. As the lack of toilets is an indication of the appalling living conditions for many thousands of slum dwellers, particularly women, the establishment of a public toilet center was considered to be a matter of very great urgency. Sexual harassment and rape had been an associated problem as women so far had been forced to defecate in the open field before dawn or after dusk. The toilet center was aimed to bring about considerable

improvement in such conditions for women and children. The objectives of establishing a public toilet centre have been manifold:

- to improve living condition in the slum and to minimize the risk of disease spreading during monsoon flood periods,
- collecting urine and faeces for the production of fertilizer and compost,
- to generate income for the development of the slum by selling fertilizer and charging for the use of the toilet and
- finally to change the attitudes of people and encouraging them to consider human faeces as a valuable resource.

Although the ACTS ecosan toilet centre in Bangalore is successfully in operation for almost 4 years now, serving about 500 to 600 users per day, the originally designed logistic system which was based on the collection of source-separated urine and faecal matter in plastic drums and the transportation of those drums to the processing side at Rayasandra Campus was often discussed controversially. Hence a socially and culturally more acceptable, sustainable and hygienic safe collection, transportation and processing scheme has been developed and implemented with support of GTZ.

For the improved system storage tanks now replace the barrels for collection of urine and faeces. A special truck, equipped with tanks and a pumping system, evacuates faeces and urine; manual handling is not necessary any more. Urine and faeces are then transported to the treatment site, where urine is stored in storage tanks and faeces are treated in a biogas plant. Stored urine and digested slurry are used as fertilizers; whereas biogas is being used for cooking. The biogas plant has a much higher capacity to treat faeces than the previous co-composting system. The higher treatment capacity allows the extension of the project on new public toilet blocs.

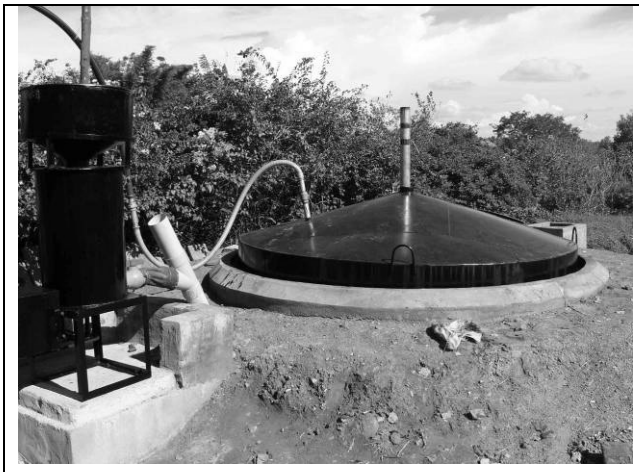

Figure 1: Biogas plant for the treatment of feaces collected from public toilet facilities in Bangalore (Johannes Heeb)

Figure 2: squatting slab providing 3 holes for source-separate collection of water used for primary washing hands, urine and feces (seecon gmbh)

ECOSAN DEMONSTRATION PROJECTS OF NAVSARJAN TRUST

Navsarjan Trust was established in 1989 to help eliminate discrimination based on caste, assure equality of status and opportunities and ensure the rule of law, not of castes.

Navsarjan Trust aims to develop, implement and disseminate socially and culturally acceptable, sustainable and hygienic safe sanitation, treatment and re-use concepts for human excreta. In cooperation with GTZ, Navsarjan Trust has developed ecologically sound sanitation concepts based on various technological components on different sites. The projects serve as show cases and provide Navsarjan Trust with first-hand experiences on ecosan and the knowledge for further dissemination in rural areas in Gujarat.

Navsarjan Trust project at the vocational training centre "Dalit Shakti Kendra"

A vocational training centre called Dalit Shakti Kendra (DSK) was established in Gujarat in 1999. The centre provides technical training in various fields to the Dalit youth, as well as links with financial institutions for financial assistance for self-employment. The DSK comprises an administration and kitchen building, a workshop building, a common toilet centre, a hostel and a community training centre. DSK is used by around 250 students, and a variable number of guests attending meetings and workshops. The sanitation concept comprises following components:

- Night-soil based biogas plant;
- Urine-Diversion Dehydration Toilets;
- Common urinal centre for ladies and gents;
- Treatment/reuse of greywater from new bathroom cum laundry facilities;
- Treatment/reuse of kitchen water;
- Treatment/reuse of water spent on washing dishes;
- Treatment/reuse of greywater from the Community Training Centre.

A common toilet bloc comprises toilets for men and women, a biogas plant and subsequent treatment of the digested slurry in soilisation fields. The biogas plant also receives the manure of about 5 to 10 buffaloes. Source separated urine from the urinals and the squatting pans is collected in tanks outside the toilet building. Urine storage and hygienisation tanks (black plastic tanks) are exposed to the sunlight to facilitate hygienisation.

In order to keep dilution of blackwater low, specially designed squatting pans (so called "pourflush" pans) made of ceramic that require a little amount of water for flushing excreta and that are equipped with a seal („P-trap"), as shown in figure 9, have been installed. Digested slurry will be collected in a subsurface basin, before being pumped to elevated sludge drying beds. The dried sludge shall be applied as soil amendment to the kitchen garden or plantations.

The biogas will be used as a substitute to LPG (Liquefied Petroleum Gas) in cooking. Greywater that is collected from washbasins at the toilet centre will be directly used for gardening purposes. The greywater shall be applied to elevated flowerbeds, ornamental gardens, etc. without any pre-treatment. Distribution of greywater shall be done in mulch-filled absorption trenches; discharge to the greywater gardens shall happen about 2 inches above the surface of mulch into which it will quickly disappear. Perimeter bunds shall keep additional surface run-off water from entering the reuse facility. Mulch trench allow sub-surface application and safe reuse of untreated greywater. As organic mulch material decomposes after some years, the trenches have to be restored in periodical intervals.

Figure 3: Simple mulch trench for sub-surface application of untreated greywater

Figure 4: Construction of toilet center (source: seecon)

Figure 5: Greywater garden for the reuse of the water from the showers (source: gtz, Christine Werner)

Figure 6: female urinal (source: gtz, Christine Werner)

Navsarjan Primary Schools Project

Navsarjan Trust is establishing 4 primary schools in rural areas of Gujarat. After completion each school will have a total capacity of 210 pupils and comprise 6 classrooms, a sanitation building comprising toilets, showers and washing facilities, an administration building, a kitchen building, a workshop building and 4 residential buildings for staff members.

Figure 7: Navsarjan primary school in Gujarat (source: gtz, Christine Werner)

Figure 8: school sanitation block (source: gtz, Christine Werner)

A sanitation bloc has been designed to provide toilets, showers, washing and laundry facilities to pupils and staff, while allowing the recovery of urine, faeces and water for productive purposes. The ecosan toilet block comprises 8 single-vault-urine–separation dehydration toilets and 4 waterless urinals for the male pupils and staff members. The toilets are operated in batches to facilitate the harvest of the finished compost. That means that only 4 toilets are in use at the same time and receive daily deposits until the dehydration chamber below the squatting slab is "full". The toilet cabins of the “closed” toilets are then used as showers. A specially designed cover prevents water entering the composting compartment or to be drained to the urine collection tank.

Figure 9: on-site fabricated 3-hole squatting slab (source: gtz, Christine Werner)

Figure 10: prefabricated 3-hole squatting pan of UNICEF (source: gtz, Christine Werner)

Figure 11: pupils doing laundry (source: gtz, Christine Werner)

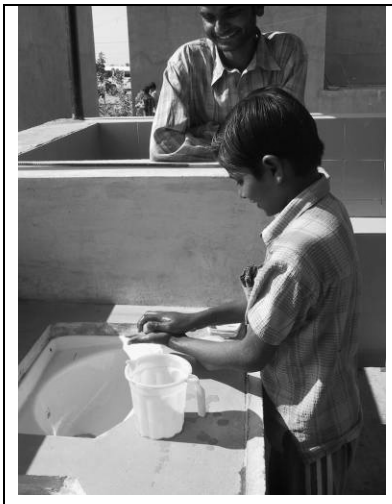

Figure 12: hand washing (source: gtz, Christine Werner)

Figure 13: rear view of dehydration chambers (source: gtz, Christine Werner)

Figure 14: waterless urinals (source: gtz, Christine Werner)

Figure 15: infiltration of anal cleansing water (source: gtz, Christine Werner)

Figure 16: storage of treated greywater (source: gtz, Christine Werner)

The urine from the UD-toilets and urinals is collected in a container and reused as fertiliser. The anal cleansing water from the toilets is infiltrated into a subsurface irrigation of ornamental flowers. Greywater produced from showering is diverted to the outside with the help of a channel and being reused for irrigation. The alternative use of the cabins as a toilet or shower helps to reduce the interior space and therefore construction costs.

ECO-FRIENDLY SANITATION FACILITY FOR ADRASH VIDYAPRAKAASH SANSTHA'S COLLEGE AT KULGAON BADLAPUR

The "Adarsh Vidya Mandir School" is located in Badlapur town, in Maharashtra's Thane district, about 68 kilometres from Mumbai. The school accommodates about 11,000 students attending Primary School, Secondary School and Junior College or the "Adarsh Vidyaprasarak Sanstha's College of Arts & Commerce". The city of Badlapur does not have a sewer system. So far, the

school therefore depends on conventional on-site sanitation, consisting mainly of septic tanks followed by infiltration.
Following some capacity building workshops organised by the Indian Water Works Association IWWA in cooperation with GTZ, seecon and other partners. The city of Badlapur and the Adarsh School have taken the decision to refurbish the schools sanitation system towards ecological sanitation.
Construction began in august 2006 for a sanitation building for the three-storeyed College of Arts & Commerce building with a total number of about 2,700 students. The open ground that is located in the centre of the school premises is rented out on ca. 20 days per year for special programmes such as wedding ceremonies, which are attended by up to 1,000 people each. At present no sanitary facilities are provided during such events.

Figure 17: college students (source: gtz, Christine Werner)

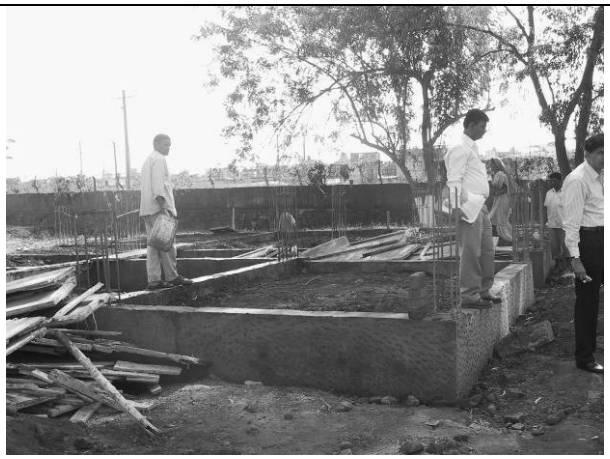

Figure 18: toilet center under construction (source: gtz, Christine Werner)

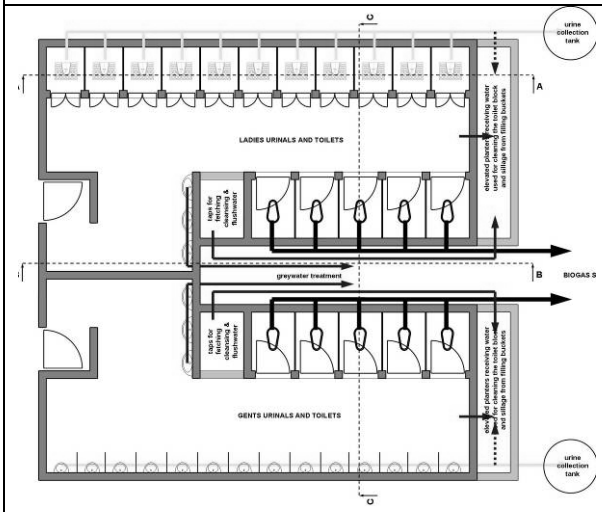

Figure 19: toilet and urinal center schema (source: seecon/gtz, Martin Wafler)

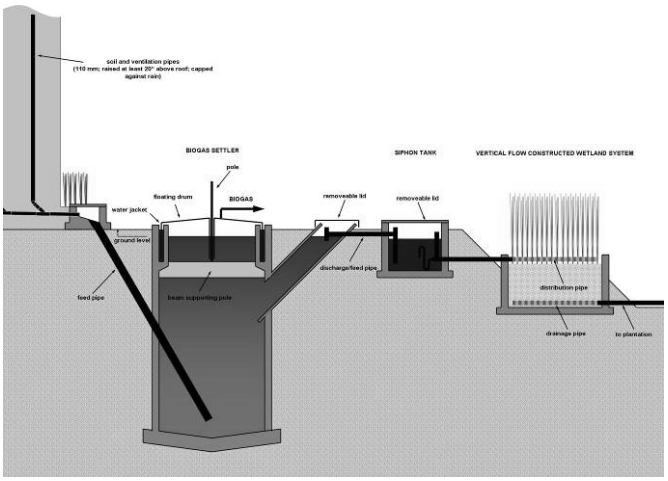

Figure 20: brownwater treatment schema (source: seecon/gtz, Martin Wafler)

The construction comprises a sanitation block with urinals for men and women, pour flush toilets and hand washing facilities. The urine is collected in two storage tanks and reused as fertiliser. The brownwater from the toilets is treated in a biogas settler tank. The biogas will be used for cooking. The pretreated water is then added via a syphon tank into a vertical flow constructed wetland and then used for irrigation. The greywatrer will be used on-site for the beautification of the buildings with greywater gardens.

VANAMATI NAGPUR PROJECT

VANAMATI Nagpur, the nodal training institute for watershed development and agricultural extension management in Nagpur, started the design and planning of its new construction in June 2003. The new VANAMATI Nagpur is composed by two main buildings, an office building and a hostel, providing board and lodging for up to 120 people. In November 2004 it was decided to include the ecological sanitation concept into the VANAMATI Nagpur construction project, after the construction had already started. The challenge of this ecosan pilot project is that the ecological sanitation systems have to adjust to the given design of the buildings and the space available.

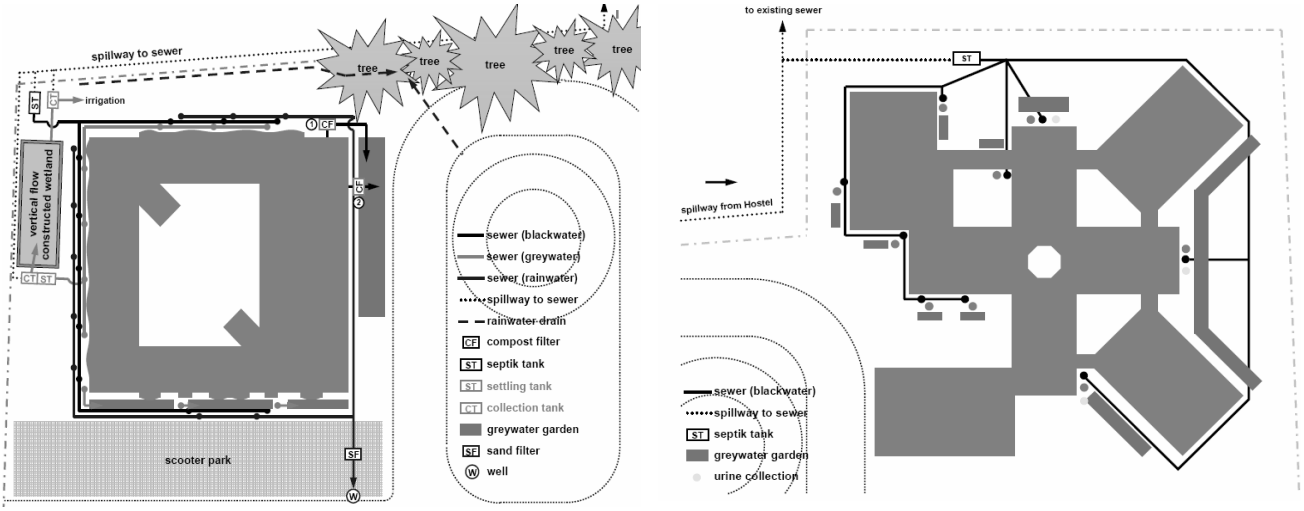

Figure 21: Ecological sanitation plan for VANAMATI Nagpur buildings: hostel (left) and office building (right) (source: seecon/gtz, Martin Wafler)

The blackwater produced in the institute will be collected separately and drained into a septic tank to remove settleable and floatable solids. Its effluent will be discharged into the municipal sewer via a spillway. The septic tank should be designed in a way that it can be converted into a solid-liquid separation tank when a subsequent treatment in the future is required. Sludge in the septic tank is to be removed periodically.

Greywater from the office building will be used for watering flowerbeds through mulch-filled trenches without pre-treatment.
The collection pipes and the subsurface storage tank for source-separated urine from urinals at the institute are already installed, but will only be used in future when a research project for the use urine as fertilizer is started. For the time being, the urine is discharged to the blackwater sewer and treated together with the blackwater.

The blackwater coming from the hostel is treated in the same way. First a pre-treatment takes place and then a subsequent treatment of the greywater produced at the hostel is done, which consists in settling the water in a tank and then passing it through a vertical flow constructed wetland. The effluent can be reused for irrigation purposes.

CONCLUSIONS

Ecological sanitation looks for holistic approaches that are tailored to the needs of the users and to the respective local conditions. The flexibility of the approach allows to its incorporation in various situations. Instead of favouring specific sanitation technology, ecosan promotes any technology that enables a closed loop material flow.