Environment

Water Community

Solution Exchange for the Water Community
Consolidated Reply

Scaling up Solid and Liquid Waste Management

Compiled by Nitya Jacob, Resource Person and Sunetra Lala, Research Associate

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From Yusuf Kabir, United Nations Children's Fund, Kolkata

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I am Yusuf Kabir, working with United Nations Children's Fund (UNICEF), Kolkata, in the Water and Environmental Sanitation Department. I am involved in demonstrating and scaling up of Solid and Liquid Waste Management (SLWM) under the Total Sanitation Campaign (TSC) in rural West Bengal, in partnership with panchayats, the West Bengal State Rural Development Department and several NGOs.

The Department of Drinking Water Supply, Ministry of Rural Development, Government of India, has modified the TSC guidelines and included a component for solid and liquid waste management. Up to 10% of the funds allocated for TSC in a particular district have now been set aside for SLWM.

In urban areas, there are a few examples of good practices of Community-Level Solid Waste Management (Patna and Bangalore). However, the urban per capita generation of solid waste is 500-600 gm/day of which 60-70% is compostable/biodegradable. As a result, while centralised composting and wastes management is possible, solid waste remains a problem in urban areas.

The situation is different in rural areas, where it has been observed that waste generation trend is 50-150gm/day/capita. However, this is on the higher side as most of it comprises green waste, which is consumed by domestic animals. Therefore, in rural areas the nature of wastes is quite different from urban areas.

We seek inputs from the community's members on the following three broad areas:

- Social Mobilisation
- Intervention Level
- Technology Options

These are elaborated as follows:

Social Mobilisation

- How can we make SLWM a demand-driven activity just like household-level toilet promotion under TSC in rural areas?

Intervention Level

- Is community-level solid waste management (house-to-house collection and community level composting) a sustainable and viable option for rural areas?
- What can be the possible roles and responsibilities of Gram Panchayats?

Technology Options
- What cost-effective SLWM technologies exist for use at the household level?
- What are the cost-effective technology options for conservation and cleaning of ponds in villages?

Your response will help us to develop a strategy and roadmap for scaling up SLWM activities in gram panchayats in West Bengal under TSC. These will be applied in panchayats with heterogeneous characteristics in terms of population density, urbanisation trend and socio-economic profile.

Responses were received, with thanks, from

1. **Abhishek Mendiratta, Consultant, New Delhi**
2. **R. K. Sood, National Institute of Epidemiology, Chennai**
3. **Harshad Gandhi, Excel Industries Ltd., Mumbai**
4. **Asit Nema, Foundation for Greentech Environmental Systems, New Delhi (Response 1; Response 2; Response 3)**
5. **R. K. Srinivasan, Centre for Science and Environment, New Delhi**
6. **Dharmesh Antani, Sahjeevan, Gujarat**
7. **Uday Bhawalkar, Bhawalkar Vermitech Pvt Ltd, Pune (Response 1; Response 2; Response 3)**
8. **Surekha Sule, Independent Journalist, Pune**
9. **Ranjini Gupta, Urban Development Department (T&CP), Government of West Bengal, Kolkata**
10. **Arunabha Majumder, Jadavpur University, Kolkata**
11. **D. Chandrasekharam, Indian Institute of Technology Bombay, Mumbai**
12. **Saji Das, BIOTECH, Kerala**
13. **Jayakumar C., Thanal, Thiruvananthapuram**
14. **Chicu Lokgariwar, People's Science Institute, Dehradun**
15. **P. K. Jha, Sulabh International Academy of Environmental Sanitation Mahavir Enclave, New Delhi**
16. **Ashok Ghosh, A N College, Patna**
17. **Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad**
18. **Puran Singh Yadav, Haryana Institute of Rural Development, Karnal**
19. **Atul Rawat, DMV Business and Market Research Pvt. Ltd., Hyderabad**
20. **Arun Jindal, Society for Sustainable Development, Karauli**
21. **Shantilal Nagpure, Dhapewada Village, Madhya Pradesh**
22. **Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi**

Further contributions are welcome!

Summary of Responses

Solid and liquid waste management (SLWM) is best done in a decentralized manner at the household, village or locality level using various technology options available. An information-education campaign for social mobilization can precede the implementation of any community SLWM activity to build awareness on the health aspects of sanitation, technology and methodology. Social mobilization can take precedence over technology in SLWM.

Social mobilization includes inter-personal communication, focus-group discussions, technology demonstrations and field visits. It has to recognise SLWM is more a social than technical issue. An important component is educating people to avoid using plastics; their increasing use for packaging is one of the biggest challenges in effective SLWM since plastics are not biodegradable and used extensively in towns and villages. Another is providing information about waste segregation, handling and disposal, vermiculture and biogas plants, recycling inorganic material. Most household waste comprises 50 per cent organic material, 35 per cent inorganic non-recyclables and 15 per cent inorganic recyclables.

Panchayats and urban local bodies (ULBs) are the best suited as vehicles for social mobilization since they comprise local leaders. NGOs can assist them by developing and providing appropriate material. Under the Total Sanitation Campaign (TSC), 10 per cent of funds are allocated for SLWM. There is a wealth of literature already available under TSC on this topic that Gram Panchayats can use for community mobilization. Panchayats in many states have implemented TSC so effectively as to process all solid and liquid waste from the village, in addition to eliminating open defecation. These are ideal sites for field visits by members of Panchayats and community leaders from other villages.

Different approaches to generate community awareness in villages and towns owing to different demographics, the quantity of waste generated and shortage of space for sanitary landfills. NGOs have demonstrated effective decentralized SLWM methods in towns. Broadly, they begin with building household awareness on waste segregation and building a network of stakeholders, including communities, entrepreneurs, policy makers, corporate houses and financial institutions.

In addition to creating awareness on the above issues, communities need to be educated on optimal waste disposal, especially vermiculture and biogas plants, that have emerged as the processes of choice. Communities implementing vermiculture need accurate information on setting up vermicompost pits. Similarly, they need adequate and accurate information on biogas plants, especially to overcome the reluctance to cook on gas generated from human and animal faeces.

ULBs also need information on decentralized SLWM. For example, under a programme called Advanced Local Management in Mumbai, **Maharashtra**, an NGO is training women rag pickers. They and community members segregate dry and wet waste; the former is segregated and the latter is composted. While it is successful, in Pune, a similar scheme, backed by penalties for non-segregation of garbage, failed because the implementer did not collect the penalties. In Bhuj, Gujarat, an NGO works with the city's rag pickers and the community, generating awareness on waste segregation and collection. In Delhi, the Department of Environment and an NGO have created awareness on individual environmental responsibility and promoted home composting.

SLWM **interventions** executed at the community level ensure a critical mass, funds and space for waste processing units. All technology to process solid waste focuses on converting organic garbage into manure. In villages, individual families or groups of families can set up vermicompost pits and biogas plants under TSC, and use the vermicompost in fields. The key is education on waste segregation and the method for setting up vermicompost pits and biogas plants. Too often these fail to deliver desired results owing to poor design, the wrong type of earthworms or toxins in the organic waste that is fed into the vermicompost pits.

In Kasargod, Kerala, the Kanhangad municipality has used windrow composting to dispose organic waste; several gram panchayats have followed suit. Others have used this in combination with biogas plants.

The projects have been viable and working for several years. The Pathanampuram Gram Panchayat, Kollam district, implemented the state's first waste-to-power in 2003-04, while the Kaddakal panchayat set up an integrated waste treatment plant.

In urban areas, where TSC is not applicable, there are many instances where NGOs and ULBs have together reduced the problem of solid and liquid waste disposal. In **Andhra Pradesh**, the Suryapet municipality as successfully implemented a town-level solid waste management project without any NGO or private participation. It is now a role model for handling municipal solid waste in the state and the Supreme Court in 2004 ordered all municipalities to study the Suryapet model.

There are many instances where waste processing plants have failed to deliver, especially in urban areas. Biomethanation plants in Lucknow, Thane, Delhi, Trivandrum, Mumbai, Baroda and Vijayawada closed shortly after they opened due to a variety of reasons. These include inadequate feedstock, poor quality feedstock and technical failure. In most instances, the feedstock's calorific value was so low the operators had to spend large amounts on buying supplementary fuel, defeating the plant's purpose.

The point to note in rural areas is households generate more organic than inorganic waste, while in urban areas, the mix is different. Therefore, different strategies are needed in both. Collection of inorganic waste may be unremunerative in villages because rag pickers may not get enough to sell, but there would be sufficient quantities of organic waste to power individual biogas plants and vermiculture. Villages also have space around homesteads to locate both. In cities, collection of inorganic waste is profitable for rag pickers. However, houses have no space for vermicompost pits and biogas plants; these may be viable at the community level. This calls for different strategies for urban and rural areas.

Gram Panchayats are key to the TSC and therefore, to SLWM in villages. They receive funds under TSC for SLWM and could arrange for awareness campaigns about the hazards of solid and liquid waste, benefits of proper SLWM. Panchayats can draw on technical experts, NGOs, government officials and the village community. They can engage paid garbage collectors and arrange for transportation of garbage to processing points. Panchayats can organise periodic cleanliness campaigns and set up vigilance committees to make SLWM a way of life. They can also institute awards for clean households as an incentive measure.

At the household level, there is a range of **cost-effective technology** for managing solid and liquid waste. However, each depends on proper waste segregation at source. The Ministry of New and Renewable Energy supports most of these options through subsidies and grants.

One solution is the Bio Waste Treatment Power Generation Plant that converts waste to energy. There are different models depending on the characteristics of the waste feedstock, and each plant generates 3-10 kW of energy. Non-combustible and non-biodegradable material is put into landfills or trenches. Kitchen waste is shredded and vermicomposted. This system is suitable for both rural and urban areas.

In villages at the household and community levels, vermicomposting is a viable option for kitchen waste. Other organic waste including leaves, street sweepings, etc., can be processed into manure by windrow composting. Earthworms are very sensitive to temperature variations and require humid and shady places to be effective. The temperature in the waste piles needs to be maintained in the 20-28°C range and they need protection in summer and winter. As aerobic composting is an exothermic process, the core temperature of the waste pile can be quite high; to prevent this, people need to use pre- or semi-digested organic waste, restrict the height of vermibeds to 30-45 cm, thatch the sheds and cover the vermibeds with moist gunny bags to keep the earthworms cool. Indigenous species of earthworms are not suitable for converting kitchen waste and therefore, exotic species are required from Europe.

There are several eco-friendly methods of cleaning water. Artificial Floating Islands (AFIs) is one such option. AFIs are bamboo rafts with coconut fibre layers, on which reed grass grows. The grass' root

system removes particulate matter and nitrates from polluted water. Another option is the duckweed technology that is being tried in Punjab for cleaning village ponds. Pisciculture, wetland stabilization and Jal Kumbhi are other options for cleaning village ponds.

A different method involves skimming the debris annually, removing the fish to another container and draining the water. Village people can excavate the accumulated silt and debris; the silt is an excellent fertiliser. Once done, the pond can be refilled with water and the fish released back into it. This, in fact, is the system followed in villages where ponds are still the main source of water.

The Panchayats have to take the lead in implementing any technical solution to clean ponds. They also have to ensure community participation, ownership and responsibility so the ponds remain clean. They have to spell out community rules about defecating near ponds, bathing and washing clothes in them. In rural areas, panchayats play a central role in SLWM under both TSC and other schemes and have therefore to take the lead in community mobilization, adopting suitable technology for SLWM, and cleaning ponds. ULBs play a similar role in towns and cities. The emphasis is on decentralized options to encourage community participation, reduce transportation costs and the volume of waste handled at centralized locations.

Comparative Experiences

Andhra Pradesh

Social Mobilization Leads to Waste Management, Suryapet *(from Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad)*
The Suryapet Municipality was grappling with issues of waste disposal. To deal with the problem the municipality engaged in social mobilisation and adopted proper waste collection and segregation with community involvement. Through these efforts the municipality became the first municipality in India to successfully implement the "Solid Waste Management and Handling Rules 2000" on its own without any NGO/private organization participation. Read more

From Saji Das, BIOTECH, Kerala

Kerala

Kerala's First Waste to Electricity Project Meets With Success, Kollam District
Kerala's first waste to electricity project was implemented by Biotech in Pathanapuram Gram panchayat during 2003-2004. The plant has the capacity to treat 1 tone of solid waste and 500 liters of animal blood and wastewater everyday. The plant has given the panchayat a permanent solution to the environmental problems they had faced for the past several years and have also given them asscess to a steady supply of eletricity generated from the waste. Read more

BIOTECH Helps Installat Kerala's First Bio-Waste Treatment Power Generation Plant, Kollam District
To address the problem of solid waste generated from market places in Kaddakal Grama Panchayat, in 2003-04 BIOTECH helped install Kollam's Bio-Waste Treatment Power Generation Plant for generating 3KW electric power. Since then 26 Grama Panchayats have come forward for the installation of such plants. The power generated from these projects is being utilized for energy requirements of the markets. Read more

Maharashtra

Advanced Locality Management (ALM) Helps With Solid and Liquid Waste Management and Creates Livelihood Opportunities, Mumbai *(from Surekha Sule, Independent Journalist, Pune)*
The Advanced Locality Management (ALM) programme organised the unorganised rag-picker sector and imparted training in ALM. As per ALM, all entities in a locality work together to manage their waste - composting wet garbage and recycling dry garbage, and the rest (ideally very little) goes to the garbage dumping yard. The programme has provided livelihood options for the rag pickers as well as acitively invovled community members, whose support has been key to the programme's success. Read more

Use of BIOSANITIZERS Converts Organic Waste to Wealth, Pune *(from Uday Bhawalkar, Bhawalkar Vermitech Pvt Ltd, Pune; response 3)*
In 1980, the 'wealth from organic waste' movement was started to make people realise that there could be earnings from proper disposal of waste. The Pune Municipal Corporation (PMC) officials, who earlier carried out indiscriminate dumping, spent a huge amount to educate people that they should 'dispose' of their waste properly. By doing so the community managed to not only protect the environment, but also earn a profit using BIOSANITIZERS for waste disposal. Read more

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Related Resources

Recommended Documentation

From Surekha Sule, Independent Journalist, Pune

Municipalities Overruling the Supreme Court
Article; by Surekha Sule; India Together; Bangalore; July 2004
Available at http://www.indiatogether.org/2004/jul/env-muniswm.htm
Describes how except for one municipality in AP, no other towns and cities in India are complying with the Supreme Court directive on solid and liquid waste management

Whose Garbage Is It, Anyway?
Article; by Surekha Sule; India Together; Bangalore; January 2005
Available at http://www.indiatogether.org/2005/jan/env-ragpick.htm
Explains how with municipalities outsourcing city solid waste collection to private contractors, rag-pickers are losing their livelihood

Neutralising Industrial Waste With Worms
Article; by Surekha Sule; India Together; Bangalore; September 2005
Available at http://www.indiatogether.org/2004/sep/env-vermtoxic.htm
Discusses vermicomposting, which is used to convert household solid waste into manure and can also be used to treat toxic waste

Green Power Technology to Clean the Hussain Sagar Lake and Support its Neighbourhood Energy Utility (*from D. Chandrasekharam, Indian Institute of Technology Bombay, Mumbai)*
Artilce; by D. Chandrasekharam; Indian Institute of Technology-Bombay; Environmental Pollution Control Journal; Gurgaon; August 2008; Permission Required: Yes, contact circulation office for a copy
To avail of a copy contact circulation@epcjournal.net
Explains how solid and liquid wastes from the Hussain Sagar Lake were managed by using heat pumps and heat exchanger technologies

From Jayakumar C., Thanal, Thiruvananthapuram

Zero Waste Kasaragod
Report; District Panchayat Kasaragod; Kerala; November 2008

Available at http://www.solutionexchange-un.net.in/environment/cr/res-15120801.pdf (PDF; Size: 2.1 MB)

Describes the project initiated in the district for solid and liquid waste management – "Zero Waste Kasaragod" and the success it has witnessed

Malinya Mukta Keralam - Action Plan
Report; Local Self Government Department, Government of Kerala; Kerala; November 2007
Available at http://www.solutionexchange-un.net.in/environment/cr/res-15120802.pdf (PDF; Size: 620 KB)

Provides a detailed action plan for managing solid and liquid waste in a phased manner in Kasaragod district, Kerala

From Asit Nema, Foundation for Greentech Environmental Systems, New Delhi; response 3

Risk Factors Associated Wth Solid Waste Treatment Technology Options in the Indian Context
Article; by Asit Nema; Foundation for Greentech Environmental Systems; New Delhi; Available at http://www.green-ensys.org/site/publications/RISK_FACTORS_MSW_TREATMENT2.pdf (PDF; 52KB)

Discusses the case study of 11 municipal solid waste treatment plants to understand the effect of diverse risk factors associated with various waste treatment technologies

Bioreactor Landfill - A Sustainable Option for Municipal Solid Waste Treatment and Disposal in India
Report; by Asit Nema; Foundation for Greentech Environmental Systems; USAID; New Delhi; February 2008
Available at http://www.solutionexchange-un.net.in/environment/cr/res-15120803.pdf (PDF; Size: 95.1 KB)

Describes the viability of using an advanced form of landfill known as bioreactor landfills to treat and dispose of municipal solid waste

Solid and Liquid Waste Management in Rural Areas: A Technical Note (*from Puran Singh Yadav, Haryana Institute of Rural Development, Karnal)*
Report; United Nations Children's Fund (UNICEF) and Department of Drinking Water Supply; New Delhi
Available at http://ddws.gov.in/popups/SLWM_2.pdf (PDF; Size: 3.21 MB)

Presents some cost-effective technologies for solid and liquid waste disposal and recycling, includes detailed scientific inputs outlining the technological aspects of SLWM

Evaluation of DFID Support to Andhra Pradesh: Lessons Learnt from Municipal Service Delivery (*from Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad)*
Report; Centre for Good Governance; Hyderabad; 2007
Available at http://www.solutionexchange-un.net.in/environment/cr/res-15120804.doc (DOC; Size: 3.2 MB)

Details about the implementation of the "Solid Waste Management and Handling Rules 2000" by the municipality of Suryapet (Andhra Pradesh), the first municipality in India to do so

From Sunetra Lala, Research Associate

The Municipal Solid Wastes (Management and Handling) Rules, 2000
Notification; Ministry of Environment and Forests, Government of India; Publisher; New Delhi; 25 September 2005
Available at http://envfor.nic.in/legis/hsm/mswmhr.html

Rules that apply to every municipal authority responsible for the collection, segregation, storage, transportation, processing and disposal of municipal solid wastes

Handbook of Solid Waste Management
Book; by Frank Kreith and George Tchobanoglous; McGraw-Hill Publishing; June 2002; Permission Required: Yes, paid publication
Ordering information at http://www.amazon.com/Handbook-Solid-Waste-Management-Kreith/dp/0071356231

Handbook offers an integrated approach to the planning, design, and management of economical and environmentally responsible solid waste disposal system.

Solid Waste Management in India
Book; by R. K. Sinha; Vedams eBooks Private Ltd; New Delhi; 2000; Permission Required: Yes, contact Vedams eBooks for a copy
Ordering information at http://www.vedamsbooks.com/no18249.htm or vedams@vedamsbooks.com

Contains 12 chapters on various aspects of solid waste management (SWM) including modernisation of SWM systems, management information system, financial aspects, etc

Recommended Organizations and Programmes

From Abhishek Mendiratta, Consultant, New Delhi

Department of Drinking Water Supply, New Delhi
Ministry of Rural Development, Government of India, 9th Floor, Paryavarn Bhawan, CGO Complex, Lodhi Road, New Delhi 110003; Tel 91-11-24361043; Fax: 91-11-24364113; jstm@water.nic.in; http://ddws.nic.in/

Central Government agency responsible for providing drinking water and sanitation services to rural areas across India; also assists in the management of solid and liquid waste

Nirmal Gram Puraskar, New Delhi
9th Floor, Paryavarn Bhawan, CGO Complex, Lodhi Road, New Delhi 110003; Tel: 91-11-24366372; Fax: 91-11-24364113; nirmalgrampuraskar@nic.in;
http://nirmalgrampuraskar.nic.in/nirmalgrampuraskar/index.jsp

Incentive scheme to promote fully sanitized and "open defecation free" Gram Panchayats, Blocks, and Districts, which has led to better management of solid and liquid waste

Ministry of Rural Development, New Delhi
9th Floor, Paryavaran Bhawan, CGO Complex, New Delhi 110003; Tel: 91-11-23384467; Fax: 91-11-23382408; secyrd@nic.in; http://rural.nic.in/g1.htm

Implements the Nirmal Gram Puraskar scheme along with other sanitation programmes in rural India, which has lead to improved solid and liquid waste management systems across India

From Harshad Gandhi, Excel Industries Ltd., Mumbai

Excel Industries Limited, Mumbai
184-87, S.V. Road, Jogeshwari (West), Mumbai 400102 Maharashtra; Tel: 91-22-66464200; Fax: 91-22-26783657; excelmumbai@excelind.com; http://www.excelind.co.in/cat.htm; Contact Harshad Gandhi; Consultant (Business Development); Tel: 91-22-66464200; hvgandhi@excelind.com

Organisation providing solutions for solid waste management and has developed an organic waste converter that converts waste into compost

Ministry of Environment and Forests, New Delhi
Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi 110003; Tel: 91-11-24361669; envisect@nic.in; http://envfor.nic.in/

Ministry responsible for implementing environmental schemes, including the management of solid and liquid waste through its various rules, regulations and acts

Jawaharlal Nehru National Urban Renewal Mission, New Delhi
Ministry of Housing and Urban Poverty Alleviation, Government of India, Nirman Bhawan, New Delhi 110011; http://jnnurm.nic.in/

Focuses on bringing efficiency to urban infrastructure and service delivery mechanisms, including sanitation, waste management, and improving the accountability of ULBs/parastatal agencies

Foundation for Greentech Environmental Systems, New Delhi *(from Asit Nema; response 1)*
K 12, Sarita Vihar, New Delhi 110076; Tel: 91-11-41054084; greentech@airtelmail.in; http://www.green-ensys.org/site/projects.html; Contact Asit Nema; Director; Tel: 91-11-41054084; greentech@airtelmail.in

Promotes sustainable reutilisation and management of solid and liquid waste and has promoted home composting activities in and around New Delhi

Sahjeevan, Gujarat *(from Dharmesh Antani)*
175-Jalaram Society, B/h, Vishwamangal Appt., Vijay Nagar, Bhuj 370001 Kutch, Gujarat; Tel: 91-2832-251814; Fax: 91-2832-251914; sahjeevan@gmail.com; http://www.sahjeevan.org/ourprofile.htm

Runs a programme on solid waste management with a focus on waste segregation and using garbage bins in homes and commercial complexes in Kutch

Directorate of Municipal Administration, Mumbai *(from Surekha Sule, Independent Journalist, Pune)*
MHADA Building, Ground Floor, Bandra East, Mumbai Maharashtra; Tel: 91-22-6453126; Fax: 91-22-6412812; sec_mededu@maharashtra.gov.in; http://www.maha-arogya.gov.in/programs/default.htm;

Developed a manual on best practices in solid waste management for Maharashtra, covering 40 cities of India and their SLW management practices

Urban Development Department, Kolkata *(from Ranjini Gupta)*
Nagarayan, Sector-I, Block-DF-8, Bidhan Nagar, Kolkata 700064 West Bengal; Tel: 91-33-23349394; Fax: 91-33-23347880; psecyud@wb.nic.in; http://www.wburbandev.gov.in/htm/about_us.htm; Contact Ranjini Gupta; Assistant Town Planner; ksgupta@vsnl.net

Works on issues of solid and liquid waste management and has been promoting community level participation in waste management

BIOTECH, Thiruvananthapuram *(from Saji Das)*
PB. No. 520, M.P. Appan Road, Vazhuthacadu, Thycadu. P.O., Thiruvananthapuram 695014, Kerala; Tel: 91-471-2332179; biotechindia@eth.net; Contact Saji Das; Director; Tel: 91-471-2332179; biotechindia@eth.net

Has developed biogas digesters for managing food waste and other organic waste that are currently being used in 12,000 households, 220 institutions and 19 municipal sites in India

Ministry of New and Renewable Energy, New Delhi *(from P. K. Jha, Sulabh International Academy of Environmental Sanitation Mahavir Enclave, New Delhi)*
Block-14, CGO Complex, Lodhi Road, New Delhi 110003; Tel: 91-11-24361298; Fax: 91-11-24361830; asfa.moca@nic.in; http://mnes.nic.in/

Promotes projects which produce biogas from waste and also promotes the proper segregation of waste

Department of Water and Environment Management, Anugrah Narayan College, Patna *(from Ashok Ghosh)*

Boring Road, Patna 800013, Bihar; Tel: 91-612-2222482; Fax: 91-612-2222482; principal@ancollege.org; http://www.ancollege.org/faculty.html#; Contact Ashok Ghosh; Professor-in-Charge; Tel: 91-612-2282387

Developed the fusion system for the Artificial Floating Island and SFCW Treatment Systems, which can be used to manage waste

From Puran Singh Yadav, Haryana Institute of Rural Development, Karnal

United Nations Children's Fund (UNICEF), New Delhi
73 Lodhi Estate, New Delhi 110003; Tel: 91-11-24690401; Fax: 91-11-24627521; newdelhi@unicef.org; http://www.unicef.org/wes/

UNICEF works in India to improve drinking water supplies facilities in schools and communities, and has helped to address issues of waste management as well

Punjab State Council of Science and Technology, Chandigarh
MGSIPA Complex, Adjacent Sacred Heart School, Sector-26, Chandigarh; Tel: 91-172-2795001; Fax: 91-172-2793143; info@pscst.com; http://punjabgovt.nic.in/government/SCIENCE_TECHNOLOGY.HTM

Has been involved in solid and liquid waste management across Punjab, using a variety of processes such as duckweed technology and pisciculture

From Sunetra Lala, Research Associate

Sulabh International Social Service Organization, New Delhi
Sulabh Gram, Mahavir Enclave Palam-Dabri Road, New Delhi 110045; Tel: 91-11-25031518; Fax: 91-11-25034014; sulabh1@nde.vsnl.net.in; http://www.sulabhinternational.org

Provides sanitation services across India and has provided livelihood options to rag-pickers previously employed in the removal of solid and liquid waste in unhygienic conditions

Society for Community Organization and Peoples Education (SCOPE), Tiruchirapalli
P/17, 6th Cross, Ahmed Colony, Ramalinganagar, Tiruchirapalli 620003, Tamil Nadu; Tel: 91-431-2774144; scopeagency86@rediffmail.com, scopeagency86@sify.com; http://www.scopetrichy.org/sanitation.html

Works on solid and liquid waste management, sanitation, health and hygiene issues among disadvantaged communities in Tamil Nadu

Recommended Portals and Information Bases

MSW and Home Composting, Foundation for Greentech Environmental Systems, New Delhi *(from Asit Nema; response 1)*
http://indiahomecompost.blogspot.com/; Contact Asit Nema; Director; Tel: 91-11-41054084; greentech@airtelmail.in

Provides information on solid and liquid waste management and provides options and techniques for home composting of solid waste

Waste to Health, Bhawalkar Vermitech Private Limited, Pune *(from Uday Bhawalkar, Bhawalkar Vermitech Private Limited, Pune; response 1)*
http://www.ecoguru.org; Contact Uday Bhawalkar; Director; Tel: 91-20-24226916; bhawalkar@datatone.in

Provides information on how solid and liquid waste can be treated and reused by using BIOSANITIZERS, which is also an ecologically safe option

India Environment Portal, Centre for Science and Environment, New Delhi *(from Sunetra Lala, Research Associate)*

http://www.indiaenvironmentportal.org.in/taxonomy/term/2526; Contact Tel: 91-11 29955124; cse@cseindia.org

Provides case studies of best practices in solid and liquid waste management across India, with examples from Kochi, Durgapur, etc

Recommended Upcoming Events

From Sunetra Lala, Research Associate

24th International Conference on Solid Waste Technology and Management, USA, 15 - 18 March 2009
Sponsored by University of Pennsylvania, USA, Philadelphia, PA, USA; Information available at http://www2.widener.edu/~sxw0004/call.html; Contact. Ronald L. Mersky; Conference Chair; Tel: 001-610-4994042; solid.waste@widener.edu

Conference on solid waste technology and management, with participants coming from 40 countries interested in the issues of waste management

Middle East Waste Summit 2009, Dubai, 26-28 May 2009
Sponsored by Dubai Municipality and United Nations Environment Programme, Dubai; Information available at http://www.wastesummit.com/; Contact Emma Hilditch; Conference Director;Tel: 971-2-444 6011; e.hilditch@turretme.com

Mideast region's premier exhibition and forum dedicated to delivering waste management and recycling solutions to the area

Related Consolidated Replies

Solid Waste Management in Urban Settings, from Nidhi Prabha Tewari, Sanket Information and Research Agency, New Delhi (Advice). Water Community, Solution Exchange, India, Issued 16 August 2005
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-16080501.htm

Highlights successes and failures of recycling and revenue generation potential of solid wastes through case studies

Treatment of Wastewater for Reuse, from K.A.S Mani, APFAMGS, Hyderabad, (Experiences). Water Community, Solution Exchange, India, Issued 14 March 2006
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-14030601.doc (DOC,, Size: 135 KB)

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

Popularizing Treatment Technologies for Kitchen Wastes, from Gopal Sane, Samruddhi, New Delhi (Experiences). Water Community, Solution Exchange, India, Issued 13 April 2006
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-13040601.htm

Provides range of experiences and lessons learned by trying to promote adoption of ecologically friendly technologies and related innovations into communities

Comparative Analysis of Biogas Digester Models, from Sheldon Mendonca, Watershed Organisation Trust (WOTR), Ahmednagar (Experiences, Examples). Water Community, Solution Exchange, India**,** Issued 18 July 2006
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-18070601.htm

Provides experiences in working with different biogas models, criteria for evaluating models and dos and don'ts while implementing biogas programmes

Waste Management at Tourism Sites, from R. K. Anil, Endogenous Tourism, United Nations Development Programme, New Delhi (Experiences; Referrals). Water Community, Solution Exchange, India, Issued 31 March 2007
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-21020701.pdf (PDF,Size: 160 KB)

Provides experiences in designing, & implementing waste management programmes in tourism sites, also lists broad application strategies based on experiences of successful case studies

Best Practices in Effective Sewage Disposal, from Aniruddhe Mukerjee, Government of Madhya Pradesh, Bhopal (Experiences). Water Community, Solution Exchange, India**,** Issued 13 June 2007
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-21050701.pdf (PDF, Size: 170 KB)

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

Urban Waste Composting Methods and Uses for Agriculture, from Avanish Kumar, Toxics Link, New Delhi (Examples; Experiences). Water Community, Solution Exchange, India, Issued 31 December 2007
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-food-31100701.pdf (PDF, Size: 165 KB)

Recommends various composting approaches and techniques, highlights issues for deciding on composting options for urban areas, and outlines lessons learned from ongoing MSWM initiatives

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Responses in Full

Abhishek Mendiratta, Consultant, New Delhi

The information requested related to Solid and Liquid waste management (SLWM) is given below:

1. **GP/ Block action plan should broadly contain the following**
    a. Social Mobilization and awareness generation: It should focus on inter personal communication, focused group discussion, technology, demonstration and exposure visits to successful sites.
    b. Technology Options: Household and community level technological options with approximate cost estimates should be worked out.
    c. Operation and Maintenance: Success of the technology depends upon proper O & M at the household and community level. This aspect should be discussed in detail during the planning process and incorporated in the action plan.

2. **SLWM is part of TSC.** Hence, the same institutional structure as is already in place in respective states, districts and GPs will be responsible for managing this component.

3. **Resource Mobilization:** With recent changes in TSC guidelines, each district can allocate up to 10% of the TSC funds for SLWM for which revised proposals should be sent to the Department of Drinking Water Supply (DDWS). Following types of resources can also be mobilized for taking up SLWM activities.
    a. Nirmal Gram Puruskar (NGP) Award money: A large number of PRIs have received NGP. The corresponding award money should be utilized for SLWM activities
    b. Finance commission grants: Funds available under central and State finance commission grants to the PRIs may also be utilized for this purpose.
    c. Dovetailing with MoRD programmes: Funds available under various development programmes of the Ministry of Rural Development may be dovetailed after following the respective programme guidelines

d. Other resources: Resources available under State plan schemes, other centrally sponsored schemes etc. may also be dovetailed for this purpose.

4. Steps for effective management of Solid Waste

a. Sorting out or segregation at Household level
b. Treatment/ management of household level waste:
    i. Windrow composting
    ii. Vermi composting
    iii. Biogas plant
    iv. Collection and Transportation
c. Treatment/ management of community level waste:
    i. Windrow composting
    ii. Vermi composting
    iii. Biogas plant

The non bio-degradable waste may be further sorted into various categories (e.g., plastic , paper, metals, cloth, etc). Those which are recyclable may be sold to kabadiwalas or recycled at the community level by adopting suitable technologies. Those waste materials which can neither be recycled nor sold may be sent to the landfill sites in the village.

5. Guidelines for utilization of funds reserved for solid and liquid waste management under TSC

a. As per GOI guidelines 10% of the total project cost can be utilized for solid and liquid waste management component of TSC.
b. Cost sharing should be in the ratio of (60:20:20) that is 60 percent form the central share, 20 percent from the state share and the 20 percent from the beneficiary. (as per the revised TSC guidelines which came into effect from 1.4. 2006)
c. This fund being limited should be used judiciously and effectively in places where there is a large amount of solid & liquid waste management required in rural areas.
d. The project should clearly bring out benefits to the target population through technologies using locally available resources.
e. Attention to be paid for local income and employment generation. The end result should be Clean environment, proper waste management and disposal, no stagnation of waste water in the village.
f. Drainage construction to be avoided from this fund; if inevitable & absolutely required a maximum of two percent of the funds can be utilized for construction of drains.
g. As far as possible the drains should be part of a holistic plan which is an integral part of waste water treatment systems etc. like for example interconnecting drains for waste water treatment plants and other such requirement.
h. Incinerators in High schools attached to the Girls toilet and community Sanitary complexes can be constructed as part of the Solid and liquid waste management for the proper burning and disposal of napkins.
i. Incinerators and deep burial with proper lining can be constructed as a part of the solid waste management at the primary health center or any other appropriate place for proper burning of pathogenic waste generated by hospitals and safe disposal of the sharps, injection tube etc....
j. Secure landfill can be adopted for the proper waste management
k. No land to be purchased from this fund for solid and liquid waste management.
l. In villages having more cattle population /where large amount of bio degradable waste is generated, generating power out of waste/ generating gas for cooking, lighting etc. (Cow dung and plant waste / biodegradable waste) can be explored.
m. Recycling, Reduce and Reuse technologies for non-biodegradable waste can be adapted depending upon the amount of waste generated.

n. Equipment for managing solid waste like pushcarts, shovels, providing protection gear for handlers of waste like gloves, boots , masks etc can be supported as an incentive to Gram Panchayats to achieve Nirmal Gram Puruskar.
o. As far as possible Eco-friendly management technologies should be adopted for a clean environment.
p. Capital costs for asset creation (for solid & liquid waste management) can be borne from TSC funds. Recurring costs for operation & maintenance to be met by the Gram Panchayat/ community.
q. NGO / SSHE groups / gram panchayat / schools / yuvaka mandalas / streeshakthi groups can be partners in operation and maintaince of the assets created for the waste management and the revenue generated to enable sustainability.
r. Awareness and the training programmes on solid & liquid waste management can be conducted out of the IEC funds of the TSC on topics such as, safe disposal, recycle , reduce and reuse of the waste , operation and maintenance and other techniques for solid and liquid waste management .
s. Research & Development to develop innovative ways & means to treat solid & liquid waste can be initiated. This could be done with local technical /scientific institutes/NGOs/individuals having necessary competence.

6. **Ponds.** These are the responsibility of GP. Maintenance requirements are minimal. Regular cutting of grass on embankments and removal of any floating scum from the pond surface are the only requirements. Occasional anti-mosquito spraying treatment may be necessary.

R. K. Sood, National Institute of Epidemiology, Chennai

The problem associated with rural water supply is entirely different from the urban setting. The first is the problem of human and animal fecal matter, which can be effectively solved with biogas technology. The second is the traditional dry kitchen waste, which is biodegradable or can be used as animal feed. With the use of cement, people make good houses and pucca bathrooms and dump the wastewater into the road outside their plot. Soak pits need to be made popular to contain this menace.

However, the packaging material and plastics that have come up relatively recently in rural areas with consumer market boom are a real cause for concern. Himachal Pradesh, a hill state in north India banned polythene carry bags and this reduced the choking of drainage systems (even though polythene packing for bread, confectionery is coming in). A system of imposing manufacturer's responsibility regarding where he buys back the packaging material needs to be tried.

Mixing of wastes and dumping them in a polythene bag under the cover of darkness near other's house or in open spaces leads to dirty unmanageable points across villages. Segregation and household-level composting needs to be promoted and the gram panchayats could use some control in this regard, for example - only those households with toilets and compost pits and soak pits will be issued ration cards for subsidised food grains.

TSC has a vision of ODF, waste management could be definitely added, and thereby lead to reduction in the burden of diseases.

Harshad Gandhi, Excel Industries Ltd., Mumbai

Here are my comments about Decentralized Organic Municipal Waste Management at source/community level - Pathways towards Sustainable Waste Solution!

There are 5161 cities & towns in India; out of these cities 423 Cities are having population of over 100,000. MSW generation per capita ranges from 200 gm/day to 600 gm/day (varies depending upon city profile & living standard) amounting to about 42 millions ton annually. The Municipal Solid Waste (MSW) Management activity falls under ambit of Urban Local Body (ULB) Governance. MSW (Handling & Management) Rule 2000 has made it mandatory for every ULB to dispose-off Bio-degradable waste in scientific & eco-friendly manner.

Traditionally, the so called solution to MSW resorted to by the ULBs has been to collect it from various points in cities and towns where it is brought by MSW generator or Municipal Conservancy Staff. It was then transported over varying distances to designated dump yards and just dumped there (Pre-90s scenario).

Over time, due to awareness for better hygiene, shortage of dumping space, and unwillingness/strong opposition by local communities to new dumping sites, as also NGO and judicial activism, pressure began to mount on ULBs to offer better waste management and treatment options. It's time that we examine waste issue from the prism of total sustainability.

Some progressive corporates & NGOs began to develop and offer solutions to manage waste better through (centralized) composting, energy generation, vermin-composting etc (beginning of 90s). Some/Many of these have been functioning for past decade or so.

The enactment of MSW Rules 2000 by Supreme Court action through MoEF, due to NGO activism, put responsibility of segregation, composting and scientific landfill on the ULBs with a specified time frame from commencement of MSW Rule 2000.

However, barring some cities, the implementation of this Act has been tardy and we continue to see and experience heaps of rotting garbage in collection bins, on roads and in garbage trucks, carrying the MSW to long distances through populated areas, spreading bad smell, ugly sight, and of course disease causing pathogens.

Hardly any segregation, any composting, any scientific landfill is taking place. Even if larger scale centralized facilities are created, it will not provide optimal solution.

Fortunately, a better solution is now available – a solution that at once combines good features such as eco-friendly treatment of garbage right at the source of generation, generates a clean, rapid and cost effective solution, ensures a good degree of segregation of waste (into biodegradable and recyclable), involves the participation of community at the generating source, and very importantly, provides for employment / self-employment opportunities for the urban poor / underprivileged section of the society.

The compact solution is available today to offer what our cities and towns urgently need.

Organic Waste Converter (OWC) System www.excelind.co.in/cat.htm helps alleviate burden of waste disposal on municipal authorities. The segregated organic waste is bio-mechanically treated in the OWC machine. It homogenizes organic waste with appropriate bio-culture and organic media. The coarse wastes such as garden pruning, bones etc are shredded prior to feeding into OWC machine. The output from OWC machine is raw compost having uniform coloured and soil structured, free of bad odour, coarse powder and leachate is controlled in batch cycle of just 15-20 minutes. The waste treated in OWC machine accelerates the composting cycle. The raw compost is placed into compost curing system where moisture is controlled using fogging system. The raw compost is bio-converted into matured compost in about 10 to 15 days of curing period.

The matured compost can be utilized for in-house gardening, landscaping. The decentralized organic waste management facilitates green initiatives such as eco-housing, eco-hotel, eco-township projects and

also supplements Corporate Social Responsibility (CSR) initiatives such as community health & hygiene improvement, mine area / wasteland rejuvenation through social forestry, Bio-energy plantation etc. The decentralized waste management strategy using OWC system not only minimizes ill-effects of garbage but also has potential to promote Micro-Enterprise Service Model where urban poor, unemployed youth & conservancy staff can be gainfully employed with dignity.

Networking of Stakeholders:
It needs the participation and networking of all stakeholders viz. the Waste generating communities/organizations, the micro entrepreneurs and operators of the simple system, the ULBs, the Central and State Administrators/Policy Makers. Enlightened corporate houses, institutions, banks and trade associations can come forward as sponsors & mobilize funds needed to set up and operate the system on ongoing basis.

An appropriate resource allocation is required for asset creation in Urban Cities that would facilitate waste solutions with network of decentralized micro-level waste disposal service providers. The commercial & intuitional waste generators may create in-house facility to mitigate ill-effects of garbage to check adverse climate change & environmental degradation. An enabling institutional frame work is provided under JNNURM Community Participation Fund to support community driven micro-entrepreneurs services. The micro-enterprise initiatives will make community aware about real cost of waste disposal & thereby realizes the need to minimize waste generation as well as segregate waste at source to facilitate community based efficient recycling initiatives.

Together we can generate viable, eco-friendly, cost effective and sustainable win win solution for healthy cleaner, greener & healthier urban living in India! Such concepts / system needs to be evaluated to explore its relavance to rural sanitation program

It is in above context sensitization program can be organized by setting up few demonstration units of OWC System in urban/semi-urban locations which would go a long way to make decentralized waste management strategy a mass movement & way of life to make our cities & towns cleaner greener & healthier!

Asit Nema, Foundation for Greentech Environmental Systems, New Delhi *(response 1)*

In response to the query on solid waste management both in the urban and rural context, I am forwarding the following note which I believe will be of interest to all.

HOME COMPOSTING – AN INDIVIDUAL ENVIRONMENTAL RESPONSIBILITY

As urban India is witnessing unprecedented growth, our cities are also confronted with increasing quantities of municipal solid waste across the country. Heaps and mountains of garbage characterise the landscape of urban India. Delhi, the capital city itself is generating around 7000-8000 metric tonnes of mixed municipal solid waste every day and it is estimated that daily waste generation across the country is of the order of 120,000 metric tonnes. This is expected to double by 2015 and quadruple by 2025.

Unfortunately the municipalities of large and small cities alike are unable to handle this mounting crisis as they do not have adequate resources to collect, transport, treat and safely dispose of the waste. As a result of systemic limitations, a large part of the waste is not collected and it is found accumulating within residential areas.

The other part which is collected and transported is disposed of in open dumps on the outskirts of the towns, along highways, near river banks, etc. Among others, because land is scarce and expensive, municipalities have not been able to construct sanitary landfill sites, and as a result they resort to unscientific methods of disposal. Open disposal of waste is unsafe because it creates breeding grounds for pathogenic bacteria, viruses and other disease vectors which adversely affect public heath. Diseases

that can be spread because of poor solid waste management include dysentery, viral and bacterial diarrhoea, gastro-enteritis, typhoid, trachoma, plague, typhus, salmonella, leptospirosis, filariasis, malaria, tapeworm, etc. Open dumps also cause river and groundwater pollution and release odour which lead to severe environmental and psychosomatic health impacts on the surrounding communities. Decaying waste in dumps and more so in the landfills also releases methane - a powerful green house gas, which contributes to global warming. Last but not the least, because open dumps attract scavenging birds, they are a major threat to air traffic, as many a times accidents take place when birds hit aircrafts near the airports.

In order to address this growing public health and environmental concern, the Foundation for Greentech Environmental Systems has developed an alternate approach which involves motivating urban residents to start exercising their 'Individual Environmental Responsibility' by adopting the 'Earth Friendly Green Hobby' of 'Home Composting' and thereby evolve as concerned 'Earth Citizens'.

In this approach, the biodegradable kitchen waste (whatever a cow can eat!) from a house is put in the Green Earth Machine (GEMÔ) – an improvised bin of 100-150 litre with plenty of holes for composting which has been developed by the Foundation. A GEMÔ is designed for Indian conditions such that it can absorb 1-2 kg/day of vegetable waste from a typical family on a continuous basis, all round the year. The GEMÔ works on completely natural forces - it requires no energy, chemicals, earthworms or bacterial solutions; it works under aerobic conditions and transforms the waste into a good quality compost.

The art and science of 'Home Composting' requires maintaining a balance between vegetable kitchen waste, dry leaves (or waste paper, etc.), moisture and mixing the contents once a fortnight with a rod or a garden rake. From time to time one can sprinkle garden soil, compost, ash or neem khali (de-oiled cake of neem seeds). First compost will come out in about 3 months and then every month one can take out small quantities. Users can integrate this practice with or cultivate the hobby of gardening and derive joy from doing good for the environment.

For the motivated individuals, this practice represents sacrificial offering to the Mother Earth which one can perform by chanting the mantra "Peace be in the universe, peace be on the Earth, peace be in the water, peace be in the herbs and vegetation and peace be there everywhere..." (*Om dhyo shanti Antariksha gwam, shanty Prithvi, shantyrapah, shantyroshadayah, shanty vanaspatayah...' Rigved)* which is normally done on completion of a *Hawan*. For a municipality, this represents an ultimate form of community participation and decentralised solid waste management, which offers reduction in cost of collection, transport, treatment and disposal.

Over last 2 years we have helped about 500 families in Delhi area to adopt this practice which enables returning kitchen waste in a humble manner back to the Earth. In this regard, we aim to create India Home Compost Network with committed NGOs and municipalities such that more cities and towns can adopt this approach and improve sanitation levels and safeguard public health respectively.

For more information, you can visit our website www.green-ensys.org and my blog, http://indiahomecompost.blogspot.com.

R. K. Srinivasan, Centre for Science and Environment, New Delhi

The urgent need of the hour is a decentralized liquid waste management system for urban centers. As we know, our cities generate 33,000 MLD of sewage but they only less than 15 per cent of it is treated and rest 85 per cent of untreated sewage pollutes our rivers and lakes and groundwater, which are our primary water source. Over the years we have adopted centralised systems to treat wastewater which never worked. The river Yamuna is a typical example; under various Yamuna action plans in the last 10 years Rs 1,500 crores have been spent in building sewage treatment plants, sewer lines and pumping stations, but the river remains polluted.

In the centralised systems collecting and transporting sewage to the treatment plants is a tough job, since our pumping stations do not work either due to lack of electricity or due to clogging. Hence, sewage directly flows to the rivers instead of going treatment plants. Moreover, treating sewage is five times costlier than treating water for drinking purposes. Since the our water tariffs are highly subsidised and sewer charges are negligible, centralised systems are not working in India.

We have to go for decentralised wastewater treatment systems, were we have to collect sewage from small catchments and reuse it. Currently, in the centralised systems, we treat sewage and dispose it in the same dirty drain, thereby defeating entire sewage treatment process. Decentralised treatment focusses mainly on reuse. In India, we have different kinds of decentralized wastewater practices. Western countries like UK, USA and Canada adopts have constructed wetlands to treat sewage, but we rely on mechanical systems, which are capital and energy intensive.

Hence, the urgent need is to create awareness and model projects in decentralsied wastewater treatment to save our water sources and scale up liquid waste management in India.

Dharmesh Antani, Sahjeevan, Gujarat

We are an NGO called Sahjeevan based in Kutch. We work with the Bhuj nagarpalika on the city's solid waste management system to generate awareness in the community. We focus on generation of awareness on waste segregation and use of dustbins at homes or commercial establishments. The waste in dustbins is collected by women called sakhis, going door to door. The process is running smoothly.

Uday Bhawalkar, Bhawalkar Vermitech Pvt Ltd, Pune *(response 1)*

Solid and Liquid Waste Management(SLWM) needs to be discussed together because the chemical reactions are similar whether the waste is processed as solid, semi-solid(slurry) or liquid. Only the water content varies. We think of sewage when liquid waste is mentioned. Actually, humans produce human excreta in solid form (at least when we consume healthy food and water). Modern man decided to flush it away using liberal amount of drinking water and then 'sewage' was created. Modern sewage, thus, has 99.9% water.

Such liberal use of water helps in solving the problem using a NIMBY (Not In My Back Yard) approach. With increasing shortage of water and resulting pollution of water bodies, modern trend is again towards dry toilets where solid state processing is carried out. Another approach can be total water recycling toilet which generates its own flushing water through eco-friendly sewage treatment and balance water is used for irrigation.

Sanitation challenge of human excreta and urine is actually decided by the food/nitrate ratio. Higher ratio means it is easy to handle/process. Tiger's excreta (in the natural habitat) attract honeybees. This implies that the tiger produces healthy excreta, in spite of consuming flesh. Tiger's food and lifestyle is logical, hence healthy excreta is produced. In fact, all the animals (except the modern man) produce their excreta that is 'cleaner'(higher food/nitrate ratio) than the food that is consumed. Hence, they put no sanitation burden on the environment. Yes, each animal needs food of a specific narrow band of food/nitrate ratio. We can thus, know the excreta quality just by noting which creature is attracted to it.

When I was a child and used to defecate on the soil (better than sending it to the river, with NIMBY attitude), dogs used to eat the human excreta. Later when I grew up, I found pigs were eating human excreta in villages. Now, bacteria eat the excreta and create foul air. As modern rain started getting polluted with nitrates(due to burning of fossil fuels) and also as human waste started getting rich in nitrates with higher use of urea in agriculture, SLWM became more and more challenging, requiring

better technology interventions. In fact, the modern man cannot cope with the speed of pollution of air (hence rain), food and water.

Healthy soil (with earthworms) can create the nitrates that are genuinely required by the plants. But this 'need-based' action is possible only at low nitrates. Hence it is wrong to feed the soil with NPK fertilizers. When the soil is sick (high nitrates), it cannot consume organic food. When organic wastes cannot be fed to the soil, they need to be processed away from the soil.

Bath and kitchen water used to grow banana plants when I was young. Now the sullage (greywater) only creates nuisance. People are sensible to use something to grow plants because they know the advantages of plant cultivation. Problem is that wastes are changing (spoiling) their chemistry too fast, making it challenging also for the scientists. Very few academic and research institutions that preach about water and sanitation, have actually solved their waste problem through its utilisation. Most of them practice NIMBY technology.

If BIOSANITIZER is used to correct nitrates, heavy metals, sodium, chlorides, fluorides, iron, sulphates and other inorganics, we get truly clean drinking water. Pathogens and pests actually come to consume the nitrates. Hence killing them using poisons, is a wrong approach; it amounts to shooting the fire-fighters. When truly clean water is used, it does not breed pathogens and pests. When it is used for drinking, cooking, washing, etc. we get clean (low nitrates) waste that becomes food for the soil. It starts growing plants so easily that everybody gets attracted to the practice of waste management through its utilisation, to grow food, fuel, herbs, timber, fibre, etc.

This approach, thus, includes social mobilisation, interventions and technology options. All need to go together, to get a truly eco-friendly solution. It has been promoted and practiced in several cities in India and has inspired the Central and State Pollution Control Boards to insist on 'Zero Discharge' for all the polluting units. In fact, modern housing complex does not get a green signal unless decentralised waste utilisation scheme is planned.

Nashik city has used this approach in totality and we see fish, honeybees, butterflies and birds on the sewage treatment units, instead of odour, pathogens and pests.

Asit Nema, Foundation for Greentech Environmental Systems, New Delhi *(response 2)*

I would like to enumerate the challenges of vermin-composting. Fundamentally, 'vermicomposting' represents one of the most 'Earth Friendly' 'Ecological Sanitation' solutions and no wonder many agencies and individuals are enamored with the docile earthworms with regard to their capacity to convert kitchen waste (as against mixed municipal solid waste) into useful compost. There is no doubt about the capability of earthworms to devour food left-over and other vegetable waste (read - partially digested) and in the process deliver a very homogeneous, uniform, pleasant textured and sweet smelling compost.

However, in order to deliver such a high quality product, the earthworms need a great deal of care and protection. A number of well intentioned initiatives at the level of individuals, communities and even municipalities have been discontinued due to a number of inherent and external risk factors. A set of concerns, problems and risk factors are described hereunder to help practitioners and researchers consider more robust options:

- Earthworms are very sensitive to temperature variations and require humid and shady place to work effectively. Temperature within the vermibeds/waste piles needs to be maintained within the ideal range of 20-28°C otherwise the earthworms start dying. Typically in peak summer and winter seasons a higher die-off rate is observed if the vermibeds are not well covered and protected. Secondly, aerobic composting being an exothermic process where the temperature in the core of a high waste pile rises beyond 55°C, it does not offer a very conducive environment for earthworms to survive. It is essentially to avoid heat build up that it is recommended to use (a) pre- or semi-

digested organic waste, (b) restrict the height of vermibeds as low as 30-45 cm, (c) provide a shed of thatch and (d) cover the vermibeds with moist gunny bags to keep the army of earthworms cool.

The requirement of feeding pre-digested food waste entails provision of a pre-processing section with 15-30 days holding capacity. Secondly, restriction on height of vermibeds (as against 1-1.5 high windrows) translates into large area requirement for a community level treatment facility. Easy availability of land is a limitation and therefore either the throughput is restricted or the vermibeds get overloaded. A combination of overload and raw waste as feedstock results in higher die-off of earthworms.

- Earthworms are also not comfortable under high moisture conditions. In monsoon an uncovered facility experiences higher die-off.

- Earthworms are easy targets of predators and therefore vermibeds need to be well 'guarded' against centipedes, snakes, rodents, birds, hens and even red ants. Generally to avoid ants, every vermibed requires a 'moat' of water all around!

- It has been found that the indigenous species and soil burrower category of earthworms are not effective for direct devouring of kitchen waste. Exotic species such as Eudrillus euginiae, Eisenia foetida and Perionyx excavatus which are found to be most suitable are required to be cultured or purchased (and some agencies have imported from Germany, Italy and Israel). The market rate of exotic species varies between Rs. 700 – 1000/kg of earthworms. Given the risk of predation and sensitivity to climatic factors, no wonder some agree-entrepreneurs are more interested in selling the earthworms rather than vermicompost /setting up a vermicomposting operation!

Once an individual or a large facility operator (e.g., an entrepreneur or a municipality) experiences colony die-off, he/she does not get second time motivated to procure a new batch of earthworms at the prevailing market rates and recolonise the vermibeds. There are so many uncertainties involved. And to ward them off, a good deal of care is required. Because of these reasons, it is generally found that sooner or later most of the vermicomposting initiatives are abandoned.

Further, because of the inherent uncertainties, the vermicomposting systems are not suitable for scaling up to treat large quantities of mixed MSW at a municipal ward or city level. It is understandable that these very reasons contributed to abandoning of a plant, which was ambitiously designed for 400 MT/day capacities at the Devnar landfill site in 1992-93 in Mumbai!

Recently I had the opportunity of assessing performance of couple of smaller municipal vermicomposting plants of 20-30 MT/day which were also unfortunately found to be dysfunctional and the investment of Rs. 45 lakh each was about to be classified as 'non-performing' (see above picture on the right).

In conclusion, municipalities should not expect a vermicomposting plant to be their end solution. Agri-extensions agencies in warm climatic conditions may also like to give a second thought with regard to biological sustainability of operations. Even the motivated individuals must recognise the limitations of our friendly and docile earthworms for community level applications. At individual or community level one could ideally go for simple aerobic composting, letting the friendly aerobic bacteria, protozoa and the fungi do the good job!

Surekha Sule, Independent Journalist, Pune

According to the Municipal Solid Waste Management Rules 2000, all municipalities should have implemented waste management systems by December 2003. However, there have been few efforts in bits and pieces with a few exceptions. I wrote a story on one such zero garbage town in Andhra Pradesh, and am giving the URL of this and other related stories below-
http://www.indiatogether.org/2004/jul/env-muniswm.htm

http://www.indiatogether.org/2005/jan/env-ragpick.htm
http://www.indiatogether.org/2004/sep/env-vermtoxic.htm

I also worked on a Best Practices manual for city managers brought out by Directorate of Municipal Administration, Maharashtra. We covered about 40 cities of India and what practice they follow for SWM.

I also would like to mention about Advanced Locality Management (ALM) in Mumbai where Stree Mukti Sanghatana has added a feature of organising rag picker women and given them training in ALM. As per ALM, all entities in a locality come together and manage its waste through composting wet garbage and recycling the dry garbage and see that minimum possible goes to the garbage dumping yard. It also creates livelihood and gives rag pickers dignity of labour. Here communities support is the key to the success. Many efforts meet limited success with households not giving segregated waste. In Pune, there is 'Ghanta Gadi' - garbage collection vehicle and initially all gave segregated waste as the system of penalty was followed. When people saw penalties are not levied, now once again all are not serious.

Best option however is to get household wet garbage processed at household level opting for suitable model like balcony, terrace, backyard or collectively for a housing complex etc. Famous Marathi daily 'Sakaal' carries prominently on the top of the city page examples of household waste management and gives a lot of publicity to functionaries/facilities. Yet, there is not much visibility to these efforts and Pune is as littered as any big city.

As for villages, I would suggest backyard processing and developing strong commitment to deposit plastic at an assigned place as depot and gram panchayat takes responsibility to send to recycling. This may sound simple but it needs to be done when you see that thin polythene bags flying all over the countryside, fields jeopardizing fertility of land. This in the long run can badly impact food production.

Ranjini Gupta, Urban Development Department (T&CP), Government of West Bengal, Kolkata

I am working for the Urban development Department, Government of West Bengal. I have been working with sustainable SWM for small and medium towns in West Bengal for over a decade and have studied critically many of the centralized and decentralized SWM activities in different parts of the country. Some of these pilot-scale attempts have been showcased as best practices, but most of them have not been studied thoroughly. These can be either replicated as such or modified according to the location and depending on the socio-economic condition and cultural practices of the people.

The incumbent community needs to be very well apprised of the kind of interventions to be taken, expected results and should be mandatorily involved from the very planning process of SWM through its implementation stage. Local wisdom plays a vital role in selection of appropriate technology, choice of location, priority fixation and the entire planning of the operation. Community participation comes from thorough and intensive motivation through man-to-man campaigning, which is very difficult to pursue but definitely achievable and works like magic.

Most of the rural areas facing critical SWM situation in West Bengal are either fast urbanizing or fast industrializing or both. Urban Development Department is working in many such critical areas. Each case needs to be dealt separately, drawing similarity from existing models. No mechanized plant or bio-culture is likely to succeed without 100% involvement of the community and all such attempts throughout the country till date have failed miserably. Composting (aerobic and vermicomposting) with semi-mechanical facilities for sorting, shredding etc needs to be promoted in a huge way by all governments with all incentives and subsidies to the composters, and mandatory provisions to be made for marketing of the product through fertilizer- producing companies.

I am based in Kolkata and have lots of more information to share. Yusuf Kabir is most welcome to get in touch with me after 5 January 2009.

Uday Bhawalkar, Bhawalkar Vermitech Pvt Ltd, Pune *(response 2)*

There are two ways to process the waste (solid or liquid) – (a) Current destructive microbiology that destroys the food(energy) molecules and leaves behind organic and inorganic toxicity, and (b) – Ecotechnologies (the ultimate is BIOSANITIZER) that convert all toxins into resources(organic food for the soil).

The choice is ours. Former group of technologies also need expenditure of energy and produce greenhouse gases. BIOSANITIZER, on the other hand, uses greenhouse gases from the air, to convert toxicity into resources, without using any external resources.

There are also separation-based technologies that use external resources to partition the pollutants, but end up giving us a concentrate of pollutants that has to be rejected and dumped somewhere. This is just a NIMBY attitude.

Arunabha Majumder, Jadavpur University, Kolkata

The solid waste management system must be sustainable. The solid wastes need to be segregated at source as organic, inorganic non-recyclables and inorganic recyclables. In terms of percentage they are 50%, 35% and 15% (approximately) respectively. Inorganic recyclables, if collected from all sources through organised system, the can fetch good returns. By selling inorganic recyclables Rs 11/- per capita per year can be mobilized. This can be achieved through sensitization and awareness campaigns. House-to-house collection of solid wastes may fetch Rs 1/- per person per month as contribution/subscription from the beneficiaries. Organic solid waste can be converted to organic manure through Windrow process as community initiative.

By selling organic compost, Rs 36/- per person per year can be generated. Actually, 18 kg organic compost will be produced per year from solid waste generated by a person. In the above estimation 200gm/capita/day solid waste generation has been considered.

Hence, Rs 59/- per person per year can be generated through selling of recyclable and compost and contribution from the beneficiaries. SWM program will be successful if communities participate in the programme. Interest-group must be formed in the Gram panchayats. The programme must generate work/employment/earning opportunities. If chemical fertilizer is sold at subsidised rate (subsidy provided by government) the government must also provide subsidy to organic manure/compost. There is a need to consider environmental cost of solid waste generation and disposal.

Uday Bhawalkar, Bhawalkar Vermitech Pvt Ltd, Pune *(response 3)*

Recycling of junk nonperishable industrial goods is an old trade. It is our duty to avoid the mixing of industrial and natural (biodegradable) items. If we tell people that they should avoid mixing, they take interest. People want to avoid extra work, isn't it? They may resist segregation, thinking that is an extra task for them. Use of the right terminology, is thus, very important.

We started the 'wealth from organic waste' movement in Pune since 1980. People are sensible and selfish. They get attracted to wealth. And it is better to be selfish than to be foolish. It is a foolish act to waste 'organic wastes' that actually are 'wasted organics'. The Pune Municipal Corporation (PMC) officials, who carried out 'disposal' so many years, spent a huge budget to educate people that they should 'dispose' the waste properly, in their own premises, taking inspiration from our movement.

People think that 'disposal' is a dirty work that the municipal staff has to do. Only the concept of 'wealth creation' can attract them. Municipal authorities are spending about Rs. 2,000/- per ton of garbage, just to collect and dump it outside the city, creating pollution havoc there. They should pay this amount to entrepreneurs who collect and process the wasted raw material and produce resources out of it. At least the environmental damage of dumping and use of chemical fertilizers will be saved.

On the technology side, one should choose technologies that produce no leachate or greenhouse gases. This leads to production of lower amount of resources. Eco-friendly waste processing is achieved if actively growing plants are there in the processing area.

D. Chandrasekharam, Indian Institute of Technology Bombay, Mumbai

In connection with the query on scaling up solid and liquid waste management I would like to share a paper on cleaning up the Hussain Sagar Lake published by the Environmental Pollution Control Journal.

The paper is titled "Green Power Technology to clean the Hussain Sagar Lake and Support its Neighbourhood Energy Utility," Environmental Pollution Control Journal Vol. 11, No. 5, July-Aug 2008. The same can be obtained from the circulation office in Gurgaon, the address for which is Kanuj Envirotech Pvt. Ltd., B-46, F.F., Mayfield Garden, Sec-50, Gurgaon, E-mail: circulation@epcjournal.net.

Saji Das, BIOTECH, Kerala

We are working in the area of waste management and would like to share our thoughts on the topic.

Social Mobilization

As part of social mobilization, conduct some awareness campaigns among the rural areas. The campaigns should set some objectives like the proper handling of waste and the necessity for the waste management in the future generation. Waste management is also carried out to recover resources from it. Biomethanization or anaerobic digestion which was developed by biotech is the best example for the proper waste treatment and recovering resources from that.

So it is important to initiate an awareness campaign emphasize on the point regarding the ill effects the waste will cause to humans and the proper waste treatment technologies and the benefits that we get by using these cost effective treatment technologies. The excessive waste that is generated should be controlled by taking certain preventive measures. As a part of total sanitation campaigns instead of ordinary toilets we can construct ecofriendly toilets. Ecofriendly toilets are a great innovation of biotech. The methodology used for this treatment is biomethanization. We can generate resources like biogas and biomanure from this treatment.

This will become a best and suitable solution for the energy crisis now we are facing. This will improve our sanitation facilities to a great extend. This will lead to the development of our society and in turn our country. The authorities of each panchayat in rural areas make the SLWM a necessary purpose like the household level toilet promotion. Make a source of waste management technology for e.g. the domestic waste treatment technology (Biomethanization) a strict in every houses. By this way we can make the SLWM a demand driven activity.

Intervention Level

By community level solid waste management we mean house-to-house collection and community level composting. This is the centralized method of treating the waste. This centralized treatment method is one of the expensive methods of treating the waste due to the collection, transportation and the segregation of waste into degradable and non biodegradable.

But if we choose de -centralized treatment method which includes the treatment of waste from the place of its origin itself has got some advantages compared to the earlier one. One of the best examples for the decentralized treatment method is biomethanization or anaerobic digestion. Everyday from households we got many types of organic wastes. These wastes can be treated by the process of biomethanization. By this treatment we will get biogas and biomanure. The fuel can be used for cooking and the biomanure (liquid fertilizer) that we got is very good for agricultural purposes. So the decentralized is more beneficial than the centralized technology. Biotech introduces various decentralized treatment methods. The major advantage of this decentralized methods are they are pollution free, ecofriendly and also it has the capability of complete waste treatment technology. Biotech implements projects suitable to treat biowaste at the domestic level and public institutions like Hostels, Hospitals, convents, slaughter houses etc. Biotech has a long experience in this field from 1993 onwards. From all these experiences biotech will recommends the decentralized technology for the proper waste treatment. It is a 100% waste handling and energy recovery programme which was developed by biotech.

What can be the possible roles and responsibilities of Gram panchayats?

Grama panchayat will conduct awareness campaigns and exhibition regarding the proper disposal of waste and the proper handling of waste. Conduct seminars and make them aware about the harmful effects of waste and the infectious diseases spread due to this. School wise awareness programs will be conducted to make the future generation aware about the proper disposal of waste. Provide financial assistance for all the houses through panchayat and encourage them to install household level waste treatment plants. A fixed percentage of funds provided by government can be used for waste disposal and waste handling methods.

Panchayat authorities can contact some experts in this field and make suitable arrangements for the waste handling. Panchayat wise demonstration programs have to be done for the proper disposal of the waste. These demonstrations will include the domestic waste treatment technologies like the biometanization etc Biotech implements various programs in the state in association with various panchayat. Joining hands with the panchayat biotech implements several programs in various panchayat through out the state and they are 100% successful endeavors of biotech. Biotech implements programme through Anganwadis, schools, and colleges and all other educational institutions for making the people aware about these technologies. Biotech implements plants in the panchayat premises itself. Biotech will provide subsidies for the installation of the plant.

Technology options

In the house hold level one of the most cost effective solid liquid waste management technology is the biomethanization or the anaerobic digestion. The domestic biowaste treatment technology is the best example for biomethanization. It is a technology concerning microorganism. Biodegradable organic waste materials such as waste food waste, fruit and vegetable waste can be treated anaerobically producing methane gas and organic manure. The easily degradable organic waste material mixed with waste water from the house hold is fed into the plant. This waste is converted into gas, which is a good substitute for LPG. This treatment is done with the help of a special type of bacteria called methonogens.

The main content in the gas is methane. Methane gas is a renewable source of energy, which is used for cooking, lighting, running engines and the generation of electricity. The cost involved is low when compared to other fuel. Another bye-product of this treatment is organic manure. It can be used for agricultural purposes. Digested Slurry that we got can be used effectively in any type of soil and for any crop. Biomanure improves the water retention capacity of the soil. This method is very cost effective method because the gas generated from the waste of a 5-member family is sufficient to work a stove for 2 hours every day. So we can save our conventional energy sources. In addition to that it is an ecofriendly treatment method which saves our environment from infectious and harmful diseases. Many technologies are available for this waste to energy program. Most of them are very expensive and complex. Biotech has developed simple and unique system for power generation.

Ecofriendly Toilets: - Another important cost effective treatment is ecofriendly toilets, which was a great innovation of biotech. By the process of biomethanization biogas is generated from the night soil treatment. This is a very good cooking fuel. This ecofriendly toilet is working effectively in many houses.

Institutional plants are located in public institution like markets, slaughterhouses etc. In these places the quantity of waste is very large. In these places the waste is collected in separate bins so there is no need for the segregation of waste. These waste are fed into the plant .These waste are converted into biogas by the process of biomethanization or anaerobic digestion. This gas is mainly used for power generation. This power can be utilized to meet in house requirements of the treatment plant and local electrification like street lighting. The waste content in the treated slurry is filtered and it is reused for the regular operation of the plant. So there is no chance of pollution from the treated water. The solid residue can be collected and used as a biomanure. With the technical guidance of Biotech, several local bodies have utilized the waste to energy projects in the state. All these plants are functioning very well. Kerala's first waste to electricity project was implemented by Biotech in Pathanapuram Gram panchayat of the Quilon District during 2003-2004.Biotech also implemented the first integrated waste treatment plant in Kadakkal market in Kadakkal grama panchayat, Quilon district, Kerala. This plant has the capacity to treat 1 tone of solid waste and 500 liters of animal blood and wastewater everyday.

Another best example is the plant which was installed in Kumbalangi village. Because of this plant the panchayat had find a permanent solution for the environment problem they had faced for the last years.

Pre Digesters developed by biotech:-This technology is mainly meant for slow degradable vegetables and green plant parts. The technology used for this treatment is same as the biomethanization. In this technology predigestors are used along with the main digesters. Main digesters are used for easily degradable waste. Pre digesters are used for slow degradable and green plant parts. After the treatment in the leach bed it is poured into the main digesters. About 20 days these slow degradable and green plant parts get treated and converted into biogas and manure.

What are the cost effective technology options for conservation and cleaning of ponds in the villages?

As an organization engaged in waste management we would like to say something about the conservation of ponds. Proper and frequent cleaning of ponds is not easier. To conserve the pond first we have to prevent water pollution through the mixing of waste water from the external drains.As a preventive measure in the nearby houses of the ponds install domestic biowaste treatment plants and ecofriendly toilets.

I am also putting my suggestions for the conservation and cleaning of ponds. When cleaning ponds we can do a periodic cleaning of skimming out the debris but it is also necessary to do a thorough cleaning once a year. This requires a very physical scrubbing of the entire pond. When cleaning pond we need to remove the fish and plants. Add a dechlorinating tablet to the water. Using a net catch the fish and gently place them in the container in a shady spot. After that drain as much as water as possible from the pond. Then scrape out the mud and debris that has attached itself to the walls of the pond. The silt and the debris from the pond can be used as a good fertilizer. After cleaning the pond, put back some old water into the pond and fill the rest up with new clean water.

Waste is directly linked to the human development, both technologically and socially. So it is very necessary to find out a proper waste management technology and a proper solution for the scarcity of power**.** All the technologies which were developed by biotech is a complete waste disposal programs and a permanent solution for the scarcity of energy sources. By all these technologies we can make each and every house an energy producing centers. So we can make dream of our father of our nation a practical one –a self sufficient India.

BIOTECH- Organizational Background:

BIOTECH-Kerala, in South India is a registered Non-Governmental Organization (NGO). The main activities of BIOTECH from the very inception of the organization involve promotion, implementation, training and R&D, and also the creation of awareness in the field of conservation Renewable Energy by waste management. BIOTECH is specifically focusing on implementation of Eco-friendly organic waste management scheme for power generation as a sustainable alternate source of conventional energy and for carrying out this message to the people at the grass-root level by creating effective awareness in the field throughout the country.

BIOTECH had successfully installed around 12,000 family size plants with the financial assistance from MNES/MNRE throughout Kerala state and also with the active Co-operation of the local bodies.

Another milestone of BIOTECH is the installation of Kerala's first Bio Waste Treatment Power Generation Plant at Pathanapuram Grama Panchayat in the Kollam District for generating 3KW electric power from the market waste. After the successful completion of the above said project, 26 Grama Panchayats in Kerala State came forward for the installation of such plants and BIOTECH completed the installation of the power generation projects using market/slaughter house waste with capacities ranging from 3 KW to10 KW.

The power generated from these projects is being utilized for energy requirements of the concerned markets and to meet the in-house requirements of the projects. These power projects had won the appreciation of Ministries, District Collectors and other public men of repute. BIOTECH had created awareness among the people of Kerala by conducting users program with the financial assistance of MNES/MNRE. These programs enabled BIOTECH to reach the beneficiaries who need our help services and feedback.

BIOTECH focuses special attention on production of renewable energy from waste, after treatment, by adopting different technologies. BIOTECH helps to reduce the accumulation of waste, which in the long run ameliorate the natural hazards like, climate changes, global warming, etc. By applying suitable scientific methods, the waste materials are being treated to generate energy such as cooking gas, electricity etc to be the utilized for various purposes. The residue left behind the plant after the treatment will also be used as good manure.

Different models of plants for the treatment of waste, according to the requirement of the consumers and nature of waste, have been developed by BIOTECH. These models cater to the needs of different categories of beneficiaries such as domestic households, public institutions like hospitals, schools, hostels, convents, etc. and also local body establishments like panchayats, municipalities, corporations, etc for treating wastes generated in the fish and vegetable markets and slaughter houses.

BIOTECH also renders consultancy services, for the preparation of projects, conducts feasibility studies and under takes project implementation as well.

International Ashden Award

In recognition of our services to society through our system of waste management and the generation of energy from waste BIOTECH was honoured by conferring on it the International Ashden Award "GREEN OSCAR 2007" during June 2007 at London, U.K. The august occasion was celebrated at Royal Geographical Society, London in the presence of specially invited guests and the Award was presented by the chief guest Mr. Al Gore formerly the US Vice-President and a well known environmentalist and the winner of Nobel Prize for PEACE for the year 2007.

For more details please contact BIOTECH at the address provided below:

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Jayakumar C., Thanal, Thiruvananthapuram

Thanal has been working on the issue for quite some time with a new approach to waste management. We are extremely happy to share with you that the state Government of Kerala took the idea and created several operational documents and is implementing the programme here in Kerala.

The "Shuchithwa Mission" is in charge of coordinating the efforts. We attach two documents and will be extremely happy to share more insights if you feel the need. Please visit http://www.solutionexchange-un.net.in/environment/cr/res-15120801.pdf (PDF; 2.10MB) and http://www.solutionexchange-un.net.in/environment/cr/res-15120802.pdf (PDF; 620KB) for more details. You can send a team to Kerala for looking at the progress of the work.

We also had worked with UNDP facilitated ETP and we have made a handbook for waste management in rural tourism areas and it address the issue of technology choices and lays out the options and how to choose very clearly. In addition, it also lays out the way once could go forward. The book is yet to be published and the Copyright is with UNDP so we cannot share the same with you. You may contact R.K. Anil at r.k.anil@undp.org for the soft copy as the same.

I feel the challenge in addressing the issue is to create good awareness with out which all technology will fail.

Asit Nema, Foundation for Greentech Environmental Systems, New Delhi *(response 3)*

It is intriguing that the moment we talk about municipal solid waste treatment and disposal, questions of resource recovery and financial self-sustainability are raised. Why is it that the same level of questioning is not done on another reject of the individuals and the society that is human excreta? Both are negative externalities, aren't they?

How do we expect that solid waste treatment and disposal should pay for itself? It is not like a raw material or feedstock going to an industry and then coming out as a value-added product which can sell at a high premium. Solid waste treatment is about reducing the volume of waste (or in terms of the language of economists – reducing negative externality) that needs to go to a landfill and not about making money from trash, least of all, 'wealth'. It is about minimizing the potential collateral damage that can occur to public health. It is about reducing the health and environmental costs.

All 'mixed municipal solid waste' treatment plants which are set up with the objective of making 'wealth from waste' are an attempt to defy the might of the **First and the Second Laws of Thermodynamics**. A case study of several dysfunctional treatment plants across the country carried out in 2005-06 brought out more than 50 risk factors – both inherent and external. This overwhelming level of involved risk can only be explained with the help of the Second Law of Thermodynamics. As per this law, mixed municipal solid waste can be classified as a material with the highest degree of entropy (disorder) (as against any other industrial raw material). It not only contains the tempting 50% organics, but also 50% of abrasive and corrosive materials, which eat away the plant and machinery very soon.

Similarly, the system as a whole, starting from the point of generation to collection, to transport and disposal, is characterized by a very high degree of systemic disorder/entropy. Therefore, feedstock delivery in required qualities and quantity and as per desired schedule of the plant operator cannot be ensured.

It is because of these profound reasons that the Lucknow biomethanation/anaerobic digestion plant was closed down within 6 months of commissioning; the Thane compost plant was dismantled under court intervention due to odour problems; the Trivandrum compost plant operator exited after six years of engagement and took a compensation of Rs. 5 crore from the corporation; several compost plants in Delhi and other towns across the country are not performing to their designed levels or have closed down; the RDF plants in Baroda and Mumbai have been dismantled and the recent one in Vijaywada closed down last year; and the classic mass burn plant at Timarpur (Delhi) was also closed down way back in 1988 within 6 months of commissioning.

You will notice that these illustrations cut across all technology options available in the country and are spread over different geo-climatic regions and, therefore, the failures are just not specific to any one factor but must be attributed to profound systemic limitations and weaknesses, besides, of course the technological limitations. It is in recognition of such limitations that in some advanced countries a 'gate fee' (payment against everything accepted at the plant gate) has been introduced to compensate the operator and sustain his interest in running the plant.

The failures of the RDF and Mass Burn plants must also be appraised through the **First Law of Thermodynamics**. As per this law 'energy can neither be created nor destroyed', it can only be converted. Since the feedstock from MSW has low intrinsic energy (low calorific value, in the sector parlance), it is because of this Law that the operator has to invariably provide supplementary fuel in the form of biomass (e.g., rice husk, wood chips, etc.) or LDO/HDO to sustain the combustion. Now, it's the cost of the supplementary fuel which undermines the financial sustainability of such plants and therefore, here again the need for a 'gate fee' is strongly perceived. Since a proportionate and reasonable gate fee is not available, the operators are forced to shut the shop in a short period of time when the gap between the operating costs and the projected revenues starts hurting.

Last but not the least, we need to appraise all MSW treatment plants based on the **'Law of Diminishing Returns'**. MSW, the feedstock to the plants is at the end of its useful economic life and any further attempt to process it and bring about value addition will only yield marginal returns in relation to the overall investment. We find that all such plants are not financially sustainable as stand-alone business ventures, i.e., as in the 'waste to wealth' paradigm. (Please note that recovery by informal sector i.e., rag pickers and kabariwalas is not on the wealth paradigm but on the livelihood paradigm).

In this regard we have posted two papers on our website, viz., 'Risk factors associated with solid waste treatment technology options in the Indian context' and 'technological challenges in municipal solid waste treatment'. These papers are available on http://www.green-ensys.org/site/research_publication.html. In addition, last year we had developed a Project Note on behalf of the INDO-US FIRE(D) Project entitled 'Bioreactor Landfill – A Sustainable Option for Municipal Solid Waste Treatment and Disposal in India' for wide dissemination within the community. (http://www.solutionexchange-un.net.in/environment/cr/res-15120803.pdf) (PDF; 95.1KB).

In the light of the above arguments we need to objectively look at the sustainability of large investments which are currently underway as a part of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) in several cities across the country. A robust and least risky option under urban context would be a combination of a mixed waste sanitary landfill complemented by a small capacity compost plant, the latter just to provide daily covering material, not to meet the organic carbon demand of Mother Earth.

Regarding solid waste treatment in rural areas, drawing a parallel from the above referred Project Note, with the specific requirement of the current query re-solid waste treatment in rural context, I believe trenching (equivalent to a micro-landfill) is the least cost option which involves no risks of plant/process malfunction but guarantees public health and aesthetics all the time. All it requires is labour input which

can be arranged under the National Rural Employment Guarantee Act (NREGA). Further, in case the waste contains a relatively higher fraction of organics, then the stabilized material could be mined after about a year and used as soil conditioner after screening.

Chicu Lokgariwar, People's Science Institute, Dehradoon

It is heartening to see attention being focused on waste management in rural areas. In most isolated villages, the waste generated is largely bio-degradable, and as has been discussed is eaten by animals.

Non-biodegradable packing (plastic and glass containers, bags) is stringently reused. Most of the waste generated is by low-thickness plastic bags and tobacco (*gutkha*) packets. This is on the rise, and more so in road-side villages. Here there is considerable, and increasing, use of polythene for packaging, and consumption of foods that are invariably sold in foil packets. The collection and disposal of these is challenging, and I am looking forward to the rest of this e-discussion. Lack of the perceived need for waste management in rural areas seems to be a major hurdle we need to clear. The quantities of garbage encountered on hill slopes while visiting any village in the Himalayan foothills are considered an eyesore and a health hazard by visitors, but rarely noticed by the villagers.

While segregation and collection at the household (and tea stall) level is the single most efficient way of managing garbage, it can only be successful in areas with a high level of awareness. Otherwise, setting up a system to deal with segregated garbage tends to intensify the problems when effective segregation does not take place. Imposing a demand for sanitation does not always work. This need will arise from within the community once the benefits are visible. I would suggest starting with the establishment of a fairly efficient system for waste collection, segregation and disposal. Once the benefits are seen, and the importance of segregation is understood by the community, then household segregation may be encouraged.

The steps for such a system (extremely simplified for the purpose of a preliminary discussion) could be:

1. Survey of the village area with attention paid to places where garbage is thrown/ collects.
2. Placing sturdy bins at these places.
3. Employing staff for sanitation- including collection, segregation, and disposal, and providing them with equipment for safety.
4. Setting up a system for clearing garbage bins daily, or at least twice a week.
5. Setting up systems and places for disposal of segregated garbage (composting, recycling/sale, and landfill)
6. Encouraging segregation in areas where most of the garbage tends to be of a particular type (organic matter near vegetable vendors, and plastic/foil at tea stalls)
7. Encouraging roadside roadside eateries to set up vermicomposting units.
8. Some incentive may be offered for segregation (point 6 above) and vermicomposting. This need not be monetary – recognition in the form of a certificate (renewed annually) would also work.

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

Resource recovery from any waste is not a problem; however, to make the system financially self-sustained is a major challenge, particularly while dealing with human waste or solid waste management. In my view solid waste management is more a social problem than a technical one, particularly in a developing country like ours. The examples of failures of waste management technologies/system as highlighted by Asit Nema are mainly due to the fact that social issues were ignored/not covered properly under the project. We know that composting or biogas generation is possible only from bio-degradable wastes. For that purpose segregation of wastes at source is perhaps the most important and also the weakest aspect of the system.

Social issues should be undertaken through adequate awareness, education for local people. Our society is mostly heterogeneous in nature with respect to socio-economic and cultural aspects that makes the social issues even more challenging. Proper social marketing of waste management involving local community can help solve the problem. Lucknow Biogas plant failed due to the fact that unsegregated wastes containing debris and everything were dumped into the plant. There was no any campaign or system of segregation of waste at household level for generation of biogas from such a large capacity biogas plant.

There are several examples of success of biogas generation from wastes in different parts of India. Now the Ministry of New and Renewable Energy (MNRE) has also realised that projects for biogas from wastes should be encouraged only where proper segregation of waste is practiced. There are several examples in developed countries where waste management is not only self-sustained but also a profit-making business.

Ashok Ghosh, A N College, Patna

Ecotechnology is an emerging concept, which can be effectively utilized for bioremediation of highly polluted ponds and lakes. Ecotechnology may be viewed as artificially designed macro-ecosystems based on ecological principles in order to achieve desired degree of treatment (wastewater treatment, and water body restoration). The following two structures may be utilized for this purpose, independently or jointly:

1. Subsurface flow Constructed wetland (SFCW) Treatment System
2. Artificial Floating Islands (AFIs)

The fusion of both the systems has been already used for restoration of stagnant water bodies after comprehensive evaluation of pollution load reduction efficiency of individual system by students at the Department of Water and Environment Management, AN College, Patna.

Artificial Floating Islands (AFI) can be developed very easily with resources readily available in rural and urban areas. Each indigenously fabricated floating platform skeleton can be manufactured by using bamboo as tough and buoyant material. The two layers of criss-cross heavy-duty bamboo skeleton has a thickness of 10 cm between top and bottom surface in which coconut coir is stuffed in layers as a base for plant growth and an anchorage medium because coconut coir serves as a soil substitute. The structure is very buoyant and floats freely on water. The buoyancy in AFI is initially developed by using heavy duty high-density polyethylene floats and later the hollow rhizomes increase buoyancy.

Reed Grass (*Phragmitis karka*) can grown on AFIs. Reed grass is an 8-foot tall angiospermic plant with luxuriant plant growth and high nutrient uptake. Its root systems adsorb particulate matter of water column. It can also remove nitrate, TKN and BOD very fast and purify polluted water. It also acts as marvelous habitat for fish. AFIs invite birds for nesting and in turn serving as floating ecosystem. Tender roots and slimy layers are microbe-friendly, that assist in bioremediation. Sponges like attachment in the bed provide substratum for the growth of Friendly animals. Presence of waste degrading friendly animals in reed root coir matrix help in cleaning the polluted water. The following parameters show marked decrease through this technology:

1. T.S.
2. T.S.S.
3. T.D.S.
4. T.K.N
5. NH_4-N
6. NO_3-N
7. BOD.

The following parameters show marked increase through this technology:

1. Dissolved Oxygen (DO)
2. Transparency of water

It can be concluded that by installing two types of constructed wetlands in combination, that is the land based Sub-surface flow constructed wetland (SFCW) to intercept the ongoing wastewater stream, and secondly the AFI on the stagnant water body, receiving the wastewater stream, are low-cost, nature-based eco-technologies. The combined package seems to be a long-term and sustainable option for overall treatment of sewage-polluted water body. If anybody is interested, we can provide this technology for remediation of ponds and lakes.

Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad

The Suryapet Municipality has shown how social mobilisation, inspiring leadership, committed team work and adoption of simple technology can become four pillars for the success of solid waste management at town level. The initiative went on to win accolades and the first prize set up by IL&FS on urban management last year at the India Urban Space 2007.

Andhra Pradesh Urban Services for the Poor (APUSP) has taken inspiration from it and worked on it to some extent although it did not meet with the same level of success but some ULBs like Kapra municipality have shown good progress in that direction. An evaluation of the programme and learnings were documented by me in a Report "Evaluation of DFID support to Andhra Pradesh: Lessons learnt from Municipal Service Delivery".

Please visit http://www.solutionexchange-un.net.in/environment/cr/res-15120804.doc (DOC; 3.2MB)for more on the lessons learnt from the Solid waste management initiative of the DFID funded APUSP. The complete document is available with CGG/DFID India.

Puran Singh Yadav, Haryana Institute of Rural Development, Karnal

Gandhiji actively advocated for sanitation and believed cleanliness is next to godliness. Wherever he went he appealed for sanitation. He was unhappy with the contemporary sanitary conditions in rural areas. Regarding village sanitation Gandhiji observed that “Divorce between intelligence and labour has resulted in criminal negligence of the villages. And so, instead of having graceful hamlets dotting the land, we have dung heaps. The approach towards many villages is not a refreshing experience. Often one would like to shut one’s eyes and stuff one’s nose, such is the surrounding dirt and offending smell.” He further observed that “a sense of national or social sanitation is not a virtue among us.” Gandhiji considered sanitation above independence. He once said, “Sanitation is more important than independence.”

Therefore, he included village sanitation in his ‘constructive programme’. He wanted to inculcate sustainable sanitation among the villagers so that they take care of their surrounding themselves. Though independence was achieved, rural sanitation remained the most neglected area in the post independence era. The rural scenario is certainly not a refreshing experience even today. People defecating in the open, heaps of dung and garbage lying in and around the village, the wastewater spreading in the streets and stinking village ponds present – is a common village scenario today.

To my mind, the problem of village SLWM is not much different from the urban area in this age of globalisation, with penetration of modern culture into the remotest areas. With the increasing use of packaged items and polythene in daily routine, changing food habits and living styles, the problem of SLWM is almost similar in rural and urban areas. Polythene is the biggest menace in rural areas as in urban areas. The village drains are generally found blocked/choked with polythene. Heaps of polythene is seen floating in the village ponds. Polythene is spread all around. The other area which requires attention is management of cow dung in the cattle based rural economy. With the provision of piped

water supply, management of the grey water is also becoming a problem. Village ponds, once the source of fresh water, have become cesspool of wastewater due to flow of village wastewater into these ponds. These ponds also act as breeding grounds/hatcheries of mosquitoes.

How do we handle the situation? It is possible with the dedicated, concerted and sincere efforts of all? I forward the following lines for consideration in reference to the request from Yusuf Kabir.

Social Mobilisation

Taking the queue from Gandhji, community based SLWM is the best option, if possible. The village community needs to be motivated to make sanitation a way of life. How to mobilise village community for sustainable SLWM is a million dollar question in this age of self-conceitedness. Community mobilisation is possible only through creating awareness among the rural community about the hazards of insanitary conditions caused mainly due to solid and liquid waste. The community should be educated and made aware about how such waste contaminates our food and water sources and pollutes community environment and causes the spread of deadly diseases like cholera, diarrhoea, malaria, hepatitis, etc. There are different tools and techniques of community mobilisation.

Inter-personal communication is best tool to mobilise the community for SLWM

Further to the above, community mobilisation has become a buzzword these days. But it is not something, which can be brought about by 'mantra'. Routine kind of strategy cannot work in SWM. Community mobilisation requires dedicated, motivated and socially oriented paid volunteers having leadership qualities equipped with finest of community mobilisation skills and conversant with low cost SLWM technologies. Such people are generally found missing in the society due to multiple reasons. These volunteers/motivators should focus on the different groups like school children, women, youth and old people. The community needs to be made fully aware that waste can be converted into source of income generation. With the said provision of funds under TSC, few SLWM model are needed to be created for the purpose of demonstration as the funds available under this head of TSC are not sizable.

Level of Solid Waste and Viable option

For sustainability and viability, solid waste management needs to be taken up both at community level as well as individual/household level. For example, for management of cow dung and domestic bio-degradable waste, vermicomposting should be popularised at individual as well as community level. Management of non-bio-degradable waste should be taken up at community level by the Gram Panchayats. Management of non-biodegradable waste can be taken up at cluster level also. For the community as well as cluster level solid waste management, mechanism for household waste collection needs to be worked out and laid down. Gram Panchayats should engage paid workers for collection of door to door waste. The waste processing should pay for itself. It should become an income generating activity.

Role and Responsibilities of Gram Panchayats

Gram Panchayats have crucial role and greater responsibilities for SLWM. Gram Panchayats should arrange for awareness campaigns about the hazards of solid and liquid waste and benefits of proper SLWM in collaboration with technical experts, NGOs, Officials and village community. They should engage paid garbage collectors and arrange for transportation of garbage at processing point. Gram Panchayats should organise monthly or bio-monthly or quarterly cleanliness campaign in their respective villages. Gram Panchayats should formulate Vigilance Committees in the villages to help villagers to make SLWM a way of life. Gram Panchayats should introduce awards for clean households, etc.

Technology Options

1. Ministry of Rural Development and d UNICEF have brought out a Manual "Solid and Liquid Waste management in Rural Areas: A technical Note ", which contains various cost effective household level SLWM options like household soakage pits for management of household waste water. This is best effort ever made by MoRD and UNICEF. Wastewater generated at the household level

should be absorbed at source through soakage pits. Kitchen gardening, wherever possible is another option for absorption of household wastewater. Windrow composting and vermin composting are two best cost effective technologies for management of solid waste at household level.

2. Duckweed technology is being tried in Punjab for cleaning of village ponds. Pisciculture can also be taken up for conservation and cleanliness of village ponds. Wetland stabilisation is another option. Jal Kumbhi is another option, which should be tried only in controlled conditions. Punjab State Council of Science and Technology has done some pioneering work in this field. Dhamner (Satara) Maharashtra model can also be taken up for maintaining village ponds. The manual as mentioned above explains various technologies for management of waste water before the same enters into the village pond.

In the end I would like to say that only teams of dedicated, motivated, paid volunteer workers can bring about a change in the SLWM scenario in rural areas and not the routine kind of planning.

Atul Rawat, DMV Business and Market Research Pvt. Ltd., Hyderabad

I work as an energy analyst in Hyderabad. I believe that Gram Panchayats can play a significant role in scaling up solid and liquid waste management. With the help of their respective Ward/Panchayat members, Gram Panchayat can spread the message at the micro levels. It will help people in understanding the benefits of waste management in their own language and through their own people.

Social mobilisation can be brought about though publicity and knowledge imparting (training) campaigns, using local volunteers and by educating common people about wastewater and sanitation techniques. It is also important to encourage people to use cost effective solid and liquid waste disposal mechanisms like drainage, soak pits, kitchen gardens, etc.

Arun Jindal, Society for Sustainable Development, Karauli

Social Mobilization

How can we make SLWM a demand-driven activity just like household-level toilet promotion under TSC in rural areas? Liquid waste is generated by households and SLWM can involve communities at household levels by cleaning campaigns in the streets or wards. SLWM should be linked with community mobilization.

Intervention Level

Is community-level solid waste management (house-to-house collection and community level composting) a sustainable and viable option for rural areas? Since rural communities generate less solid waste and more green waste, solid waste collection may not be useful in rural areas. One can think of cleanliness drives and weekly waste collection may be useful.

What can be the possible roles and responsibilities of Gram Panchayats? Gram Panchayats ought to take a major responsibility in cleanliness drives and if someone does not adhere to the rules, Panchayat may have the power to take action against them.

Shantilal Nagpure, Dhapewada Village, Madhya Pradesh

I would like to thank Abhishek Mendiratta for his inputs. I am the Sarpach of Dhapewada Village, Balaghat District, Madhya Pradesh. Our village is in the process of receiving the Nirmal Gram Puruskar

soon. However, I would like to draw your attention to the fact that accessing funds for taking up TSC and SWM has been a constraint for the village.

I would also like to state that there are some practical problems, which the Panchayati Raj Institutions face at the grassroot levels. These need to be addressed to attend to the issues of SLWM. I would also be happy to receive any guidance from Abhishek Mendiratta regarding accessing funds for TSC.

Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi

We the members of the Water Community are happy to know that the Gram Panchayat of a village in Madhya Pradesh has picked up the concepts of SLWM and are confident that the same can be applied in the village.

It is good that such stories are documented through the Water Community and can thus be replicated in more villages. There is a need for networking among members regarding such stories so that the same may be replicated, just as it is important to use appropriate technologies for sustainable development and SLWM.

Many thanks to all who contributed to this discussion!

If you have further information to share on this topic, please send it to Solution Exchange for the Water Community in India at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-watr] DISCUSSION: Scaling up Solid and Liquid Waste Management. Additional Reply."
