Sustainable Decentralized Model for Solid Waste Management in Urban India

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ABSTRACT

This paper attempts to assess the various factors that govern the sustenance of a decentralized solid waste management system in urban India. Towards this end, two decentralized composting facilities (one operational and the other closed) were studied both of which were started at the same time in Bangalore. The parameters covered under the study were the technology and the technical expertise, managerial influence, economic viability, community support including the socio- economic status of the community and the influence of parallel government schemes. Our findings indicate that success and long-term sustainability of the model depend on sustenance parameters to a varying degree. It also seeks out those factors that need to be addressed if the system is replicated in other urban settings.

Introduction

Waste heaps piling up are a common sight in most of the cities and townships of India. Exploding populations and changing lifestyles are generating enormous amounts of waste. Studies have revealed that the quantum of waste generated varies between 0.2 - 0.4 kg/capita/day in urban cities and goes up to 0.5 kg/capita/day in metropolitan cites. Municipal agencies spend 5 - 25% of their budget on MSW management, which is Rs 75 - 250/capita/year. In spite of the various measures to treat waste the ULBs are currently unable to satisfactorily fulfill their general duties. This has resulted in health problems such as diarrhea, cholera and malaria among the masses. The quality of life has depleted and manpower has become less due to this increased disease frequency.
Of the total MSW generated in India, 30 - 40% consists of organic waste, 30 - 40% ash and fine earth, 3 - 6% paper while a meagre proportion of less than 1% accounts for plastics, glass and metals. The following table shows the MSW generated per day in 6 city corporations of Karnataka.

City corporation	*Population*	*Waste generated (tons/day)*	*Waste collected (tons /day)*	*Per capita waste generated (grams/day)*
Bangalore	5,882,162	2500	1400	425
Mangalore	5,51,701	250	200	453
Hubli/Dharwad	80,442	250	200	311
Mysore	794,677	230	183	289
Belgaum	516,155	120	100	232
Gulbarga	452,944	120	100	264
Total	8,999,081	3,470	2,183	386

Table 1: MSW generated in 6 city corporations of Karnataka

At present, in the municipality of Bangalore, the corporation lorries and staff carry the waste collected from the residents and bins to dumping areas. Private contractors

selected by a tendering process to clear and take away the waste also supplement this effort. In several wards, door-to-door collection has been introduced with BMP employees playing a major role in collecting and transporting the wastes away from the residential areas. The KCDC (Karnataka Compost Development Corporation), Sunrays composts and Terra Firma get their wastes from the BMP lorries and compost the organic part of the wastes. This centralized scheme poses problems in that the wastes are not collected in an efficient manner. It is thus a common sight to see overflowing garbage bins at the public collection sites.

One of the obvious advantages of a decentralized system is the improved aesthetic condition in the locality. Also it will not require a secondary collection service by the municipality. Decentralized schemes provide better income and employment options to the underprivileged sections of the society.

The legal framework of the country, headed by the Honorable Supreme Court of India has given support to community based waste management schemes through a national legislation – the Municipal Solid Waste (Management and Handling) rules, 2000 (Ministry of Environment and Forest, 2000). One section of the rules requires the urban local bodies to promote and implement waste segregation at the source. The community can thus avail of legal backing for its decentralized initiative for municipal waste management.

In light of this aspect a study was undertaken to ascertain the various parameters governing sustainability of a decentralized composting unit in urban India.

Method of study

It was a challenge for the authors to determine the parameters, which make decentralized models successful. After a brain storming and literature search session, the authors have zeroed in on the factors given below. For a case study, two existing decentralized facilities were selected in Bangalore and the data collected through an informal interview with the personnel manning the facility and the management, besides field observations as regards the operation of the facilities. Care was taken during selection of the two facilities that one is operational and the other not. The functional model has been in operation for 11 years and the non-operational while being functional for 8 years, closed down in 2005. Hence, most of the information collected at the latter facility is by means of informal interviews with the management. There was thus no opportunity to interact with the workforce. A brief review of the sustenance factors that were considered and discussed are given below.

Technology and technical expertise: Any waste treatment venture adopts a specific technology for treating the wastes it receives. The selection of the technology and the skill with which it is carried out reflect the sustenance values of the venture.
The technology's influence on the running of a model is assessed through its simplicity, economic viability and the skill with which it is executed. Also it is evaluated in terms of its ability to address every aspect of materials present in the Municipal Solid Waste.

Scientific Handling of Wastes Society at Dollars Colony

Managerial hierarchy*:* The management's role, involvement and attitude are keys to the success of any venture. Hence the initiatives taken up by each management were studied. In addition, discussions were held with day-to-day operating personnel to understand their perspective and a relation was drawn between management and sustainability of the operation.

Economic viability: An economic analysis was undertaken to understand the overall costs and benefits involved in the project. Income and expenditure details of the project during commissioning and operation were collected to see whether the project was capable of making profit and sustaining itself for a long term. The income was calculated based on the amount generated from door to door collection and sale of byproducts and products. Expenditure was figured out through the operational costs in terms of rent of the allotted area, salaries, consumables, electricity and water bills. Also depreciation costs (at an assumed rate) for hardware installed at the facility were added to this expenditure on an annual basis to arrive at the total expenditure.

Community support and socio-economic status: Since these facilities are one of a kind, intellectual (in terms of scientific advisors) and financial support were received from senior citizens, municipalities and local residents. Due to such a support, an adequate working capital was built to run the facility for some time till it started generating revenue. In community initiatives, the support of the residents is very crucial either in

terms of segregation at source or paying the monthly or even tolerating the odor and spillages during mishandling.

Parallel government initiatives: A parallel government initiative to treat the Municipal Solid Waste can have serious repercussions on an existing community based venture. The BMP *(Bangalore Mahangara Palike)* has introduced the *Swaccha Bangalore* scheme on a centralized basis, which collects and disposes of the wastes from its many wards. This could have had an effect on the projects under study and it was thus a factor that was looked into.

Observations

Technology and technical expertise

While both the units under study made use of aerobic bin type composting systems, subtle differences were noticed in the method of executing the process. The following table highlights these differences

SHOWS	RISE
Three-stage segregation is practiced. The first segregation is done at the source followed by twice at the unit. This multiple segregation of incoming garbage ensures complete separation of organic and inorganic wastes.	Incoming garbage is segregated only once at the unit leading to inerts and toxins finding their way into the composting stacks thereby affecting the composting process adversely.
Kitchen and leaf litter wastes composted separately ensures that different qualities of compost are generated separately.	No attempt made to segregate the kitchen waste from the leaf litter.
Adoption of forced aeration technique using blowers ensuring speedy composting and better yields. Turning over of the disintegrating garbage is thus required at fewer intervals.	Natural aeration without any electric power was adopted. This was achieved by means of a system of air holes in the stacks. Turning over the disintegrating garbage regularly ensured uniform aeration.
The process is made completely odor-free by use of multiple deodorizing agents. This is very important, as the site is located amidst the community.	A single deodorizing agent namely charcoal on a sand bed was used leading to the emission of a foul smell in the surroundings and related complaints from the residents.

Table 2: Technological analysis of SHOWS and RISE

All these technical superiorities in the case of SHOWS have resulted in a speedy composting time of 90 days as against the 120 days required by RISE. Advanced

scientific approaches towards the carrying out of the selected technology at SHOWS such as forced aeration and separate composting of kitchen wastes and leaf litter have ensured greater efficiency in treating wastes while keeping the unit free of technical hassles. Also, multiple segregations practiced at the unit ensure the entry of only composting fit matter into the unit.

Managerial hierarchy

Differences were noticed in the managerial system at the two units. While these may not have played a major role in their sustainability, these differences are nevertheless highlighted.

SHOWS	RISE
Well organized system	Less organized system
Better worker to household ratio (1 worker per 100 households)	Worker to household ratio comparatively higher (1 worker per 160 households).
Presence of a supervisor for monitoring the unit.	Absence of a supervisor.

Table 3: Managerial Systems at SHOWS and RISE

An important factor to be looked into is the presence of a supervisor. This is an added advantage in terms of monitoring the technology and keeping it free of technical hassles. Also the supervisor can look into technical improvements and correction of technical failures at the unit. It would also be his responsibility to replace the workers if necessary. Additionally, in case of the municipality grants being withdrawn at any point of time, the supervisor is handy for collecting the user charges that would then be levied on the households.

Another important factor seen in SHOWS is the commitment of the management to remove unpleasant thoughts associated with the project from the minds of the residents. Every effort has been made to make the site cater to aesthetic values like the planting of a bamboo patch bordering the site. This could also act as a deodorizing factor. Such initiatives by the management are crucial steps towards enlisting community tolerance of the project. SHOWS is kept functioning largely due to the commitment of the group of people directly involved in the operation and management of the system.

Economic viability

A sustainable venture should also support itself economically. The study also looked into the economic viability of the ventures to determine whether the model could be replicated in another set up.

SHOWS:[1] Capital investment: Rs.2.6 lakhs on the setting up and infrastructure of the unit.
Number of households covered under the project: 500

Parameter	*Cost per month in Rupees*	*Cost per annum in Rupees*
Manpower a) Supervisor (Rs.4500 per month) b) Workers (Rs.1800*5) per month	13, 500	1, 72, 000
Electricity	800	9600
Water	Minimal	Minimal
Consumables	800	9600
Total	15, 100	1, 91, 200

Table 4a: Operational expenditure

Parameter	*Monthly income in Rupees*	*Annual income in Rupees*
Residential collections	------	------
Annual grants	------	1, 00, 000
Residents Welfare Association	2, 500	30, 000
Sale of compost manufactured	5, 100	61, 200[2]
Total	7, 600	1, 91, 200

Table 4b: Revenue generated

It is observed from the above deductions that if the annual grants were withdrawn the resultant deficit would have to be borne by the residents. This works out to Rs.200 per household per annum (or Rs.20 per household per month app.) to cover the operational costs. This low user tariff gives the system a high sustenance quotient. A key factor to be noted is that SHOWS does not charge the residents for the services it offers. Its services are free as it is funded entirely by the municipality. This accounts for its higher acceptance and is also accountable for its efficient operation through the years.

[1] Data for RISE unavailable for a complete economic analysis.
[2] At an assumed rate as data available was not sufficient.

Community support and Socio-Economic Status

A community based venture must avail of institutional support, as the community itself may not be equipped to provide for the initial and operational expenditure of the unit. The table highlights the scenario witnessed in the projects under study.

SHOWS	RISE
Initial investments supported by the BMP	Initial investments supported by Prestige group.
Avails of an annual grant by BMP	No municipal support received for the venture
Avails of some amount of residential support in terms of sponsorship of electricity and water charges, uniforms for the workers	Residential support totally absent

Table 5: Community support availed by SHOWS and RISE

It is observed that RISE, which was not supported by the government as also the community, collapsed halfway through the operations. Initial capital being funded by an organization alone does not ensure its sustainability in the long run. The initial investments have to be supported by grants to ensure smooth functioning. It should be in the interest of Urban Local Bodies to provide for the setting up of community based composting schemes by providing monetary support.
Studies were also conducted on the socio-economic status of the communities involved and it was found that this did not have a significant bearing on the findings, as both the communities are sufficiently affluent. However in order to replicate the system elsewhere the stakeholders may also look into this aspect of the locality under question.

Parallel Government initiatives

Presence of Swaccha Bangalore: SHOWS was established in 1995 before this parallel government venture came into existence. It was thus able to commence operations and garner residential support well before the centralized government schemes came into full force. However, RISE already struggling without grants and community support collapsed with the advent of this programme. Residents were not willing to pay for two schemes for waste treatment at the same time.

Results

The analysis of the various parameters covered in the study throws light on the following aspects, which determine the sustainability of a decentralized solid waste management unit for urban India. The most important factor, which enables the unit to ensure smooth operation, is the financial support it receives. Citizen's initiatives are not in a position to

manage on their own resources unless funded by municipalities, NGOs or similar institutions. The initial investment costs are generally borne by the initiators namely, the government, national or international agencies. For the set up to sustain itself it requires additional support in the form of grants, which could be ideally provided by municipalities. Citizen's initiatives are also found to be dependant on community support and goodwill. Some amount of community support in terms of minor operational sponsorships could also ensure the sustainability of these ventures. It is wholly dependant on the single-minded dedication and support from an individual or a group of people committed towards the working of the operation under question.

The limiting factor as regards technical aspects is not the technology itself but the problem of efficient execution of the technology. Feasibility of a community-based initiative is also dependant on the acceptance of composting sites by the locality. A key issue in the sustainability of SHOWS is highlighted in the fact that no collection charges are levied on the households of the community. In addition it is funded by the municipality, which reduces the burden of making ends meet using residential collections. Also parallel efforts by the government act as a deterrent to community based ventures by diverting the resident's support away from the decentralized scheme of waste treatment.

In short, the sustainability of a decentralized option is dependant to an equal extent on commitment of the workers, management as well as the institutional support it receives. Hygienic composting practices and residential support also play minor roles in ensuring sustainability.

Discussion

A decentralized initiative has many indirect advantages. The localised collection and processing of wastes, avoids the carting of wastes to far off dumping sites. It reduces the expenditure of imported diesel, consequent traffic congestions, air pollution and road maintenance costs. It also reduces the contamination of ground water through the seepage of leachates. The government should thus see the advantages of treatment of wastes locally, and provide better initiative to communities in order to make this practice more widespread.
To attain long term sustainability values, certain points have to be reflected upon by the stakeholders of the composting business.

Technical expertise: Improvements are necessary in the field of executing the technique adopted at the unit. Odor emissions and related complaints have to be addressed to prevent the residents from withdrawing support to the venture.

Role of Municipalities: Financial support by the municipalities to the community based decentralized schemes will provide the right impetus for the development of this waste treatment method. Municipal authorities should encourage community initiatives and integrate them into the overall waste management strategy in all localities thereby helping to reduce the amount of wastes going outside the locality. Specialists could further assist

these ventures offering consultancy services on organizational issues or technical constraints.

Parallel schemes by the Government: The municipality of Bangalore has a parallel scheme, *Swaccha Bangalore,* which levies mandatory fees for all households, businesses and educational institutions to increase its financial resources. These user fees imply that the residents will expect the municipality to provide waste collection services. They are unlikely to support the community venture, as they would not be willing to pay for two parallel systems.

Conclusion

" There are two things certain in life – one is death and the other is waste" as said by a waste plant operator, accurately sums up the waste scenario in urban India.
The findings of the project indicate that sustainability of a decentralized waste treatment option can be achieved with adequate municipal and residential support and the dedicated efforts of those people involved in the actual running of the operation.

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References

Balasubramanyan V.K., A Preliminary Discussion Paper on the Possible Role of Decentralized Solid Waste Management Efforts in Urban Solid Waste Management, pg12.

Balasubramanyan V. K., Breakthrough in the Technology of Solid Wastes Management: A Proposal for Fine Tuning and Dissemination, February 2004.

Christian Zurbrugg and Christian Aristanti, Solid Waste Management, Waste Collectors are Operating a Composting Unit on Neighborhood Level An Indonesian Example, http://www.sandel.ch/solid waste/pages/composting - Indonesia. htm accessed on Jan 4, 2006, 4.0.

Christian Zurbrugg, Silke Drescher, Almitra Patel, Sharatchandra H.C., Taking a Closer Look at Decentralized Composting Schemes - Lessons from India, Published in Asian Society for Environment Protection (ASER) newsletter, March 2003.

Christian Zurbrugg, Silke Drescher, Almitra Patel, Sharatchandra H.C, Decentralized composting of urban waste - an overview of community and private initiatives in Indian cities, Waste Management, 24(2004) pg 665 - 662.

Christian Zurbrugg, Silke Drescher, Isabelle Rytz, A.H Md. Maqsood Sinha, Iftekhar Enayetullah, Decentralized composting in Bangaladesh, a win-win situation for all stake holders, Resources, Conservation and Recycling, 43(2005), pg 281- 292.
Ministry of Environment and Forests 2000, Municipal Solid Waste Management and Handling Rules, The Gazette of India, Part II, Section 3, Sub section ii, Delhi.
Pachuri R.K., Sridharan P.V., Solid Wastes, Looking Back To Think Ahead, Green India 2047, Growth with Resources, Enhancement of Environment and Nature, TERI, New Delhi, 1998.
Silke Drescher & Chris Zurbrugg, Paper 72, Decentralized Composting: Lessons Learnt and Future Potential for Meeting the Millennium Development Goals, CWG WASH Workshop, 2006, 1-5 February, Kolkata, India, pg 6.
Www.deccanherald.com/deccanherald/sep222005/dheducation1141462005921.asp accessed on Friday, 27 January 2006 at 04:52:02 pm.