ECOLOGICAL SANITATION - A NEED OF TODAY!
PROGRESS OF ECOSAN IN INDIA

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1 THE CRISIS OF SANITATION

According to most recent reports, around 2.6 billion of the 6 billion on the planet have no access to any form of basic sanitation. Sanitation is a critical issue as it is linked to both human health and dignity. Poor sanitation is leading directly to a decline in the quality and quantity of available water resources, and the problem is now finally being treated with a greater degree of seriousness than ever before. This was highlighted during the World Summit on Sustainable Development in Johannesburg, 2002, where the existing Millennium Development Goals (MDG's), adopted by the UN in New York in September 2000, were expanded to include the sanitation target of halving the proportion of people without access to sanitation in 1990 by the year 2015. The current lack of sanitation, whilst having devastating effects on public health is also causing an alarming degradation of the environment. The poor nations are affected most dramatically by a decrease in fresh water resources and bear the brunt of water related diseases. India is already experiencing the weight of this rising burden. In the WHO (2006) report, it is reassessed that diarrhoea is the biggest childhood killer. Nearly 1/3rd of all diarrhoeal diseases occur in India, whilst the population represents only 1/6th of the global population.

2 SANITATION IN INDIA

2.1 Profile of India: location and general conditions

India, the seventh largest and second most populous country in the world, is located in the southern peninsula of the Asian continent and lies to the north of the equator between 8°4' and 37°6' north latitude and 68°7' and 97°25' east longitude. The Indian mainland is about 3,200 kilometres from north to south and about 2,900 kilometres from east to west and encompasses an area of 3,268,090 square kilometres.

2.2 The current sanitation situation

The per capita fresh water availability in India is on the decline, from 3450m^3/cap in 1951 to 1967m^3 today, and it is estimated that it will fall drastically to between 1500 to 1800m^3 by 2025, even though annual precipitation is around 4000 billion cubic meters. It is the contamination of fresh water that is increasing the stress on availability of water. Statistics for India shows that only 60-62% of the urban population (which is about 45% of the total population) has access to safe sanitation. Out of the wastewater generated only about 36% is treated and the rest is left untreated and discharges into water bodies or infiltrates into groundwater. Out of this 60-62% population, about 34% is connected to septic tanks. Rural India accounts for 55% of the total population and out of this only 35% has access to sanitation. This gives the figure of 220 million and 430 million in respect of urban and rural population without access to sanitation. With the increase in population, and a more rapid urbanization, the generation of wastewater will increase drastically.

Enormous physical and financial efforts have been made by the Government of India. The following table shows the magnitude of such efforts to provide safe water and sanitation to the people / population of the country over the last 55 years.

Table 1: Planwise investment - water supply and sanitation sector (rs.crore)

Sl.No.	Plan (Period)	Total public sector plan outlay	Total plan outlay under water supply and sanitation sector		Plan outlay for Urban Water Supply and Sanitation		Plan outlay for Rural Water Supply and Sanitation.	
			Amount	% of public sector outlay	Amount	% of public sector outlay	Amount	% of public sector outlay
			Col.4 ....X100 Col.3		Col.4 ....X100 Col.3		Col.8 ....X100 Col.3	
	1 (2)	3	4	5	6	7	8	9
1	I Plan (1951-56)	3360.00	49.00	1.46	43.00	1.28	6.00	0.18
2	II Plan (1956-61)	6750.00	72.00	1.07	44.00	0.65	28.00	0.41
3	III Plan (1961-66)	8573.00	105.70	1.23	89.37	1.04	16.33	0.19
4	3 Annual Plans (1966-69)	6664.97	106.42	1.60	N.A.	N.A.	N.A.	N.A.
5	IV Plan (1969-74)	15902.00	437.00	2.75	282.00	1.77	155.00	0.97
6	V Plan (1974-79)	39303.49	1030.68	2.62	549.44	1.40	481.24	1.22
7	Annual Plan (1979-80)	12549.63	430.22	3.43	197.93	1.58	232.29	1.85
8	VI Plan (1980-85)	97500.00	4047.00	4.15	1766.68	1.81	2280.32	2.34
9	VII Plan (1985-90)	180000.00	6522.47	3.62	2965.75	1.65	3556.72	1.98
10	2 Annual Plans (1990-92)	137033.15	4427.29	3.23	1721.37	1.26	2705.92	1.97
11	VIII Plan (1992-97)	434100.00	16711.03	3.85	5982.28	1.38	10728.79	2.47
12	IX Plan (1997- 2002)	859200.00	39538.00	4.46	18624.00	2.16	20914.00	2.43
13	X Plan (2002-2007)	1525639.00	44206.55	2.89	19758.55	1.30	24448.00	1.60

But, the goal is still far from being achieved, especially if we look at the sanitation sector. Comparison of the Indian population, to that of the other nations in the South Asian region, shows that the task is enormous, and concerted efforts and innovative solutions are required to achieve the Millennium Development Goals. This will directly or indirectly help to improve other factors, as health, poverty, economic growth etc.

So far the Conventional Sewer System (CST) could not produce desirable results on improvement of public health. Instead the water based conventional sewer system is adding to the woes of water scarcity and the mindless consumption of scarce water in India. It is estimated that about 650 million Indian people do not have access to sanitation/improved sanitation, and that to reach the goals approximately 82,000 people need to be provided with sanitation facilities every day in India. Recycling and reuse of waste products cannot be possible in the present CST.

The costs of the present system have proven to be exorbitant whilst the operating functional efficiency is low. These systems commonly add to the contamination of fresh water instead of solving the problem of sanitation.

Table 2: Trend of water supply, wastewater generation and treatment in Class I Cities/Class II towns in 2003-04

Parameters	Class I Cities	Class II Towns	Total
Number	423	498	921
Populaltion (millions)	187	37.5	224.5
Water Supply(MLD)	29782	3035	32817
Water Supply (lpcd)	160	81	
Wastewater generated (MLD)	23826	2428	26054
Wastewater generated (lpcd)	127	65	
Wastewater treated (MLD)	6955 (29%)	89 (3.67%)	7044 (27%)

2.3 Need of the hour

The survival and well being of the Indian nation depends largely upon sustainable development and for this, sustainable water supply and sanitation are essential requirements. For the poor people living in urban slums and rural areas, bereft of adequate sanitation and water supply, to achieve a better economic growth rate and higher productivity, priority has to be given to the health of these people. For this, improved sanitation and safe water supply is necessary. It is obvious that a massive effort is needed to reduce the sanitation backlog in the coming years and India has a major contribution to make in this regard. Moreover, it is of utmost importance, that the concept of sustainability is considered as part of this contribution.

Recent symposia in different parts of the world indicated that there is a need for alternative solutions, and that only a change in paradigm will allow us to achieve the Millennium Development Goals (MDGs). A paradigm shift that leads from the 'FLUSH & FORGET' systems to 'RECYCLE' in consonance with 'WASTE TO WEALTH' approach is therefore essential. There is an acute shortage of water and power, in fact a near crisis situation for water, in some parts of India.

At the same time the issue of food security must be considered. Sustained food production depends on sustained soil fertility and soil carrying capacities. With fertiliser production requiring a lot of energy and natural phosphorus reserves declining, and with soil quality not being maintained by artificial fertilizing, there is a need worldwide and in India to find solutions for these problems. The CST discharges nutrients and organic material into our drinking water supplies, it does not recover them for food production. Closing the loop between agriculture and sanitation will help address these issues.

Innovative, decentralized solutions that are less costly and which can save water, have to be developed without any further delay, for India. Amongst the various sanitation concepts, **Ecological Sanitation**, referred to as **ecosan**, which can be termed as a holistic approach to sanitation and water management, is the most significant and viable solution.

3 ECOSAN IN INDIA

Figure 1: **Mapping of IESNI ecosan meetings in India**

3.1 Innovative Ecological Sanitation Network of India

The Ecosan concept is being promoted world over since last 10 years and in India since last 6-7 years. The **'Innovative Ecological Sanitation Network India'** (IESNI) was established in April 2004 through a joint initiative of GTZ (German Agency for Technical Co-operation), and the Indo-German Bilateral Project Capacity Building and Training (IGBP-CB&T) in Maharashtra State, which aims at capacity building and training in the field of watershed development and agricultural extension management. Being a voluntary network the IESNI aims to promote the development, implementation and dissemination of socially and culturally acceptable, sustainable, hygienically safe and ecologically sound sanitation approaches for India and other activities such as the organisation of joint workshops.

Networking organizations and activities:

The organizations given below (Table 2) have been quite active in ecosan capacity building, and the training of volunteers over the last 4-5 years. Most of them are members of the IESNI, which has so far organised seven workshops, and one International Conference (Nov. 2005) (Figure 1).

Table 2: List of organisations active in ecosan capacity building in India

• Ecosolution – India
▪ Founded by Paul Calvert.
▪ Ecosan innovator, promoter, practitioner, in India since 1994.
▪ Founder of IESNI along with GTZ and others.
▪ 2001 conducted all India ecosan awareness raising drive.(web:http://www.eco-solution.org)
• German Technological co-operation GTZ - (web : http://www.gtz.de/ecosan/)
▪ Leading founder organization for IESNI in India.
▪ Promotion through information material, workshops, conferences, in close association with IWWA.
▪ Pilot projects with local state govt. agricultural dept. for R&D.
▪ Well set for up scaling of activities.
• Seecon Gmbh – Switzerland - (web: http://www.seecon.ch/)
▪ Capacity building through e-learning.
▪ Close association with IWWA for workshops and conferences.
▪ Successful pilot projects.
• SCOPE-Trichy (web: http://www.scopetrichy.org/)
• Navsarjan (web: http://www.navsarjan.org/)
• BORDA – Germany - (web: http://www.borda-net.org/)
▪ Capacity building workshops.
▪ Training of manpower for project implementations.
▪ Reuse of waste but without urine separation.
▪ Executed different range of projects.
• Indian Water Works Association India: IWWA (web: http://www.iwwainternational.com)
▪ Foremost NGO of water and sanitation engineers and professionals in India.
▪ Strong membership of 6000 plus with 27 centers allover India.
▪ Organized various workshops with GTZ and Seecon.
▪ Promoting through pilot project.
• Ecosan Services Foundation – India
• ACTS - (web: http://www.acts.co.in/)
• EcoSanRes/SIDA
• CSE Centre for Environment
• UMB Norwegian University of Life Sciences (web: http://www.umb.no/)
▪ Training through short courses to Indian volunteers.
▪ Knowledge sharing, R&D.
• UNICEF (web: http://www.unicef.org/)
• UNDP (web: http://www.undp.org/)

3.2 Examples of joint projects in execution of GTZ-Seecon-IWWA

One important activity of the IIESN and its partners is the implementation of demonstration projects in different areas of India. The overall objectives of those projects are:

- to introduce the ecological sanitation concept and to identify the appropriate wastewater handling approaches that satisfy technology, cost and institutional framework and enable maximizing the utilization of existing pipes and treatment facilities;
- to recover the nutrients from urine and faeces for agricultural purposes;
- to contribute to the reduction of wastewater discharged to sewers through recycling of greywater.

Examples of IESNI projects are presented below.

3.2.1 Virar Science Garden

The aim of this project is the evaluation of designs for a public toilet linked biogas, which shall be located at Virar Science Garden. Co-processing of wet organics from a nearby vegetable market is considered.

It is proposed to go for specially designed squatting pans (so called “rural” or “pour-flush” pans) made of ceramic that require a little amount of water for flushing the excreta only and are equipped with a seal („P-trap“). The blackwater (toilet wastewater) shall directly be discharged to a biogas plant for its hygienically safe treatment and recovery of valuable energy in form of biogas for direct use (e.g. lighting of toilet centre during night time, lighting of compound wall of “Virar Science Garden”). The limited usage of water is necessary to restrict dilution of the blackwater and keep reactor sizes small. The digested slurry shall be collected onsite and hauled off-site for drying in sludge drying beds before being applied as soil conditioner in agricultural production for improving soil structure and increasing carbon content and water holding capacity.

Figure 3: Picture of pour-flush squatting pan (“rural pan“) and water seal („P-trap“)

The installation of urinals (both for ladies and gents) shall facilitate source-separated collection of urine. On-site collection of urine shall happen in subsurface tanks made of plastic. Using a suction truck the accumulated urine has to be collected and conveyed to storage tanks for hygienisation purposes before being applied as nitrogen-rich liquid fertilizer in agricultural production. Grey water (wastewater from all non-toilet plumbing fixtures) that is collected from the washbasins shall be used for watering of nearby plants.

Box 1: Virar Science Garden Project characteristics

Black water production:

Calculation of daily black water production is based upon the following assumptions:

- People contr. to black water prod.: 200 to 400 per persons per day
- Specific black water production: 3,5 to 4,0 litres per person per day

For calculating the appropriate size of the digester, 3,5 to 4,0 litres of wastewater per user per day is considered. Based upon these assumptions daily black water production will be 0,8 to 1,5 m^3. If no further biowaste (e.g. wet organics from the nearby vegetable market, …) or manure is co-digested along with the black water, the required reactor capacity (hydraulic volume of the biogas plant) has to be 45 m^3 (considering a hydraulic retention time of 30 days).

Sludge drying beds:

Calculation of size of sludge drying beds is based upon the following assumptions:

- slurry production: 0,8 to 1,5 m3 per day.

If no further biowaste (e.g. wet organics from the nearby vegetable market, …) or manure is co-digested along with the black water, weekly slurry (digested sludge) production is estimated to be about 6 to 10 m^3.

Considering heavy rainfalls and therefore reduced evaporation and infiltration rates during monsoon season, provision of 4 to 5 elevated sludge drying beds having a surface area of 40 m^2 each is recommended. Each bed should have a height of at least 0,75 meters and thus provide a storage capacity of 30 m^3.

Biogas production:

Calculation of daily biogas production is based upon the following assumptions:

- people contr. faecal matter: 200 to 400 persons per day
- specific biogas production:. 0,025 to 0,030 m3 per person per day

If no further biowaste (e.g. wet organics from the nearby vegetable market,) or manure is co-digested along with the black water, daily biogas production is estimated to be 6 to 10 m^3. Weekly biogas production (about 40 to 70 m^3) equals 1 to 2 cylinders of LPG (@ 14,2 kg each). Annual biogas production of 2,200 m^3 to 3,600 m^3 (equals 50 to 100 cylinders of LPG) is worth Rs. 22,000 to Rs. 44,000 (@ present costs of about Rs. 425 per cylinder).

Yellow water (urine) production:

Calculation of daily yellow water production is based upon the following assumptions:

- number of urinal visits: 300 to 500 per day
- specific urine production: 200 to 300 ml per visit
- anal cleansing water, 100 ml per visit

Based upon these assumptions the total amount of urine to be collected per day is about 100 litres. In addition about 50 litres of cleansing water (used by ladies after urination) has to be collected with the urine. Assuming that hauling of urine will be done once a week only, on-site storage capacity has to be at least 1,500 litres . Considering a hygienisation time of at least 3 weeks, 4 number of storage tanks having a capacity of 1,5 m^3 each, have to be provided off-site.

Grey water production:

Calculation of daily grey water production is based upon the following assumptions:

- number of people: ca. 500 to 1,000 persons per day
- specific grey water production: ca. 1,5 litres per person

Based upon these assumptions daily grey water production is calculated to be 0,75 to 1,5 m^3.

The grey water may be used for direct subsurface irrigation of nearby plants without any pre-treatment.

3.2.2 Public toilet in a low-cost housing / School in Badalapur

This project aims to evaluating designs and treatment concepts for source-separated flow streams for a school in Badalapur.

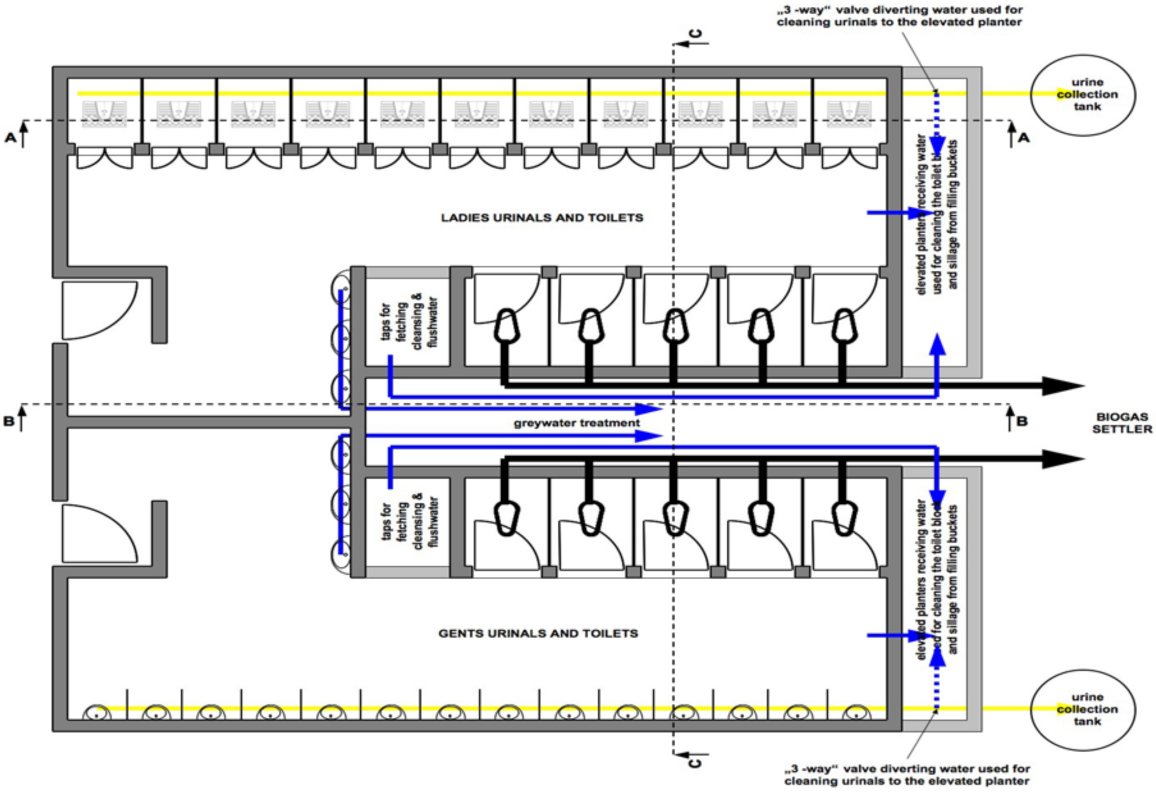

Figure 4: Conceptual sketch for Badalapur project

Box 2: Characteristics of Badalapur project
Possible number of users: Possible number of users of the new sanitary facilities on a day in, day out basis is about 2,700 students (1,500 students attending Senior College in the morning and about 1,200 students attending Junior College in the afternoon). On certain occasions (about 20 days per year) up to 1,000 to 5,000 people gather for special programs such as wedding ceremonies….. **Ecosan concept:** Assumptions and design parameters: **Black water production:** Possible number of users: For calculation and designing of the biogas settler and the horizontal flow constructed wetland system, day in, day out users are considered only. Day in, day out user contributing to black water production: Number of day in, day out users contributing to black water production was set with 500 during a planning meeting. **Specific** night soil production and BOD contribution: Composition and quantity of faeces produced per capita per day depends on various factors such as diet, climate and state of health. Specific amount of faeces produced per capita in India is reported as low as 225 grams per day and as high as 435 grams per day. A different source considers 250 ml faeces and 25 grams BOD (biological oxygen demand) per capita for calculation of the appropriate size of a community toilet linked digester in Bangalore, India. For calculation and designing of the biogas settler and the horizontal flow constructed wetland system 250 grams faeces along with 25 grams BOD per person per day are considered.

Specific black water production:

For calculation and designing of the biogas settler and the horizontal flow constructed wetland system 3 litres of water (anal cleansing and flushing) per person per day are considered.

Calculation of daily black water production is based upon the following assumptions:

number of users: 500 persons per day

specific black water production: 3 litres per person per day

specific feces contribution: 250 grams per person per day

specific BOD contribution: 25 grams per person per day

black water production:

$$Q_{BW} = 3\,l/cap,d \ \$ \ 500\,cap/d = 1,500\,l/d \qquad (1)$$

feces contribution:

$$F = 250\ g\ feces/cap,d \ \$ \ 500\,cap/d\ .\ \ 120,000\ g\ feces/d \qquad (2)$$

$BOD_{raw\ blackwater}$:

$$BOD_{RB} = \frac{25,000\,mg\,BOD_5/cap,d}{3\,l/cap,d}\ .\ \ 8,500\,mg\,BOD_5/l \qquad (3)$$

$BOD_{raw\ blackwater}$:

$$BOD_{RB} = 25\ g\ BOD_5/cap,d \ \$ \ 500\,cap/d\ .\ \ 12,000\ g\ BOD_5/d \qquad (4)$$

Black water production is calculated to be ca. 1,500 litres per day (1.5 m^3/d) having a BOD level of ca. 8,500 mg per litre. Faeces contribution and BOD load is calculated to be ca. 120 kg and about 12 kg per day, respectively.

Yellow water (urine) production:

Calculation of urine production is based upon the following assumptions:

- number of possible users: 2,700 persons per day
- number of urinal visits: 1 to 2 per person per day
- urine: 200 to 300 ml per visit

For calculation and designing of urine collection tank(s) 300 to 400 ml urine per person per day are considered.

Grey water production:

Calculation of grey water production is based upon the following assumptions:

- number of possible users: 2,700 persons per day
- number of toilet/urinal visits: 1 to 2 per person per day
- water consumption: 1,5 ltr per visit

For calculation and designing of grey water treatment/reuse facilities a specific grey water production of 1,5 to 3,0 litres per person per day is considered.

Biogas settler:

Recommended hydraulic retention time of wastewater in the biogas settler is about 8 to 10 days and 15 days with and without urine-separation, respectively.

As urinals are provided for ladies and gents, HRT of black water in the biogas settler is chosen to be 10 days.

Horizontal flow constructed wetland system.

BOD parameters will be decisive of calculation and designing of the constructed wetland system for treatment of biogas settler effluent due to reduced flush water consumption.

BOD reduction biogas settler: 75 %

organic load (cross section):150 g BOD per m² per day

org. load (surface area): 10 g BOD per m² per day

Calculation of appropriate size of the biogas settler has to be based upon the following assumptions:

- Black water production: 1,500 litres per day
- HRT: ca. 10 days (with urine-separation)
- faeces contribution; 120 kilograms per day
- BOD contribution: 12 kilograms per day

Important information:

An experienced company is doing the detailed designing and construction of the biogas settler.

Information on desludging intervals has to be provided by the experts.

Treatment of excess sludge for reuse as soil amendment may be done onsite in elevated sludge drying beds.

3.2.3 Navsarjan Trust Vocational Training Centre Project

The Navsarjan Trust was established in 1989 to help eliminate discrimination based on caste and gender and to assure equality of status and opportunities. In cooperation with GTZ and with support of the Swiss Agency for Development and Cooperation SDC, Navsarjan Trust has developed ecologically sound sanitation concepts based on various technological components on different sites.

A vocational training centre for Dalit youth called Dalit Shakti Kendra (DSK) was established in Gujarat in 1999. 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 the following components:

(1) A common toilet block with toilets for men and women, a biogas plant and subsequent treatment of the digested slurry in humification fields. The biogas plant also receives the manure of between 5 and 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. (2) Greywater from showers in the hostel and from the kitchen is treated in organic filters for solids removal and reused for surface irrigation. (3) Two double vault urine-separation vermi-toilets are installed. Earth worms facilitate the composting of faeces in the batch-chambers. (4) Urine is collected separately and directed together with water from hand washing to a greywater garden. Leachate from the composting chamber is treated and reused in a special leachate garden. The leachate is applied below surface to avoid public exposure to pathogens. (5) Mixed wastewater and blackwater from toilets in the community training centre is treated in organic filters, followed by evapotranspiration/infiltration beds. (6) Some greywater is being separately collected and directly treated and used in mulch trenches which allow a safe reuse of untreated greywater. As organic mulch material decomposes, the trenches have to be restored periodically

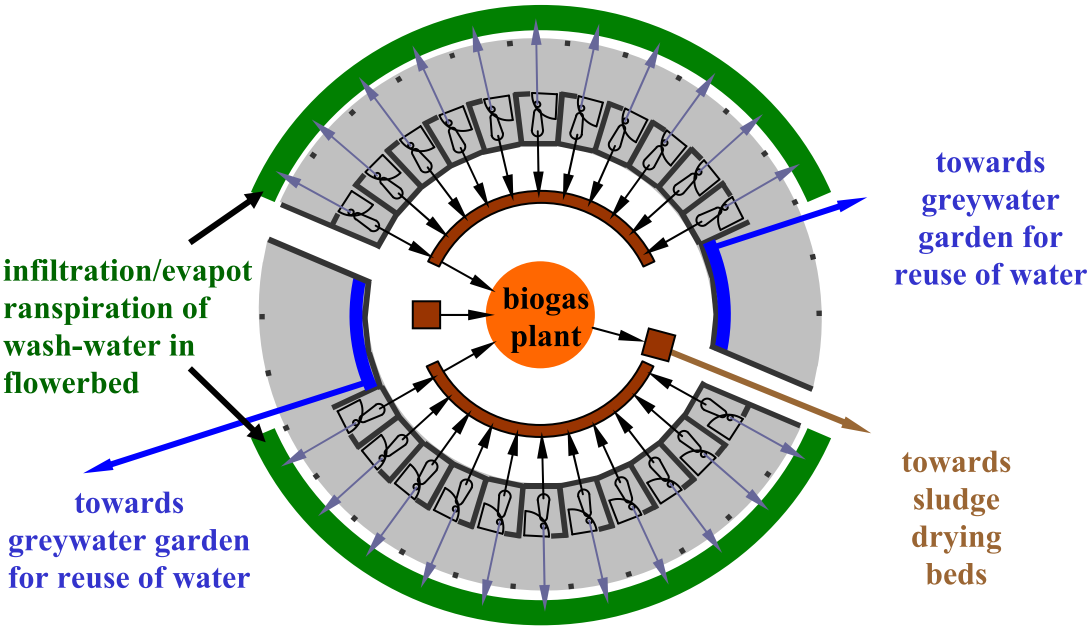

Figure 5: Conceptual sketch for students toilet block cum biogas plant at the Navsarjan Vocational Training Centre Project

Figure 6: Students residence (left) and building of the student's toilet block cum biogas plant (right) at the Navsarjan Vocational Training Centre Project

3.2.4 Navsarjan Primary Schools Project

Annother project of the Navsarjan Trust is to establish primary schools in 4 talukas (wards) in Gujarat State. After completion each school will have a total capacity of 210 pupils and comprise 6 classrooms, toilet and shower facilities, an administration building, a kitchen building, a workshop building and 4 residential buildings (staff quarters).

A sanitation bloc has been designed to provide toilets and showers 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 compost toilets. The toilets are operated in batches to facilitate harvest of the finished compost. That means that only 4 toilets are in use at the same time and receive daily deposits until the composting chamber below the squatting slab is "full". Worms are then added to the faeces to improve the composting process while the other toilets will now be used. The toilet cabins of the “closed” toilets are now used as showers. A specially designed cover prevents water entering the composting compartment or to be drained to the urine collection tank.

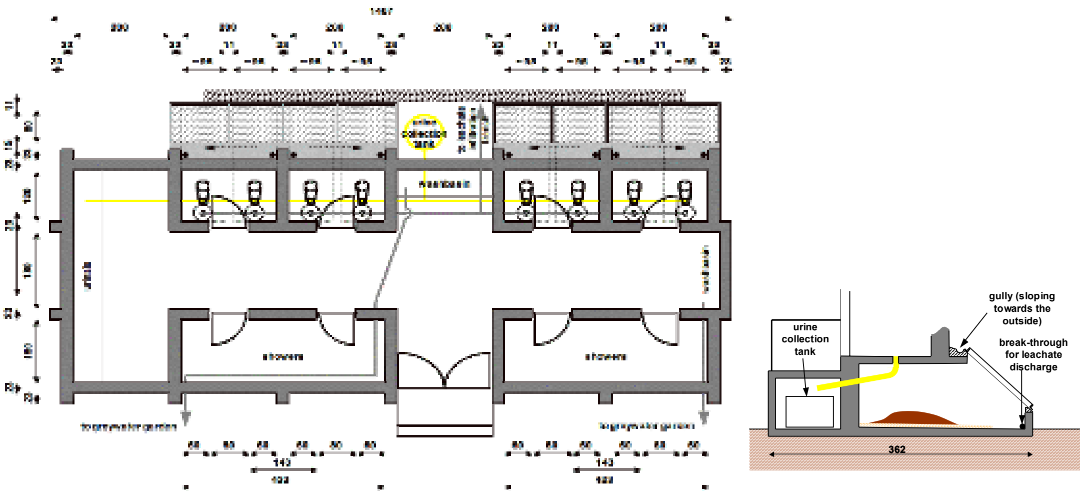

Figure 7: Conceptual sketch for toilet and washroom building (left) and Urine-diversion-dehydrating toilet (right) of the Navsarjan Primary Schools Project

Greywater produced from showering is diverted to the outside with the help of a channel and being reused for subsurface irrigation of flowerbeds. The alternative use of the cabins as a toilet or shower helps to reduce the interior space and therefore construction costs.

3.2.5 Ecosan Prefeasibility Study "PANDHARPUR

Four times a year several hundred thousand (laths) pilgrims gather at Pandharpur:

- "Maghi" is celebrated in the month of **January/February** (according to Hindu calendar) and upto **3 lakh** (300,000) devotees are gathering in Pandharpur;
- "Chaitry" is celebrated in the month of **March/April** (according to Hindu calendar) and upto **3 lakh** (300,000) devotees are gathering in Pandharpur
- "Aashadhy" is celebrated in the month of **July/August** (according to Hindu calendar) and upto **10 lakh** (1,000,000) devotees are gathering in Pandharpur;
- "Kartiki" is celebrated in the month of **October/November** (according to Hindu calendar) and upto **5 lakh** (500,000) devotees are gathering in Pandharpur.

The periods between the festivals are roughly calculated to be as given in the following table.

Table 3: Periods between the festivals

Festivals	Period duration
"Maghi" (Jan./Feb.) – "Chaitry" (March/April)	ca. 9 weeks
"Chaitry" (March/April) – "Aashadhy" (Jul./Aug.)	ca. 17 weeks
"Aashadhy" (Jul./Aug.) – "Kartiki" (Oct./Nov.)	ca. 13 weeks
"Kartiki" (Oct./Nov.) – "Maghi" (Jan./Feb.)	ca. 13 weeks

Table 4: Estimated waste water production at „Desert Areas"

Festival	Expected population [heads]	Duration of festival [days]	Specific wastewater production [liter/head/day]	Total wastewater production [m^3/festival]
"Maghi" (Jan./Feb.)	ca. 100,000	4	ca. 6	ca. 2,500
"Chaitry" (March/April)	ca. 100,000	4	ca. 6	ca. 2,500
"Aashadhy" (Jul./Aug.)	ca. 500,000	10	ca. 6	ca. 30,000
"Kartiki" (Oct./Nov.)	ca. 300,000	5	ca. 6	ca. 9,000
Total		23		ca. 44,000

Wastewater production at "Desert Areas"

It is assumed that during the festival seasons up to 500,000 people per day will use the sanitary facilities at the "Desert Areas". A BOD-load of 45 grams per person per day along with a specific wastewater production of 6 liters per person per day are design parameters. Considering the maximum number of population, the duration of the festival and the specific wastewater production per head per day, the total amount of wastewater produced for each festival is calculated. Total wastewater production from the „Desert Areas" during the festivals

„Maghi“, „Chaitry“, „Aashandhy“ and „Kartiki“ is estimated to be 2,500 m^3, 2,500 m^3, 30,000 m^3 and 9,000 m^3, respectively (Table 4). Annual wastewater production at the „Desert Areas“ will therefore arise to ca. 44,000 m^3.

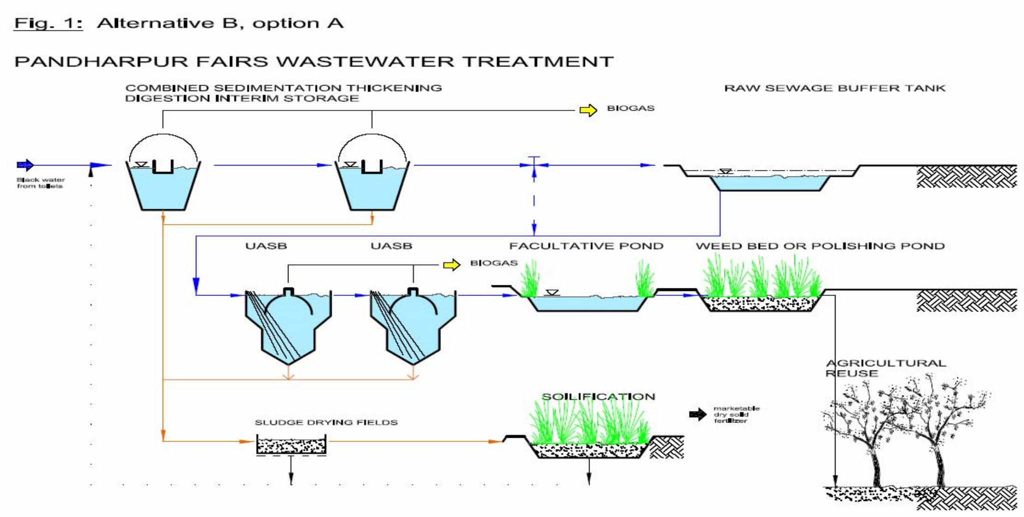

Figure 8: Conceptual sketch for proposed treatment at Phandapur

Box 3: Proposal for treatment of Toilet wastewater from „Desert areas“
A wastewater treatment scheme comprising the following elements is proposed: **Water** treatment line: Combined plastic covered channel type – digestor (solid - liquid separation, thickener, anaerobic digestion), Buffer pond for raw sedimented sewage, UASB (Upflow Anaerobic Sludge Blanket – Reactor), Facultative pond and/or constructed wetland polishing, Agricultural reuse of liquid effluents **Sludge** treatment line: Sludge drying beds and production of marketable solid fertilizer or Humification **Gas** utilization: Modified motor-generator set The raw toilet waste water is given, after mechanical pre-treatment via rake and a sand trap, into two parallel operated plastic covered channel – digesters (2 x 1.000 m3). These channel digesters are combining several process steps in one unit, namely sedimentation, thickening and the fermentation of the solids. The construction is made by reinforced concrete; alternatively it may be executed by solid (laterite) soil formations at low cost, as already has been demonstrated in pilot plants. Nearly all sedimentable solids are kept in the channel type digesters where anaerobic digestion takes place. The digested sludge is being extracted after a digestion period of at least 30 days and introduced to sludge drying beds or constructed wetlands for the soilification of the sludge. The settled raw wastewater is being stored in a buffer tank of about 30.000 m³ capacity. From the buffer tank the wastewater is being treated and anaerobically stabilized in a continuous flow of about 120 m³/day throughout the year in two Upflow Anaerobic Sludge Blanket – Reactors (UASB) (each about 700 m^3). During the fairs, the UASB reactors can also be charged with the fresh wastewater bypassing the buffer tank. Post treatment will be done by facultative ponds (size about 1,05 ha) or constructed wetlands (size about 0,3 ha) (water line) and sludge drying beds or constructed wetlands for the soilification of the sludge. (Sludge line).

3.2.6 Public toilet project in Rajendar Nagar Slum in Bangalore

To meet urgent community needs the Indian NGO ACTS and the Swiss 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, serving about 500 to 600 users per day. Although it has successfully been in operation for almost 4 years now, 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. A socially and culturally more acceptable, sustainable and hygienically safe collection, transportation and processing scheme has therefore been developed and implemented with the support of GTZ.

For the improved system, storage tanks now replace the barrels for collection of urine and faeces. A suction truck, equipped with tanks and a pumping system, evacuates faeces and urine and manual handling is no longer necessary. Urine and faeces are then transported to the treatment site, where urine is stored in large storage tanks and faeces are treated in a biogas plant.

Figure 9: Urine diverting public toilet in Bangalore (left; Heeb); biogas plant (right; Wafler)

The stored urine and digested slurry are used as fertilisers and the 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 will allow the extension of the project for further public toilet blocks.

3.3 Challenges for providing sanitation in India

Considering the geographical size of India, also being the second most populous country of the world, much more concentrated efforts, up scaling of these activities on urgent basis is required. Creating more awareness to the receptive Indian people and increasing of more volunteers and constructing more pilot/ demonstration projects across India, is now the task of the network. The response so far has been quite encouraging.

Some of the key points, which have to be taken into account are:

- Geographical diversity.
- Social and Cultural Issues.
- Psychological and cultural taboo for reuse of urine.
- Anti-scavenging Laws.
- Inadequate Funds for Innovation and Alternative Solutions.
- Large population with moderate literacy.
- Requirement of continuous IEC campaign.

There are, however, a couple of achievements so far, to which the IESNI has contributed. These include:

- Effective network in place.
- Awareness generation programme continued.
- Workshops and Conferences to reach masses.
- Training courses to begin for ecosan professionals.
- Pilot cum R&D projects on the rise.
- Ecosan material in local languages.

Some observations and suggestions to create a sustainable Indian sanitation future are:

- More ecosan experts are needed.
- Sustainable campaigns should highlight the ecosan concept.
- New townships being developed where no CST can be implemented (e.g. because of water scarcity), here ecosan can help developing viable alternatives.
- Peri Urban areas not connected to CST should be regarded as potential ecosan sites on an informed choice basis.
- Ecosan service provider need to be developed.
- More pilot cum R&D projects are needed, particularly for reuse of urine.
- Funds for Information Education and Capacity building need to be increased, considering size of the country.

4 CONCLUSION

With regard to the pilot projects implemented or to be implemented and based on its concepts, ecosan appears to be a sound alternative solution to conventional sewer system, and can contribute to the achievement of several of the MDGs and to poverty alleviation in general. Ecosan indeed looks for holistic approaches that are tailored to the needs of the users and to the respective local conditions. Instead of favoring one specific sanitation technology, ecosan promotes any technology that enables a closed loop material flow. Ecosan is so flexible that it can be incorporated in a new construction project but also can be integrated in an existing structure. Thereby a conversion from conventional linear to recycling oriented systems can be achieved in successive project steps.

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