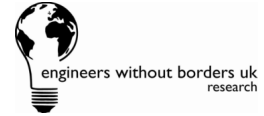


**engINDia & EWB-UK Research**

## **Project Proposal: Human Waste Disposal**

### **Full description of Problem:**

Since 1965 Indian farmers have increasingly used high-yielding, imported seed varieties. They have also increasingly relied upon chemical fertilizers and intensive irrigation; this phenomenon is known as the 'Green Revolution'. The Green Revolution has allowed the Indian economy to develop and for India to break free from the previous cycle of regular famines. However in recent years people have increasingly recognised that this 'development' has come at a tremendous cost to the environment and that this system is ultimately unsustainable.

Since the Green Revolution farmers have reduced the number of cows that they keep. Cows have always been valued for their milk and in the past were also valued for their dung. Once fertilizers were adopted less dung was necessary, so fewer cows were needed. Since the Green Revolution farmers have noticed that dung 'strengthens' the soil and plants (even making them more resistant to pests), while chemical fertilizers do not (soil quality diminishes and pesticides must be used). Unfortunately farmers no longer have enough cows to produce enough dung to fertilize their fields.

The Indian government very strongly encourages the use of toilets with plumbing. Villagers are given a relatively large grant if they build an outhouse on their land. Local government is given extra funding in proportion to the percentage of houses within their area that have a plumbed-in toilet. Teachers do not get paid unless they have a plumbed-in toilet in their house and encourage their students' families to do the same.

Some villagers will build an outhouse, receive the grant and then continue to defecate in the open, while they use the outhouse as a storeroom. The reason for this is that in the past the population level was low enough for this practice to cause no noticeable ill effects. Although defecation in the open has become increasingly unacceptable in Pabal, the shortage of water means that people cannot afford to waste water in flushing their toilet and so some people consider it better not to use their toilet at all.

Another factor that discourages people from using a plumbed-in toilet is the rockiness of the soil in and around Pabal, which makes it difficult and expensive to dig latrines or to put in drains.

All of these issues may be solved in one system.

**How the local community will use the proposed solution:**

Vigyan Ashram is interested in experimenting with a system that converts human waste into useable compost and/or biogas. A system may be designed to produce biogas year-round and produce compost at the appropriate time for farmers to use it in their fields, reducing the need for NPK fertilizers.

Vigyan Ashram will use the compost toilet as part of their guest accommodation building. They may use an already existing compost toilet design or may be persuaded to use the solution that will be developed. Their main interest is in performing a trial of this "new" technology so that they can identify any problems that need to be solved before the system is implemented throughout the region.

**Estimate of the economic benefit anticipated and plans for training of the local community:**

The economic benefit of this project is almost impossible to quantify; most of the benefit is to the environment and is in terms of sustainability. Fertilizer costs only Rs. 52 for 50kg, so it will be difficult for a solution to compete in terms of cost of fertilizer. Organic fertilizer production is an aim of the solution from the western perspective, but it may be seen as of secondary importance by locals. Water must be shipped in for 8 months of the year, costs Rs. 2 per 15 litres, and is sometimes difficult to obtain. So people will probably value the fact that a compost toilet conserves water. Gas costs Rs. 320 per 14.5kg and so access to a cheaper source of biogas may be another product that will make people value a composting toilet.

**Full description of the local situation:**

There is a dam and water tank system being completed in the next 3 years to solve Pabal's water shortage problems, but once water is more easily available, people may increase their consumption and so there may always be a moderate shortage, even if water no longer must be brought into Pabal by tanker.

A local farmer who grows tomatoes and chilli peppers uses between 100kg and 150kg of NPK (20:10:10, 95% pure) fertilizer on his 1 acre of land each harvest (he seems to only have one harvest per year). He says that vegetables and grains only need one treatment, but if he were to grow beans he would need to use twice as much fertilizer.

He starts his annual farming cycle at the first sight of clouds or at the first rain (June or July). First he levels his field and then he goes into Pabal (his farm is on the outskirts of the village) to buy some high-yielding seeds. He plants seed in rows that are just over one ft apart and each plant is just under a foot away from those in its row. As soon as his plants are around half a foot tall he digs irrigation ditches and pumps water into his field. Once the water has soaked in he adds fertilizer and dung. (He tries to avoid adding fertilizer if it is likely to rain since he recognises that it will wash the fertilizer away into his well, wasting fertilizer and contaminating the water.) He brings in his harvest in August and claims that each chilli plant will produce 5kg of chillis and that each tomato plant will produce 100kg of tomatoes.

The Indian government launched the "Gobergas" project in the 1980'S. This project provided every rural farmer with a biogas generator like the one below if they owned several cows and less than five acres of land.



*A local teacher's biogas generator - this generator has been used for the last 18 to 20 years. It requires 25kg of dung per day and produces enough biogas to cook for 3 hours.*

**Full description of relevant infrastructure and resources available locally:**

At a village near Pabal human faeces is used for biogas generation. The village has a communal toilet and the biogas is distributed to villagers for cooking. A household biogas tank is available in Pune for Rs. 3000.

Although some people are aware that compost can be made from human faeces (it is called "sownkhat") the team did not see any evidence of human faeces being composted. A local doctor, who told the team about "sownkhat" thought that the concept of a compost toilet would be a very good idea. Presumably composting human faeces is a practice that has been lost to the past.

Poorer families often share a plumbed-in toilet with three or four other families.

Some people have latrines that encourage the faeces to rot away and be absorbed into the soil, while others (including Vigyan Ashram) use soak-away latrines. A soak-away latrine (similar in principle to slow-sand filtration) passes faeces through a chamber filled with stones and gravel which collect bacteria allowing the organic material and water to pass harmlessly into the soil.

**Useful background reading or resources:**

See engINDia Website: <http://www.engindia.net/resources.htm>

**Organisation Contact Details:**

Name of Organisation      engINDia

Contact                      engindia@mit.edu

Web site                      www.engindia.net

Background information      engINDia exists to promote appropriate and sustainable engineering solutions in developing areas. Currently the program focuses on Pabal, Maharashtra, a rural village in India located 80 miles east of Mumbai. Pabal is home to Vigyan Ashram (see details below), an educational institution that focuses on rural technologies. The existence of Vigyan Ashram and Pabal's proximity to Mumbai made it the perfect starting point for engINDia.

engINDia is a partnership between 6 students from the University of Cambridge, Massachusetts Institute of Technology (MIT) and the Indian Institute of Technology Bombay (IITB). An expedition was conducted during the summer of 2005 to the area of Pabal, Maharastra. There, the engINDia team worked with Vigyan Ashram and the local community to gain an understanding and appreciation of the development issues faced by rural India which could be tackled through engineering.

Name of Organisation      Vigyan Ashram

Web site                      <http://vigyanashram.com/>

**Background information**

Vigyan Ashram is an educational institution situated just outside Pabal, Maharashtra, about five hours east of Mumbai. The focus of the institution is on rural education and enabling the rural population of Pabal and the surrounding areas to learn about technology and start their own businesses. The facility includes classrooms, labs, workshops, and living quarters for students. There is also a Fab Lab installed at the site (for more information, see <http://fab.cba.mit.edu/>). VA is striving to become an internet service provider for the area and to that end many of the organization's activities are becoming focused on internet-related projects, such as internet kiosks for rural farmers. A few people at VA speak English, but some knowledge of Marathi or an interpreter will be needed in order to carry out work in the area.