Environment

Water & Environmental Sanitation Network (WES-Net India)

Solution Exchange for WES-Net India
Consolidated Reply

Query: Sanitation schemes and biogas digesters, from Gwalior Childrens Hospital, Madhya Pradesh (Comparative Experiences, advice).

Compiled by Preeti Soni, Resource Person and Moderator; additional research provided by Ramya Gopalan, Research Associate

28 December 2005

Original Query: Dr. B K Sharma, Gwalior Childrens Hospital, Madhya Pradesh

Posted: 9 December 2005

Dear friends,

I am posting this query on behalf of Gwalior Childrens Hospital, a grassroots organization in Madhya Pradesh. We are working in Gwalior and Chambal region especially in rural areas and building the Orphanage- Snehalaya near village Sikroda, where there is no infrastructure for sanitation at present. We are hoping to cater for 100 children and adults in its first phase though shall expand it to accommodate 500 children and adults there ultimately. We need to construct toilets and drains as well as to sort and compost organic waste in Snehalaya. We are searching for technical expertise in constructing these and linking them to a biogas digester to which animal waste can also be added.

My request to the Network Members is to share your experiences while working with similar community sanitation schemes that use biogas digesters, and information on the relevant technologies that have proved efficient and easy to maintain. I also request you to suggest names of persons or organizations in India that design such systems and supervise their construction.

Many thanks for your help.

Responses received with thanks from:

1. **Prabhjot Sodhi, UNDP GEF SGP, New Delhi**
2. **V. Kurian Baby, Socio-Economic Unit Foundation (SEUF), Kerala**
3. **Arumugam Kalimuthu, Plan International (India), New Delhi**
4. **R Uma, The Energy and Resources Institute (TERI), New Delhi**
5. **Vikram Rajola, Sulabh International Academy of Environmental Sanitation, New Delhi**
6. **Jeevan Porwal, Grameen Vikas Trust, Ratlam, Madhya Pradesh**
7. **D Vidya Sagar, SKG Sangha, Kolar, Karnataka**
8. **Subodh Kumar, Udyog Bharati, Ghaziabad, Uttar Pradesh**
9. **Vinod Kumar, Maithri, Kerala**
10. **R K Pandey, Action for Food Production (AFPRO), New Delhi**
11. **Shirish Sinha, New Delhi**
12. **Joe Madiath, Gram Vikas, Orissa**

Further contributions are welcome!

Summary of Responses

Biogas can be produced from human waste, animal dung and other organic matter by means of an anaerobic digestion process using specific digesters. Sanitation schemes with biogas plants

have been attempted and are operational in many parts of the country. Responding to this query on community sanitation schemes using biogas digesters, members shared their experiences, provided additional contacts, and offered technical assistance.

Members have stated that there are several models that are being used in India (such as, KVIC, Janata, Deenbandhu, Pragati, and Sulabh), some of which are discussed below. Sanitation linked biogas digesters help in maintaining sanitary and hygienic conditions, provide biogas (for lighting, cooking etc.), and the biogas slurry produced as a bi-product can serve as organic manure. Considering the high utility these plants in meeting sanitation and energy requirements, some respondents have pointed out that their usage has so far not been commensurate to their potential utility. This may be among other reasons due to a casual approach in designing the plants or a laxity in their maintenance.

While discussing the models and experiences, the members' responses also highlight a number of considerations while dealing with community sanitation schemes. These include:

- **Technical considerations** and design of the sanitation facilities and the biogas plant are critical for the performance of such schemes. Some key factors are:
  - **Number of users**: This is important both for technical and economic impact. The hydraulic retention time (HRT) or the number of days the feed material is required to remain in the digester to begin and maintain the gas production is critical in determining the volume of the digester which in turn determines the cost of the plant.
  - **Temperature**: Temperature is a critical determinant in the gas formation process. Members point out that biogas plants perform more effectively in warmer climatic areas. In cold areas the rate of HRT goes down considerably. Winter operations also have to be carefully timed, and can be assisted through the use of (low-cost) solar-heated water. It was also suggested that the option of constructing underground/subsurface tanks too could be considered in meeting the requirements of temperature.
  - **Other feeds**: Other feeds may be added in proportions accounted in the plant design. For example, human excreta combined with kitchen wastes follow a natural biological process for biogas production. Toilets-attached biogas plants in a few locations in South India have also revealed that combining human and animal wastes can produce good results. It was suggested by a Member that if the matter from the toilets in the sanitation based biogas plants is less than 20% of the feed material, hardly any modification in the conventional biogas plant is necessary.
  - **Locational factors**: The distance of the sanitation facilities and the biogas digester site has a bearing on its size and design; shorter distance may be generally advisable.
  - **Contamination**: Possibility of inorganic materials like soap, detergents, antibiotics etc, going in to the biogas tank may be averted, as it may result in outflow contamination. For night-soil based plants, the tanks with a 60-day retention capacity are recommended to ensure that pathogenic bacteria are dead before the commencement of outflow to negate chances of its contamination.
  - **Others considerations**: including type, volume and layout of the tanks, piping of the gas and area context specificity. Another important aspect is maintaining a specified ratio of water and the solid wastes (as well as that of carbon and nitrogen) for smooth functioning of the plant. It was suggested that the distortion in water/solid waste ratio can be corrected, for instance, through modifications in closet designs/channeling out excess toilet water in case of night-soil based plants, and through addition of solid organic waste in feed mixture in the other types of biogas plants.
- **Social acceptability** related to sanitation linked biogas plants in general is lower compared to other biogas plants. This may be due to social inhibitions in respect of routine operation and maintenance of these plants.

Members' responses have indicated that it is possible to significantly expand the use of biogas plants for use by the community/institutions. Some of the experiences and examples are detailed below.

Comparative Experiences and Examples

Deenbandu Model *(from R K Pandey, AFPRO and Arumugam Kalimuthu, Plan International, New Delhi)*

Deenbandhu Biogas Plants (DHP) are developed as a low cost fixed roof biogas plant. Designs of DHP have been standardized for family size installations, and are built with locally available building materials such as bricks, cement and sand. A popular example of toilet based community biogas plant is in the Harrua village, Uttar Pradesh made around 1985, which is still effectively functional. For more information, see Deenbandhu Model 2000 Biogas Plant and Manual on Deenbandhu Biogas Plant.

Sulabh Sanitation *(from Vikram Rajola, Sulabh International Academy of Environmental Sanitation; R Uma, TERI; and Shirish Sinha, New Delhi)*

Sulabh biogas plant consists of an inlet chamber, an anaerobic digester and an outlet chamber. These plants have been installed in different parts of the country and other countries have also sought technical advice in this context. An example is the biogas digester at Sulabh Complex in New Delhi. The experience in general shows that difficulties may arise during desludging of the digester or unforeseen repair and maintenance job when the flow of excreta to the digester has to be stopped. In such circumstances, the public toilet has either to be kept closed for the period or alternative arrangement has to be made. For more information see, Sulabh International Social Service Organization; Sulabh - Public Toilet Linked Biogas Plant and Sulabh Sanitation Technologies to achieve Millennium Development Goals on Sanitation; and Sustainable Technologies for On-site Human Waste and Wastewater Management: Sulabh Experience.

Mysore, Karnataka *(identified by Shirish Sinha, New Delhi)*
This collaborative project deals with a treatment facility for the human and animal wastes at the School in Mysore, Karnataka. The treatment involves a biogas plant (night soil biogas plant) with energy (methane) production that partly meets the energy requirements of the School, and subsequent composting with fertilizer production to be used on site. For more information, see Use of night soil (human and animal waste) for biogas production at a church run school in Mysore, India.

Bangalore, Karnataka *(identified by Preeti Soni, Resource Person)*
This example shows how the decentralised waste water treatment plants (DEWATs) linked biogas digesters have increased the sustainability of sanitation projects. A community based sanitation project in Ullalu, an urban slum, has benefited through improved services to the sanitation complex (toilets, hot water for bathing and gas for lighting). Another project in a hostel institution benefits from financial savings from gas for cooking. For more information, see Biogas and Dewats, a perfect match?

Some international experiences *(identified by Ramya Gopalan, Research Associate)*

- **Sichuan, China:** The experiment with biogas using farm and household waste, within the last decade has resulted in over seven million small scale fuel producing methane plants in operation. This switch to biogas energy has been beneficial particularly to the agricultural sector. The plants in China are context specific and cost effective using only indigenous materials. For details see Sichuan's Home-Scale BioGas Digesters
- **Colombo, Sri Lanka:** A pilot project implemented by the Colombo Municipal Council uses organic waste from markets to produce biogas and compost. The digesters developed by the

National Energy Research & Development Centre accept dry patches of organic waste and yield 200 tonnes of saleable fertilizer per year. See Recycling Organic Waste

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Related Resources

Recommended Contacts

Dr. P.K. Jha *(from Vikram Rajola, Sulabh International Academy of Environmental Sanitation, New Delhi)*
sulabhpkjha@vsnl.net sulabhacademy@vsnl.net

He has been working for about 2 decades in this sanitation and biogas digesters and is recommended to get information on Sulabh Sanitation method.

Recommended Organizations

Biotech India, Kerala *(from V. Kurian Baby, Socio-Economic Unit Foundation (SEUF), Kerala)*
P.B. No. 520, M.P. Appan Road, Thycaud, Vazhuthacaud, Trivandrum -14.
Phone: 0471 2332179; Email: biotechindia@eth.net

Recommended for work on testing, establishing & managing toilet based biogas plants in Kerala & outside, both domestic & institutional on turn key basis & probably could help in specific design

Action for Food Production (AFPRO) *(from Arumugam Kalimuthu, Plan International, New Delhi)*
www.afpro.org. Email: afprodel@afpro.org
AFPRO Field Unit office, Madhya Pradesh *(from R K Pandey, AFPRO, New Delhi)*
314, Jiwaji Nagar, Thatipur, Gwalior – 474 011
Tel No. 0361-2527560, Email: afpro@sancharnet.in; afu05@afpro.org

AFPRO is a national level socio-technical organization with field offices in different states. It is recommended for information and technical assistance regarding the DeenBandhu Model

Agriculture Department, Government of Madhya Pradesh *(from Jeevan Porwal, Grameen Vikas Trust, Ratlam, M.P.)*

Recommended for information and fund provision for rural areas in M.P.

M/s SKG Sangha, Karnataka (*from D. Vidya Sagar, SKG Sangha, Kolar, Karnataka)*

The NGO has been involved in constructing a number of bio gas plants, and is recommended for technical expertise.

Sulabh International *(from Shirish Sinha New Delhi)*
http://www.sulabhinternational.org

This Sulabh has developed technologies and sanitation programmes for treating waste water & solid wastes including for production of biogas

From Prabhjot Sodhi, UNDP GEF SGP, New Delhi

Chatrasal Seva Sansthan, Uttaranchal
C/o B S. Rawat, Bada Bazaar Malital, Nainital – 263001. Tel: 05242 – 36315
Contact Persons: Mr. B. S. Rawat, Vice Chairperson and Mr Ravinder Singh Chauhan
And
Sarvangeen Vikas Samiti, Uttar Pradesh

Gehuwansagar, P. O. Bargo, (New Shivpuri Colony), Gorakhpur – 273016. Tel: 0551- 2322709
Email: svsgkp@yahoo.com
Contact Person: Mr. S. R. Gupta, Secretary

These UNDP-SGP partners are recommended for their expertise in establishing community bio-gas plants and training community personnel.

Recommended Websites

Identified by Preeti Soni, Resource Person

Biogas Development
http://mnes.nic.in/frame.htm?invopp.htm

The MNES website provides information on the schemes for renewable energy as well as some case studies, including the biogas development programmes.

Biogas Technology
http://www.teriin.org/renew/tech/biogas/about.htm

This section on the TERI website provides information related to the biogas technologies, models, contacts and policies.

Identified by Ramya Gopalan, Research Associate

Bio Gas
Intermediate Technology Development Group
http://www.itdg.org/?id=biogas_expertise

This Biogas link of ITDG provides information of examples in Sri Lanka and also a technical brief and paper on biogas as an energy fuel

Sichuan's Home-Scale BioGas Digesters
MotherEarth News.com, Issue # 69, May/June 1981
http://www.motherearthnews.com/library/1981_May_June/Sichuan_s_Home_Scale_Biogas_Digesters

Article provides detailed information on one example of a local methane production program implemented in Sichuan, China outlining the benefits realized and costs incurred.

Recommended Documentation

From Shirish Sinha, New Delhi

Use of night soil (human and animal waste) for biogas production at a church run school in Mysore, India
http://www.s3idf.org/project-Operations.htm

Recommended for information about a project being done in Karnataka by an organization called The Small-Scale Sustainable Infrastructure Development Fund (S3IDF)

Best Practices - Sulabh- Public Tiolet Linked Biogas Plant
http://www.unwac.org/showhtml.php?filename=bestp_7

The link provides a case study based on experience of Sulabh International.

Sulabh Sanitation Technologies to achieve Millennium Development Goals on Sanitation

By Dr Bindeshwar Pathak. Paper presented at Delhi Sustainable Development Summit (2004) organized by TERI, New Delhi on 4th to 7th February, 2004 in New Delhi; available at TERI website www.teriin.org/dsds/2004/papers/abstract2.pdf

The paper provides an overview of the Sulabh sanitation technologies including toilet linked biogas plants, and their potential role in achieving the MDGs

Deenbandhu Model 2000 Biogas Plant (from RK Pandey, AFPRO, New Delhi)
by Action for Food Production (AFPRO), New Delhi
http://www.solutionexchange-un.net.in/environment/cr/res27120501.doc (Word file: 676 KB)
http://www.solutionexchange-un.net.in/environment/cr/res27120501.pdf (PDF: 158 KB)

The paper provides a detailed description of the Deenbandhu biogas model, particularly the innovations made to improve the older version.

Sustainable Technologies for On-site Human Waste and Wastewater Management: Sulabh Experience *(From R Uma, TERI, New Delhi)*
Dr. PK Jha, 2005 available at http://www.adb.org/Documents/Events/2005/Sanitation-Wastewater-Management/paper-jha.pdf on the ADB website containing the proceeding of the "Hands-on Workshop on Sanitation and Wastewater Management" held in Manila on 19-20 September 2005

The paper on the Sulabh experience that provides information on the night soil based biogas plant.

Additional documentation provided by Preeti Soni, Resource Person

Biogas and Dewats, a perfect match?
By Susmita Sinha & Alex Kazaglis
http://unapcaem.org/Activities%20Files/A01/BIOGAS%20and%20DEWATS,%20a%20perfect%20match.pdf (PDF: size 12 KB)

Evaluation Study of The National Project on Biogas Development
Study conducted by Programme Evaluation Organization, Planning Commission, Government of India (May, 2002).
http://planningcommission.nic.in/reports/peoreport/peo/peo_npbdexe.pdf (PDF: 520 KB)

This report provides a detailed evaluation of the biogas development programmes of the Government of India

Manual on Deenbandhu Biogas Plant
by J.B. Singh, Raymond Myles and Anil Dhussa. Published by Tata-McGraw Hill Publishing Company Limited, New Delhi, 1997
http://www.afpro.org/publications.htm

This is a guide to constructing and maintaining the Deenbandhu Biogas Plant developed by AFPRO, with suitable diagrams.

Biogas: The Indian NGO Experience
by Soma Dutta, Ibrahim H Rehman, Preeti Malhotra and Venkata Ramana P. Published by Tata Energy Research Institute, 1997.
http://bookstore.teriin.org/book_inside.php?material_id=202

This book examines the AFPRO-Canadian Hunger Foundation network biogas program through case studies of 12 NGOs spread over 8 states of India.

Additional documentation recommended by Ramya Gopalan, Research Associate

Managing Solid Waste in India

Edited by Leena Mehendale, Active Conservation Technique, Petroleum Conservation Research Association (PCRA), New Delhi. October-December, 2004
http://www.pcra.org/general/act.pdf (Size: 841 KB)

The paper details how municipal solid waste can be utilized and managed through available treatment technologies

Recycling Organic Waste
Technical Brief, Practical Answers to Poverty, Intermediate Technology Development Group
http://www.itdg.org/docs/technical_information_service/recycling_organic_waste.pdf (Size: 187KB)

This brief provides case studies of developing countries and the methods used within to treat different kinds of wastes

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Responses in Full

Prabhjot Sodhi, UNDP GEF SGP, New Delhi

We are from UNDP Small grants Program (SGP) and two of our partners have greater expertise in establishing community bio-gas plants. They have trained community personnel to supervise and install the same. I think and suggest that if you directly get in touch with them, it should serve your purpose. I am also copying the mail to them so that they respond to you directly. In case this does not work then please let me know. The details of the partners are as follows:

1. Chatrasal Seva Sansthan
   C/o B S. Rawat, Bada Bazaar Malital, Nainital – 263001, Uttaranchal, India
   Tel: 05242 – 36315
   Contact Person: Mr. B. S. Rawat, Vice Chairperson and Mr Ravinder Singh Chauhan (94151 44963)
2. Sarvangeen Vikas Samiti,
   Gehuwansagar, P. O. Bargo, (New Shivpuri Colony), Gorakhpur – 273016
   Uttar Pradesh, India
   Tel: 0551- 2322709 (m) 94158 18689
   Email: svsgkp@yahoo.com
   Contact Person: Mr. S. R. Gupta, Secretary

V. Kurian Baby, Socio-Economic Unit Foundation (SEUF), Kerala

Apropos to your query, I would like to share with you the following contact information, who could be able to help you out. The institution, viz., Biotech India is based in Kerala. They have been working on testing, establishing and managing toilet based biogas plants in Kerala and outside, both domestic and institutional on turn key basis. Though they mainly work with human excreta combined with kitchen waste, which follows the natural biological process, probably they could help in a design having a pre-digestion chamber for degradable materials having varying digestion levels.

Biotech India, P.B. No. 520, M.P. Appan Road,
Thycaud, Vazhuthacaud, Trivandrum -14.
Phone: 0471 2332179
Email: biotechindia@eth.net

Arumugam Kalimuthu, Plan International (India), New Delhi

It is nice to know that your organization is doing a good work in the rural belt of Madhya Pradesh, especially among the children. With respect to your query - connecting a individual household toilet as well as community toilet with biogas plant have been attempted successfully in many parts of the country, hence there is no technical hassle in implementing the scheme. Also, performance test carried out on toilet attached biogas plant in a few locations in south India revealed that combining both human and animal waste would produce better result than connecting with only human waste. Hence, your plan looks perfect for the scheme.

Action for Food Production (AFPRO), a national level socio-technical organization has done a notable work in Deenabandu biogas promotion and they have technical expertise in water and sanitation activities as well. Please visit to their website (www.afpro.org) or write to them (afprodel@afpro.org).

R Uma, The Energy and Resources Institute, New Delhi

Sulabh has done work in this area.

This link contains a paper on the Sulabh experience that provides information on the night soil based biogas plant.

The paper has some details which will be of use.

Vikram Rajola, Sulabh International Academy of Environmental Sanitation, New Delhi

Sulabh International has vast experience in the field of Biogas generation from human waste and is currently running over 140 human-excreta based Biogas digesters all over the country. During the years of experience it has been learnt that dried, pulverised water hyacinth is an excellent additive to enhance yield of Biogas thereby ensuring continuous supply of gas. Temperature is a critical determinant in the gas formation process and therefore most digesters are located below ground-level; also, 1 persons excreta generates about 1cft biogas per day (approx.) hence the number of users is also a crucial factor in determining the economic viability of the project.

Dr. P.K. Jha, (sulabhpkjha@vsnl.net sulabhacademy@vsnl.net) has been working for about 2 decades in this field, you can contact him for further details.

Jeevan Porwal, Grameen Vikas Trust, Ratlam, Madhya Pradesh

As Bio-gas structures are being promoted by the government of M.P. at the district level, you many contact the agriculture department which has sufficient information and even fund provision for rural areas.

D. Vidya Sagar, SKG Sangha, Kolar, Karnataka

M/S. SKG Sangha is a NGO that has been working in this line for the past 18 years. The organization has constructed a number of bio gas plants, improved wood fuel stoves and developed expertise on solid waste management and sanitation.

We have examined the query of 'Gwalior Childrens Hospital'. There are certain technical points to be kept in mind while designing the toilets for the children. First, we have to understand whether the bio gas plant can be installed in the vicinity of the toilets. If so, we have to raise the height of the toilets about 5 to 6 feet depending on the geographical structure of the area. If the bio gas plant is far from toilets, we have to collect feacal material, urine and washed water separately. For designing the gas plant model and size, we have to take into account the number of children who will use the toilets and whether the children are in hostel or do they come from outside regularly. A crusher is to be installed to crush any organic waste before feeding in to the plant, if any other organic material is to be fed into the plant for example kitchen waste. We can help technically to look into these and other aspects.

Subodh Kumar, Udyog Bharati, Ghaziabad, Uttar Pradesh

I have two queries related to your response.

1. What is the largest size of two pits that can be built for community use, and what are the precautions involved regarding the isolation of these leaching pits from drinking water wells etc?
2. For colder climate like prevailing in hill areas what methods are to be used to assist Bio gas generation?

Vinod Kumar, Maithri, Kerala

There are a number of issues we are facing on this regard.

1. The Soap and other inorganic materials. If there is any possibility of inorganic materials - soap, detergents, antibiotics etc- going in to the biogas tank; kindly do not take this option. Even though the bacteria will regenerate in 14 to 30 days, during this period, the outflow will be contaminated.
2. The volume of the tank. It is better to have 60 days retention capacity for the tank if it is using night soil so that all of the pathogenic bacteria will be dead. Then the number of people/children using the system and the type of closet are important to work out the required size of the tank. The closets using less water are ideal. There are certain designs which require less than 2 litres/flush. The solid liquid ratio is always causing problems in similar situations
3. The other feeds. They are required to bring the solid/liquid as well as Carbon/nitrogen ratios in the optimum limit. Any organic waste can be added. But its volume should be accounted in the design.
4. Winter operations. Have to be carefully timed. Other feeds can be done during noon with solar heated water. Simple very low cost options are available for this.
5. Festivals. If there is any possibility of sudden manyfold increase in the users it should be accounted now itself. Otherwise the contamination of the outflow will occur.
6. Piping of the gas. Should be very carefully done. The shorter the distance the better. Inward sloping of the piping towards the tank and suitably located water traps are absolutely essential.
7. Lay out of the tanks. If a site plan along with levels are available, it can be suggested easily. Again the lesser the distance the better.

8. Number and type of tanks. From our experience subsurface ferrocement tanks are the best bet. They are low cost, durable and consumes almost anything but produces less gas. The scum will also make more problems in this type. It can be built by training local people. It is also better to construct a number of tanks in a cascading manner so as to get maximum gas and least possibility of contamination.
9. The Do's and Don'ts. There is a list of around 20 items which has to be learned by the users to get a problem free system. If you are going to do the system, it can be send.

These are the major points we learned from the field. More suggestions can be sent after getting the plan of the compound. Biogas is a wonderful option getting degraded by casual design and operation. I am Vinod Kumar, working with Maithri, a NGO in Kerala.

R K Pandey, Action for Food Production (AFPRO), New Delhi

In response to your query on the subject cited above, I would like to inform you that AFPRO has carried out several experiments on the biogas plants (Deen Bandhu Model) based on use of:-

1. Human excreta exclusively as a feed material for 1 m^3 to 4 m^3 (community) biogas plants for lighting purpose in the villages and in another study the biogas produced from the plant (4 m^3) has been used for lighting and cooking purpose also. Here I would mention that there is no foul smell in the biogas produced using human excreta. It is a very hygienic practice suitable for rural areas having no individual toilets and community is used to go for open defecation. However, in this particular model beside community toilets and community biogas plants the most important aspect is maintaining specified and accurate ratio of utilization of water in the toilets with that solid waste (excreta). This is being done by modifying the toilet design to discard excess water through a channel. The ratio of human excreta and water should be fifty-fifty. Normally the ratio and quantity of solid waste (human excreta) in biogas plants of different capacity should be as follows:

    1 cubic mt. Biogas plant/per day 25 kg. solid waste 25 kg. Water
    2 cubic mt. Biogas plant/per day 50 kg. solid waste50 kg. water
    3 cubic mt. Biogas plant/per day 75 kg. solid waste 75 kg. water
    4 cubic mt. Biogas plant/per day 100 kg. solid waste 100 kg. water

Normally the hydraulic retention time (HRT period) after first feeding of the biogas plant is 20-45 days depending on the temperature condition of the region. The biogas plants perform more efficiently and effectively in warmer climatic areas. In cold areas the rate of HRT (hydraulic retention time) goes down considerably. Another point is hat the more important is that the initial (first) feeding require solid waste at least 21 times greater than the per day feeding mixture. The best example of toilet based (community biogas plant) was made around 1985 by AFPRO in one of the village under “Lalbahadur Shastri National Memorial Trust”, Varanasi which is still effectively functional.

2. AFPRO carried out another biogas study through a pilot project plant fed by human and animal waste with the same NGO in their project office premises (Harrua village).

3. Third kind of Deenabandhu biogas plants are totally based on use of animal solid waste. There are very common and popular through out the country.

The best advantage of any type of biogas plant is:

- They help in maintaining the good sanitary and hygienic conditions in the area.

- The biogas slurry produced by these plants as a bi-product serve the purpose of good quality organic manure.

Please see the attached paper. You may contact of AFPRO office AFPRO Field Unit office at 314, Jiwaji Nagar, Thatipur, GWALIOR – 474 011 MADHYA PRADESH. Tel No. 0361-2527560, Email: afpro@sancharnet.in; afu05@afpro.org for further information and technical assistance.

Shirish Sinha, New Delhi

These are some of the links which provide information regarding toilet linked biogas plant:

1. http://www.s3idf.org/project-Operations.htm about a project being done in Karnataka by an organization called S3IDF.

2. http://www.unwac.org/showhtml.php?filename=bestp_7 case study based on experience of Sulabh International.

3. http://www.sulabhinternational.org/ linked to Sulabh website, which pioneered Toilet Linked biogas plant.

4. http://unapcaem.org/Activities%20Files/A01/Recycling%20and%20reuse%20of%20human%20excreta%20from%20public%20toilets%20through%20biogas%20generation%20to%20improve%20sanitation,%20community%20health%20and%20environment.pdf for a paper (attached).

5. www.teriin.org/dsds/2004/papers/abstract2.pdf for a paper from Dr Bindeshwar Pathak.

Joe Madiath, Gram Vikas, Orissa

Toilets can be attached to a biogas plant and if the matter from the toilets is less than 20% of the feed material, hardly any modification in the conventional biogas plant is necessary.

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 WES-Net at se-wes@groups.solutionexchange-un.net.in with the subject heading "RE: [se-wes] Sanitation schemes and biogas digesters, from Gwalior Childrens Hospital, Madhya Pradesh (Comparative Experiences, advice). Additional Responses"

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