Malaprabha Technology
Dehu village, Dist. Pune, Maharashtra, INDIA

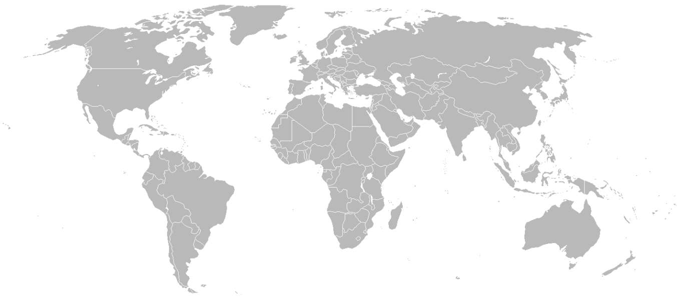

Fig. 1: Project location (*location will be added by GTZ ecosan team*)

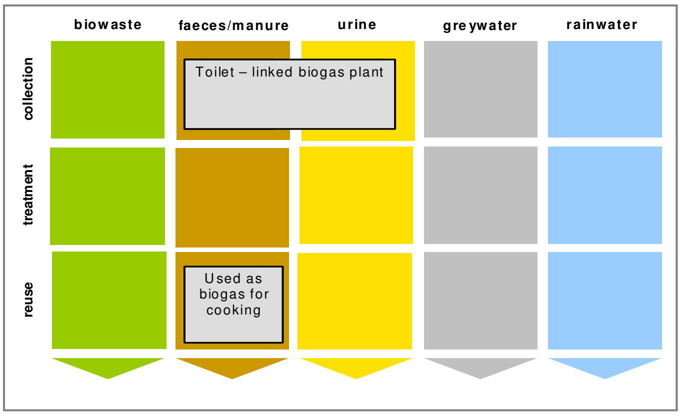

Fig. 2: Applied sanitation components in this project

1 General data

Type of project:
Rural upgrading by both individual and community-based sustainable sanitation approaches

Project period:

First successful project was implemented in 1980

Project scale:
Number of inhabitants covered: 500
Total investment: 143€ to157€

Address of project location:
Dehu village, Tal. Haveli, Dist. Pune – 412109
Maharashtra, INDIA

Planning institution:
Appa Patwardhan Sanitation and Environmental Technical Institute

Executing institution:
Appa Patwardhan Sanitation and Environmental Technical Institute

Supporting agency:

Village Panchayat, Dehu Village

2 Objective and motivation of the project

In the year 1960, Dehu village had no toilets when Dr. Mapuskar (who has designed Malaprabha technology) came to practice medicine and thus reside in the village. The sanitation status quo of the village and the issues surrounding this instigated Dr. Mapuskar to make the village a hygienically safer place to live in.

3 Location and conditions

The place of birth of a famous poet saint Tukaram, Dehu is an ancient city situated at the banks of the River Indravati about an hour's drive from Pune, Maharashtra. It is located at 18.72°N 73.77°E[1]. It has an average elevation of 594 metres (1948 feet)[i], with its average temperatures ranging between 12°C to 37°C.[ii] Summers during March to April are warm with temperature lying between 25°C and 40°C. Winters during December to February are moderate with temperature lies between 10°C to 26°C.[iii] The average rainfall recorded is 600 to 700 mm.[iv] Maximum rainfall is observed from June to September every year.
As per the 2001 census, Dehu had a population of 5340. Males constitute 52% of the population and females 48%. Dehu has settlements from huts to constructed buildings also including educational institutes like schools and colleges.

4 Project history

The initiative got the spark with Dr. SV Mapuskar (a medical doctor) started to work in the village of Dehu, and found that the village did not have any toilets at all. Thus, the main motivation to install toilets in Dehu village was the rampant practice of open defecation. After spending a few days defecating in the open, Dr. Mapuskar was convinced that the illness and deaths in the village was due to various infectious diseases spread due to inadequate sanitation facilities and bad water supply.
According to a poll conducted in 2007 by the British Medical Journal, Sanitation is the most important medical advancement in the past 150 years and Dr. Mapuskar too felt that the only remedy to this situation was by improving sanitary conditions instead of providing medical treatment to the mass. Dr. Mapuskar executed awareness programmes to improve sanitary conditions in Dehu. He started a 'latrine construction programme' in 1960 by constructing 10 toilets on the basis of 'Lenoy and Wagonar' design, (WHO guidelines published in 1958). These toilets collapsed in the monsoons

and thus induced more negative approach about toilets and also Dr. Mapuskar among people.
After 4 years, he again undertook a 'Roundworm infestation programme', where he made a demonstration of a stool sample and a mud sample of Dehu under a microscope to the mob. Both samples contained roundworms. By this he inculcated in the people that by open defecation, the soil is getting polluted by harmful pathogens, which in turn is ingested by us through food leading spread of infectious diseases all around. He inculcated amongst people that a sanitized surrounding will reduce the spread of diseases and developed positive attitude to building of toilets in Dehu for better sanitary situation.
He then came across Apparao Patwardhan's *"Sopa sandas"* – a 2 pit latrine design. Thus, he constructed a few '2 pit latrines' in Dehu. After researching on the working principles of septic tanks, anaerobic digestion process and water jacket floating dome type biogas plant, he developed the design of Malaprabha technology.
Malaprabha technology basically is a 'toilet – linked biogas plant' where human excreta are converted to biogas in a specially designed digester chambers.

5 Technologies applied

Malaprabha system, or the toilet linked biogas plant has 3 chambers, the first chamber having Hydraulic Retention Time (HRT) of 30 days, and the rest two having together of 15 days of HRT. These final calculations have been estimated by research and development on many systems installed by Dr. Mapuskar. The HRT of the first chamber is high as compared to the other two as the gas from first chamber is only trapped for reuse. There is negligible amount of gas generation from the other two compartments, which escapes to the atmosphere.
The effluent, after treatment, is discharged into the drainage system.

6 Design information

- Basic design parameters are the number of users and type of flush system;
- A vegetarian person (or a person eating non-vegetarian food occasionally) produces 250 to 300 gram night soil daily. A purely non-vegetarian person generates about 150 gram of night soil daily
- For digestion of night soil, optimum requirement of water is 2.17 L/person. But, the flush system in each toilet is different, so the number varies form case to case.
- Night soil from about 25-30 persons per day are required for generating 1 cubic metre biogas.
- 35 to 40 litres of biogas is generated from night soil of one person/day. Gas generated from night soil of 5 to 6 persons in day (i.e. 1250 to 1500 grams/ day) is sufficient to fulfil the requirement of 1 person for 1 day.
- One cubic metre of biogas in energy terms is equivalent to 0.433 kg of LPG or 4 units of electricity or 4 kg firewood. One person needs less than 0.1 kg of LPG/day. Thus, the comparable cost of firewood would be around Rs.10 per cubic metre. The cost of biogas recovered in a year would be about Rs. 3,500. Thus, even after the initial cost, interest and depreciation are considered, the recovered biogas itself provides for a payback period of around five years.
- *Salmonella typhii*, a pathogen found in night soil is the most harmful and having longest life span. It can survive for 6 weeks in anaerobic conditions. Thus, to ensure the pathogen free effluent, Hydraulic Retention Time (HRT) for the whole plant is 45 days.
- Digester volume = Number of users * Liters of water used for flushing/person * 45 (HRT)

Fig. 3: Dr. Mapuskar explaining Malaprabha Design (Source: RS Arun Kumar; *2009*)

7 Type and level of reuse

Biogas generated from the human night soil can work in compliment to LPG. Amount of biogas generated differs from case to case depending in the number of users and flush system present. Black water gets treated to certain extent before getting discharged to the drainage system.

Fig. 4: Biogas in use in a kitchen (source: Ms. Pradnya Thakur)

8 Further project components

This technology works only on anaerobic digestion of human night soil. Organic kitchen waste can also be added to the system, but till date no research has been made on the effect of oil from kitchen waste on the digestion process.

9 Costs and economics

The whole system costs about 143€ to157€, as estimated by ESF team. However, no clear costing was available from the Dehu village.

10 Operation and maintenance

As per the feedback from a survey carried out by ESF Team, it was evident that the villagers did very little in terms of O & M, and on the contrary, have been enjoying the biogas generated for over 15 years now.

11 Practical experience and lessons learnt

To improve sanitary conditions in Dehu, Dr. Mapuskar initially started a ‘latrine construction programme’ in 1960. Initially he constructed 10 toilets on the basis of ‘Lenoy and Wagonar’ design, WHO guidelines published in 1958. But, this design was not suitable for black soil of Dehu. Thus, all the toilets collapsed in the monsoons. This failure induced more negative approach about toilets and also Dr. Mapuskar among people. The whole situation was the same as before for about 4 years. Later, after another awareness campaign, he could develop positive attitude amongst people.
Being inspired by ‘Water jacket floating dome’ model biogas plant, Dr. Mapuskar designed some plants on pilot scale for experimentation. These first 3 to 4 plants failed during his experiment. The main obstacles in the success of these models were i) gas leakage ii) to create gas storage space iii) providing foolproof gas seal for the system. Further learning from his own mistakes, he came to a final design of Malaprabha technology in 1980.
Then came the harder task of convincing villagers of the need. He followed up with an information bombardment, using public meetings and posters. It paid off. People started coming forward to make their own toilets - just 100 in the first year.
The impact on the village’s health status has been nothing short of dramatic. Worm infestations are just 20 percent, diarrhea, cholera and typhoid infections are extremely low and there have no cases of hepatitis for a year.
Before 1986, when the Government of India launched the Central Rural Sanitation Programme, Dr. Mapuskar had already covered half the village without any subsidy, thanks to the involvement of the Panchayat.

12 Sustainability assessment and long-term impacts

Table 1: Qualitative indication of sustainability of system.
A cross in the respective column shows assessment of the relative sustainability of project (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project).

	collection and transport			treatment			transport and reuse		
Sustainability criteria	+	o	-	+	o	-	+	o	-
• health and hygiene	X			X				X	
• environmental and natural resources		X		X				X	
• technology and operation	X			X			X		
• finance and economics		X		X			X		
• socio-cultural and institutional	X				X			X	

Sustainability criteria for sanitation:
Health and hygiene include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.
Environment and natural resources involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.
Technology and operation relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.
Financial and economic issues include the capacity of households and communities to cover the costs for sanitation as well as the benefit, e.g. from fertilizer and the external impact on the economy.
Socio-cultural and institutional aspects refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.

For details on these criteria, please see the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

reduced in Dehu. Moreover, black water gets treated to a certain extent before discharging into drainage system. Biogas generated can be used in compliment to LPG which will help longer use of LPG and lesser investment in the same. After investing during implementation of system, minimal maintenance is needed further; thus minimal expenditure is incurred for maintenance of the system.

13 Available documents and references

1. http://en.wikipedia.org/wiki/Dehu
2. http://www.virtualpune.com/html/localguide/cityfacts/html/city_stats.shtml
3. http://www.mustseeindia.com/Kamshet-weather
4. http://www.virtualpune.com/html/localguide/cityfacts/html/city_stats.shtml

14 Institutions, organisations and contact persons

Person name and Institution name
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This document is available from:

[i] Source: http://en.wikipedia.org/wiki/Dehu
[ii] Source: http://www.virtualpune.com/html/localguide/cityfacts/html/city_stats.shtml
[iii] Source: http://www.mustseeindia.com/Kamshet-weather
[iv] Source: http://www.virtualpune.com/html/localguide/cityfacts/html/city_stats.shtml