



Environment

Water Community



## Solution Exchange for the Water Community Consolidated Reply

*Query: Leach Pit Toilets for Rocky Terrain - Experiences, Examples*

Compiled by [Nitya Jacob](#), Resource Person and [Sunetra Lala](#), Research Associate  
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From [Poulomy Chakraborty](#), Feedback Ventures (P) Ltd, New Delhi  
Posted 4 November 2008

I work for Feedback Ventures, an infrastructure consultancy based in New Delhi. We are involved in a sanitation project known as 'Community Led Total Sanitation' (CLTS) which is supported by the Water and Sanitation Programme – South Asia (WSP-SA) in Haryana, Madhya Pradesh and Sikkim.

We conduct training of trainers at the district level for people who are involved in accelerating the Total Sanitation Campaign (TSC) and scaling up CLTS in their respective districts. CLTS aims at making a village free from open defecation as the first step towards total sanitation. The focus is on behaviour change to facilitate the adoption of sanitary and hygienic practices.

During our training workshops, apart from triggering behaviour change, we also discuss rural eco-friendly low-cost toilet constructing techniques. These are usually region-specific; pertaining to local needs and depend on the geological conditions of the area. During the sessions, it has been found that digging pits in rocky terrain in parts of Madhya Pradesh becomes not only tough but also expensive. People usually have to hire earthmoving machines to dig the pits.

Moreover, as the soil is rocky, it prevents leaching. Hence, it is found that these pits start overflowing and stinking. A leach pit in rocky terrain defies technology of a common leach pit used in other regions, where the soil is more porous. These leach pits are not suitable for hard rocky terrain. Looking at the conditions of rural India, these pits should also be low-cost and eco-friendly.

Given these difficulties, we are seeking inputs on construction of leach pit toilets in rocky terrain. We would like information from members on the following:

- What are the kinds of toilet pits that can be dug in rocky terrain where the conventional leach pit technology is ineffective? These need to be low-cost, eco-friendly and durable.
- Is there any reference material available for construction of such toilets?

The inputs will help us in developing suitable training modules for construction of toilets in rocky areas.

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**Responses were received, with thanks, from**

1. [Arputhasamy Devaraj](#), United Nations Children's Fund (UNICEF) Office for Tamil Nadu and Kerala, Chennai

2. [A. J. James](#), Environmental and Natural Resource Economist, Gurgaon
3. [Babu K. Y.](#), Wash Institute, Kodaikanal
4. [Ajit Seshadri](#), The Vigyan Vijay Foundation, New Delhi
5. [Sumita Ganguly](#), Public Health Nutritionist, New Delhi
6. [Abhishek Mendiratta](#), Consultant, New Delhi
7. [Debasish De](#), Delhi Minorities Commission, New Delhi
8. [Gyanendra Misra](#), UDAAN Society, Aligarh
9. [Subburam](#), Society for Community Organization and Peoples Education (SCOPE), Tiruchirappalli
10. [Johnson Rhenius Jeyaseelan](#), WaterAid, Bhopal
11. [Uday Bhawalkar](#), Bhawalkar Ecological Research Institute, Pune
12. [Veena Upadhyay](#), Sulabh International Academy of Environmental Sanitation, Patna
13. [Nitya Jacob](#), United Nations Children's Fund (UNICEF), New Delhi
14. [Avudai Nayakam](#), Water Partners International (WPI) India Liaison Office, Tiruchirappalli
15. [Vishwanath Srikantaiah](#), Biome and Arghyam, Bangalore

*Further contributions are welcome!*

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## Summary of Responses

Providing safe, low-cost sanitation options remains a challenge in India. This is especially true for the construction of leach pits in rocky terrain. There is need for a different approach to training people how to make toilets in such terrain and members shared technical designs and their experiences in building toilets.

The **options available for constructing leach pits in rocky terrains** include ecological sanitation because it is eco-friendly and sustainable. Ecosan toilets are constructed above ground level, and therefore do not require pits, and are low-cost. They are easy to build and maintain, environmentally safe, and odourless. These toilets are cheaper in the long run than septic tank and municipal waste systems, and do not contaminate soil or breed insects. Moreover, they require less water, which is important considering that the amount of water necessary for flushing toilets accounts for half of all water consumed by households.

Members shared **experiences in constructing leach pit toilets** across India. In Borban village, [Maharashtra](#) the construction and use of 'Borban' toilets has been successful mainly because of the involvement of the Panchayat and local volunteers. This community-devised toilet is a single-pit model that suits the rocky and sloping terrain and lack of space. Similarly, in the rocky terrain of Datia village, [Madhya Pradesh](#), an NGO has helped a community construct leach pits both above and below ground level to help people improve their sanitation.

It is **best to use locally available resources**, wherever possible, for the construction of leach pits in remote, difficult to access locations. A case in point is the [Northeast](#) of India, where an NGO has helped a community make construct leach pits using bamboo, involving women in a big way. It uses bamboo cut into circular strips and plastered on both sides with cement, which are then lowered into pits. This technology reduces the cost of the unit and women from the families are involved in knitting the bamboo

together. Another successful initiative from the northeastern states of [Assam, Meghalaya, Sikkim Jammu and Kashmir, Himachal Pradesh, as well as Uttarakhand](#) in the north, involved the construction of twin leach pits in rocky terrain. The advantage of this system is when fills up, the user can change over to the other pit while the faeces in the first one decompose.

An innovative approach in Maharashtra has overcome the prospects and constraints involved with constructing leach pits in rocky areas. These odourless self-flushing toilets have been effective and demonstrated the use of natural methods for sewage treatment, and also produced water for flushing, said members.

Additional research revealed **different models of leach pits** adopted in **other parts of the world** where sanitation is a challenge. For example in [El Salvador](#), people use Lasf toilets consisting of two chambers built above ground, where the urine flows via a pipe into a soak pit under the toilet chamber. After defecation, a user sprinkles some dry material such as ashes, soil or a soil/lime or sawdust/lime mixture over the faeces. Soil is added to the first vault when it is nearly full, to top it off, and then it is closed. The second vault is then used. A year later or when the second vault is nearly full, the owner reopens the first chamber. These leach pits have proved to be a very successful low-cost option. In the [Philippines](#), research highlighted a case where a city provided sanitation to about a third of its unserved population and helped install dry urine diversion toilets.

Overall, the discussion highlighted practical initiatives by NGOs and other agencies to improve sanitation practices in India. It provided useful insights into how to train people to construct toilets in rocky terrain as well as innovative approaches used in India and abroad. It also revealed that improved sanitation leads to improved health for communities and that community involvement is key to the successful implementation of any sanitation initiative.

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## Comparative Experiences

### Maharashtra

**Borban Village Pioneers Single-Pit Toilet Model for Rocky Terrain, Ahmednagar** (from [A. J. James](#), *Environmental and Natural Resource Economist, Gurgaon*)

In the village it was hard to build leach pits due to the rocky terrain. To address this the people constructed a semi-circular masonry 'pit' with the rocky outcrop as the 'back' in areas where there is a sharp rocky drop. A gap was left under the brick structure for the liquid waste to go into a mud-covered channel. To ensure correct usage of the toilets and no open defecation, the Sarpanch and volunteers walked around the village, blowing whistles and breaking water pots. [Read more](#)

**Odorless Self-Flushing Public Toilet Provided for Slum Dwellers, Andheri, Mumbai** (from [Uday Bhawalkar](#), *Bhawalkar Ecological Research Institute, Pune*)

Slum dwellers had poor sanitation facilities. The Green Cross Society constructed odorless self-flushing toilets on the Versova Municipal Sewage Pumping Station premises. Now people carry 1-2 litres of water for defecation, and the thick sewage slurry gets treated in 2 shallow reactors using biosanitizers and a planted filter. The clean water is pumped back to feed the continuous flushing system. The toilets have been serving the community of about 100 people for more than 8 months. [Read more](#)

### Madhya Pradesh

**NGO Develops Leach Pits for Rocky Terrain, Datia** (from [Johnson Rhenius Jeyaseelan](#), *WaterAid, Bhopal*)

WaterAid India (WAI) has been working in an area with a rocky terrain to construct leach pits. Leach pit toilets were promoted with some modifications to the usual models. Leach pits were constructed two feet

above and three feet below ground level. Only the top layer lining was done. It has been observed that the recharge capacity of these pits is significant and the water percolates to the ground at a very fast rate. [Read more](#)

## **Arunachal Pradesh, Manipur, Mizoram, Nagaland and Tripura**

**Action for Food Production Constructs Bamboo Leach Pit Models** (from [Avudai Nayakam](#), WPI India Liaison Office, Tiruchirappalli)

AFPRO promoted the use of low-cost appropriate technology for the construction of sanitary latrines-using bamboo (the bamboo leach pit model). They were made with knitted bamboo structures instead of the conventional bricks. Through on-the-job training local masons were taught how to construct this model of toilet. These toilets have effectively addressed sanitation needs, providing low-cost options and utilizing locally available bamboo and masons. [Read more](#)

## **Assam, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Sikkim and Uttarakhand**

**HUDCO Develops Twin-Pit Leach Pits Models** (from [Debasish De](#), Delhi Minorities Commission, New Delhi)

HUDCO has developed a twin-pit latrine, which is being implemented in 6 states and can be used for rocky terrain. If one pit is filled up, the user manually can change the direction to other pit and the first pit gets the necessary time for the faeces to mix with the soil. The communities have benefitted in terms of greater access to sanitation facilities and also the various state governments are helping to finance the scheme in a 85:15 ratio (government:beneficiary), making it a cost-effective option.

From [Sunetra Lala](#), Research Associate

## **El Salvador**

### **Lasf Toilets Lead to Improved Sanitation, Hermosa Province**

The province is a densely built up neighborhood where the subsoil is hard. In 1991, households built Letrina Abonera Seca Familiar (Lasf) toilets, which consist of two chambers built above ground, each with a volume of about 0.6 cubic metres. The dry mixture from the toilets is used to reclaim wasteland or put in bags and sold. Years after constructing the toilets, the community continues to use them, because the structures still function due to high level of community participation in maintaining them. [Read more](#)

## **Philippines**

### **Waterless Urine-Diversion Toilets Improve Health and Sanitation, San Fernando**

Poor sanitation practices led to the contamination of groundwater in San Fernando. The Mayor of the city initiated an ecological sanitation initiative which involved recovering and reusing the resources contained in excreta and wastewater. They began installing and using waterless (dry) urine diversion toilets. The urine and solid waste generated from these toilets is now used as compost and to water gardens. [Read more](#)

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## **Related Resources**

### ***Recommended Documentation***

**Inventive Villagers: Innovative Approaches to Total Sanitation in Maharashtra** (from [A.J. James](#), Environmental & Natural Resource Economist, Gurgaon)

Report; Pragmatix Research and Advisory Services, New Delhi, and Swayam Shikshan Prayog, Mumbai; 2005

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110801.doc> (Doc Size: 568 KB)  
*Provides information on innovative approaches to building leach pits in rocky areas of Maharashtra, including wastewater reuse and vermi-composting for waste*

### **Types of Latrines** (from [Gyanendra Misra](#), UDAAN Society, Aligarh)

Presentation; Wakil Ahmed, 2008

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110803.ppt> (PPT; Size: 1.5 MB)

*Describes specifications for constructing leach pits in different areas, including in rocky terrains, high subsoil area and water-logged areas*

From [Subburam](#), Society for Community Organisation and Peoples Education (SCOPE), Trichy

### **Ecosan Toilets**

Report; by Subburam; Society for Community Organisation and Peoples Education (SCOPE); Trichy, 2008

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110804.doc> (DOC Size: 26 KB)

*Describes how pit toilets are not suitable in rocky areas and provides details on the construction of Ecosan toilets*

### **Ecosan Toilet Design**

Diagram; by Subburam; SCOPE; Trichy, 2008

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110806.jpg> (JPG Size: 870 KB)

*Provides detailed design for construction of Ecosan toilets in rocky terrain that overcome the problems faced with conventional leach pit toilets*

### **Material Required for Ecosan Toilet**

Report; by Subburam; SCOPE; Trichy, 2008

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110805.doc> (DOC Size: 34 KB)

*Contains information on all the different types of raw material required for the construction of Ecosan toilet in rocky terrain*

### **Leachpit in Rocky Terrain** (from [Johnson Rhenius Jeyaseelan](#), WaterAid, Bhopal)

Photograph; by Johnson Rhenius Jeyaseelan; WaterAid; Bhopal, 2008

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110801.jpg> (JPG Size: 2.66 MB)

*Picture of a leach pit constructed by WaterAid in the rocky terrains of Datia, near Bhopal, Madhya Pradesh*

### **Odourless Self-Flushing Public Toilet for Slum Sanitation** (from [Uday Bhawalkar](#), Bhawalkar Ecological Research Institute, Pune)

Article; by Vag Shantharam Shenai and R. Toravi Jitendra; Ecological Research Institute; Pune;

Available at [http://www.wastetohealth.com/odorless\\_public\\_toilet.html](http://www.wastetohealth.com/odorless_public_toilet.html)

*Describes odourless self-flushing leach pits, which uses natural methods of sewage treatment and does not produce sewage constructed for slums by the Green Cross Society in Mumbai*

### **The Making and Technology of Low-cost Latrines** (from [Avudai Nayakam](#), Water Partners International-India Liaison Office, Tiruchirappalli)

Presentation; by Avudai Nayakam; WPI; Tiruchirappalli, 2008

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110807.ppt> (PPT Size: 2.8 MB)

*Describes low-cost technology for constructing leach pits using locally available materials and resources, particularly bamboo, which are also suitable for rocky terrain*

### **Squat Pan for Ecosan** (from [Vishwanath Srikantaiah](#), Biome and Arghyam, Bangalore)

Photographs; by Vishwanath Srikantaiah; Arghyam; Bangalore

Available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110808.jpg> (JPG, Size: 52 KB);  
<http://www.solutionexchange-un.net.in/environment/cr/res-04110809.jpg> (JPG, Size: 56 KB);  
<http://www.solutionexchange-un.net.in/environment/cr/res-04110810.jpg> (JPG, Size: 56 KB);  
<http://www.solutionexchange-un.net.in/environment/cr/res-04110811.jpg> (JPG, Size: 36 KB)

*Pictures of squat pans for Ecosan toilets constructed by Biome, including basic versions and upgraded versions with washers at both ends*

### **Ecosquat-New Ecosan Pan from Biome**

Film; Biome; Bangalore; Uploaded November 2008

Available at <http://in.youtube.com/watch?v=2h3eqg-0n4M>

*Describes the ecosquat toilet pans developed by Biome which have been put to use in Bangalore, which are low-cost and suitable for rocky terrains as well*

From [Sunetra Lala](#), Research Associate

### **Smart Sanitation Solutions**

Report; by Peter McIntyre; IRC and International Water and Sanitation Centre; The Netherlands; 2006

Available at [http://www.irc.nl/content/download/27526/293434/file/SSS\\_2006hr.pdf](http://www.irc.nl/content/download/27526/293434/file/SSS_2006hr.pdf) (PDF Size: 4.94 MB)

*Provides examples of innovative, low-cost technologies for leach pits suitable for rocky terrain and collection, transportation, treatment and use of sanitation products*

### **Ecological Sanitation**

Book; by Steven A Esrey; Swedish International Development Cooperation Agency; Stockholm; 1998

Available at <http://www.gtz.de/ecosan/download/sida-ecosan-en.pdf> (PDF Size: 1.24 MB)

*Describes alternatives to conventional sanitation, based on an ecosystem approach and technologies for leach pit construction in rocky terrain*

### **Recommended Organizations and Programmes**

From [Arputhasamy Devaraj](#), UNICEF Office for Tamil Nadu and Kerala, Chennai

#### **Society for Community Organization and Peoples Education (SCOPE), Tamil Nadu**

P/17, 6th Cross, Ahmed Colony, Ramalinganagar, Tiruchirapalli 620003, Tamil Nadu; Tel: 91-431-2774144;

[scopeagency86@rediffmail.com](mailto:scopeagency86@rediffmail.com),

[scopeagency86@sify.com](mailto:scopeagency86@sify.com);

<http://www.scopetrichy.org/sanitation.html>; Contact: Mr. Subburam

*SCOPE works on sanitation, health and hygiene issues among the disadvantaged communities in Tamil Nadu, including promoting latrine use in the rocky Erode District*

#### **MYRADA, Tamil Nadu**

Arepalyam, P.O. 638401, Sathyamangalam Tq. Erode District, Tamil Nadu; Tel: 91-4295-244240;

<http://www.myrada.org/contact.htm>; Contact: Mr. Alagesan, Project Coordinator in the Erode District;  
[myradakvk@dataone.in](mailto:myradakvk@dataone.in)

*Works in the hilly areas of Erode District to support the construction of leach pits for the communities under the revolving funds scheme*

From [A. J. James](#), Environmental & Natural Resource Economist, Gurgaon

#### **Pragmatix Research and Advisory Services Pvt. Ltd, Gurgaon**

520 Galleria, DLF City Phase IV, Gurgaon, Haryana 122002; Tel: 91-124-4301493 ; Fax: 91-124-4101493

[info@pragmatix.co.in](mailto:info@pragmatix.co.in); <http://www.pragmatix.co.in/Contact%20Us.htm>

*Provides advisory and research services, conducted a study on construction of Borban toilet in the rocky terrain of Maharashtra*

**Swayam Shikshan Prayog (SSP), Mumbai**

101, 1st Floor, Baptista House No. 76, Gaothan Lane No. 1, Behind Paaneri Showroom, S.V. Road, Andheri West, Mumbai 400058 Maharashtra; Tel: 91-22-22907586, 26211476; Fax: 91-22-26211476; [sspindia@vsnl.net](mailto:sspindia@vsnl.net); <http://www.sspindia.org/water.htm>

*Total community sanitation, including leach pit construction, is pioneered by SSP, resulting in over 50 villages and 5,000 families living in open defecation free villages*

**WASH Institute, Tamil Nadu (from [Babu K. Y.](#))**

5 - 795, Malony Kudi, Lloyds Road End, Kodaikanal 624101, Tamil Nadu; Tel: 91-4542-240881; Fax: 91-4542-240882; [secretariat@washinstitute.org](mailto:secretariat@washinstitute.org); [http://www.washinstitute.net/about\\_institute\\_interventions.php](http://www.washinstitute.net/about_institute_interventions.php)

*Provides capacity building and research and consultancy services in the area of sanitation, and has been involved in building leach pits for communities in southern India*

**Gramalaya, Tiruchirappalli (from [Sumita Ganguly](#), Public Health Nutritionist, New Delhi)**

12, 4th Cross, Thillainagar West, Tiruchirappalli 620018 Tamil Nadu; Tel: 91-9443161263; Fax: 91-431-4021563, 91-431-4220263; [gramalaya@airtelbroadband.in](mailto:gramalaya@airtelbroadband.in), [gramalaya@hotmail.com](mailto:gramalaya@hotmail.com); <http://gramalaya.org/>

*Works in the field of rural development and has built low-cost leach pits in the rocky areas of Tiruchirappalli City Corporation*

**Sulabh International Social Service Organization, New Delhi (from [Veena Upadhyay](#), Sulabh International Academy of Environmental Sanitation, Patna)**

Sulabh Gram, Mahavir Enclave Palam-Dabri Road, New Delhi 110045; Tel: 91-11-25031518, 25031519, 25057748, 25057749, 25032617; Fax: 91-11-25034014, 45521733; [sulabh1@nde.bsnl.net.in](mailto:sulabh1@nde.bsnl.net.in); <http://www.sulabhinternational.org/>; Contact: Dr. P. K. Jha

*Works across India on issues relating to sanitation and developed several low-cost technologies for the construction of leach pits, including in the rocky terrain of Goa and Andhra Pradesh*

**Action for Food Production (AFPRO), Bangalore (from [Avudai Nayakam](#), Water Partners International India Liaison Office, Tiruchirappalli)**

56, Hutchins Road, 6th Cross, St. Thomas Town, Bangalore 560084 Karnataka; Tel: 91-80-25461711; Fax: 91-80-25461712; [afu02@afpro.org](mailto:afu02@afpro.org), [afpro2@gmail.com](mailto:afpro2@gmail.com); <http://www.afpro.org/services.htm>

*Works in the area of providing low-cost leach pits, including low-cost bamboo leach pits in north-eastern India*

From [Vishwanath Srikantaiah](#), Biome and Arghyam, Bangalore

**Arghyam, Bangalore**

2nd Floor, 840, 5th Main, Indiranagar 1st stage, Bangalore 560038 Karnataka; Tel: 91-80-41698941; Fax: 91-80-41698943; [info@arghyam.org](mailto:info@arghyam.org); <http://arghyam.org/content/view/22/74/>

*Works in the areas of water supply, health and hygiene through rural water and sanitation projects, and provides advisory services on construction of leach pits*

**Biome Environmental Solutions Private Limited, Bangalore**

1022, 6th Block, 1st Floor, HMT Layout, Vidyanarayapura Main Road, Vidyanarayapura, Bangalore 56009 Karnataka; Tel: 91-80-41672790; [contact@biome-solutions.com](mailto:contact@biome-solutions.com); <http://www.biome-solutions.com/>

*Delivers knowledge services in the area of water and sanitation, has been involved in providing advisory services regarding construction of low-cost leach pits*

***Related Consolidated Replies***

**Ecological Sanitation, from S. Janakarajan, Madras Institute of Development Studies (MIDS) Chennai - Examples, Experiences.** Water Community, Solution Exchange India, Issued 30 June 2007  
Available at <http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-05060701.pdf> (PDF, Size: 140 KB)

*Details members experiences in promotion of ecosan across India, sharing their understanding, analysis of current problems and suggestions for scaling up the same*

**Low-Cost and Ecologically Sound Sanitation Practices, from Dinesh Kumar, IWMI, Anand - Experiences.** Water Community, Solution Exchange India, Issued 3 October 2005  
Available at <http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-03100501.htm>

*Identifies low-cost, ecologically sound sanitation practices for urban and rural areas, and experiences in adopting these methods*

**Cost-Effective and Financially Sustainable Urban Water Supply and Sanitation Services, from Tushaar Shah, International Water Management Institute (IWMI), Gujarat - Experiences.** Water Community, Solution Exchange India, Issued 16 June 2005

Available at <http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-16060501.htm>

*Provides examples and experiences in context of cost-effective approaches for urban water supply and sanitation services*

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## Responses in Full

**Arputhasamy Devaraj, United Nations Children's Fund (UNICEF) Office for Tamil Nadu and Kerala, Chennai**

One option is ecological sanitation. These are eco-friendly and sustainable. With the support from UNICEF, two NGO partners (SCOPE in Tiruchirapalli and MYRADA in Erode District) have provided ecosan toilets. The terrain was rocky in Erode and in Tiruchy, the location was close to river bed, where leach pit toilets are absolutely not a feasible option.

Kindly contact the following for further details:

Mr. Alagesan, Project Manager Myrada, Erode District, Tamil Nadu ([myradakvk@dataone.in](mailto:myradakvk@dataone.in))

Mr. Subburam, Director, SCOPE Tiruchirapalli ([scopeagency86@rediffmail.com](mailto:scopeagency86@rediffmail.com))

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**A. J. James, Environmental and Natural Resource Economist, Gurgaon**

Pragmatix Research, Gurgaon, and Swayam Shikshan Prayog (SSP) in Mumbai had reviewed innovative practices in sanitation in Maharashtra for WSP-SA in 2005 and submitted a report to Mr. Ajith Kumar, then WSP representative in Mumbai and now in New Delhi. The study covered indigenous innovations in technology, community mobilization, monitoring, fund raising and procurement.

One of the examples of indigenous technology for creating toilets in rocky terrain was the 'Borban toilet', created by villagers in Borban village in Ahmednagar district. Basically, they built a 3-sided masonry structure with the fourth side being the rocky outcrop. The pit was enclosed inside this brick structure and steps led up to the toilet itself.

I attach the final report we submitted to WSP-SA, which contains the details, and trust this will be useful in your efforts. You can download it at <http://www.solutionexchange-un.net.in/environment/cr/res-04110801.doc>.

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**Babu K. Y., Wash Institute, Kodaikanal**

If the soil is rocky, it is difficult to dig and construct leach pit toilets. The suitable technical option may be Ecological Sanitation (ECOSAN). The ECOSAN toilets are constructed above ground level and therefore, there is no need of digging pits.

There are few low-cost toilet models available in ECOSAN. If you go for a urine-diverted ecosan model, it costs about Rs. 7,000 to Rs 12,000. For the superstructure if you use locally available materials the cost may reduce by more than 50 per cent.

For more details about ECOSAN construction you can contact WASH Institute, Kodaikanal, Tamil Nadu, [secretariat@washinstitute.org](mailto:secretariat@washinstitute.org), [www.washinstitute.org](http://www.washinstitute.org), 04542-240881/2.

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### **Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi**

Many have indicated that ECOSAN is the preferred solution in rocky terrain areas. It is very apt and can be implemented easily. In places where there is abundant wash-water and waste-water, a DEWATS system of waste water remediation can be applied. This uses natural principles and ends with phytoremediation as well as the use of recycled/ processed water for secondary purposes viz. flushing, horticulture, and service water.

For assessment of effluent outflow in sparse usage areas we assumed flows of 10 to 20 litre per use in toilets, and a BOD load of 500 to 800 ppm. If combined with other wash-water, the flows would be 80 to 100 litres per day and the BOD, 250 to 350 ppm. This is only a general assessment. The cost of making a DEWATS plant for low flows up to 5 kilo-litres per day is Rs. 25,000/- per KI, and for large flows of 50 KI per day and above is Rs. 20,000/-. As much as 80-90 per cent of the water is available for reuse, i.e., a 50 KI per day plant would give 40 to 45 KI per day. The losses are absorbed in the plants fixing the extra nutrients for cleaning the water.

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### **Sumita Ganguly, Public Health Nutritionist, New Delhi**

Thank you for raising this issue regarding terrain appropriate technology. In rocky terrain apart from the difficulty faced in digging the pit and the related high cost, there is also the hazard of water-borne pathogens travelling far through rock fissures. There are studies that have measured this.

One solution is an eco-toilet built on the principles of ecological sanitation. The essence of this technology is to have an above ground chamber (1.2 m x 1.2 m) divided into two parts, requiring no digging. The rock face can be used as one side of the square and the rocky surface as bed of the chamber, which will reduce the cost (as only three sides of the chamber will have to be constructed (Ferro-cement). The height could be about 7.6 cm. The top of the chamber will be the squatting plate fitted with an eco-san toilet pan. An eco-san toilet pan has three openings, one for the excreta, one for the urine, and one for the wash water.

The principle here is that the excreta, urine and wash water is delivered through separate drop holes on the squatting plate and separate conduits in order to keep the excreta dry and separate from the urine. This ensures minimising of odour and the excreta desiccates in course of time from the surrounding heat of the chamber and is reduced to a small mass. The odour factor is further reduced by dropping a handful of ash or husk after every use. This immediately reduces the odour further and arrests the spread of the pathogens.

In the eco-san toilets, the urine is collected in a large jerry can and after 15 days can be let out in fields planted for vegetables like tomato, brinjal or any plant or for horticulture. It is excellent natural fertilizer, rich in Nitrogen. There are reports of crop quality improving by use of urine as fertilizer.

The third output, anal cleansing wash water will inevitably carry some pathogens and will have to be disposed in a hygienic manner. One good model is to dig a shallow hole, 23 cm or so put a small mud pot with holes and cover and cover it pressed soil. Allow the pipe end to be in the mud pot. With each flush of wash water, the mud pot will fill up and slowly let the water trickle into the surrounding soil and keep it away from direct contact. It will be even better if this mud pot area is fenced off with a two feet square simple fencing made of twigs and some flowering plants planted. The plant will draw moisture from the wash water and will also add to the aesthetics of the toilet.

The chambers constructed above ground must have one of the three sides with a hatch, which can be kept in place with temporary sealing. When one chamber fills up with dry excreta the squatting plate with lid is sealed off with just a little mud plastering around the lid. The user moves to the second chamber and starts using.

After a gap of one year, the substance in the first chamber turns into odourless humus which is an excellent soil conditioner high in phosphate. The user opens the hatch door and takes out this humus and spreads it out on his plantation or sells it for a price.

The eco-toilet uses a liquid separation system to recycle all the outputs in a hygienic manner through on-site sanitation minimising contamination risks.

The cost of such a unit is about Rs. 5,000. For more details including trained masons who can give construction demos please contact SCOPE or GRAMALAYA, Tiruchirappalli. These two NGOs have done seminal work in this area. There are others as well but I have reviewed their work and have learnt a great deal.

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### **Abhishek Mendiratta, Consultant, New Delhi**

If the rocky stratum is more than 1.5m-1.8m deep leach pit toilets can be constructed without any problems. If the soil can absorb water, such leach pit toilets can be constructed. Sometimes it is noticed that the sub soil contains black soil. Black soil is less porous and water absorption capacity. All types of soil have small pores to absorb water and black soil also has such pores. It is true that the pore size of the black soil is smaller than the sandy soil leading to less absorption. It is expected that an average of 60 liters of water per day may be used in a leach pit toilet and that amount of water can be absorbed by black soil.

However, if it is noticed in a particular area that absorption capacity of the soil is low, it is advisable that a sand lining can be given all along the pit to increase its absorption capacity.

- A dry pit latrines/compost latrine fills quickly than a wet pit like leach pit.
- A minimum of 0.91 m effective depth is a must for all leach pits
- Pit should be located below and away from the water point
- Pit size and location varies from soil to soil
- Pit should have a life period of minimum 2 years

The advantages of leach pit toilets are:

- Low cost
- Less space
- Needs little water
- Sludge handling easy - manure
- No recurring cost
- Pit emptying easy
- No mosquitoes

The technological differences for different types of latrine are given in the table below:

Technology Differences								
Latrine type	Suitable for High Ground Water table	Suitable for areas prone to floods, tidal floods or flushes	Suitable for loose soils	Suitable for soils of low permeability	Water requirement	Ease of construction	Ease of maintenance	Remarks
Direct Single pit Latrine Without Pour-flush	Yes, if raised	Yes, if raised	Yes, if fully clay soils lined	Not for	No	Easy	Easy	Sludge unsafe
Direct Double pit Latrine Without Pour-flush	Yes, if raised	Yes, if raised	Yes, for fully lined	Not for clay soils	No	Easy	Easy	Safe sludge
Offset Single pit Latrine with Pour-flush	Yes, if raised and with soak away	Yes, if raised	Yes, for fully lined	Yes, with soak away	Yes	Easy	Easy	Sludge unsafe
Offset Double pit Latrine with Pour-flush	Yes, if raised and with soak Away	Yes, if raised	Yes, for fully lined	Yes, with soak away	Yes	Fairly Easy	Fairly	Safe sludge easy
Solar Heated single-vault ecological latrine with urine separatio	Yes	Yes	Yes	Yes	No	Easy	Difficult	Safe dehydrated material

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Single-vault ecological latrine with urine separation	Yes	Yes	Yes	Yes	No	Easy	Difficult	Safe dehydrated material
Urinal	Yes	Yes, if raised	Yes	Yes	Yes a bit	Easy	Easy	

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**Debasish De, Delhi Minorities Commission, New Delhi**

As a consultant, I was associated with an evaluation Study of Integrated Low Cost Sanitation Programme of Ministry of Urban Development (Ministry of Urban Housing and Poverty Alleviation, Government of India) in all states in India. This evaluation study was conducted by Agricultural Finance Corporation Ltd, New Delhi Office.

We are closely working with Housing and Urban Development Corporation (HUDCO), in all states and have also taken some basic directives from the Human Settlement Management Institute (HSMI), New Delhi. HUDCO has a model of leach pit latrines for the rocky terrain. The document is available with HUDCO and HSMI office.

Basically, the leach pit latrine model in the rocky terrain should be different from the common one as the rocky terrain has lower percolation rates and therefore, the rate of percolation in the leach pit is too less. If the depth of the pit measures less than six ft, there is a chance of filling up within three months, keeping in view a household size of 5 persons.

Again, the recent model of twin-pit latrine which is being implemented all over India can be suggested for the rocky terrain. The advantage the twin leach pit system is, if one pit is filled up, the user manually can change the direction to other pit and the first pit gets the necessary time for the faeces to mix with the soil. This model is also low cost and helps the poor a lot because the state governments are also financing the scheme in a 85:15 ratio, where the beneficiary has to bear 15 percent of the cost. This scheme has had a good impact in J&K, Himachal, and Uttaranchal, the areas of Assam, Meghalaya and Sikkim. Please refer to their work.

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**Gyanendra Misra, UDAAN Society, Aligarh**

Please find a file attached on the designs for toilets suitable in rocky areas. You can download the presentation at <http://www.solutionexchange-un.net.in/environment/cr/res-04110803.ppt> (PPT, Size: 1.4 MB).

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**Subburam, Society for Community Organisation and Peoples Education (SCOPE), Tiruchirappalli**

Pit toilets are not suitable in rocky terrain because digging pits in those areas is very costly, and in rainy season they will not work out properly. Additional space is needed for dig pits in rocky terrain and it becomes a costly affair.

We have found urine diversion ecosan toilets are a suitable model for this kind of area. Please find the details of Ecosan toilet at <http://www.solutionexchange-un.net.in/environment/cr/res-04110804.doc> (DOC, Size: 26 KB).

The design of the toilets is available at <http://www.solutionexchange-un.net.in/environment/cr/res-04110806.jpg> (JPG image, Size: 870 KB).

Also I am attaching herewith the materials required for construction of one Ecosan toilet and the features of the Ecosan toilet also. You can view them at <http://www.solutionexchange-un.net.in/environment/cr/res-04110805.doc> (DOC, Size: 34 KB)

Kindly go through and for more details kindly visit our website: [www.scopetrichy.com](http://www.scopetrichy.com)

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#### **Johnson Rhenius Jeyaseelan, WaterAid, Bhopal**

WaterAid India (WAI) is working along with Parhit in Datia, which is a rocky terrain area. Water and sanitation is a challenge. Leach pit toilets were promoted but with changes:

Leach pits were constructed two feet above ground level and three feet below ground level. Only top layer lining was done. In one village they blasted rocks and went for a greater depth and sold the stones from the pit.

Option 1 is the better option. The absorption capacity is low but it happens. During the recent rains when pond desilting was done, the recharge was so fast that within 4 months the pond which was full, is now holding less water as most of the water has percolated into the ground.

I am attaching a photo for reference (<http://www.solutionexchange-un.net.in/environment/cr/res-04110801.jpg>).

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#### **Uday Bhawalkar, Bhawalkar Ecological Research Institute, Pune**

We give below, a method that is suitable for rocky terrain. An open pit is provided for treatment of thick sewage. The pit is lined with stone or clay. Application of one-time dose of BIOSANITIZER does the treatment and the open pit starts is suitable for growing banana plants. These carry out the function of nutrient (C, N, P, K, Ca, Mg, S, etc.) absorption and also obstruct the view of human excreta and prevent any smell.

Treated sewage is pumped up to the overhead water tank that provides the flushing water. People who use the toilet carry only 1.5 litres of water for personal cleaning.

Please see [http://www.wastetohealth.com/odorless\\_public\\_toilet.html](http://www.wastetohealth.com/odorless_public_toilet.html) for details.

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#### **Veena Upadhyay, Sulabh International Academy of Environmental Sanitation, Patna**

I suggest you contact Dr. P. K Jha associated with Sulabh International Social Service Organization for the required information. He can be reached at [sulabh1@nde.bsnl.net.in](mailto:sulabh1@nde.bsnl.net.in) and [sulabh2@nde.bsnl.net.in](mailto:sulabh2@nde.bsnl.net.in).

Sulabh has undertaken construction of toilets in rocky areas such as Goa, Andhra Pradesh, etc. I am sure he will be able to help you.

**Nitya Jacob, United Nations Children’s Fund (UNICEF), New Delhi**

Dry composting toilets, or ecosan toilets, are one solution for rocky terrain where it is not possible to dig pits. These can be installed above ground and process human waste into nutrient-rich fertilizer. They also eliminate the need for percolation pits, and therefore, the possibility of soil contamination. Composting toilets convert faeces into fertilizer in controlled temperature and oxygen conditions to accomplish aerobic decomposition.

Dry composting wastes remain in a container, where they decompose over a bed of carbonaceous materials in a ratio of about five parts organic material to one part faeces. The compost toilet generates carbon dioxide and water vapour that are vented from the decomposition chamber. The composted material can be used as a soil amendment for shrubs, trees, grass, flowers, and berries. Pure urine, collected separately, can be applied to edible crops as well as trees and shrubs. The removed human waste is 5-10% of the original volume. Only three to ten gallons of humus is produced per person per year.

Some words on waste		
An average person produced about 1.14 kg of excreta, of which 900 gm is urine and the rest is solid matter. Faeces comprise 75% water, and urine, 94%. The nutrient breakup of the two is given below.		
Faeces		Urine
Carbon	40-50%	11-17%
Nitrogen	5-7%	15-19%
Calcium	4-5%	4.5-6%
Phosphorous	3-5%	2.5-5%
Potassium	2.5-5%	3-4.5%

Most compost toilets are made of fibre-glass masonry, plastic, or other durable material and can theoretically last for a lifetime. The technology is simple and there are no delicate mechanisms that can malfunction. The larger ones have containers that need an extra chamber or a portion of a room; this should not be a constraint in rural areas where they can be installed outdoors.

To reduce costs, the composting bins can be replaced by large 20-30 litre buckets of plastic or metal, such as used for paint, cooking oil, or other non-toxic material.

Another low-cost option is a 200 litre metal or plastic drum whose top has been cut off to make a collection chamber. This can be installed beneath a floor by cutting a 35 cm diameter hole in the floor. Beneath the floor, a recycled rubber tire is cut radically and nailed to form an insect barrier and seal for the top of the drum. The drum is placed tightly up against the tire-gasket.

A 10-cm diameter PVC pipe (bamboo can also be used) is placed in the barrel to the roof to vent CO<sub>2</sub> and moisture from the drum. This vent stack should be covered with a wire screen and a rain cap to keep out insects and rainwater.

**ADVANTAGES OF COMPOSTING TOILETS**

They are easy to build and maintain, and are very environmentally safe. They are odourless, especially when well-ventilated. They are cheaper to run than septic tank systems and municipal waste systems. They do not contaminate soil or breed insect. These toilets need less water, important as toilet flushing

uses as much as half of all water consumed by households. The fertilizer can be used locally, saving costs of buying and transporting chemical fertilizers; they are rich in all nutrients needed by plants.

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### **Avudai Nayakam, Water Partners International (WPI) India Liaison Office, Tiruchirappalli**

The past experience of AFPRO in construction of Low Cost Appropriate Technology for promotion of Sanitary Latrines by using Bamboo (Bamboo leach pit model) is attached. In this PowerPoint presentation, step by step construction procedure with photos including placement of pan and trap, squatting platform, Junction box, Bamboo strips for knitting leach pits and design & drawing of latrines are explained. You can download the presentation at <http://www.solutionexchange-un.net.in/environment/cr/res-04110807.ppt>. (PowerPoint, Size: 2.8 MB).

These low cost models are applicable in the North Eastern States of Arunachal Pradesh, Manipur, Nagaland, Mizoram and Tripura. Similarly by using locally available materials in the respective regions, one can design the latrine irrespective of different terrain and geology.

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### **Vishwanath Srikantaiah, Biome and Arghyam, Bangalore**

Biome has been working on a squat pan for Ecosan and here is Ecosquat. The basic version is for wipers - Photos 1 (<http://www.solutionexchange-un.net.in/environment/cr/res-04110808.jpg>, and <http://www.solutionexchange-un.net.in/environment/cr/res-04110809.jpg>) the upgrade is for washers with wash pans at the ends Photos 3 and 4 (<http://www.solutionexchange-un.net.in/environment/cr/res-04110810.jpg> and <http://www.solutionexchange-un.net.in/environment/cr/res-04110811.jpg>).

The pan works on the principle that it should take 1 GI sheet as a roof for the toilet and 1 plywood sheet for it to be fixed to the substructure. We have been working also on the costs of the pan - depends on numbers ordered but for now close to 1200. Here is a youtube film on that: <http://www.youtube.com/watch?v=2h3egg-0n4M>. There is greater interest in Ecosan especially with nutrient reuse thanks to the ARGHYAM/UNICEF/SEI supported initiatives with the Centre of Excellence in the GKV, the work of the GKV-University of Agricultural Sciences Bangalore and also in the 4 villages where MYRADA has done wonderful work in the implementation.

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***Many thanks to all who contributed to this query!***

*If you have further information to share on this topic, please send it to Solution Exchange for the Water Community in India at [se-wes@solutionexchange-un.net.in](mailto:se-wes@solutionexchange-un.net.in) with the subject heading "Re: [se-watr] Query: Leach Pit Toilets for Rocky Terrain - Experiences, Examples. Additional Reply."*

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