Current State of ecosan Pilot Projects in India supported by seecon gmbh and GTZ

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Abstract

This paper gives a comprehensive overview on the current state (as per end of October 2005) of ecosan pilot projects in India, which are implemented in the context of the Innovative Ecological Sanitation Network India (IESNI) and are supported by seecon gmbh and GTZ (German Agency for Technical Co-operation). The following projects are described in detail:

- The Government of Maharashtra, Department of Agriculture, ecosan pilot projects VANAMATI Nagpur and RAMETI Khopoli,
- the Navsarjan Trust ecosan pilot projets at the Vocational Training Institute “Dalit Shakti Kendra” and at 4 primary schools in Gujarat and
- the ACTS ecosan pilot project in Rajendra Nagar Slum, Bangalore, and the ACTS Rayasandra Campus.

Keywords

ACTS Trust, ecosan, Government of Maharashtra State, GTZ, Indo-German Bilateral Project Capacity Building and Training (IGBP-CB&T), Innovative Ecological Sanitation Network India (IESNI), Navsarjan Trust, pilot projects, seecon gmbh

The Innovative Ecological Sanitation Network India (IESNI)

The Innovative Ecological Sanitation Network India (IESNI), established through a joint initiative of GTZ (German Agency for Technical Co-operation), the Indo-German Bilateral Project Capacity Building and Training (IGBP-CB&T) and local as well as international partners (among others: Government of Maharashtra, Department of Agriculture; Navsarjan Trust; ACTS Trust; Indian Water Works Association (IWWA); Norwegian University of Life Sciences (UMB); Waste Netherlands; BORDA Germany; seecon gmbh and many more), aims to promote the development, implementation, evaluation and dissemination of socially and culturally acceptable, sustainable, hygienic safe and ecologically sound sanitation approaches for India and explore operational, institutional and economical set-up models for the implementation of those systems.

For the time being the Government of Maharashtra (GoM), Department of Agriculture (DoA), the Navsarjan Trust and the ACTS Trust (an acronym for Agriculture, Crafts, Trades and Studies) agreed on the implementation of the following ecosan pilot projects, which are supported by seecon gmbh, a Swiss consulting company, and GTZ:

- **Government of Maharashtra, Department of Agriculture, ecosan pilot projects:**
  Implementation of ecosan concepts at the new VANAMATI Nagpur and RAMETI Khopoli, which are either under construction or undergoing renovation, rehabilitation and extension.
- **Navsarjan Trust ecosan pilot projets:**
  Implementation of ecosan concepts at the Navsarjan Vocational Training Institute (VTI) "Dalit Shakti Kendra" and at 4 primary schools in Gujarat.
- **ACTS ecosan pilot project:**
  Improvement of an existing ecosan demonstration toilet centre in Rajendra Nagar Slum, Bangalore, and construction of a new treatment facility for faecal matter at the ACTS Rayasandra Campus.

The GoM, DoA, ecosan pilot project – new VANAMATI Nagpur

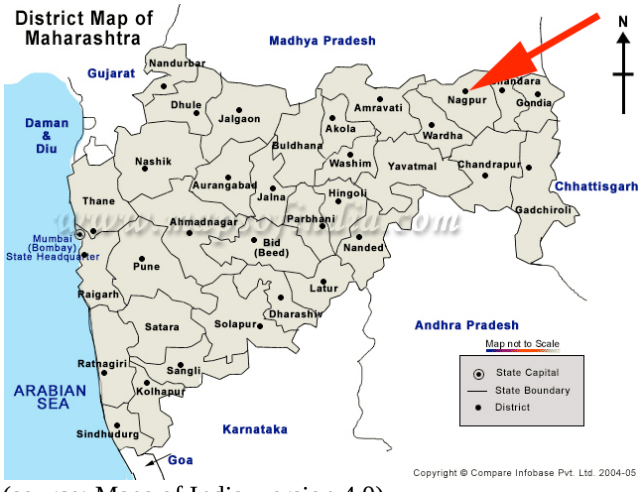
Objectives of the project

The GoM, specifically its DoA, is intending to become a lead agency in promoting sustainable resources management while increasing productivity and profitability of agricultural production and therefore agreed on the implemention of an ecosan concept at the new VANAMATI (Vasantrao Naik State Agricultural Extension Management Training Institute) in Nagpur, Maharashtra State. VANAMATI Nagpur, the nodal training institute of the GoM, DoA, for knowledge dissemination in watershed development and agricultural extension management shall become a showcase for natural resources management and savings in general.

Location and general conditions

The new VANAMATI Nagpur is located at Main V.I.P. Road, Mouza Godga, Khasra No. 322, Nagpur, Maharashtra State (figure 1). Nagpur is situated 837 km east of Mumbai, 1094 km south of Delhi, 1140 km west of Calcutta and 1092 km north of Chennai and is practically at geographical centre of India.

figure 1: District map of Maharashtra State (left) and map of Nagpur City (right) depicting the location of Nagpur City and of the new VANAMATI Nagpur, respectively



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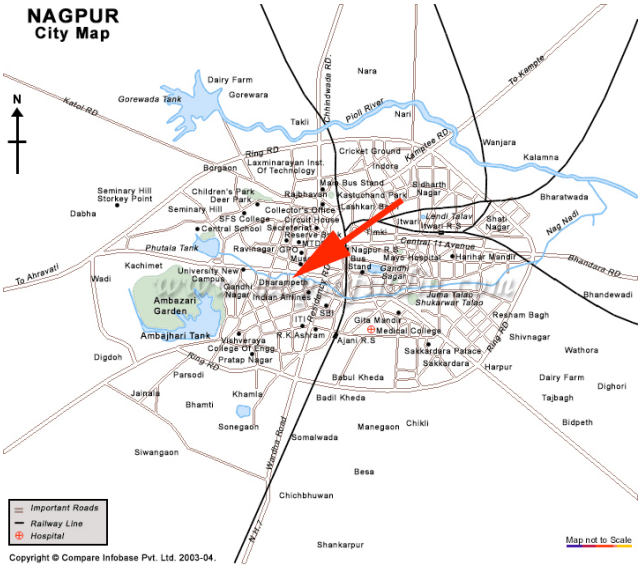


(source: Maps of India, version 4.0)

Situation before the project

Construction of the new VANAMATI Nagpur, which comprises two main buildings, an institute and a hostel, started in November 2004 and therefore the ecosan concept had to be ajusted to the given design of the buildings and the space available rather than being designed and developed simultaneously. The Institute, a two-storeyed building, comprises offices, several faculty and syndicate rooms, a library, as well as lecture, conference and exibition halls. The Hostel, a four-storeyed building, provides accommodation for up to 120 people, lecture halls, recreation rooms, a kitchen and a dinning hall.

The originally designed sanitation scheme envisaged the joint treatment of blackwater from the Hostel and wastewater produced at the Institute in a septic tank to remove settleable and floatable solids. The liquid should be drained to a soak-pit to be infiltrated into the ground. Mechanically pretreated (sieves and a grease trap) kitchen water ought to be drained to another soak-pit. For the treatment of the remaining greywater from the Hostel a settling cum collection tank should be built and the water being reused for surface irrigation purposes.

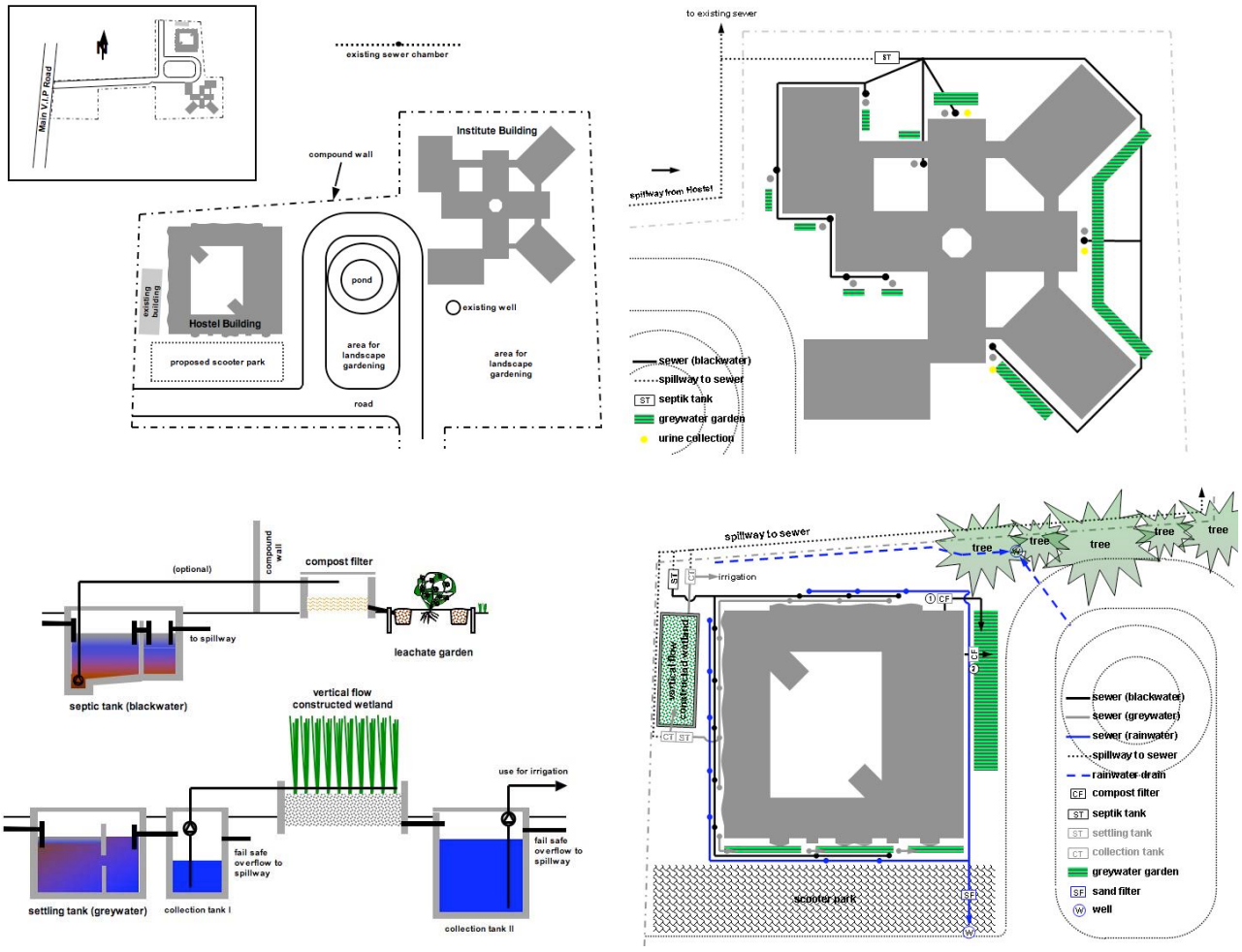
Current state of the project

Grand opening and inauguration of the new VANAMATI Nagpur will be end of November 2005.
The ecosan components implemented at VANAMATI Nagpur are described below and depicted in figure 2.

Blackwater produced at the Institute is drained to a septic tank to remove settleable and floatable solids before the liquid flows to a municipal sewer. For the time being no subsequent treatment of accumulated sludge is implemented and therefore periodical desludging of the septic tank will be mandatory. Greywater is collected separately and used for subsurface irrigation of nearby flowerbeds; distribution of the water is done in mulch-filled absorption trenches without pretreatment. Separate pipings for the collection of urine from urinals have been laid, but for the time being the urine is discharged to the blackwater sewer. In future urine shall be collected and be pumped to storage/hygienisation tanks before application. The use of urine in agricultural production may be demonstrated on a large scale, if a research program on the safe use of urine as a liquid fertilizer can be launched in co-operation with RAMETI (Regional Agricultural Extension Management Training Institute) Nagpur and the Agricultutal University of Nagpur, as both instutions hold plots for field tests and are located close-by or bordering the VANAMATI Nagpur.

Blackwater produced at the Hostel is drained to a septic tank to remove settleable and floatable solids before the liquid flows to a municipal sewer. Due to the lack of practical experience in the designing of large-scale “solid-liquid separation cum composting systems” for the treatment of highly diluted blackwater and the limited space availabale it was decided not to go for this technology at first and therefore periodical desludging of the septic tank will be mandatory. But measures are taken that the septic tank can easily be adapted to be a presettling and collection tank for solids, if in future ample experiences with “solid-liquid separation cum composting systems” are gained and such a treatment step may be implemented. For the treatment of greywater from the Hostel a vertical flow constructed wetland system was built. The greywater is pretreated in a settling tank to remove settleable and floatable solids before the liquid is pumped to the wetland system. The treated water is collected and reused for irrigation purposes. Rainwater, collected from the roof of the Hostel, is drained to an infiltration & storage well. Rainwater that doesn’t infiltrate into the ground is used for irrigation purposes.

figure 2: Ecosan components implemented at VANAMATI Nagpur (clockwise from top left: sketch map of VANAMATI Nagpur; sketch of ecosan components at the Institute; sketch of ecosan components at the Hostel; sconceptual sketch of ecosan system at the Hostel)



The GoM, DoA, ecosan pilot project – RAMETI Khopoli

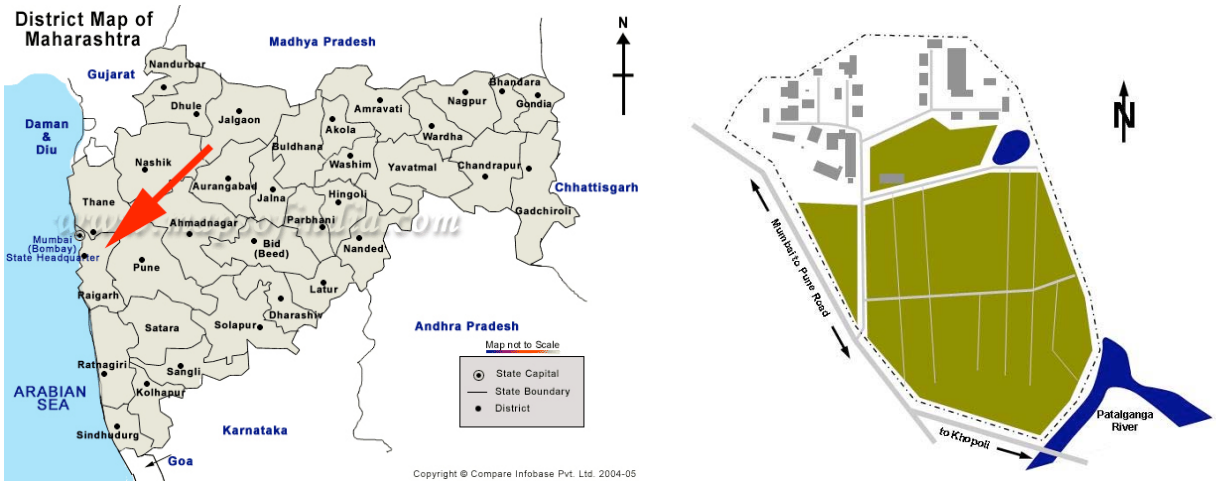
Objectives of the project

The GoM, DoA, runs seven training institutes called RAMETIs, which are located as per agro-climatic conditions of Maharashtra State in Amravati, Aurangabad, Daund, Khopoli, Kolhapur, Nagpur and Nashik. RAMETI Khopoli, being an official capacity building organisation for knowledge dissemination in watershed development and agricultural extension management, shall become a showcase for the demonstration of the safe reuse of source-separated human urine and processed faecal matter in agricultural production.

Location and general conditions

RAMETI Khopoli is located a little distance outside Khopoli village in Khalapur Taluka in Raigarh District, Maharashtra State, approximately halfway between Mumbai and Pune (figure 3). It was established as paddy farm by the DoA, developed as “Paddy Extension Centre” under Indo-Japanese Project in 1964/65, became a “Soil Conservation Training Institute” in 1983/84, was affiliated to VANAMATI Nagpur as Satellite Institute in 2001 and became autonomous and renamed RAMETI in 2002.

figure 3: District map of Maharashtra State (left) and map of RAMETI Nagpur and adjoint demonstration farm (right)

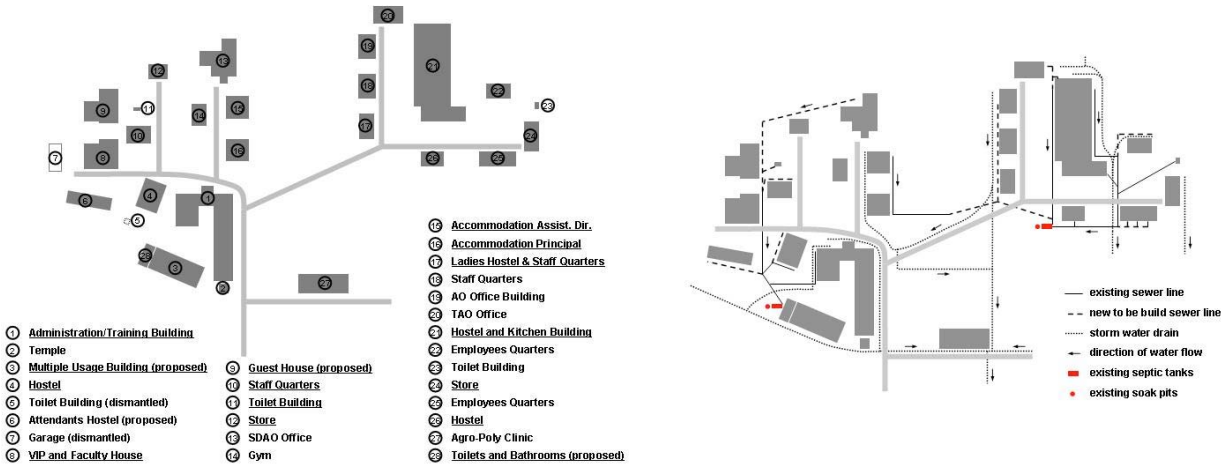


(source: Maps of India, version 4.0)

Situation before the project

About two years ago step-by-step renovation, rehabilitation and extension of buildings, which had been built in 1964/65, started. At the same time 2 new sewer systems, septic tanks and adjoint soak-pits for the treatment and disposal of wastewater were built. As rehabilitation and extension wasn't finished, not all buildings had been connected to the sewers to that day (figure 4). Wastewater from buildings, which had not been connected to the sewers, was treated in individual septic tanks and the liquid was either soaked away or discharged to storm water drains.

figure 4: Sketch map of RAMETI Khopoli (left) and proposed conventional sanitation scheme (right)

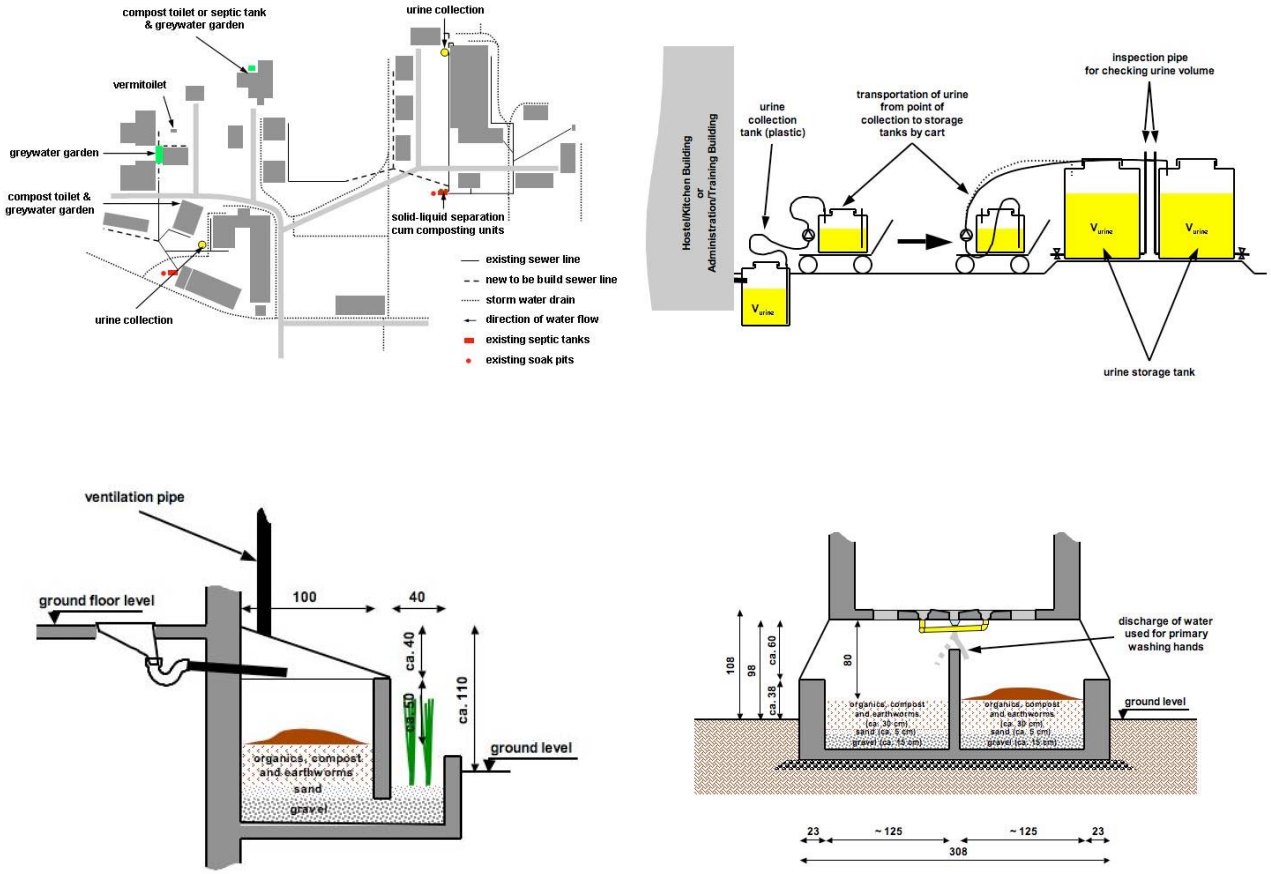


Current state of the project

As soon as funds are approved, the following ecosan components (figure 5) will be implemented at RAMETI Khopoli

To demonstrate the safe reuse of source-separated urine in agricultural production, urine shall be collected from urinals at the Administration & Training building and the Hostel & Kitchen building. The urine shall be collected in plastic tanks and be transported to storage/hygienisation tanks, located at the ajoint

figure 5: Proposed ecosan components at RAMETI Khopoli (clockwise from top left: sketch map showing proposed ecosan components; sketch of urine collection system at the Administration & Training and the Kitchen & Hostel building; vertical cross section of urine-separation vermicomposting toilet system; vertical cross section of pour-flush vermitoilet system)



demonstration farm, when full. The collection tanks shall be equipped with fail-safe overflows to drain the urine to the sewer before overflowing occurs. An unoccupied apartement, which will be used for accommodation of trainees in future, shall be equipped with a pour-flush vermicomposting toilet system. A socalled “rural” or “pour-flush squatting pan” made of porcelane, which requires 1.5 to 2.0 litre of flushwater for proper flushing only shall be installed and the blackwater be treated in a vermicomposting unit outside the building. The leachate shall be drained to a leachate garden for assimilation and evapotranspiration. To avoid waterlogging and overflowing of the garden during monsoon times, the bed shall be equipped with a fail-safe overflow do drain a surplus of liquid to a nearby sewer. Greywater produced at this apartement shall be piped to a flowerbed in front of the building and distribution of the water shall be done in mulch-filled absorption trenches witout pre-treatment. An existing toilet, which serves staff members, shall be replaced by an elevated double vault urine-separation vermicomposting toilet system. To facilitate the harvest of the finished compost and to demonstrate the hygienic safe reuse of the finished compost as a soil amendment the toilet is designed to be operated in batches. The leachate will be drained to a leachate garden. Buildings, which are arranged in a cluster around the Hostel & Kitchen Building, shall be connected to the existing sewer and the wastewater, for the time being, be treated jointly in the existing septic tank and soak-pit. If ample experiences in treating blackwater in “solid-liquid separation cum composting systems” are gained, such a treatment facility may be built at RAMETI Khopoli.

The Navsarjan Trust ecosan pilot project – VTI "Dalit Shakti Kendra"

Objectives of the project

Navsarjan Trust was established in 1989 to help eliminate discrimination based on caste, assure equality of status and opportunities and ensure the rule of low, not of castes and is traditionally working with Dalits, but also tribals and other poors all over Gujarat.

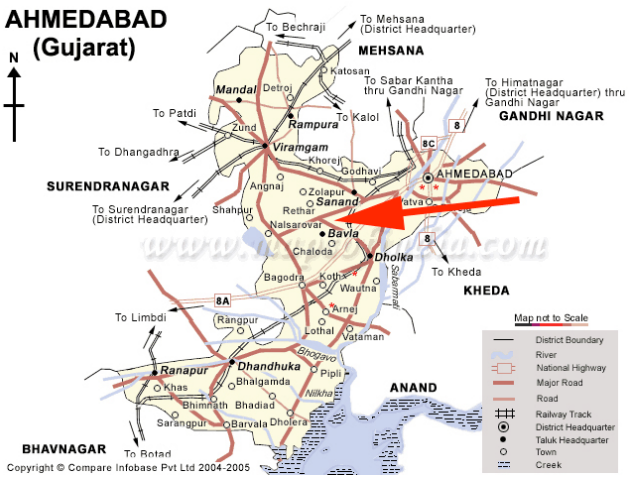
To help in the improvement of sanitation, specifically in rural areas, Navsarjan Trust aims to develop, implement, evaluate and disseminate socially and culturally acceptable, sustainable and hygienic safe sanitation, treatment and reuse concepts for human excreta. The ecosan concept which is going to be implemented at the VTI "Dalit Shakti Kendra" will therefore not only be a showcase but also provide Navsarjan Trust first-hand experiences on ecosan and the knowledge for further dissemination of ecologically sound sanitation concepts in Gujarat State.

Location and general conditions

Established on an eight-acre land in Nani Devti village near Sanand, the Navsarjan VTI "Dalit Shakti Kendra", or DSK for short, is located about 30 km southwest of Ahmedabad City at Sanand-Bavla-Road, Gujarat State (figure 6).

figure 6: District map of Gujarat State (left) and map of Ahmedabad district (right)

(source: Maps of India, version 4.0)



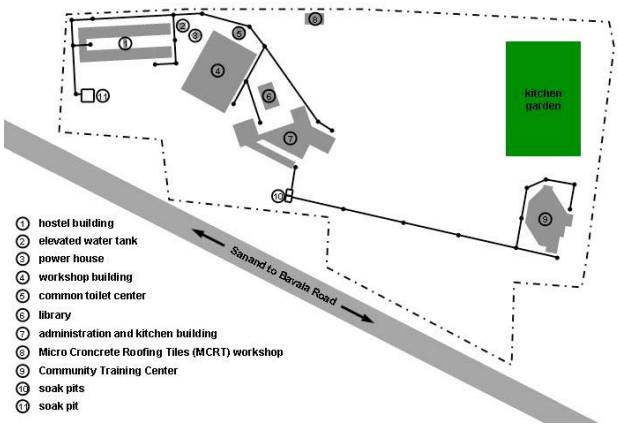
(source: Maps of India, version 4.0)

Situation before the project

The VTI "Dalit Shakti Kendra", established in 1999, comprises an administration & kitchen building, a workshop building, a common toilet centre, a hostel and a Community Training Centre (figure 7). In 2003/04, on an average, 150 students, broken into ca. 25 females and about 125 males, had been attending technical training courses at DSK throughout the year. The number of students shall be increased to 240 at maximum in near future and at the same time the proportion of female students shall be increased to 51%, at least. Besides students and staff members a variable number of guests, attending meetings and workshops at the CTC, are staying at DSK. To increase the number of accommodations, construction of a first floor level at the CTC was started in beginning of 2004. Wastewater produced at the administration & kitchen building, the workshop building, the common toilet centre and the hostel was drained to a soak-pit infront of the hostel. Wastewater from an office at the administration & kitchen building and from the CTC (ground floor

only) was discharged to a soak-pit next to the administration & kitchen building. Water from washing dishes was discharged to the open field next to the washstand, which is situated vis a vis the library. Water used by students for washing clothes and bed sheets was disposed to trees and bushes behind the hostel building.

figure 7: Sketch map of VTI "Dalit shakti Kendra" (left) and pic of hostel (right)



Current state of the project

Implementation of the ecosan system at the VTI "Dalit Shakti Kendra" is under construction and the following ecosan components are already implemented or to be implemented within the next months.

Collection, treatment and reuse of flow streams at the new common toilet centre:

A new sanitation complex comprising common toilets for females and males, a biogas plant and subsequent treatment of the digested slurry is under construction right now (figure 8). Blackwater will be directly discharged to the biogas plant, which will also receive the manure of ca. 5 to 10 buffaloes. Water used for primary washing hands will be drained to elevated flowerbeds arranged in 2 semi-circles. Greywater from washbasins shall be used for subsurface irrigation of greywater gardens. The biogas produced will be used for cooking and substitute a certain proportion of LPG (liquefied pressurized gas).

figure 8: Pic of new common sanitation complex at DSK (under construction)

Collection, treatment and reuse of water from washing dishes:

For the treatment of water used for washing dishes an organic filter was built (figure 9). Rice husk and wood chips, which are stuffed in gunnysacks shall retain solids. The liquid is drained to a collection tank and reused for the irrigation of nearby plantations.

figure 9: Pic of wash-stand (left) and organic filter (right) for the treatment of water used for cleaning dishes

Elevated double vault urine-separation vermitoilet system:

Two elevated double vault urine-separation vermicomposting toilet systems are going to be built close to the hostel and will serve students and staff members as “emergency toilets” during nighttime. In order to facilitate harvest of the finished compost, the toilets are designed to be operated in batches. Daily deposits will be made into one of the two composting chambers below the squatting slab. One chamber will be used until it is "full". The worms will then be allowed to complete digestion while the second chamber accepts faecal material. When the second chamber becomes filled, the first chamber will be emptied and the process starts all over. Each processing chamber will be equipped with a ventilation pipe, that runs above the roof, is screened for flies and capped for rain. Leachate and water used for primary washing hands will be drained to an evapotranspiration bed planted with reed. Urine will be piped to a collection tank and greywater from the washbasin will be discharged to a flowerbed.

Collection, treatment and reuse of greywater from the hostel and kitchen:

As soon as the new common sanitation block is put in operation and the “emergency toilets” are built, all toilets inside the Hostel will be closed down. As there won’t be any blackwater production at the Hostel any longer, the existing sewer will be used for collection of kitchen water and greywater from the Hostel. The sewer and an additional collection chamber will provide sufficient storage capacity for collection of half the daily greywater production. The accumulated water will be lifted to treatment cum storage unit, which will combine a reed bed and a storage tank. Solids will be retained on the surface of the reed bed and the liquid will be collected in the concrete basin. To avoid overflowing, the treatment cum storage unit shall be equipped with a fail-safe overflow, which shall situated ca. 10 cm below the surface of the bed to avoid stagnant waters and mosquito breeding. An outlet (equipped with a ball valve) will allow the use of pretreated water for irrigation purposes. To reduce water consumption all but one water tap in the bathrooms will be closed down and students will have to fetch water (e.g. showering, …) from a waterstand outside the

building. The remaining water taps, one in each bathroom, will be connected to water tanks and will provide a limited amount of water, as they will be filled once a day only.

Collection, treatment and reuse of urine from urinal centre:

The common toilet block behind the workshop building will be a common urinal centre in future serving females and males. Source-separated urine will be collected in a subsurface collection tank outside the building. Using a hand- or foot-operated pump the urine has to be lifted to nearby storage/hygienisation tanks periodically. Both, the collection and storage/hygienisation tanks will be equipped with floating scales and transparent pipes, respectively, to show the urine volume.

Collection, treatment and reuse of wastewater from CTC:

Mixed wastewater from the ground floor level and blackwater from the first floor level of the CTC will be pretreated jointly in an organic filter to remove solids. The pretreated water will be drained to an evapotranspiration/infiltration bed for reuse. The remaining greywater from the first floor level will be used for subsurface irrigation of nearby flowerbeds or greywater gardens. Distribution of the water will be done in mulch-filled absorption trenches with or without pretreatment.

The Navsarjan Trust ecosan pilot project – Primary Schools in Gujarat

Objectives of the project

Navsarjan Trust has come to realize that education coupled with imparting skilled training could help in the economic empowerment of the Dalit community. Thus the necessity of establishing a suitable education and training system was felt.

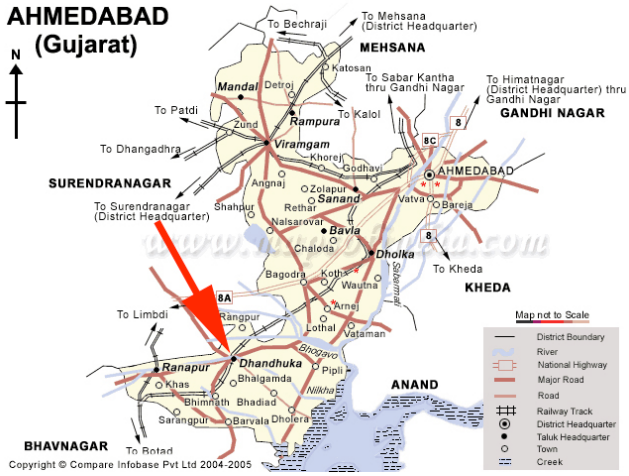
Location and general conditions

For the time being Navsarjan Trust established 4 primary schools in different talukas viz, Dhandhuka Taluka in Ahmedabad District; Karjan Taluka in Vadodara District; Limbdi Taluka in Surendranagar District and Sami Taluka in Patan District (figure 10).

Situation before the project

After completion each school will have a total capacity of 210 pupils and comprise 6 classrooms, toilet and shower facilities for pupils and staff members, an administration building, a kitchen building, a workshop building and 4 residential buildings (staff quarters). The main units of each school will be the classrooms, which will double up as dormitories as pupils are staying overnight. 3 classrooms with a capacity of 35 students each will be arranged to form a cluster.

figure 10: Location of Navsarjan Primary Schools in Gujarat State (clockwise from top left: Dhandhuka Taluka in Ahmedabad District; Karjan Taluka in Vadodara District; Limbdi Taluka in Surendranagar District and Sami Taluka in Patan District)



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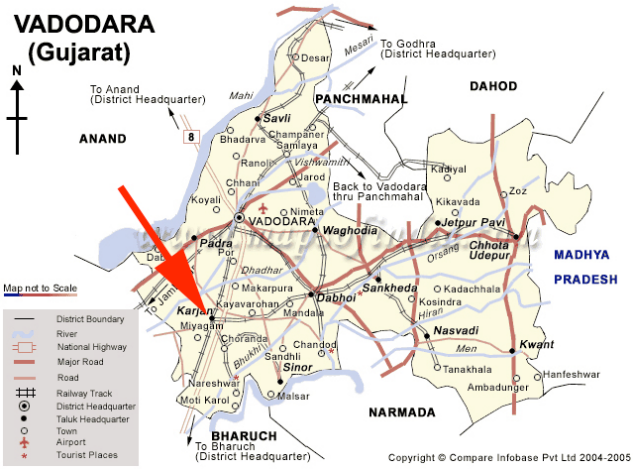

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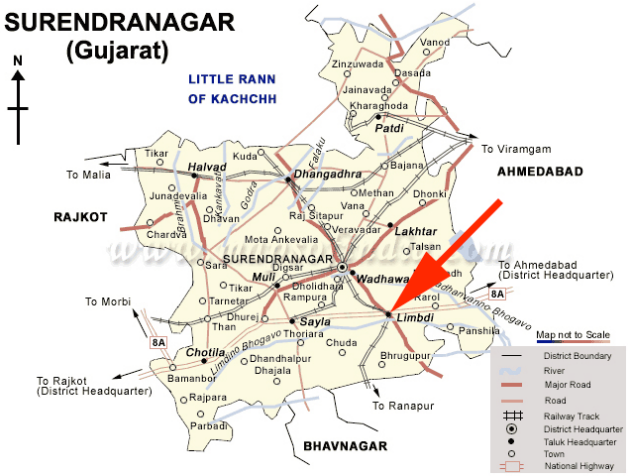

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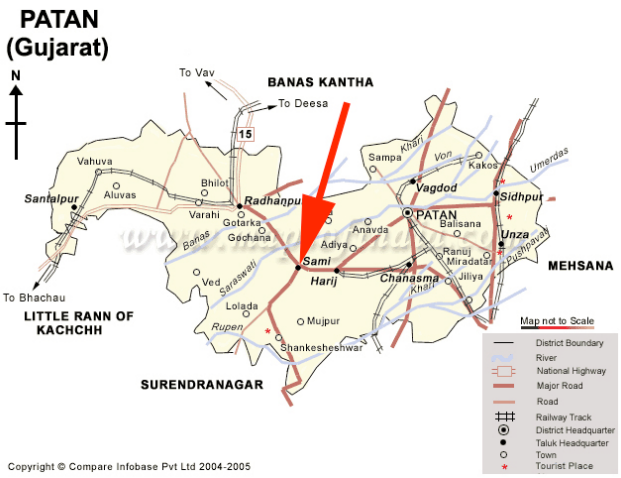


(source: Maps of India, version 4.0)

Current state of the project

Construction of the main toilet block at the Navsarjan Primary School in Dhandhuka is finished and the others will follow within a few weeks.

To overcome a common drawback of double-vault composting toilets - the increased surface area required for construction in comparison to conventional toilets – a new idea on how to use the interior space of the toilets best was needed (figure 11). Instead of 4 double-vault cabins, 8 single-vault-urine–separation compost toilets will be arranged in 2 clusters. To facilitate harvest of the finished compost the toilets will be operated in batches. It follows that only 4 toilets will be in use at the same time and receive daily deposits until the composting chamber is "full". The worms will then be allowed to complete digestion while the toilet cabin above will be used as a shower. A specially designed cover will prevent water from entering the composting compartment or to be trained to the urine collection tanks. Greywater produced from showering will be diverted to the outside with the help of a channel and being reused for subsurface irrigation of flowerbeds. The alternating use of the cabins as a toilet or shower helpes to reduce the interior space and therefore construction costs.

figure 11: Pic of toilet block at Navsarjan Primary School in Dhandhuka Taluka (clockwise from top left: front view of sanitation block; rear view of toilet cabins; 3-hole squatting slab; pipings for separate collection of urine and wash-water)

The ACTS Trust ecosan case study – public toilet centre in Bangalore

Objectives of the project

Before 2001 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 only one indication of the appalling living conditions for many thousands of slum dwellers, particularly women, the establishment of a public toilet centre 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.

Thus the objectives of establishing a public toilet centre have been manifold [1]:

- Improving living conditions in the slum, minimizing the risk of disease spreading during monsoon flood periods and increasing women's security;
- Recycling of nutrients and organics due to the collection, treatment and reuse of urine and faeces for the production of fertilizer and compost, respectively;

- Generation of income for the development of the slum by charging for the use of the toilet, selling of fertilizer and bananas produced;
- Finally changing attitudes of people and encouraging them to consider human urine and faeces as a valuable resource

Although the ACTS ecosan toilet centre is successfully in operation for almost 4 years now, serving about 500 to 600 users per day, the originally designed logistics system 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 seecon gmbh and GTZ.

The objectives for upgrading of the collection, transportion and processing scheme are listed below:

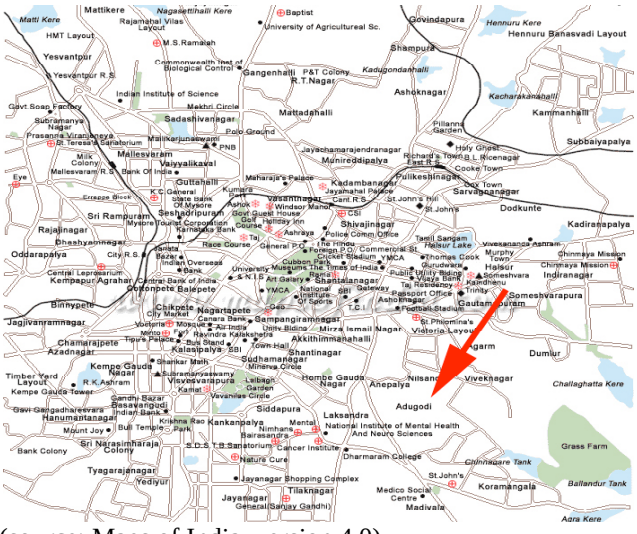
- Improving working conditions for labourers in regard to hygiene due to draining surplus of wash-water to a sewer instead of collecting and transporting the water to Rayasandra Campus when the collection tank is full;
- Improving the collection and logistics systems at the public toilet centre will avoid shifting of urine and faecal matter drums in future;
- Improved hygienic conditions due to the treatment of faecal matter in a biogas plant at Rayasandra Campus;
- Extension of the sanitation project on new to be built toilet centres will be possible due to an increased treatment capacity of the new biogas plant in comparision to the old composting trenches;
- Reduced LPG (Liquid Pressurized Gas) consumption for cooking at Rayasandra Campus, due to the use of biogas produced

Location and general conditions

The ACTS eco-friendly public toilet centre is located in Rajendra Nagar Slum, Bangalore, Karnataka State. Processing and reuse of source-separated urine and faecal matter happens at the ACTS Rayasandra Campus for Higher Education which is situated about 12 km from the public toilet centre in the surroundings of Bangalore.

figure 12: District map of Karnataka State (left) and map of Bangalore city (right)

(source: Maps of India, version 4.0)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Project phase I – Implementation of an eco-friendly public toilet centre and processing site

In 2001 the local NGO ACTS (an acronym for Agriculture, Crafts, Trades and Studies), in co-operation with seecon gmbh, established an eco-friendly public toilet centre in Rajendra Nagar Slum and a co-composting site for faecal matter at the ACTS Rayasandra Campus.

Urine and faecal matter were separately collected in 120 litre plastic drums. Once a day the full drums were picked up and conveyed to the ACTS Rayasandra Campus where faecal matter was co-composted with waste paper from a nearby IT company and biodegradable waste in composting trenches and urine was applied to a banana plantation after storage. Wash-water produced at the toilet centre was drained to an infiltration bed in front of the toilet block. Water that didn't trickle away was collected in a subsurface collection tank, which was emptied when full.

Project phase II – Upgrading of the toilet centre and processing site

A new biogas plant, which has been designed and built by Suma Khadi Gramodyoga Sangha, a local NGO, is in operation for almost 2 months now and replaces composting trenches at the ACTS Rayasandra Campus, which had been previously used for the treatment of faecal matter collected from the ACTS Public Toilet Centre in Rajendra Nagar Slum. The biogas produced is used for cooking and substitutes a certain proportion of LPG. Having a retention capacity of 25 m^3, the biogas plant allows extension of the sanitation project on new to be built public toilets. Subsequent treatment of the digested slurry is done in sludge drying beds.

Wash-water produced at the toilet centre, that isn't taken up by the planted infiltration bed, is now drained to a nearby municipal sewer.

Construction of the new suction unit for the evacuation of faeces and urine is already done and the new logistics system for collection and transportion of source separated urine and faecal matter will be implemented by November 2005. Faecal matter will be collected in 8 tanks, one below each toilet cabin. All tanks will be equipped with ball valves and be connected to a main suction pipe, which provides a connection point for emptying of the tanks. Urine will be collected in 2 plastic tanks, which are connected to allow balancing of liquid levels. The lorry will be equipped with tanks and pumping systems for the evacuation of faeces and urine. Urine and feces are then transported to Rayasandra Campus, where the urine is stored in large tanks and feces are treated in the biogas plant (figure 13).

Lessons learnt

- The slogen "ecosan - an approach to human dignity, community health and food sequrity" is clearly implemented by the project: The project shows a positive impact on the dignity and health of the toilet users and the urine and the faeces are successfully used to produce high quality food (bananas) and biogas.
- "Closing the loop" in terms of nutrients-cycles between urban areas (consumer areas) and rural areas (production areas) is feasible and opens new economical options.
- A strong local organizational embedding and a good long-term management of the ecosan-technology are key prerequisites for a successful and sustainable project operation. Wherefore a strong local project partner and manager is crucial for the project.
- Planning ecosan-system is not a green-desk-job but needs stakeholder involvement.

figure 13: Upgrading of ACTS ecosan toilet centre (clockwise from top left: view of ACTS Public Toilet Centre in Rajendra Nagar Slum; newly tiled squatting slab; use of biogas for cooking; sketch of new collection system at the toilet centre; suction unit for evacuation of urine and faecal matter from the public toilet centre; new biogas plant at ACTS Rayasandra Campus)

(pic by J. Heeb)

- Communication plays an important role to prevent misunderstandings and political problems. Involvement of "critical voices" helps to develop the projects efficiently. Public or individual concerns have to be considered as deciding inputs for project planning, improvement, adjustment, etc.

- The project development has to consider and synthesise relevant political, institutional and technical issues into an integrated system and communication design.
- Even generating income and workplaces the project depends on external financial support. This problem could be solved developing new contracting systems involving and obligating the local authorities (private-public-partnership approach).
- Failures are unavoidable and have to considered as essential elements of the learning process.
- Long-term experiences and international embedded research are very important: After 4 years of project operation, communication the project reached a national and international recognition.

Bibliography

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