



**Food and Nutrition Security
Community**



Environment

Water Community



Solution Exchange for the Food & Nutrition Security Community Solution Exchange for the Water Community Consolidated Reply

Query: Use of Human Excreta for Agriculture - Experiences

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**From Nivedita Varshneya, German Agro Action/Deutsche Welthungerhilfe
(DWHH/GAA), New Delhi**

Posted 11 September 2007

Dear All,

Following a recent trip to Sweden, I want to share an interesting insight on experiments on the use of human faeces by the Swedish farmers. The Swedish farmers (besides those in other Nordic countries) have experimented with using urine as a liquid manure and dry matter from faeces as a soil conditioner. The urine is stored in sealed vessels for some months and then ploughed in a way as to avoid nitrogen losses. Yields from experimental plots fertilized with human urine were the same as yields from plots fertilized with an equal amount of nitrogen in mineral fertilizers. At the Swedish University of Agricultural Sciences, Uppsala, in a long term (started in 1956), small plot field experiment, the best soil nitrogen turnover was from sewage sludge, as we could well see.

We in India have experimented with this in some ways (Ecosan, biogas etc), but have too many prejudices and social taboos to adopt it on a wider scale. One person produces annually approximately 500 liters of urine, which contains 98% of the Nitrogen, 65% of the Phosphorus and 80% of the Potassium excreted by a human being. Given Wolgast's estimation that one person's faeces is enough to grow grain for his/her annual grain consumption, is it possible that with our population of one billion, we can move towards producing our food organically if we could utilize this resource along with other inputs?

In this context, I would like members to share their experiences on:

- Research experiments in India on the efficacy and environmental impact of the use of human excreta in agriculture, particularly for edible plants and the compatibility of such input use with organic standards
- Indigenous composting or other technologies that have been successfully adapted towards this objective
- Use of sewage sludge in agriculture, if permitted and standards and guidelines for these, if any
- Response of farmers and consumers for produce grown from this waste

The discussion outcomes would help in integrating this concept and applying it in field situations.

Responses were received, with thanks, from

1. B. L. Kaul, Society for Popularization of Science, Jammu ([Response 1](#); [Response 2](#))
2. S. Vishwanath, Rainwater Club and Arghyam Trust, Bangalore ([Response 1](#); [Response 2](#))
3. [Dinesh Shukla](#), Indian Veterinary Research Institute, Izatnagar
4. [Ramesha Gowda](#), Karnataka State Pollution Control Board, Bangalore
5. [T. P. Trivedi](#), Indian Council for Agricultural Research (ICAR), New Delhi
6. [Umesh Babu](#), Institute for Social and Economic Change, Bangalore
7. [Murali Kochukrishnan](#), Action for Food Production (AFPRO), Bhubaneswar
8. [Sudhirendar Sharma](#), The Ecological Foundation, New Delhi
9. Vijay Sardana, Centre for International Trade in Agriculture and Agro-Based Industries (CITA), New Delhi ([Response 1](#); [Response 2](#))
10. Ramney Koul, Independent Consultant, New Delhi ([Response 1](#); [Response 2](#))
11. [Bashu Babu Aryal](#), International Fund for Agricultural Development (IFAD), Nepal
12. [C. P. A. Iyer](#), Independent Consultant, Bangalore
13. [R. Srikanth](#), WaterAid, New Delhi
14. [Ramesh Sakthivel](#), WES-Net India, New Delhi
15. [Ravi Singh](#), Margshree Farms, Agra
16. [Sandeep Parkhi](#), Saksham Foundation, Pune
17. [J. David Foster](#), Administrative Staff College of India, Hyderabad
18. [Madhab Nayak](#), Fountain of Development Research and Action, New Delhi
19. [K. P. Reddy](#), Byrraju Foundation, Hyderabad
20. [Jyotsna Bapat](#), The Energy and Resources Institute (TERI), New Delhi
21. [Arunabha Majumder](#), All India Institute of Hygiene and Public Health (AIIPH), Kolkata
22. [S. C. Prasad](#), Independent Consultant, Ranchi
23. [Mahtab S. Bamji](#), Dangoria Charitable Trust, Hyderabad
24. [Uday Bhawalkar](#), Bhawalkar Vermitech Private Limited, Pune
25. [Constanze Windberg](#), United Nations Children's Fund (UNICEF), Colombo, Sri Lanka
26. G. Misra, Directorate of Economics and Statistics, Port Blair ([Response 1](#); [Response 2](#))
27. [Sanna Leena Rautanen](#), World Bank, Washington, USA
28. [V. D. Sharma](#), Department of Business Economics, Veer Bahadur Singh Purvanchal University, Jaunpur
29. [Jyoti Parikh](#), Integrated Research and Action for Development (IRADe), New Delhi
30. [K. V. Peter](#), Kerala Agricultural University, Thrissur
31. [Subodh Kumar](#), Udyog Bharati, Ghaziabad
32. [P. K. Thampan](#), Peekay Tree Crops Development Foundation, Kochi
33. [Bhawna Vajpai](#), Spatial Decisions, New Delhi
34. [Sajan Venniyoor](#), UNESCO, New Delhi
35. [P. K. Jha](#), Sulabh International Academy of Environmental Sanitation, Enclave, New Delhi
36. [Santhanam R](#), Indian Society of Agribusiness Professionals, New Delhi
37. [Ranjan Mohapatra](#), Vision Foundation for Development Management, New Delhi

Further contributions are welcome!

[Summary of Responses](#)
[Comparative Experiences](#)
[Related Resources](#)
[Responses in Full](#)

Summary of Responses

All living beings on this planet produce waste in some form or the other. As per the principle of five kingdoms of nature, waste of one kingdom can become a resource for another, providing energy and other nutritional needs. Responding to the query on the possibility of using human waste (excreta) as a nutrient recycling option for agriculture, members shared various traditional and current practices as well as emerging technologies, outlined risks and precautions involved in handling of such waste, and suggested mechanisms for an integrated operational approach to its use.

Respondents highlighted the fact that open defecation is an ancient practice in most parts of rural and peri-urban India, usually done on or near agricultural fields. The excreta would undergo natural decomposition over a period and people believed it benefited crop production.

Members shared **examples of customary practices**, which have helped farmers achieve good crop yields, like in [Jammu and Kashmir](#), where human excreta has been used as manure for growing vegetables for centuries. Another example highlighted was a case of farmers preferring manure from septic tanks and sewage treatment plants over other types of manure in [Karnataka](#) and in [Shimoga district](#), members mentioned how a progressive farmer uses waste generated by livestock and people to produce biogas and manure for plants. In [Agra](#), sludge from the municipality used to be in great demand by farmers; however, recent urbanization and changes in farming practices have reduced interest. Another interesting approach was from [Nagarsuda village](#) in **Karnataka** where a school has adapted ecosan methods and is now supplying the urine and sludge as manure to farmers. In another ecosan effort, GTZ has provided a toilet facility for a slum in [Bangalore](#) that is serving the community with clean sanitation services and farmers with organic manure from the collected excreta. Using human extra for agriculture was also traditionally practiced in other countries, discussants noted, such as in [China](#).

Discussing various **types of toilets**, respondents listed innovations in septic tank systems designed to hygienically collect human liquid and solid waste. They explained the normal pan and trap method used in toilets cannot separate urine and night soil, but systems that separate urine and excreta at the source, allow quicker conversion to compost. This dry toilet approach is the type [Finnish farmers](#) use. Another method mentioned is the traditional toilet used in [Ladakh](#), which has two levels and separate outlets for the waste. This allows communities to dilute the urine with water and compost the excreta for use in gardens. A third method shared was the two-pit pour flush latrine that allows excreta and urine to be stored in pits, for later use as manure. In 1950, the government of [Kerala](#) tried to encourage the practice of using human excreta as manure by providing appropriate defecation systems to facilitate the composting of human waste and urine separately; however, the system died out with the introduction of chemical fertilizers. Members also mentioned ban of [Goan pig toilets](#) as it was not ecological and caused parasite infection when excreta was directly used in agricultural fields.

Elaborating on the possible **risks of using and handling human excreta** respondents stressed such manure needs the utmost care and diligence when processing for agriculture production purposes. Human excreta contain various pathogenic bacteria and helmenthic cysts and are unsafe unless sanitized. It is necessary for complete conversion into "good compost" before application to avoid deleterious

effects; the risks of spreading diseases due to poor sanitation is a potential problem, more than issues with food security. Another concern is the possibility of heavy metal contamination like nickel, lead, and cadmium of the vegetables produced from the human excreta compost. Members also cautioned the risk of markets following EUREPGAP standards will not accept such products and that some consumers, especially in the United States, will believe diseases are transmitted through these type of agricultural products.

Outlining the **safety precautions**, discussants stressed that only composted solid waste and diluted urine stored for an appropriate period, is safe to apply to crops. The type of soil chemistry also requires consideration before applying composted human excreta and urine as nutrition requirement of a soil is dependant on its type. During processing of food items, safety measures are necessary to avoid the associated risk of round worms and pinworms. Finally, as a precautionary measure, members advised not using human excreta manure to grow vegetables usually consumed raw, like carrots and lettuces.

Respondents also shared various [research studies and experiments](#) conducted to determine the level of safety when using human excreta and urine for food production. For example, the Tamilnadu Agricultural University examined how the [application of urine](#) and composted faeces to rice, maize and bananas affected production. The results suggested that urine correctly applied had the same ability to ensure production as artificial fertilizers, if farmers take the necessary precautions to avoid any excessive buildup of salts.

On the **attitudinal response** of farmers and consumers, discussants stressed that since it is not a new concept, farmers' response has been good, but consumers' reaction is generally negative due to lack of awareness regarding the effectiveness and safety of the method.

In view of various uses, associated risks and psychological barriers, members suggested several **mechanisms towards institutionalizing** the concept and making it more environmentally and human friendly.

- Design and operate well-managed systems with standard maintenance procedures for proper processing of large quantity of excreta along with evaluation of costs and ensuring safety through appropriate risk management of the end product; possibly through Public-Private Partnerships
- Integrate markets and create demand for bio-manure and biogas at a national level to support the processing of human and cattle waste into manure and gas
- Have research institutions serve as single point contact and come up with scientific data, papers or studies to substantiate that the output of such farms are free from pathogens, including comprehensive recommendations on safety precautions (like not to apply such manure to tubers or ground based vegetables)
- Develop appropriate standards and [guidelines](#) with regulatory standards for generating data on risks, safety parameters, and product labels
- Educate and reach out to the masses through media outlets, community relations, and health agencies with scientific facts about this approach
- Use human waste for landscaping and greening parks/gardens and for reclamation of degraded lands
- Generate awareness and knowledge sharing on various [ecosan initiatives](#) across the globe

In country like India, where large tracks of land have low crop productivity due to limited soil fertility, using human excreta as a resource for agriculture seems to be a viable option - provided appropriate sanitary procedures, scientific processing, and standardized safety measures adopted to avoid the potential health and environmental risks.

Comparative Experiences

National

Jammu and Kashmir

Human Excreta Aiding Good Vegetable Yield, Ladakh (from *B. L. Kaul, Society for Popularization of Science, Jammu, [response 1](#)*)

Use of human excreta for manure is common in this part of the country. Due to non-existence of the "water closet" concept for defecation, people use dry toilets. While urine drains out the excreta is removed every morning by scavengers, who later transport the waste to vegetable gardens. The excreta is then composted before being used as manure. The yields from these vegetable gardens has been excellent, providing the farmers a good profit.

Traditional Toilet Designs Aid Reuse of Solid and Liquid Human Waste , Leh (from *Jyotsna Bapat, The Energy and Resources Institute, New Delhi*)

Traditionally designed toilets in this region have two outlets for separating liquid and solid waste. The liquid waste is mixed with water and discharged into agricultural fields. The solid waste is covered with sand after every use, which is left for a while in a ditch, and later is collected as manure for agricultural purposes. Communities work together to ensure appropriate sanitation is maintained in this difficult area, which at the same time is producing good manure for better crop yield.

Tamil Nadu

Rice Seeds Treated with Cow's Urine, Coimbatore (from *S. Vishwanath, Rainwater and Arghyam Trust, Bangalore, [response 1](#)*)

In an experiment conducted by the Tamilnadu Agricultural University, rice seed varieties were treated with cow's urine. Followed by proper scientific and organic treatments at the nursery the young seedlings were transferred to the main field that was pre-treated with green leaf manure and farmyard manure. The crop grew well with no incidence of any major pests or diseases. [Read more](#)

Urban Elites Accept Sewage Recycling in their Homes, Chennai (from *T. N. Anuradha, Research Associate*)

In a 133-apartment complex in Medavakkam, over 40,000 litres of wastewater (toilet and bathroom let-offs) are recycled everyday. The wastewater undergoes an appropriate purification processes before it is supplied again in homes for flushing toilets and gardening. Such systems have proven useful to communities without a sewer network and sufficient water supply. [Read more](#)

Karnataka

Manure from Human Exrceta in Demand, Mysore (from *Ramesha Gowda, Karnataka State Pollution Control Board, Bangalore*)

"Sewage farming" is popular in this part of the country. Farmers are using the sewage water for paddy cultivation. Using this approach, farmers have had good yields and now prefer to pay more for the manure from septic tanks and sewage treatment plants than purchase organic manure.

School Provides Manure to Farmers, Nagarsuda village (from *Ramesh Sakthivel, WES-Net India, New Delhi*)

The ecosan toilet constructed in Swami Vivekananda Kannada HPS Chikpet School provides 300 litres of urine every month to farmers who use it their fields as fertiliser. This has helped farmers by providing them a cheaper source of fertiliser and also promotes the "eco-sanitation concept" in the construction of household toilets. Encouraged the approach, 10 eco-sanitation based households toilets have now been constructed in the village. [Read more](#)

Ecosan for Multi-Services, Bangalore (from *Constanze Windberg, United Nations Children's Fund (UNICEF), Colombo, Sri Lanka*)

As a part of its Ecosan programme, GTZ has provided a toilet block in a slum community. The toilets serve multipurposes, providing clean sanitation services at low cost to the slum inhabitants and a way for farmers to access organic manure. Provision has been made in these blocks for the collection of faeces and urine, which are the provided to farmers. [Read more](#)

No Waste Goes Waste, Shimoga District (from [Umesh Babu](#), *Institute for Social and Economic Change, Bangalore*)

An organic farmer is using all the organic waste (plant, human or animal) generated on his farm to nurture his agricultural crops. The farm has adopted various methods to convert the waste to manure by using a biogas plant and sludge. Liquid waste is used on plants through a sprinkler method. This is not only helping reduced the use of chemical fertilisers, but also in the appropriate management of wastes. [Read more](#)

Kerala

Technology to Encourage for Composting of Human Waste (from [P. K. Thampan](#), *Peekay Tree Crops Development Foundation, Kochi*)

In 1950, households were provided with technologies for composting of human urine and night soil to produce manure. This was done as a part of a community project carried out by agricultural extension workers. Two tons of valuable urine compost could be prepared in one year. Many households used the manure in their kitchen gardens, however with the introduction of chemical fertilizers the practice slowly waned.

Uttar Pradesh

Sewerage Sludge for Sale, Agra (from [Ravi Singh](#), *Margshree Farms, Agra*)

In the Agra municipality, sewerage sludge was in great demand among farmers, who would even buy sludge on the black market. They used for their summer squash crop - tinda, because it gave very good yields. However, growing urbanization has led to glass, stone and other material being mixed with the sludge, which along with the introduction of hybrid plant varieties and increased use fertilizers has resulted in a decreased demand for sludge by farmers.

International

Finland

Dry Toilets Serving Multipurposes (from [Bashu Babu Aryal](#), *International Fund for Agriculture Development (IFAD), Nepal*)

Many families are changing from water to dry toilets. One of the prime reasons is decreasing water resources and adaption of organic agricultural practices. The dry toilet modle used allows for urine separation and has a composting chamber right under the toilet seat. The urine is diluted with grey water and utilized as fertilizer in family gardens. Farmers are also extensively using this manure with great satisfaction. [Read more](#)

China

Ancient Evidence of Use of Human Excreta for Agriculture (from [R. Srikanth](#), *WaterAid, New Delhi*)

Human excreta have been used as fertilizer for crops since the Shang Dynasty (about three thousand years ago). The method for utilizing human excreta, included basal fertilization, top application, and seed coating. Even human waste generated in the cities and towns were used by farmers and transported to rural areas. But by the 1980s this ancient tradition was overpowered by the introduction of chemical fertilisers. [Read more](#)

Improvements in the Use of Human Excreta in Chinese Agriculture *(from Ramya Gopalan, Research Associate)*

Under the influence of China's long tradition, human excreta is always used as a crop fertilizer by the application of direct usage for crops, compost, and direct usage as feed for fish. Difficulties faced in rural areas absorbing the increasing human waste generated in cities and towns and extension of transportation distances. However, improvements in toilet structure, transportation method, treatment method and application approach helped tackle the issues. [Read more](#).

Sweden

Reuse of Urine and Sludge, Hulta *(from T. N. Anuradha, Research Associate)*

Borje Johansson a dairy farmer who also produces fodder for cows and cultivates grain, collects urine from local villages and uses it as a fertiliser for grain production. The urine helps to improve the nutrient balance on the farm. The sludge collected in septic tanks is composted with straw. The compost is used in agriculture. Many of villagers are now buying food that is produced using their own excreta as fertilisers. [Read more](#)

Vietnam

Legislation on Excreta and its Use in Agriculture *(from Ramya Gopalan, Research Associate)*

Until recently the definition of "hygienic safe human excreta" was based on composting time only, and the Ministries of Health and Agriculture and Rural Development, applied different standards. The lack of common standards hindered promotion of safe practices. However, following recent revisions to the guidelines both ministries now recommend a composting time of six months for producing hygienic safe excreta that can be used as fertilizer. [Read more](#)

Related Resources

Recommended Documentation

From [Constanze Windberg](#), United Nations Children's Fund (UNICEF), Colombo, Sri Lanka

Guidelines for the Safe Use of Wastewater, Excreta and Greywater, Volume 4

Guidelines; World Health Organization; 2006

Available at http://www.who.int/water_sanitation_health/wastewater/gsuweg4/en/index.html

Explains requirements to promote the safe use of excreta and greywater in agriculture, including minimum procedures and specific health-based targets

Guidelines on the Use of Urine and Faeces in Crop Production

Article; EcoSanRes; Stockholm Environment Institute; Stockholm, Sweden; April 2005

Available at http://www.ecosanres.org/pdf_files/Fact_sheets/ESR6lowres.pdf (PDF Size: 255 KB)

Provides guidelines for use of urine and faeces in agriculture, requires customisation to local conditions

Ecological Sanitation Closes the Loop between Sanitation and Agriculture

Article; Federal Ministry for Economic Cooperation and Development; German Development Cooperation (GTZ)

Available at <http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/8524.htm>

Provides activity details of ecosan programme of GTZ, noting the importance of such programmes working to remove misconceptions about human excreta being simply "wastes"

Toilets That Make Compost

Book; by Peter Morgan; EcoSanRes, Stockholm Environment Institute; 2007

Available at http://www.ecosanres.org/toilets_that_make_compost.htm

Provides practical information for the rural, peri-urban and urban populace of Africa to build and practice the art of recycling nutrients from their excreta for better crops

Improving the Rural-Urban Nutrient Cycle Through Peri-Urban Agriculture

Article; International Water Management Institute; 28 February 2007

Available at <http://www.iwmi.cgiar.org/africa/West/projects/Nutrient%20cycle%20-%20Re-use%20options.htm>

Outlines how a project is analyzing the viability of composting municipal organic waste, co-composting of solid waste with night soil, and direct night soil application

An Assessment of Community Attitude on Human Excreta Use and Products Produced from Human Excreta Plots

Report; by Edward Guzha and Sakios Muduma; Mvuramanzi Trust; Marlborough

Available at <http://www2.gtz.de/ecosan/download/en-Guzha-assessmentonmaizeproduktion-2005.pdf>
(PDF Size: 126 KB)

Study assesses community attitudes on using human excreta for agriculture and on consumption of food products produced from human excreta plots

The Utilization of Human Excreta in Chinese Agriculture (from [R Srikanth](#), WaterAid, New Delhi)

Article; by Luo Shiming; South China Agricultural University; Internet Dialogue on Ecological Sanitation ; China; November-December 2001

Available at <http://www.ias.unu.edu/proceedings/icibs/ecosan/luo-02.html>

Informs about the long time use of human excreta by the Chinese and details reasons for the diminishing practice and advises possible strategies for revival of the practice

From [Ramesh Sakthivel](#), WES-Net India, New Delhi

Should Ecological Sanitation Carry a Health Warning?

Article; by Rebecca Scott ; Water, Engineering and Development Centre (WEDC); WELLS; UK

Available at

<http://www.lboro.ac.uk/well/resources/Publications/Briefing%20Notes/BN27%20Ecological%20sanitation.htm>

Explains that ecological latrines reduce the pathogen level in faeces to safe levels, with sufficient storage times and proper management of the latrines

Contaminated Irrigation Water and Food Safety for the Urban and Peri-Urban Poor

Briefing Paper; by Fiona Marshall *et. al*; University of Sussex; Toxics Link; 18 July 2007

Available at <http://toxicslink.org/dn.php?section=1&id=176&atn=0> (PDF Size: 6 MB)

Looks into the risks of heavy metal contamination with the use of sewage water for agricultural purposes

Eco-Sanitation in School- New Opportunities for Farmers

Article; by Kumar Alok; United Nations Children's Fund (UNICEF)

Available at

http://www.wesnetindia.org/fileadmin/attachments/Resources_on_Ecosan/case%20study%20on%20school%20eco-san.doc (Document Size: 2 MB)

Provides the experience of using eco-sanitation based toilets in one of the schools of Nagarsuda village where farmers use the human urine and excreta as fertilisers for their fields

Ecosan – Recycling-Oriented Wastewater Management and Sanitation Systems (from [Constanze Windberg](#), United Nations Children's Fund (UNICEF), Colombo, Sri Lanka and [Sanna Leena Rautanen](#), World Bank, Washington, USA)

Article; German Development Cooperation (GTZ); Water and Sanitation Section; Eschborn, Germany; December 2005

Available at <http://www.gtz.de/de/dokumente/en-ecosan-topicsheet-2005.pdf> (PDF Size: 1 MB)

Aims to recognise ecological sanitation concepts internationally as an innovative approach in management and reuse of human wastes for improved water sustainability

Organic Farming: Traditional Rice Varieties Ideal (from S. Vishwanath, Rainwater Club and Arghyam Trust, Bangalore, [response 1](#))

Article; The Hindu; 4 July 2004

Available at <http://www.hindu.com/seta/2004/07/08/stories/2004070800431500.htm>

Reports good yield and no incidences of pest attack on newly tried rice seeds varieties treated with cow urine and further nurtured with organic manure

Urine Diverting Toilets in Climates with Cold Winters (from [Bashu Babu Aryal](#), International Fund for Agricultural Development (IFAD), Nepal))

Report; by Anna Richert Stintzing *et. al*; VERNA Ecology Inc.; Women in Europe for a Common Future; The Netherlands; July 2007

Available at http://www.wecf.de/cms/download/2007/WP-26_web-07.pdf (PDF Size: 2.3 MB)

Provides technical considerations for reuse of nutrients from human excreta through specially designed toilets, provides practical examples of such reuse in practice

From [Sanna Leena Rautanen](#), World Bank, Washington, USA

In Search for Drivers for Dry Sanitation

Report; by Sanna Leena Rautanen and Eva Liisa Viskari; Tampere University of Technology; Land Use and Water Resources Research; Tampere, Finland; 2006

Available at <http://www.luwrr.com/uploads/paper06-04.pdf> (PDF 780 KB)

Summarises findings of International Dry Toilet Conference where dry toilet based urine diversion was recommended, as nutrients from urine could be used for agriculture purpose

Ecological Sanitation

Book; by Uno Winblad and Mayling Simpson-Hebert; Stockholm Environment Institute; Sweden; 2004

Available at http://www.ecosanres.org/pdf_files/Ecological_Sanitation_2004.pdf (PDF Size: 1.2 MB)

Presents findings of research on ecological sanitation to promote conservation of water to prevent water pollution and to recycle the nutrients from human excreta

A Guide to the Development of On-Site Sanitation

Guide Book; World Health Organization; 1992

Available at http://www.who.int/docstore/water_sanitation_health/onsitesan/ch04.htm

Looks into technical factors affecting excrete disposal and provides design examples for compost toilets, so manure from these can be used for agriculture

What We Do in Vietnam (from [Arunabha Majumder](#), All India Institute of Hygiene and Public Health (AIIPH), Kolkata)

Article; Nippon International Cooperation for Community Development (NICCO; Vietnam

Available at http://www.kyoto-nicco.org/vietnam_e.htm

Project includes construction of composting toilets to enable use of human waste into resources to be used in farms

From [Sajan Venniyoor](#), UNESCO, New Delhi

The Sad, but Increasing Demise, of the Goan Pig Toilets

Article; The India Travel Forum; 2002

Available at <http://www.indiamike.com/india/goa-f23/the-sad-but-increasing-demise-of-the-goan-pig-toilets-t1127/>

Views on the Goan pig toilet, which is almost extinct, had a opening allowing pigs to consume human excreta

Japan's Response to Health and Medical Care Challenges

Report, Page 134; Institute for International Cooperation, JICA; 2000

Available at <http://www.jica.go.jp/english/resources/publications/study/topical/okinawa/pdf/okinawa.pdf> (PDF, Size: 780 KB)

Reports after ban of "pig toilets" the human excreta was transported for use as fertilizer in farming areas, but due to direct use of excreta caused high rate of parasite infection

Lesser Humans

Film; by Stalin K.; Drishti Media Collective; Navsarjan Trust; Ahmedabad; 1997; Film available on request from Drishti – Media, Arts & Human Rights, 103 Anand Hari Tower, Sandesh Press Road, Bodakdev, Ahmedabad 380054; Tel: 91-79-26851235; drishtiad1@gmail.com

Available at <http://www.oneworld.cz/oneworld/2000/english/films/asia/lesserh.htm>

Investigates continuance of inhuman practice of manually disposing human excreta, calls for appropriate sanitary practices and technology if human excreta to be used as manure

From T. N. Anuradha, Research Associate

Council Gives Consent for Underground Drainage System

Article; The Hindu; 3 January 2007

Available at <http://www.hindu.com/2006/01/03/stories/2006010301690300.htm>

Initiative by Municipal Corporation of Erode to treat the septic tank wastewater to be used for agricultural purposes and sediments converted to manure to be sold to farmers

A Virtuous (Re)Cycle

Article; by S. Shanker; The Hindu; Chennai; 23 April 2005

Available at <http://www.hindu.com/pp/2005/04/23/stories/2005042300310100.htm>

Reports that over 40,000 litres of toilet and bathroom let-offs recycled and supplied for flushing of toilets in the apartments and also used for gardening

Pathogens in Human Excreta

Article; SulabhENVIS Centre

Available at http://www.sulabhenvi.in/pages/database_detail.asp?id=46

Informs about the various pathogens in human excreta and their deleterious health effects; and suggests various precautions to use before using human excreta for agriculture

Human Excreta for Plant Production

Review Article; by Helvi Heinonen-Tanski a and Christine van Wijk-Sijbesma; Department of Environmental Sciences, University of Kuopio; Finland; 22 October 2003

Available at http://www.irc.nl/content/download/8929/135439/file/HeinonenWijk_Human_Excreta_.pdf (PDF Size: 188 KB)

Reports human urine and composted human faeces fortified with wood ash and garden waste could meet potassium and phosphorus needs of plants and improve soil structure.

From Ramya Gopalan, Research Associate

An Assessment of Community Attitude on Human Excreta Use and Products produced from Human Excreta Plots

Paper; by Edward Guzha and Sakios Muduma; German Development Cooperation (GTZ); Marlborough

Available at <http://www2.gtz.de/ecosan/download/en-Guzha-assessmentonmaizeproduktion-2005.pdf>

(PDF Size: 125 KB)

Reveals community attitude on using human excreta is positive with 76.7% fine to eat produce from ecosan and 78.1% willing to use human excreta as a crop nutrient

WHO Guidelines for the Safe Use of Wastewater and Excreta in Agriculture

Review Paper; by S. A. Petterson and N. J. Ashbolt; Microbial Risk Assessment Section; World Health Organization (WHO)

Available at http://www.who.int/water_sanitation_health/wastewater/mrareview.pdf (PDF Size: 253 KB)

Summarises available data, use of Microbial Risk Assessment and example outcomes to aid in setting health targets and the use of wastewater and excreta in agriculture

Human Excreta Use in Agriculture in Vietnam - A Study from the Field to the Latrine

Project Brief; Institute of Public Health; University of Copenhagen

Available at http://pubhealth.ku.dk/ais_en/research_areas/water_sanitation/research_projects/

Identifies legislation and sanitation strategies for the use of human excreta in agriculture, their agreement with farmers needs and practices assessed and issue of hygienic quality

Guidelines on Agricultural Reuse of Human Excreta

Article; EcoSanRes; Stockholm Environment Institute; September 2007

Available at http://www.ecosanres.org/agricultural_reuse_of_human_excreta.htm

Aims at educating ecological sanitation users about handling the urine and faeces in a safe and beneficial manner, thus promoting the use of human excreta in agriculture

Successful Sanitation Promotion Must Recognize the Use of Latrine Wastes in Agriculture – The Example of Vietnam

Perspectives Paper; by Peter Kjær Jensen *et al.*; Bulletin of the World Health Organization; Vol. 83 No. 11; November 2005

Available at [Link](#)

Comments on excreta reuse and health, implementation problems, legislation on excreta and its use in agriculture and future research needs all set in the East Asian context

Possibilities for Sustainable Nutrient Recycling by Faecal Separation Combined with Urine Diversion

Doctoral Thesis; by Bjorn Vinneras; Department of Agricultural Engineering; Swedish University of Agricultural Sciences; Uppsala; 2002

Available at http://diss-epsilon.slu.se/archive/00000332/01/Agraria_353.pdf (PDF Size: 3.65 MB)

Discusses how this Separation Method seems to be an interesting way to decrease the resource usage and possibly improve the hygienic standard of wastewater systems.

Use of Human Excreta from Urine-Diversion Toilets in Food Gardens: Agronomic and Health Aspects

Report; No 1439/3/06; Water Research Commission; South Africa; June 2006

Available at <http://www.fwr.org/wrcsa/1439306.htm>

Establishes current "state of the art" in ecological sanitation and explores appropriate practices for faeces collection, disposal and use in agriculture and food gardens

Human Faeces as a Resource in Agriculture

Paper; by Sirkka Malkki; TTS-Institute; Rajamäki

Available at <http://orgprints.org/8477/01/njf4.pdf> (PDF Size: 2.55 MB)

Details how nutrients in faeces should be used in plant production, instead of ending up in wastewater treatment plants

Recommended Contacts and Experts

Dr. Prafulla Chandra, Shimoga District, Karnataka (from [Umesh Babu](#), Institute of Social and Economic Change, Bangalore)

Krishi Sampada, Lakshmipura, Hosahalli Post, Shimoga District, Karnataka; Tel: 91-8182-272730; <http://www.shimoga.nic.in/prafu.htm>

Conducted extensive work in recycling of organic waste like human excreta and using for agricultural purposes

Valmiki Sreenivasa Ayyangarya, Arunachal Pradesh (from [Santhanam R](#), Indian Society for Agribusiness Professionals, New Delhi)

vajadeva@rediffmail.com

Has conducted extensive experiments on use of cow dung and other biomass as manure for tea plantations and also recommends use of human excreta after proper research

Recommended Organizations and Programmes

Sulabh International Social Service Organisation, New Delhi (from [T. P. Trivedi](#), ICAR, New Delhi and [G Misra](#), Directorate of Economics and Statistics, Port Blair and [P K Jha](#))

Sulabh Gram, Mahavir Enclave, Palam Dabri Marg, 110045 New Delhi; Tel: 91-11-25032617/1518; Fax: 91-11-25034014/6122; sulabh1@nde.vsnl.net.in; <http://www.sulabhinternational.org/pg06.htm>; Contact Dr. Bindheshwar Pathak; President

Research and Development Unit has developed many technologies for conversion of human excreta to biogas and manure

Fountain of Development Research and Action (FODRA), New Delhi (from [Madhab Nayak](#))

302, Jai Apartments, Sector-9 Rohini, 110085 New Delhi; Tel: 91-11- 27553976; Fax: 91-11- 27566715; fodra@vsnl.com; <http://www.fodra.org/finn.asp?getfl=inov4>

Organisation engaged in the promotion and use of recycled urine and human faeces for agriculture as a part of their ecosan activities

From [Constanze Windberg](#), United Nations Children's Fund (UNICEF), Colombo, Sri Lanka

Ecosan Services Foundation (ESF), Pune

"Vishwa Chandra", 1002/42 Rajenda Nagar, Maharashtra 411030; Tel: 91-20-64000736; Fax: 91-20-24530061 ecosanindia@gmail.com; <http://www.ecosanservices.org/page.php?id=1>

Foundation's objective is to promote "ecosan" technology as a method to produce hygienically safe and useful resources from human wastes

Eco-Solutions, Trivandrum

'Pulari', 49 Asan Nagar, Vallakadavu, Kerala 695008; Tel: 91-471-2502622; paul@eco-solutions.org; <http://www.eco-solutions.org/contactus.html>

Promotes ecological toilets and wastewater recycling systems among communities, government and non-government organisations for reuse of human waste

Mythri Sarva Seva Samithi, Bangalore

1300 D, 1st Cross, 1st Main, HAL 3rd Stage, New Thippasandra, Karnataka 560075; Tel: 91-80-25273941; Fax: 91-80-25255543; contact@ecosanindia.org; <http://www.ecosanindia.org/ea.html>;

Contact: Mr. Anselm Rosario; Executive Director

Working towards creating awareness for recycling of human waste as well as developing an adequate toilet design for separating urine and faeces for agricultural use

WASTE Advisers on Urban Environment and Development, Netherlands

Nieuwehaven 201, 2801 CW Gouda Netherlands; Tel: 31--182-522625; Fax: 31-182-550313; office@waste.nl; <http://www.waste.nl/>

WASTE focuses on solid and liquid waste management and resource recovery through low-cost sanitation programmes

Global Dry Toilet Association, Finland (from [Sanna Leena Rautanen](#), World Bank, Washington, USA)

Kauppakatu 11 C 2 krs, 33200 Tampere Finland; Tel: 358-50-3012539; secretary@drytoilet.org <http://www.drytoilet.org/>

Promotes the use of dry toilets to make it an essential part of sustainable development, to control the management of toilet waste to use it for agriculture

Recommended Portals and Information Bases

WES-Net India, New Delhi (from [Ramesh Sakthivel](#))

<http://www.wesnetindia.org/index.php?id=120>; Contact Mr. Ramesh Sakthivel; National Coordinator; Tel: 91-11-46558484/90; desk@wesnetindia.org

Portal provides information on ecosan and other related sustainable sanitation concepts which are important in context of using human excreta for agriculture

EcoSanRes, Stockholm Environment Institute, Stockholm (from [Constanze Windberg](#), United Nations Children's Fund (UNICEF), Colombo and [Sanna Leena Rautanen](#), World Bank, Washington)

<http://www.ecosanres.org/>; Tel: 46-8-6747070

Portal contains exhaustive information on various sanitation programmes and activities promoting recycling of human waste to use for agriculture and other purposes

Turning Pollution into Resources, Bhawalkar Ecological Research Institute, Pune (from [Uday Bhawalkar](#))

<http://www.biosanitizer.com/>; Tel: 91-20-24226916; bvpl@vsnl.com

A biocatalyst used for treatment of sewage wastewater without production of any sludge, which can be used as resource for agriculture and natural fertiliser

Related Consolidated Replies

Sanitation Schemes and Biogas Digesters, from B. K. Sharma, Gwalior Children's Hospital, Madhya Pradesh (Comparative Experiences; Advice). Water Community. Issued 28 December 2005

Available at <http://www.solutionexchange-un.net.in/environment/cr-public/cr-se-wes-28120501-public.pdf> (PDF Size: 143 KB)

Provides experiences on community-based sanitation schemes using biogas digesters, and information on relevant technologies

Treatment of Wastewater for Reuse, from K. A. S. Mani, APFAMGS, Hyderabad, (Experiences). Water Community. Issued 14 March 2006

Available at <http://www.solutionexchange-un.net.in/environment/cr-public/cr-se-wes-14030601-public.pdf> (PDF Size: 160 KB)

Explores range of approaches in wastewater treatment covering small household level treatment devices, middle range technologies and large intensive solutions

Best Practices in Effective Sewage Disposal, from Aniruddhe Mukerjee, Government of Madhya Pradesh, Bhopal (Experiences). Water Community. Issued 13 June 2007

Available at <http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-21050701.pdf> (PDF Size: 160 KB)

Outlines technical options and good practices from different parts of India and gives suggestions for designing institutional interventions for effective sewage management

Ecological Sanitation, from S. Janakarajan, Madras Institute of Development Studies (MIDS), Chennai (Examples; Experiences). Water Community. Issued 30 June 2007

Available at <http://www.solutionexchange-un.net.in/environment/cr-public/cr-se-wes-05060701-public.pdf> (PDF Size: 180 KB)

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

Responses in Full

B. L. Kaul, Society for Popularization of Science, Jammu (*response 1*)

In Kashmir valley and Ladakh region, human excreta has been used as a manure for growing vegetables for centuries. The practice is common even now. In recent past the concept of Water Closet (W.C.s) was not there and people used dry latrines. While urine flowed out into the drains excreta stayed back and was removed every morning by scavengers employed privately by most house holds or by vegetable growers. The excreta were then transported by horse driven carts to the vegetable gardens where it was composted and then used as manure. The vegetable growers had also built dry latrines on the peripheries of their gardens for use by occasional passers by and by any one wanting to use them. This practice was more in use in urban areas than in rural areas. In the latter animal manure was used for the purpose.

Regarding the points raised by you I have to add:

- In Jammu and Kashmir, I am not aware of any scientific research being carried out about efficacy of the system but my experience is that the system was quite efficient and vegetable yield was excellent. The valley never felt the need of importing vegetables in the past except in winter months when the whole landscape was covered with snow. Regarding environmental impact of the system it was profound. Nematode worms especially Round worms (*Ascaris lumbricoides*) and Pin worms flourished especially in children and stools of most people showed presence of eggs of worms. The presence of worms in human guts resulted in anemia and other complications.
 - The technique that our farmers used was simple. They dumped excreta in deep pits and covered them with raw soil. New additions of night soil were made every day in the same pits and covered with fresh layers of soil.
 - In many parts of India composite animal farming and in fisheries animal urine and dung are used. By the side of a pond animals like pigs, sheep, goats and cattle are put in sheds and the waste - urine and dung - is thrown into the pond to fertilize it for rearing fish and ducks. This practice also follows in East Asian countries and China.
 - Response of farmers is good in some states but farmers and consumers by and large respond negatively to the suggestion of using human night soil as a manure for obvious reasons.
-

S. Vishwanath, Rainwater Club and Arghyam Trust, Bangalore (*response 1*)

Nivedita asks very interesting questions and here are some comments and answers

- I would be very careful in the use of words here especially when Eco-san is at an initial stage and gaining momentum. It is not human excreta but composted faeces and stored urine that is applied.

Let no one get the impression that raw human waste is being applied to the land directly. I hope it is on this composted and safe application that the attention will be focused.

- At the conference in Erdos in China recently a few papers were presented on the application of human urine and the test results. Prof. Lokesh et al report a few trials with human urine on test plots. Prof Lokesh is with the S J College of Engineering Mysore.
- The Tamil Nadu Agricultural University at Coimbatore is carrying out experiments with the application of urine on rice.
- Prof Srinivas Murthy and P.M. Sreedevi a Ph.D. student have been carrying out excellent field trials on the application of urine on Maize and bananas. They are with the Gandhi Krishi Vigyan Kendra, the University of Agricultural Sciences in Bangalore.
- Kitchen level experiments have been reported more anecdotally both with urine and composted faeces from Mysore, Trichy and Bangalore where eco-san is in application for some years now.
- Our experiment has been with rice on the roof using grey water, composted faeces and urine. This is in Bangalore.

In overall, all the results suggest that urine if correctly applied has the ability to ensure production as much as artificial fertilisers. The precaution is the excessive buildup of salts especially sodium, which needs to be carefully monitored.

A Professor from South Africa suggested that beetroots do very well as well, as reduce salt build up and therefore can be considered as an alternate crop.

I would however contest the claim that there is a psychological barrier against the use of urine and composted faeces. In the rural areas where we have worked we have found no such barrier. It is only in urban India that such thought processes exist.

On a personal note, I have been using eco-san for the last 4 years now and using the toilet has been a revelation converting me from a faeco-phobic person to faecophile.

Dinesh Shukla, Indian Veterinary Research Institute, Izatnagar

I very much appreciate your concern about the innovations in agriculture and suggesting the use of human excreta as manure for maximizing agriculture production particularly on the basis of Swedish experiments and farmers practices. However, I don't find any new concept or finding in this idea as in our country this was an age old practice in villages that farmers use to go for their natural calls in their own fields and this was giving them many fold advantages including the use of their excreta as manure. Few other Asian countries were also using this practice. But with time these practices have changed in the name of sanitation and unhealthy practices.

Even now in small/medium towns the vegetables are grown near the drains and sewage water is usually used for irrigation. Thus this concept is nothing new and was already in practice in our old farming system and it may be just as old wine in new bottle. Probably ,what you mean as I could understand by your idea ,that we must develop some well managed system for proper processing of huge quantity of excreta in big cities and diverting it to farm land so that the nitrogen and other undigested nutrients present in the human excreta may be properly utilized. Probably you will be aware that animal faeces (cow, buffalo, sheep, goat etc,) are very well in use for this purpose. Experiments have been conducted even for use of Poultry excreta as feed supplement for cattle and other animals in our own country.

Ramesha Gowda, Karnataka State Pollution Control Board, Bangalore

The concept is not new and is practiced extensively. In Karnataka, there is lot of demand for manure from septic tanks and sewage treatment plants. People are ready to pay more than what is paid to other organic manure. Hence, it is not easily available. Further in Mysore and other local bodies there is practice of sewage farming.

Vartur lake in Bangalore will be full through out the year mainly because of entry of sewage and industrial effluents. The water is being used by farmers for paddy cultivation and are getting good results.

In my village people prefer to attend to nature call in the fields as urine and feces form manure. In developed countries it done other way first they attend the nature call in there house then carry all the way to fields.

T. P. Trivedi, Indian Council for Agricultural Research (ICAR), New Delhi

Since generations farmers have been using their fields for toilet purpose also for enriching soil. The human excreta or dung is decomposed over a period and believed to be useful in crop production. The validation of various practices is research and use of crop and animal waste in agriculture is practice for ancient time. The use of human excreta by Sulabh International is subject for discussion.

Umesh Babu, Institute for Social and Economic Change, Bangalore

This is a good methodology to use human excreta as manure to agricultural activities to reduce the chemical fertilizer. Once I made field visit to Shimoga in Karnataka, there is one innovative farmer, Dr. Prafulla Chandra has adopted this method to his agriculture activities, he is not wasting any liquid and solid waste generated by people and livestock. He adopted a biogas plant, sludge is used as manure and he pumps the liquid waste into plants by sprinkler method, in that he is a good organic farmer.

If you want more details please contact. Dr. Prafulla Chandra, Innovative farmer, Krishi Sampada, Lakshmipura, Hosahalli post, Shimoga District, Karnataka State, Ph: 91-8182-272730.

Murali Kochukrishnan, Action for Food Production (AFPRO), Bhubaneswar

The concept of utilizing Urine and Human excreta for agriculture production purposes should be taken up with utmost care and diligence. The human excreta should be completely converted/sanitized into good compost before application. Otherwise, the deleterious effect will sprout. The spread of diseases due to poor sanitation is more problematic than food security.

If at all, we need to use the composted human excreta and urine to soil, different types of soil may react differently as per the soil chemistry. Hence, a standardized quantity of application need to be derived based on the chemistry of soil profile. Further, the varitional diet will certainly have an effect on the mineralogical make up of the feaces compost. Person with vegetarian diet may have lower in heavy metal content than the person with non-vegetarian diet. The heavy metals may be of nickel, lead, cadmium and so on. Hence, the vegetables generated out of the usage of human excreta compost and urine needs to be tested for heavy metal content also. A line of thought in the above mentioned aspects will be appreciated.

Sudhirendar Sharma, The Ecological Foundation, New Delhi

I would consider the last item as the lead question 'response of farmers and consumers', as it is more critical than the apparent gains of segregating excreta to get the organic gain. Testing the veracity of the Swedish experiment from the notion of replication and up scaling may not answer the core issue relevant to our socio-cultural conditions. Though relevant, I'm a bit cynical about such long-term experiments. The longest ever Rothamsted Experiment, already well past 200 years, on the impact of fertilizer applications may have yielded interesting results but nothing by way of altering the manner in which the world has gone about using chemicals at the farm.

On a tangent it occurs to me that we ought to get the context right if we were to address the cultural taboo. Isn't it amazing that something the nature had segregated at source (urine and faeces) has been conveniently aggregated by us as 'waste'. Shouldn't it be mandatory for us to view it differently and assign different social 'values' to them? Morarji Desai and the likes did contribute their bit to lift urine to the level of an effective therapy but its nutritional value hasn't even caught the attention of the ministry of fertilizers and chemicals, leave aside environment ministry. Time we bring the invaluable nutrient contribution by the inevitable daily secretions of a billion-plus on the national agenda.

Vijay Sardana, Centre for International Trade in Agriculture and Agro-Based Industries (CITA), New Delhi (response 1)

Under Good Agriculture Practices use of human excreta is banned. Any evidence supporting the use or presence of human excreta will nullify the EUREPGAP certification; means product is not fit and safe for human consumption. Reason is the pathogens, present in human excreta can survive in soil for more than two years according to EUREPGAP experts.

So first of all we have to get the scientific opinion with evidence on the subject before we move ahead.

Ramney Koul, Independent Consultant, New Delhi

A fresh look at the age old problem is required probably the Need for Public-Private Partnerships.

After reading all the responses to the proposed fresh look at agricultural practices with managed waste (human and animal), I come up with very basic solution: We must refine what we know that works. I am sure some of it may have been tried or is being looked at in India: waste incineration.

I encourage us to be aware of systemic problems inherent in the current processing techniques that carry the associated risk costing human health. The population groups that can be affected adversely most are the children, old and the sick, especially the immuno compromised.

B L Kaul's statement on parasitic infection remains a concern as we all know it. The waste management process using composting and incineration will be the answer to address the big public health issue: prevention over cure.

As lot of institutions are involved with research projects, I urge us to define the problem well and take a piece to study incineration at the pilot level. Emission levels in air can again be a problem in urban area but in rural area, the dispersion levels can mitigate that issue and the benefits can be quantifiable. In a country where our most vulnerable are already affected by environmental compromises, it is imperative that we as a society move forward with risk benefit analysis and long range effects rather than swing the age old practices only to gain a publication in print.

Modern practices and science will ultimately allow us to reuse, recycle and remediate and we have to be broad minded to include compliance and standards before signing off on the practices.

Education/outreach should accompany the release of such practices through media outlets, community relations, and health agencies must not be overlooked. Ultimately, better informed population remains the target population where all the good has to get validated and produce benefits for the larger good of population as a whole. Currently organic practices in India show a class conscious response when it comes to accepting urban vs. rural practices. This is mostly due to lack of public health education and awareness, and emphasis in communities to manage solid waste, waste water practices. Sanitation not only is a problem of managing generated waste but also of water scarcity and not addressing the waste reduction.

If there is a need for proposal/ grant writers to have industries invest in such an operation, we must look at it since such projects need a private/public partnership and public support to gain momentum and actually produce sustainable benefits.

I thank all those who have voiced on this very important issue and addressed the underlying factors regarding Nivedita's very important observation.

Bashu Babu Aryal, International Fund for Agricultural Development (IFAD), Nepal

Practice of dry toilets (<http://www.drytoilet.org/dttechnology.html>) in Europe, especially in the Nordic countries, is getting popularities these days. As far I know there have two International Conferences in Dry Toilet (<http://www.drytoilet.org/dt06.html>) in Finland. University of Tampere is the main organizer of the both events.

In Europe, manufacturers have designed such a pan for dry toilet that excreta and urine are separated during defecation. The urine is channeled through a pipe to a separate vessel and excreta in a separate container. When the first container is filled they replace it with a new one and leave for decomposition.

Finnish farmers are using both excreta and urine for manure purpose. Government has exempted some taxes to the families who are using dry toilets. More information could be collected from University of Tampere.

C. P. A. Iyer, Independent Consultant, Bangalore

There is already a strong bias against importing of fruits and vegetables from many developing countries by some consumers in the US, since they feel that diseases transmitted by human faeces can be transmitted through such agricultural products. They feel that human excreta is used as fertilizers in these countries or people defecate in agricultural fields in these countries. Hence one should be very careful before advocating such practices.

R. Srikanth, WaterAid, New Delhi

Although both urine and excreta provide nitrogenous fertilizer and can be profitably used and has been in practice in China for decades. However, it requires caution on its use. When it comes to urine one need to dilute it to desired level before experimenting in the field crops because urea and uric acid in the

urine have deleterious effects on the roots when applied directly. Human excreta contains various pathogenic bacteria and helmentic cyst and therefore not safe unless sanitized.

Helmentic cyst and protozoan like giardia cyst are more likely to survive even after taking necessary precaution and it is recommended not to grow vegetables that are taken as raw salad like carrots and lettuce using human excreta as manure. However, one does not excrete toxic metals in significant level even in geographically contaminated areas and does not warrant its testing and soil invariably contains more metals both beneficial and toxic than any excreta. Sewage sludge is being used in Peri-Urban areas of all major cities in India for cultivating forage and vegetables without following any norms including FAO guidelines and till date its impact on consumers is not studied.

S. Vishwanath, Rainwater Club and Arghyam Trust, Bangalore (*response 2*)

Please emphasise the need to use composted and treated human waste after testing and developing a protocol for correct use. To argue that this is nothing new is wrong because what is now being attempted is to link urban and rural sanitation to its productive and safe use and capture its nutrient value. Defecating on the field and arguing that is proper use of human waste is questionable as is the application of untreated waste water from cities. The health argument must be considered and factored in. Many field trials have shown that this is possible.

The other crucial thing which appears is the phosphate link. World resources of phosphates are running out and critical would be to note phosphate flows and see the recovery potential from composted human waste and treated urine.

Interestingly it would appear that simple steps such as application before seeding, applying to crops that are not tubers or ground based vegetables but to crops like wheat, maize and rice or fruit bearing trees where there is no chance of direct contact with the fertilizers eliminates most risks feared by phyto-sanitary regulations.

Nivedita's questions will help in consolidating experiments and field trials all across India and it would be a pleasure to see if this coordination will help in carrying out the eco-san movement further in a structured fashion. I would be more than happy to see if this could all come into one website to take it forward and offer my services for the cause. Coordinating or understanding India based efforts are a tough task and it is good that we draw on the answers for consolidation but also updation at regular intervals to learn lessons from all experiments.

Ramesh Sakthivel, WES-Net India, New Delhi

Members may find the following documents useful in relation to use of human excreta, urine and waste water reuse in agriculture:

Well Briefing Note 27 - Should ecological sanitation carry a health warning?
<http://www.lboro.ac.uk/well/resources/Publications/Briefing%20Notes/BN27%20Ecological%20sanitation.htm>

Assessing the health risks of ecological latrines

Contaminated Irrigation Water And Food Safety For The Urban And Peri-Urban Poor,
Published by Toxics Link

<http://toxicslink.org/pub-view.php?pubnum=176>

Case study on “Eco-Sanitation in Schools - New opportunities for farmers” (Source: Kumar Alok, UNICEF)

http://www.wesnetindia.org/fileadmin/attachments/Resources_on_Ecosan/case%20study%20on%20school%20eco-san.doc (Size: 2 MB)

In the context of using human excreta for agriculture, ecosan is an important and upcoming area that needs greater focus. We wish to share with members that WES-Net India has recently developed a new section on its website to offer assistance to stakeholders involved in promoting ecosan. Members would find information related to Ecosan and other related sustainable sanitation concepts, and could also share further information to make this initiative effective.

Please visit <http://www.wesnetindia.org/index.php?id=120> for further details.

Ravi Singh, Margshree Farms, Agra

I have used the sludge from our septic tank on our farm, no spectacular yields yet.

Historically in Agra Municipal sewerage was purchased by farmers and used in their fields. In our village outside Agra they purchased it & used it for the summer squash Crop- *Tinda*. It was very effective. I am told there was even a black market premium for the sludge.

Farmers stopped buying it after, glass, stones & other material started to appear in it.

One of the Sewage Treatment Plants (STPs) in Agra now sells it in blocks, not too many takers. However I do know a farmer who transported it in truck loads to his farm and was able to spectacularly improve the soil condition & fertility on the marginal farming land he had purchased.

Maybe sewerage plus the organic part of Municipal Solid Waste may make interesting start to solving the major issue facing most Municipalities & the farmers thirst for organic fertilizers.

Sandeep Parkhi, Saksham Foundation, Pune

After reading the multiple contributions, I wish to highlight the key issues and comment:-

- There appears to be a debate on health safety and hygiene associated with the use of this kind of manure
- The likelihood of presence of pathogens and other harmful organisms in fruits/vegetables produced in such farms cannot be ignored
- Very few / none scientifically proved techniques have evolved so far
- To be practical enough, there is going to be an obvious resistance to consume such farm products by human beings

Considering these aspects, I believe that the best use of such a manure can be made for landscaping and greening our parks/gardens in our cities. The development authorities can take an active role for such a promotion, since most of the STPs-sewage treatment plants are operated by them.

J. David Foster, Administrative Staff College of India, Hyderabad

Glad that you are sharing your experience with a broader audience. My guess is that you may show the most significant improvement when first applying sludge to the poorest lands (rather than average lands) and even there the biggest improvement may be in soil condition rather than specific organic and inorganic nutrients.

There is some interesting information involving the restoration of badly degraded lands in Tamilnadu that may be relevant.

Madhab Nayak, Fountain of Development Research and Action, New Delhi

We are engaged in promoting use of recycled urine and human faeces in agriculture. The pilot research is on near Delhi only. The productivity and over all fertiliser input output result has very encouraging. After remarks by [Mr. Vijay Sardana](#) on use of urine and faeces, we want to undertake tests in relation to the food chain pathogen contamination if any. If we can get some in this regard would be useful.

K. P. Reddy, Byrraju Foundation, Hyderabad

Use of municipal sewerage water for growing vegetables is an old practice in many towns in Andhra Pradesh and perhaps in many other towns in the country (e.g., Mumbai). The main concern of this practice is the health hazards – is the water safe enough. The same concern applies to use of human urine and solid excreta especially if they are not properly decomposed.

There is no doubt that human urine is rich in ammonia. It can be a good nitrogen source. The issues to be addressed are:

- Cost of its collection, storage and transport cost – what volume makes it a commercially viable proposition? (Sweden may be collecting urine more for hygienic purposes than for using it as fertilizer)
 - Health risks – how safe is such urine collected from a large number of people. How is it to be treated to make safe for use
 - Cultural issues related to use of urine for crop cultivation (I guess there will be much less inhibition to use of urine than for using human excreta for growing crops)
 - Viability in villages: I don't think collecting urine from people is a viable activity in villages – at least in the near future.
 - However, there is huge scope for collecting municipal wastewater, treating it and using it for growing crops in many towns in the country.
-

Jyotsna Bapat, The Energy and Resources Institute (TERI), New Delhi

My last trip to the high altitude Leh made me appreciate the efforts that the community there puts in using this valuable resources mainly human waste both liquid and solid. Their traditional toilet design has two levels and separate outlets for the waste. While the liquid is mixed with water and let out to the field the solid is covered with sand after every use. The solid waste after its removal twice a year in a family size of four people is left for a while in a ditch after it is removed for next six month. Then it is available as manure for field.

It is never used directly as it carried helminthic diseases and needs some processing. So I disagree that using of open fields for defecation is a good idea. The second thing is, this process need a lot of open spaces and is good option for low density population settlements.

So when recommending such an option extreme caution needs to be taken that its use does not create additional problems.

Arunabha Majumder, All India Institute of Hygiene and Public Health (AIHPH), Kolkata

The normal pan and trap used in toilets (Indian, European, Anglo-Indian type) can not separate urine and night-soil. So to separate, design of toilets must be different. Vietnam model compost toilets separate urines. The conversion of night soil to compost is quicker if urine is separated. The leach pits (Two pits pour flush toilets) generate compost with higher NPK.

The sludge quantum varies between 0.03 and 0.04 cubic metre/capita/year. Sludge generated from Sewage Treatment Plants (Conventional type) requires digestion. It can be done anaerobically. It generates biogas, which can be used for cooking or producing electricity. The digested sludge is dried in SDB. The dried sludge can be used as manure. In villages composite solid waste (night soil, agricultural waste, water hyacinth, animal dung etc) can be biologically processed to produce biogas and digested sludge.

Vijay Sardana, Centre for International Trade in Agriculture and Agro-Based Industries (CITA), New Delhi (response 2)

If majority is agreeing that we should use the human excreta for production of food crops, in that case, it would be good to share some scientific data like research papers or studies that proves that the output of such farms are free from pathogens and crop can be used for non-cooking application like salad.

S. C. Prasad, Independent Consultant, Ranchi

It is nice to explore many alternatives to enrich soil vis a vis crop. No wonder we have enormous source of organic material from plants, animals & humans. Compared to any source animal organics are close to plants. Let us exploit these resources than human, which are not accepted by us. I am sure if planned well to combine crops & cattle organic, we are sufficient in organic resources to boost our crops/vegetables. Let us plan to use them properly & efficiently.

Ramney Koul, Independent Consultant, New Delhi (response 2)

I think it is time to consolidate what has shown results, set standards, collect data, pool resources towards implementation. It will not be accepted without public education and public relations campaign. We have to show need of our time, cost savings and natural resource scarcity, carcinogenic effect of use of chemicals and the consequences long term.

India is a large population of well meaning, class conscious, cost conscious, and largely led by belief system under different religious practices. However, we are at the same time an equally ill-informed, uninformed at various socio-economic levels and bound by diverse religious practices and the wisdom that we each draw home from our belief system.

Waste processing and waste reutilization however, safe will have to be understood by consumers before we see any results in the market place. Consumer decisions are driven by their pocket books and the cost of risk acceptance. We have to reach to that level. We will always get the results by the rational choices made by the consumer. While we see all this good work being churned out at the scientific level, here are simple ways that we could expedite the process:

- Single point of contact for all this good scientific information on how the process of waste restructuring is harmless, increased yields and type of crops that the results were obtained from.
- Simultaneously, working with regulatory standards and generating risk data, labels for product information.
- Set up channels of public health education (extension work through universities and schools).
- Involve public (consumer) and the chamber of commerce through environmental and health agencies, industry personnel who in turn can build an armed PR message either directly, in partnership or through NGOs.
- While all this is going on need for more data and accounting of behavioral score on risk acceptance will help this great cause furthering its objective.

I would like to hear a better suggestion, if any. Certainly we need to keep this subject in focus and move forward now.

Mahtab S. Bamji, Dangoria Charitable Trust, Hyderabad

The two pit model of pour flush latrine suggested by UNICEF allows excreta mixed with urine to enter one pit till it gets filled. This pit is then blocked and waste diverted to the second pit. After some time the contents of the first pit turn in to manure and can be used for farming. We have promoted the two pit latrines but am not sure if any farmer has used the night soil manure. When explained they did not voice any objection because in any case they do go out in the field to defecate.

B. L. Kaul, Society for Popularization of Science, Jammu (response 2)

I have gone through all the responses to the query in question and believe that most members feel that this resource needs to be put in good use. My only reservation is regarding the spread of parasitic diseases. A way can be found out to eliminate this risk.

It has also occurred to me that human excreta is spread all over the country between the railway tracks. It is virtually wasted and is in fact causing foul smell on railway stations besides breeding rats, cockroaches and disease causing parasites. Railways should find a means of collecting the excreta and urine, composting it and then selling it as manure to farmers. The suggestion may appear difficult to implement but I hope this finds favour with members.

Uday Bhawalkar, Bhawalkar Vermitech Private Limited, Pune

We have found that sewage is an organic resource that gets spoiled by inorganics, hence sewage pollution is actually due to inorganics, not by organics.

Cow dung and urine from a desi cow, for example, has no solution problems, in fact, it offers a way to solve several pollution challenges.

Biosanitizer (<http://www.biosanitizer.com/>) is a bio-catalyst based on traditional practices, refined by modern knowledge of ecology and ecological engineering. It primarily works on inorganic pollution, hence

also on organic pollution and converts both a resource for agriculture, as natural fertilizer and also as a pest-control remedy. Here, the focus is not on separation or destruction of pollution, but converting it into resources, using time-tested laws of nature. Since the inorganic pollution stems from the raw water, it is advised to put the biosanitizer (it is a bio-factory with a long life) in the overhead water tank. This helps produce self-healing sewage and one gets corrected sewage just out of a septic tank, it becomes a plant tonic as well as natural pest repellent.

Constanze Windberg, United Nations Children's Fund (UNICEF), Colombo, Sri Lanka

I am following this query with great interest. UNICEF is trying to initiate a regional sustainable sanitation/ecosan network. The ongoing discussions is encouraging. It shows that there is a need for enhancing the exchange of information and good practices across national boundaries.

The use of human excreta in agriculture: As already mentioned in several replies I have to stress again, every well implemented ecosan system assures the safety of any end product (e.g. urine, compost, dried faeces, biogas, greywater). Using human excreta in agriculture is not about farmers defecating in the field. The human excreta used in agriculture and the applying procedures have to meet respective guidelines (e.g. Guidelines for the safe use of wastewater, excreta and greywater, Vol. 4: Excreta and greywater use in agriculture

http://www.who.int/water_sanitation_health/wastewater/gsuweg4/en/index.html); Ecosanres guidelines on the use of urine and faeces on crop production

http://www.ecosanres.org/pdf_files/Fact_sheets/ESR6lowres.pdf) to ensure hygienic safety. The WHO guidelines are based on a risk assessment approach.

Useful information on the subject discussion is available on the sites of GTZ (<http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/8524.htm>), and Ecosanres (<http://www.ecosanres.org/>). Also visit: www.ecosan.org, www.waste.nl. Interesting for the Indian context are the following websites: www.ecosanservices.org, www.eco-solutions.org, www.ecosanindia.org

My comment on organic standards: This depends on the standards you are using and which are permanently under discussion. According to my knowledge, if the products are meant for the European market they don't meet the respective guidelines yet. Since human urine is not included in the Annex of approved fertilizers. This might change. The guidelines relevant for other markets could be different.

Sewage sludge in agriculture: Also for this issue there is literature available in particular Land and Water division - AGLW_ (<http://www.fao.org/landandwater/default.stm>) of FAO and International Water Management Institute (http://www.iwmi.cgiar.org/africa/West/projects/Nutrient_cycle_-_Re-use_options.htm)

Response of Farmers/Consumers: I did several interviews mainly in Sri Lanka and Uganda. The response is different for each individual. But similar is the question: Would you eat vegetable fertilized with human excreta, is very likely to get a negative response. Whereas the individual choice from a range of vegetables presented and labeled with the method of fertilization (including also the type of chemicals) is not as predictable. And when celebrating the harvest of a demonstration garden, people normally join the feast. In general, with no labels attached, the consumer tends to pick the more appealing healthy looking vegetable or the one which supposedly contains minimum chemicals.

G. Misra, Directorate of Economics and Statistics, Port Blair (response 1)

For this query, I think it would be good to draw learnings from the experiences of Sulabh Shauchalaya (<http://www.sulabhinternational.org/index.html>). Twenty years back when Sulabh was just a starter we used to read and think lot of things about using the urine and excreta for several purposes, debates were on in public media but I don't know of any kind of concrete experiments carried out in producing urinase from urine or producing manure from Sulabh Shauchalaya. But however if toilets are made available at every bus terminus of big cities this can be then comes the airports and railways stations and wagons.

Traditionally farmers in interior rural belts have been using the excreta as manure in fields. Because since ages they had been going out to fields for this purpose. Problem of having the toilets in the households was highlighted only because of urban slums and the areas captured by the urbanisation. I mean the areas which were in periphery of cities, after the industrialisation have been captured by the urban and became part of the cities outskirts then only the problem of sanitation came to fore. Other wise in interior rural areas usually the practice of going out in field has been in existence. And the garbage collected near the fields is used as manure in fields. The garbage dumped at a place, which is called as "Ghoora" in my village, consist of daily garbage of household and also the foliage, dung etc all put together for months. During the month of June and July, this is spread in the fields just before the monsoons. The practice has been changed on the introduction of the hybrid varieties of plants and the farmers were taught that to get high yields you have to use fertilizers.

Similarly, the biogas was also tried to be made popular in rural areas. But strangely the success rate of gobar gas was not much up to the expectation. This was meant for large holding farmers and/or it was supposed to be a community affair where many families can join together. That too remains a dream. However, corporate under the PPP- public private partnership can be roped in by the ministry and or by the states which have independency in many affairs can initiate this on priority, and health aspects can be taken care by the departments concerned and educating on vector borne diseases.

Sanna Leena Rautanen, World Bank, Washington, USA

It is always interesting to hear about this kind of discussions, and therefore, I would like to thank Bashu for forwarding your mail to me.

As a member of the Global Dry Toilet Association, I would of course recommend you to have a look at <http://www.drytoilet.org/>. We made a summary article based on the most recent International Dry Toilet Conference (2006), you can find it from the <http://www.luwrr.com/uploads/paper06-04.pdf> (it is on line journal called Land and Water Resources Research Journal, the article is in Volume 6 - 2006. One has to register but it is free)

I personally think there are couple of key points to think about:

- Operation & Maintenance needs: It is important to understand willingness of people to to maintain the system. It they are not then possibility of a local contractor who could be given the maintenance job. Another important component is sustainability, Willingness of people to be ready to pay for this kind of service.
- Costs of such systems need to be evaluated and it would be good if members can share, if there is any real life data on such comparatives (Ecosan; Sulbah latrine)
- Ensuring Safety / risk management of the end product

Here are some useful references for further information:

Revised and Enlarged Edition of Ecological Sanitation

Winblad etal; Stockholm Environment Institute; 2004

http://www.ecosanres.org/pdf_files/Ecological_Sanitation_2004.pdf (PDF 1,271Kb)

This book is about seeking new solutions in the form of ecological sanitation. The book discusses what is currently known about ecological sanitation systems, their strengths and weaknesses. It gives advice on how to make such systems work with regard to the selection, design and management of devices as well as about the promotion and support aspects so necessary to their success. Ecological Sanitation is intended for all who share the will to explore new ways of tackling urban sanitation systems.

The EcoSanRes Programme, financed by Sida and managed by the Stockholm Environment Institute (SEI). Second Phase of EcoSanRes (2006-2010) financed by Sida will emphasize pro-poor sustainable sanitation through development of regional nodes, capacity building and knowledge management. Various publications and presentations, see especially the EcoSan Fact Sheets series. (Website) <http://www.ecosanres.org>

The Ecosan Project by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, acting on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), aims to investigate ecosan-systems, establish them in national and international guidelines and prepare them for dissemination. A range of publications, presentations and related links. <http://www2.gtz.de/ecosan/english/publications.htm>

A Guide to the Development of on-site Sanitation

WHO; 1992. Part II - Detailed design, construction, operation and maintenance

http://www.who.int/docstore/water_sanitation_health/onsitesan/ch04.htm

Technical factors affecting excrete disposal; Operation and maintenance of on-site sanitation; Components and construction of latrines; Design examples. A number of on-plot technologies, including leach-pit design

V. D. Sharma, Department of Business Economics, Veer Bahadur Singh Purvanchal University, Jaunpur

It is really an immense opportunity to share the discussions particularly on such a topic use of human excreta for agriculture. There has been Indian experiences for innumerable years in this area.

- If we use the human excreta in agriculture, we not only benefit the agriculture but we may get a greater resource of non-conventional source of energy.
 - Human excreta of a person generate the bio gas equally to 4-5 animal dung.
 - This practice may save from the pollution and opportunity for the fertility of agriculture fields
-

Jyoti Parikh, Integrated Research and Action for Development (IRADe), New Delhi

This has been a very useful discussion. Other forms of waste like crop residues and animal dung- could provide 90% of rural energy, but there has been no investment, management and technology innovation in this area. It's the women who are left to fend themselves on a daily basis for their energy needs. Cooking fuel is an essential item for food and nutrition security.

We have succeeded in persuading the Planning Commission to include the goal of having energy within one Km. This can be done either by setting up plantations, kerosene depot where people can afford and need to organise agricultural wastes. There is scope for looking into all these.

K. V. Peter, Kerala Agricultural University, Thrissur

A lot of ethical, cultural, religious and social issues are involved in use of faecal matter for vegetable production. Already there are issues of pesticide residues and heavy metals in vegetables grown using sewage water. Chinese case may be examined in this context. Biogas production for home energy may be tried.

Subodh Kumar, Udyog Bharati, Ghaziabad

This topic was studied at great length nearly 50 years ago, when the American troops were stationed in Japan. Manure based on human excreta is called humanure. It is considered desirable to use humanure for food grain crops like, wheat, corn, paddy, sugar cane etc. In case of vegetables and salad greens, the human excreta parasites have a chance of getting back on to your dining plate. For countries like Japan, China etc. which have long tradition of using humanure, the population has developed immunity to these parasites. But the American suffered stomach ailments, which were attributed to the Americans not having immunity to humanure in salads and vegetable growing.

P. K. Thampan, Peekay Tree Crops Development Foundation, Kochi

Encouraging the use of human excreta for crop production was one of the rural development activities assigned to the Agricultural Extension Workers during the period of Community Project in the early 1950's. I was actively involved in the related promotional activities in a few villages in Kerala.

The technology for composting of human urine was introduced to many rural farm-households during that period. The participating households were encouraged to open pits of one-meter cube and to fill it with dry leaves and soil in alternate layers. Before filling, a hollow bamboo piece with perforated holes on the sides was introduced in the pit with its lower end just above the bottom of the pit and the top end 5-6 cm above the ground level. An average family could use a pit like this for about three months. After three months, the pit could be covered and another pit prepared for use. From two pits of this type nearly two tones of valuable urine compost could be prepared in one year. Many households in their kitchen gardens used the manure so prepared. Ofcourse, with the introduction of chemical fertilizers the practice slowly waned.

Simple method for converting night soil into compost was also introduced to many households. Each household was encouraged to open trench of 0.5 m broad, 1.0 m depth and of convenient length and to divide it in to 5-6 segments. The trench has to be provided with wooden planks for sitting and after use the excreta has to be covered up with dry leaves and soil. After the first section is filled up it is covered with soil and left for decomposition. Like this each section could be used and when the trench finally gets filled up another one could be excavated for use. In a period of six months the entire mass in the first trench would have decomposed in to very fine manure devoid of any bad smell. This system of converting night soil in to manure was adopted by some farm-households at that time.

Bhawna Vajpai, Spatial Decisions, New Delhi

The query is quite pertinent to the country like India, where land availability is a limited resource and soil fertility a limiting factor. There is an urgent need to increase the resource base through increased productivity.

Recently we did a social impact assessment survey in a sanitation and sewerage project in state Haryana. We had an opportunity to interact with a number of slum dwellers, villages near urban extent and government functionaries about re-use of excreta. The study revealed that, perception and built systems (in 85% cases) are primarily developed and inclined towards unproductive disposal of sewage and wastewater, rather its productive use, though it is not feasible and practical practice. Addition to this most of the people & functionaries are not aware and has access to the information, that these kind of ecologically viable efforts are underway in the India and in alike developing countries.

Even if we consider the human population of 1 billion in our country, 13 million tone dry excreta may be tapped for productive use. Albeit the fact of usage of excreta for various productive use in parts of India, it is quite interesting to note that much of the rural and urban population is not aware about it. In this project, we are trying to make space for reuse of sludge/waste water as well as promoting the ecological sanitation in the villages near urban extent.

Therefore, it's quite imperative to put efforts in continuous awareness generation and getting best practices examples disseminated at large through different possible means. I would like to emphasis again, like in any other subject, this issue needs larger awareness generation and effective dissemination mechanism to take away the prejudices and social taboos, considering the sentiments of the people.

Experiences of organization and institutions, undertaking the good work in this direction would be useful.

Ranjan Mohapatra, Vision Foundation for Development Management, New Delhi

We had an opportunity to study the Solid Waste Management System for UN - Asia Pacific Center for Technology Transfer, New Delhi (UN-APCTT) for Cattle Dung based project in Ambala Cantt (Haryana).

The points of learning are as under.

- Demand for Bio-Manure has to be created nationally, can not be limited to individual farmers here and there or pockets in rural-urban centers. Demand for Bio-Manure from Human Waste, Cattle Waste, Kitchen Waste is there by not spread evenly, all over the country. There is a need for integration of markets - demand for Bio- Manure, which will drive the value chain. In Delhi, the New Friends colony area is supplied by human waste based Bio-Gas through pipes, commonly called Okhla Gas since long. But, the consumers generally don't know that is out of human waste. The stigma still remains.
- Demand for Biogas also need be created at a national level to support the process of processing human waste, cattle waste in to manure and gas.
- The massive Bio-Gas project (subsidy based) launched by Government of India during seventies, failed because of just following the Chinese model and forgetting the need to align it in to life style of Indians, creating demand for Bio-Gas and Manure, neglecting Bio-Manure (85 % of output value) and focusing on Gas (only 15 % of output value).

The challenges are primarily to, create awareness among the Users of Bio-Manure and Gas i.e. Farmers in Rural and urban areas (all over the country).

G. Misra, Directorate of Economics and Statistics, Port Blair (response 2)

The problem of contamination of crops is another issue, which is directly related to this discussion. In our Indian Tradition, during the months of rainy seasons, which is called as "Chaumasa" means four months, one should not eat the green leafy vegetables, dairy products etc. This was idea to save life by observing these very simple things to avoid any infections. Now a day everything has changed. We use the

vegetables fruits contaminated with pesticides, insecticides and other lots of chemical residues. Thus by proper usage of human manure in fields, and by generating awareness among the users we can reduce the risk of infections/infestations. There are also examples of vector borne diseases, which are being tackled. Similarly if this humanure is used, methodology for reducing the infection will also have to be developed.

Regarding the usage of sewage in agriculture, I will have to say that in many parts I have found that small plot holders are using this unknowingly. The canals, which were initially the rainfed now after the urbanisation, are functioning as the sewage canals outlets for colonies developed on the agricultural lands. I saw this in Kanpur. Areas developed on the road from Kalyanpur to Panki, the areas in Bithoor mandhana. Also the pumps churning out groundwater is contaminated, this water is being used in irrigation. No scientific study has been carried out for the impact.

Sajan Venniyoor, UNESCO, New Delhi

On the vexed issue of the use of human excreta for agricultural purposes, I would like to draw your attention to what the India Travel Forum (<http://www.indiamike.com/india/goa-f23/the-sad-but-increasing-demise-of-the-goan-pig-toilets-t1127/>) calls "the sad, but increasing demise, of the Goan pig toilets." The Goan pig toilet has a long and ecologically sound tradition. Otherwise a conventional outhouse, the pig toilet has a little opening at the back that allows pigs to consume human excreta from the source, as it were. In many ways, this was an admirable and hygienic solution to the problem of human waste disposal, and considerably superior to the abhorrent practice of manual scavenging that is still prevalent in India.

My Goan friends tell me that there are still many pig toilets left in Goa, but they are an endangered species. As IndiaMike (<http://www.indiamike.com/>) observes, the current "rage for semi-flushing toilets and septic tanks with their mosquito-friendly vent pipes" has led to an explosion of mosquitoes in Goa.

Interestingly, it is reported that from 1886 through to around 1930, the toilets used by most Okinawan farming households in Japan were designed to feed human faeces to pigs. A study (<http://www.jica.go.jp/english/resources/publications/study/topical/okinawa/pdf/okinawa.pdf>) of public health and medical care in Okinawa notes that after the Second World War, the American administration "banned the use of "pig toilets" on the grounds that these were unhygienic and provided a breeding ground for parasites", and these were replaced by toilets of the pump-out variety. The waste was then spread on the fields as fertilizer, but this caused an even higher rate of parasite infection among local residents. As the study says, "the pump-out toilets were breeding grounds for maggots and were also cockroach and rat nests", so obviously the ban on pig toilets had more to do with American prissiness than with any concern for public health.

As K Stalin's documentary on human scavenging ('Lesser Humans', 1977) shows, there are greater evils that body forth from our squeamishness about human waste than ever came out of a pig toilet.

Santhanam R, Indian Society of Agribusiness Professionals, New Delhi

A new technology of interest is that of the "Keshav Krishi" technique, developed after extensive experimentations in Karnataka, Tamilnadu and in Maharashtra and finally at Arunachal Pradesh in a tea estate and a Kiwi Orchard by a person named Valmiki Sreenivasa Ayuyangarya. The owner of the tea estate, Mr Binod Saharia, posted e mail messages in ISAP Digest. Abali Tea Estate was able to become free of pest infestations and the tea bush became free of various common diseases and are able to produce plentiful vigorous growth of good quality. The tea, an Assam variety has tested for zero residuals, enabling certification as an organic produce and enjoys good demand.

Keshav Krishi to put it briefly, uses cow dung and urine to ferment available bio mass wastes and uses the fermented broth as soil drench or foliar spray in dilutions. He also uses meat of fish or fowl (low cost) in such fermentations using cow dung and urine. Sree Valmiki has published extensive articles on his experiments including at Arunachal Pradesh.

This technology is therefore also suitable for use by Indian farmers as a 'Do It Yourself at one's own farm technique' using available wastes. It uses lot of labour and hence should help create employment. Organic farming is labour intensive anyway. Also since it avoids use of external inputs or not requiring purchase of costly inputs, it can be practiced by small and marginal farmers also as a low cost, low resource and energy intensive agricultural technique, enabling organic farming to become viable and offer both qualitatively and quantitatively good yields free of pests. Dung and urine of dry cattle are also suitable, enabling an economic use for a waste. Adaptations through experimentation for other crops are essential. According to Valmiki, human excreta is even better but requires experimentation and the social barrier is to be overcome.

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Sri Valmiki Sreenivasa Ayyangarya: vajadeva@rediffmail.com; Mobile: 919435032997

Shri Valmiki has decided to offer training to suitable aspirants wanting to learn this technique and also to be absorbed in their employment.

P. K. Jha, Sulabh International Academy of Environmental Sanitation, Enclave, New Delhi

Pig toilet is a black history now. In the state of Goa, there has been rapid conversion of such toilets in two pit pour flush toilet during recent years. It is not ecological as it causes transmission of several diseases. With septic tank system, vent pipe is not a problem due to mosquitos, as in most of the cases such pipes are in open with sufficient light where mosquitoes can't breed. Problem with septic tank system lies during desludging and disposal of sludge. During desludging, bottom layer of tank contains degraded human wastes where as upper layer fresh as well as semi-digested human wastes having full spectrum of pathogens. For its safe reuse for agricultural purposes, composting is required, that is seldome done. Normally it is disposed off in open space or in main hole, if available. Moreover, for desludging, mechanical device is required, when unavailable manual labour is used, that is unhealthy and unsocial.

In case of two pit pour flush toilets there is no such problems. It does not require vent pipe. Cleaning of undigested/undegaded sludge is not required. Due to alternate use of pits, human wastes degrades completely converting it into odourless and pathogen free semi-solid manure, that is taken out easily by the beneficieries and used for agricultural purposes. Use of human wastes for biogas generation and utilisation is perhaps the best option to deal with it.

Recycling and reuse of human excreta for biogas generation is an important way to get rid of health hazards from human excreta, besides promoting use of biogas for cooking, lighting and electricity generation. Biogas from public toilets has multiple benefits - improve sanitation, community health & hygiene, environment, making available quality liquid manure, in addition to using biogas for different purposes. Sulabh developed an efficient design of biogas plant linked with public toilets. Under the system only human excreta with flush water is allowed to flow into biogas plant for anaerobic digestion. One cft of biogas is produced from the human excreta of one person per day. Human excreta based biogas contains 65-66% methane, 32-34% carbon oxide about 1% hydrogen sulphide and trace amounts of nitrogen and ammonia. Cooking is the most convenient use of biogas. Based on 'Sulabh Model' design, 174 number of biogas plants of 35 to 60 cum per day gas production capacity have been constructed by Sulabh in different states of the country so far.

SET (Sulabh Biogas plant Effluent Treatment) System for reuse of effluent Biogas Plant effluent contains good percentage of nitrogen, potash, phosphate and other micronutrients for plants, but its aesthetically bad odour, yellowish colour, high BOD and pathogen contents limit its reuse for agriculture and horticulture; and not safe for discharge in water body. Sulabh has developed a simple and convenient technology named as SET (Sulabh Effluent Treatment) to further treat such effluent.

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 Food and Nutrition Security Community in India at se-food@solutionexchange-un.net.in and/or Solution Exchange for the Water Community at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-food][se-watr] Query: Use of Human Excreta for Agriculture - Experiences. Additional Reply."

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