

**ICRIER's Program on Capacity Building and Knowledge Dissemination on Urbanization
in India:**

Preparing for the Urban Challenges of the 21st Century

Focus: Solid Waste Management

7 Kerala Workshop

August 26 and 27, 2013

August 26, 2013: Solid Waste Management in Urban India

Day 1: 26 August 2013

Session I: Challenges of Urbanisation in India

Dr. Isher Ahluwalia, Project Leader and Chairperson, ICRIER

- Dr. Isher Ahluwalia addressed the growing challenges in solid waste management sector and the need for capacity building and knowledge dissemination. She emphasized that officials of the state government as well as urban local bodies will benefit from interactions, particularly in the presence of the resource persons that have been brought to this workshop. She hoped that the participants will get a clearer understanding of the nature of the challenge and the possible ways to respond in individual cases.
- Dr Ahluwalia drew upon the findings of High Powered Expert Committee (HPEC) report, and observed that investment requirement for the urban sector in India is about Rs. 40 lakh crore at 2009-10 prices over a 20 year period 2012-2031. The increase in investment amounts to an increase of 15% per year for the first 5 years beginning 2012-13, then 12% in next 5 years, and 8% in the subsequent 10 years.
- Solid Waste Management must be seen in the context of the overall challenge of water and sanitation in the country and has a direct connect with public health conditions in our cities.
- Financing of investments in urban infrastructure is intimately linked with issues of governance. Citizens will be willing to pay user charges to cover costs if they found service delivery mechanisms to be efficient. Even to mobilise finance from external resources, we need a revenue model which in turn is dependent on the state of governance. The HPEC (Ahluwalia) Report recommends devolution of funds from the state governments to the third tier, and also from the central governments through schemes such as the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) to the urban local bodies.

- In the end, she announced that six sessions were planned for the two day workshop. These are the urban challenge as documented in the HPEC (Ahluwalia) Report, solid waste management and disposal, biomethanation plants for segregated waste, experiments in waste-to-energy and public private partnership in the solid waste sector.

Ms. Tanushree Bhan, ICRIER, New Delhi

- Ms. Tanushree Bhan gave a general overview of the HPEC (Ahluwalia) Report India's urban population is projected to touch 600 million by 2031 and the number of metropolitan cities is projected to increase to 87. Urbanisation is likely to be seen in much faster growth in the number of census towns than in statutory towns. In the case of Kerala, the number of census towns has increased fivefold during the period 2001 to 2011.
- Ms Bhan pointed out that the growth rate of Kerala's GDP has suffered a slowdown in the three years beginning 2006-2007. Data are available only upto 2008-09.
- In India's current stage of development, cities should act as engines of growth for providing the required agglomeration economies.
- The total investment required over the period 2012-2031 is estimated at Rs 39.2 lakh crore at 2009-2010 prices).over the twenty year period (Out of this, one-fourth, i.e., Rs 8.3 lakh crore) is required for water and sanitation sectors.
- These investment requirements are feasible if the state governments have a constitutionally mandated revenue sharing arrangement with the urban local bodies. Further, if the states are able to provide an enabling environment for the ULBs to reform, then the requirements of transfer from states to the ULBs could decline from 0.32 percent of GDP to 0.16 percent of GDP over the twenty year period.

Dr. Suneel Pandey, Senior Fellow, TERI, New Delhi

- Dr Pandey gave a presentation on ‘Overview of Municipal Solid Waste Management in India’, highlighting the key facts related to municipal solid waste. Solid waste generation is generally considered as an urban phenomenon, and with the growth of the cities and increasing population, solid waste management service is deteriorating, along with increasing management costs.
- Dr Pandey highlighted the findings of a study done by the Central Pollution Control Board (CPCB) on waste characterisation. The study shows that the compostable fraction of the waste has the highest percentage in Indian solid waste, followed by construction and demolition waste. The Carbon/Nitrogen ratio in the Indian Municipal Solid Waste (MSW) ranges from 14% to 53%, moisture content from 17% to 65% with low calorific value of organic fraction suggesting favourable factors for biochemical conversion.
- The recycling rate is around 70% in India and most of it is through informal sector. Also, construction and demolition waste can be recycled, but is presently dumped on land.
- According to MoUD, Urban Local Bodies (ULBs) are performing fairly well in collection efficiency and complaint redressal, but the performance indicators show that the ULBs are not segregating the waste, the disposal is not scientific and cost recovery is low.
- There are a number of technologies that can be used for scientific treatment and disposal of waste. The suitability of the technology depends on the environmental conditions: composting (windrow, in-vessel composting, and vermicomposting), anaerobic digestion (biomethanation), incineration (also in cement kilns) and the use of Refuse Derived Fuel (RDF)/ fluff for energy generation, landfilling with landfill gas recovery system, pyrolysis/gasification and plasma torch.
- Issues related to landfills are the availability of land, cost of transportation for disposal of waste. MSW Rules prohibit disposal of organics and recyclables on land.

Shri Manjalamkuzhi Ali, Minister of Urban Affairs, Department of Local Self Government, Kerala

- Shri Ali enumerated the extant situation of Municipal solid waste management in the state, the problems experienced, and the attempts at improving the situation, and their experience from the same.
- Shri Ali emphasized the role of the state as the coordinating agency and in assisting the local self governments (LSGs) in implementing MSW Rules.
- As per a sectoral study conducted in 2006, the total waste generated in Kerala was 8300 tonnes per day; of which 70-80 % was bio degradable. Out of which, 13 % was generated by the 5 municipal corporations and 23% by the 60 municipalities. The minister mentioned that the present day contribution of the municipal corporations and municipalities could be around 50 % of the total.
- In the state, 27 municipalities and all 5 municipal corporations have operational solid waste processing plants using windrow composting and bio gas plants. These local bodies were supported with financial support from various sources i.e. State plans, JnNURM etc.
- He mentioned that the LSGs faced various problems w.r.t. processing facilities i.e. lack of adequate land for rejects, odour nuisance, water pollution, environmental concerns from operations etc. These issues have been highlighted by the media, and there have been public protests in some LSGs. Thereby the government has been actively searching for better alternatives, while keeping in mind the special geographical, environmental, and waste characteristics.
- Several initiatives have been being taken by the government for facilitating the LSGs in MSW. Source treatment of waste at household level has been encouraged by providing a 75% subsidy.
- The minister also highlighted the various legislative initiatives introduced by the state. The state has introduced provisions which attach waste management responsibilities to hotels, commercial establishments, hospitals, meat outlets. There has also been active encouragement for recycling and reusing plastic bags, and stringent penalties for littering and disposing waste in water bodies. The state also launched an intensive year long

information and communication program with support from media establishments, non governmental agencies.

- The minister also cited the NIMBY (Not-in-my-backyard syndrome) as being responsible for the reluctance and objections from people's representatives allowing the establishment of processing plants in their areas.
- In his concluding remarks, the minister acknowledged that there was room for improvements, and to build upon the measures already taken to improve SWM. He then thanked the organizers for selecting the very relevant topic of MSW management for the workshop.
- A special note of thanks was given to Dr. Isher Ahluwalia. The minister hoped that the workshop would provide more information on viability and suitability of various technologies, given the Indian context. He wished success to the workshop in achieving its goal outcomes, and concluded.

Shri Bharat Bhushan, Chief Secretary, Kerala

- In his closing remarks, he highlighted the need to empower the Urban Local Bodies. He argued that the shift of responsibilities to local government has happened, but now there is a need to empower those with responsibilities and thus address the issue more carefully.
- There are no easy fixes as far as solid waste management is concerned. Each technology has its positive and negative sides.
- The technology should be chosen keeping in mind the local conditions and waste characteristics and whatever technology is decided on, it should be through popular movement.
- Also, there is an urgent need to convert this message to a mass movement to achieve success.

Session II: Solid Waste Management and Disposal

Mr. E. H. Pathan, Head (Solid waste management), Surat Municipal Corporation

- He gave a presentation on the topic of ‘Sustainable solid waste management’ and shared the experiences from the practices employed by the Surat Municipal Corporation (SMC). Before starting the technical presentation, he quoted the Commissioner, Health and Hospital, that the main aim of the ULBs should be to pre-empt people from going to the health care facilities and hospitals rather than only building hospitals.
- He presented an overview of the current regulatory framework which governs the field of waste management as per the different Rules and Acts. He also listed the various problems that plague the Municipal Solid Waste Management system. These problems ranged from lack of adequate budgetary allocation, skewed spending (80% of the budget) on collection and transportation of waste, absence of institutional and financial capacities amongst the ULBs, to technical problems like the availability of suitable sites to carry out these projects. These lacunae in the field have led to various undesirable outcomes. He further added that shifting the waste from the community disposal bins to the land fill sites, did not remedy the situation and simply shifted the problems to the new locations.
- He then highlighted the various initiatives undertaken in Surat after the plague in order to improve the situation of waste management in the city. Following the 1994-1995 plague, SMC employed 2000 more workers and established the practice of cleaning the disposal bins at night. Around 1400 MT (million tonnes) of waste was being collected daily from the city, along with 6 modern transfer stations in different zones.
- SMC employs different modes of collection of waste. Apart from door-to-door and container mode of collection, a few other modes of collection are used:
 - Night Scraping- Brushing: Started in 1996 and employs around 2000 workers.
 - Hotel Kitchen Waste: Wherein hotel waste is collected and transported by hotel associations.

- ‘*Anudhan*’ Scheme: For areas where door to door collection is not possible, the SMC pays societies and industrial houses to keep their premises clean. He added that more than 600 societies were availing of this scheme.
- He talked about the methods of waste management (solid and bio-medical waste) in Surat and elaborated upon their benefits. A Waste-to-Energy facility is being proposed on a Public-Private Partnership endeavour with an estimated waste treatment capacity of 1000 TPD. There is a centralized facility for bio medical waste collection and disposal in Surat, which was introduced in 2003.
- Comparing the benefits and drawbacks of using landfills as one of the methods for the final disposal of MSW, he mentioned a 200 hectare sanitary landfill site developed by SMC at Khajod and the quantum of waste it can accommodate. He also explained the technicalities of this land fill site, its possible contribution towards enhancing environmental quality, and finally suggested the possibility of earning carbon credits through the Clean Development Mechanism.
- SMC has banned land filling of plastic in Surat and ULB has signed a contract with ITC for plastic collection in the core zone. The plastic collected is shredded and made into pellets that generate oil.
- SMC is making some attempts on the innovation and improvisation front by designing a system which incorporates both technology based solutions, as well raising awareness amongst the citizens, and avenues for redressing the grievances of the public.
- While there has been considerable improvement in the area, with only about 12% of MSW being segregated, and about 22% of MSW being recovered, a lot remains to be done.
- While setting the way ahead, Mr. Pathan gave various suggestions like segregation at source, using centralized monitoring technology, PPP models in other aspects of SW management and the upgradation of collection practices in order to make the MSW management system more efficient.

Ms. G. Latha, Municipal Commissioner, Coimbatore

- She presented on the topic ‘Implementation of integrated solid waste management project through PPP mode’. She elaborated on the methodology adopted by Coimbatore city municipal corporation (CCMC) for implementing the SWM project. Major initiatives taken by the CCMC include segregation of dry and wet waste inside the city. Also, decentralised plants and radio frequency identification (RFID) systems fitted with the vehicles have provided better ways to manage solid waste for the city.
- Ms. G. Latha also pointed out that CCMC is under a huge financial burden due to the high tipping cost. Despite this high tipping fee, the corporation is trying new initiatives by roping in organisations, NGOs, and by considering bimethanation process.
- The Coimbatore city municipal corporation has set up waste transfer stations at Ukkadam, Peelamedu and Sathy road under the JNNURM funding.
- The Coimbatore city municipal corporation is also in the process of implementing the sharing of revenues obtained from selling dry waste. This would allow the conservancy workers to weigh and register the dry waste they have collected and sell it. The revenue earned through this source could be spent on the workers. The corporation would also like to understand how the workers would sell the dry waste to the agencies and give wet waste for manure.
- She concluded the presentation by suggesting efficient segregation of waste, community participation, grievance management system and decentralised plants.

Ms. Tarika Khanna, ICRIER, New Delhi

- She presented on ‘Experience of a municipal waste landfill disposal: a case study of Gorai landfill’. Gorai landfill closure project was the first project of its kind to be registered under UNFCCC for carbon credits.
- Municipal Corporation of Greater Mumbai, the agency responsible for solid waste management, disposes its waste at four dumpsites namely Deonar, Mulund and Gorai and Kanjur in Greater Mumbai area.

- Waste composition in Greater Mumbai shows that the maximum percentage is of biodegradable waste, while only 3.3% of the waste is composted and 0.7% of the waste is used to make RDF. The rest is disposed off in landfills. This creates a lot of pressure on the landfills.
- Sanitary closure of the landfill helps in controlled disposal of waste. It protects human and environmental health against the risk posed by open dumping. It also avoids ground water pollution and air pollution by preventing leachate percolation and capturing greenhouse gases.
- Gorai dumpsite is located at the Gorai creek and very close to the habitation. It was in use since 1972 and created a lot of human health and environmental hazards. Around 2.3 million tonnes of unsegregated waste was accumulated with an average height of 26 meters.
- Gorai Dumpsite closure project was envisioned in 2007 and was developed with the technical advisors IL&FS and contracted to a consortium of private partners on DBOOT basis. The contract was awarded for 15 years along with 15 years of O&M post closure care to the consortium.
- The project did not realise the carbon credits estimated during the carbon emission reduction calculation. Thus, MCGM has to buy carbon credits in the open market to reimburse ADB's advance that was credited to MCGM during the project period.
- The quality and quantity of waste being dumped in the dumpsite is an important factor to be considered for carbon emission reduction calculations. Also, the management practice followed at the dumpsite before closure and operation of the landfill gas capture system is important for the CERs calculation. Thus it can be said that Gorai landfill Closure Project is a learning-by-doing.

Discussion

- Segregation is an important key to manage municipal solid waste being generated. All the cities are striving for an effective segregation technique. An effective community sensitization campaign can lead to effective segregation and thus management of solid waste can be efficient.

- Source segregation is very poor in most of the Indian cities, which leads to unsegregated waste being collected from the households and dumped on landfills.

Session III: Biomethanation of Segregated Waste

Dr. Sharad P Kale, Bhabha Atomic Research Centre (BARC), Mumbai

- He presented on ‘Decentralised waste resource management: NISARGRUNA experience. Dr. Kale argued that the word ‘waste’ itself suggests a useless material, a thing that should be discarded, but the waste stream generated is a ‘resource’. Once people start understanding waste as resource, reuse and recycle will gain importance.
- He discussed about the NISARGRUNA plant developed by BARC used for decentralised processing of biodegradable waste which helps in reducing the transport cost and health hazards associated. It also helps in reducing carbon emissions and there is no by product except methane gas which is used for various purposes. He also elucidated that imbalance in nature is created once we start extracting more than we can replenish.
- He emphasised that the bio degradable waste should be treated through biomethanisation process. He stated that decentralised anaerobic plants (biomethanation) works very well in Indian conditions as they are easy to operate and maintain. For smaller municipalities, decentralized plants are the most viable option.
- From 1 – 5 ton plant, the biogas produced can be used for electricity generation; electricity can be used for decentralized purposes like kitchen cooking or street lighting. For bigger plants, grid connectivity is possible.
- Currently about 150 such plants are installed in India. He suggested decentralised installation of treatment plants at the ward level where the energy can be used at local level.
- Dr. Kale stated that there is a need for political intervention for the O&M of the system as the ULBs, especially smaller municipalities, do not have designated funds to manage these plants.
- In the end, he emphasized the key to manage solid waste is segregation of wet waste at the household level.

Mr. Mahesh Pathak, Municipal Commissioner, Pune

- Pune has been successful in employing a whole range of solutions for waste management. It is one of the few cities with an integrated waste management strategy. Mr. Pathak, at first, presented the issues, which they tackle in Pune, especially with its fast growing population, extended city boundaries, and change in the composition of the municipal waste. He then went on to explain the process that Pune Municipal Corporation (PMC) had to undertake to develop an approach with a combination of centralised and decentralised solutions.
- The main points of his presentation were: Pune city produces about 1600 metric tonnes of solid waste every day, which is collected by 158 trucks. Rag-pickers have been organised under a programme called SWaCH and they help with the collection. Compactors and containers and seven transfer stations are placed at strategic locations in the city. Ward wise segregation of waste is carried out, and 44 % households provide segregated waste. Route maps and timings are all available on the website of the Municipal Corporation.
- Pune banned open dumping in 2010, and PMC subsequently developed a strong GIS database, built capacities of staff as well as citizens by enhancing awareness about reducing, reusing and recycling waste, improved the efficiency of its complaint system, and also applied user charges for the service.
- The city carries out biomethanation through 20 decentralised plants with a capacity of 98 TPD, which convert the waste into compost and bio-gas from which electricity is generated. There is also a high-capacity waste to energy plant that uses the technique of pyrolysis and gasification to produce fuel and electricity.
- By strategizing its waste management, Pune has brought down its carbon emissions by 5 times. Experiments to produce an alternative fuel to CNG are being carried out in the city. Pune has won a number of accolades and awards at state and national level as recognition of its waste management initiatives.

Mr. Jose Joseph, Executive Director, CREDAI Clean City Movement, Kochi

- He presented on ‘CREDAI Clean City Movement in Kochi’. With the basic premise of promoting sustainable development, the project was started as a social responsibility in 2007 by CREDAI Kochi. It is an association of professional builders in Kerala which has 10,000 members all over India. The objective of the Clean City Movement is to educate and help citizens to implement self-contained solid waste management systems in building complexes, villas, flats and other living spaces, and to maintain a hygienic and healthy environment. The CREDAI movement has already installed bio bins and bio pots in 12 cities in Kerala with a capacity to handle 26,280 tonnes of biodegradable waste each year.
- He highlighted the cost effectiveness of this drive. If a comparison of the cost effectiveness of centralized and de-centralized methods of waste treatment is done, then it will be revealed that excess expenses of Rs. 1,247 per tonne are incurred with a centralized system. Mr. Joseph further elaborated on calculations revealing a cost saving of Rs. 11 crore per tonne each year to the government only on the processing of bio-degradable rejections through this project. With respect to recurring expenses incurring on the disposal of bio-degradable solid waste, it is estimated that with the clean city movement implemented in a city of 10 lakh people, the government would save about Rs. 28.63 crore in a year.
- CREDAI has estimated an investment requirement of Rs. 28.26 crore in a year for a city of 10 lakh people to fully implement the clean city movement, which is less than the potential cost saving. It was also suggested that this project could be linked with the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).
- CREDAI’s System of Decentralized Rejection Management: Decentralized rejection management can involve the use of bio bins, vermin composting, bio gas plants or bio digester plants. CREDAI operates on a simple principle of using 2 separate buckets - one to segregate bio-degradable, kitchen waste, and the other for non-biodegradable waste such as cleaned milk packets etc.

- The biodegradable waste in the green bucket is deposited in pots or bins on the terrace of the building. This is sprayed with a bio-culture which, along with processed bio-manure, catalyses the biodegradation process. The waste is then turned and kept for 15-20 days, after which it is sieved and sold commercially for agricultural and other commercial purposes.
- The nonbiodegradable waste is collected once every two weeks and is sent to a segregation and shredding unit. The plastic granules can be heated to 170 degrees Celsius and used for road tarring, so as to eliminate plastic waste as well as to improve the quality of roads; For example the Manapatti Parambu road in Cochin, which showed no signs of potholes even 2 years after polymerized road tarring.
- This is a first of its kind initiative by CREDAI, which has attracted numerous accolades such as an Award for the Best Environment Project, Award for the Best Technology.

Mr. Suhas Bhand, Managing Director, Organic Recycling Systems Pvt Ltd

- He presented a case study of 4 MW Solapur Waste-to-Energy Project. He began his presentation by putting forth the overall challenges being faced by Municipal Solid Waste Management in India. There are about 5100 municipalities that are struggling with issues relating to proper treatment and disposal of solid wastes. The amount of waste that is dumped into open areas has reached alarming levels, and despite individuals and groups trying hard to manage this waste in a scientific manner, there has only been limited success. Difficulties in arranging for funds due to high cost of financing (because of higher risk), is one of the major reasons for the limited success of these MSW projects. Other challenges relate to administrative issues like delays in clearances for these projects and certain technical challenges also hinder the management process.
- The Solapur project on SWM has a capacity to process 400 TPD of MSW and is supposed to use the DRYAD™ technology. The main rationale for using such a technology is that it can operate in a temperature that is suitable for Indian cities. Other benefits of this technology are its high loading rate, less area of operation etc. The project, which is supposed to span over 29 years and 11 months, is expected to generate

power and compost (approximately 60-70 TPD). The capital cost for a 100 tonne plant will be around Rs 14 – 15 crore.

- The entire process has three stages. The first stage is ‘Pre treatment of Unsegregated MSW and Feed Preparation’. This involves segregation of non-organic and inert materials and size reduction and homogenization for feed into digester. Around 80-85% of organics are recovered from mixed stream. The second stage is called ‘Thermophilic Anaerobic Digestion’ and this involves hydrolysis, acidiogenesis, acetogenesis and methanogenesis. In the final stage post digestion, the residue is sent for dewatering and the dewatered residue is sent for aerobic composting. The bio gas is utilized to generate power.
- The main benefits of the Solapur model of waste management accrue from the technology used. The biomethanation process is a better technology as it yields higher outputs, (like electricity generation), and better quality of composts. Further, the technology operates at a temperature that is suitable for Indian conditions. The electricity generated is evacuated at the price of Rs 6-7 per unit.

Mr. Prasada Rao, Head-Environment & Sustainable Development Division, EPTRI

- He made a presentation on ‘The State of Municipal Solid Waste in Andhra Pradesh’. Around 15000 TPD of mixed waste is generated along with 6750 TPD wet waste. Wet waste is disposed through mechanical compost plants, vermicomposting plants and biomethanation.
- He presented the cases of Vijayawada Municipal Corporation, Slaughter House waste at Al Kabeer, Hyderabad, Warangal Municipal Corporation, Bobbili Municipality, and Narsapur Municipality.
- Vijayawada SWM project was commissioned in 2004 with installed capacity of 20 TPD. Waste from vegetable market yard and slaughter house was collected for treatment and 2100 - 2275 units of power were generated. Manure of 1-1.5 MT/day was also produced. The plant was shut down in 2007, as the terms of the contract did not work out.

- Using the same method of treatment, the power produced was used for different purposes. Warangal city used the electricity for lighting up of the parks, Bobbili Municipality used the energy produced for cooking purpose, and Narsapur Municipality used it for street lighting.
- Greater Hyderabad Municipal Corporation (GHMC) has a population of 77 lakh which is spread over 625 sq km. It generates 6000 TPD of mixed waste. Implementation of Integrated Municipal Solid Waste Management Programme was initiated through PPP mode. As per the contract, door to door collection of waste, secondary transportation up to transfer station, and from there to treatment and disposal site was to be managed by the contractor.
- Five new transfer stations were constructed along with upgradation of three existing transfer stations. Weigh bridge plaza, waste receiving platform and pre-segregation facility compost plant, plastic bailing unit, and RDF storage unit were set up. Compound wall along the site was constructed along with internal roads, storm water drainage, administrative building and laboratory, maintenance facilities for vehicles, and other mechanical equipment.

Discussion

- Mr. Suhas Bhand emphasized on the fact that the plants and their treatment capacities have to differ across places, and should be created according to the need of the place in question. Since the population and the waste generated vary from one place to the other, the setting up of the plants also needs to vary accordingly.
- Mr. Bhand said that the technology used in the Solapur model is unique and first of its kind in India. It has its roots in Ireland but has been “Indianised” in Solapur.
- On the prospects of bio-medical waste, Dr. Kale and Mr. Bhand responded that although they have tried processing medical waste in BARC, the Act only talks about cleaning, incineration and gasification of wastes. However, provisions need to be widened for better more efficient processing of medical wastes.

- Mr. Mahesh Pathak responded to queries regarding the usage of the waste water while processing the bio gas. Mr. Pathak said that the best use of the water could be made in the gardens along with the fertilizers.
- A French participant, pursuing Ph.D. on solid waste management practices in India, said that efforts on solid waste management in certain Indian states are really commendable and something that one cannot imagine in Europe. He also said that it took about 15-20 years for the green initiatives to take full effect in Europe and about 20 per cent of the property taxes are spent for better solid waste management. India, on the other hand, has done much better with innovative practices. However, he also emphasized that more community participation was needed for better solid waste management.
- Mr. Mahesh Pathak informed that in Pune they have a provision where they provide rebates on property taxes if people undertake environment friendly practices. If any two out of the three (rain water harvesting, composting and using solar energy) is practiced, then they would get 10 per cent rebate on their property taxes, if it is less than Rs. 25,000 and 5 per cent otherwise. He also emphasized that although property tax and waste management are two separate departments, they have inspectors who would conduct visits and co-ordinate the whole process.
- Dr. Kale emphasized that generating revenues from biomethanation is more apt when one is talking about big units. For smaller units, revenue generation may not be possible and more emphasis needs to be given to the waste management (and not on revenue generation).
- On possibilities of private-public partnership in waste management, Dr. Ahluwalia argued that the question is really about responsibility and accountability for the process whether it is public, private, or a partnership. Dr Kale substantiated this by citing the case of Kanpur where efforts of wastes management failed despite them having the desired capacities for making the programme a success.

DAY 2: 27 August 2013

Session I: Solid Waste Management in Indian Cities

Dr. Isher Judge Ahluwalia, Project Leader and Chairperson, ICRIER

- Dr. Isher Ahluwalia started her speech by referring to cities as engines of growth. She said that there are around 377 million people living in cities and towns of India which will increase to 600 million by 2031.
- Estimate of how much will be needed to bridge up the investment deficit in infrastructure- we came up with a sum of 40 lakh crore at 2009-10 prices to be spent over the next 20 years, not including the cost of land. Out of which, two thirds of this amount is to be spent on roads, transport and traffic related infrastructure and remaining amount to be spent on water and sanitation. The amount involved is not much but the issues is of grave importance.
- She talked out the 'Urbanisation program' that ICRIER is doing in which the urban team visits different states, networking with urban local body officials for sharing their knowledge and their practical experiences on the ground for knowledge dissemination and capacity building.
- State governments are the principle players in the field of solid waste management, the centre can provide strategic leadership, funding etc. and the local body official can deliver only if they are given an enabling environment by the state governments.
- 42 million tons of municipal solid waste is generated annually in India which varies from varies from 200 grams per capita to 600 grams per capita per day. It is projected to increase around 3 - 5 % in the future because of rising urban population, rising income, changing life styles and increased usage of packaging material, plastics etc. Thus the problem of managing solid waste is bound to grow, while we still struggle to deal with the issue as of today.
- Municipal Solid Waste Management Rules came into being in 2000. It has been 13 years since then, and the door-to-door collection efficiency is still somewhere between 50%,

and as high as 90% in few cities; and less than 4% of the waste generated is scientifically managed. It is important to stress on people's minds to reduce our waste, recycle when we can and the dire need to segregate.

- Bangalore has amended the Act to make wet and dry waste segregation mandatory on household level. Changing mindset is the most challenging task to achieve.
- In Hyderabad, cleaning of roads, door to door collection and transfer from dustbins to trucks have been outsourced to a private company. Municipal workers have been provided with mobile phones and their duty is to check the status of dustbins around 11 am, if the dustbins are not clean then the photograph clicked by them shows up on web, after which the private company will be penalised. Thus, the right-to-lie was taken away from the worker.
- She emphasised the role of rag-pickers in the management of waste and the need to bring them from informal sector to semi formal by providing them better work conditions. In Pune, an NGO which was originally a trained union of rag-pickers is now working with the municipal corporation.
- She put forth a few successful initiatives being practiced in different cities. Decentralised biometanation plant which yields compost, biogas and electricity is being practiced in Pune, Guwahati etc. GPS tracking of vehicles is done in Coimbatore
- A few issues related to management needs attention like minimising transportation of waste, sanitary closure of landfill etc. The sanitary closure of Gorai did not yield promised carbon credits and thus Municipal Corporation had to repay the advance.
- Another route of management is by having PPP mode for a project. She argued that sometimes PPP is chosen because the ULBs do not have the autonomy. So by getting into a joint venture, they can work.
- She concluded that in the end government will be held accountable for the services being offered to the people.

Dr. K Kasturirangan, Member (Science), Planning Commission, Government of India

- Indian cities generate peculiar waste due to different geo-climatic zones. Also, the increasing quantity, evolving character of waste and limited resources of ULB's to deal with the issue has mounted the SWM issue in the country.
- The country lacks resources for collection, transportation and safe disposal of waste, and also has limited expertise in the urban local bodies.
- Some processing initiatives primarily related to composting and RDFs have shut down because of operational and maintenance failure; the plant experienced difficulty in dealing with some parameters. He said that technology alone cannot be the reason for the failure but also some systematic issues were encountered; proper definition and scope of the work that needs to be undertaken, delivery system, consistency, quality, quantity etc.
- There are various treatment technologies in India, but the technology should be selected based on the waste characteristics of the country or state. The biodegradable waste (having maximum percentage in Indian waste stream) has low calorific value. Thus the thermophilic technology is important in Indian context. Composting and RDF are being produced in the country for the last 30 years. The Construction and Demolition (C&D) waste can be formed into tiles and bricks. The main criteria selecting the technology to be considered are: covering least land area, compliance with environmental standards, production of more power with less waste and reduction in the amount of waste going to Sanitary Landfill.
- A landfill causes groundwater contamination, and contributes towards global warming by leachate percolation and methane emissions. They are also breeding ground for mosquitoes, bacteria, and pathogens causing issues of water borne diseases. Increasing load of garbage require more land (valuable commodity) for disposal. Such dumpsites are found on the outskirts of any city and because of its implications there is resistance from the local residents. He emphasised the need to reduce the load so that reasonable area is available for landfills.
- The main issue with the technology in the country is that it alone cannot promise success. He stressed that different kind of waste materials such as biodegradable, combustible and construction debris need to be processed separately.

- The issue of waste management should be looked beyond the commercial interest.
- He stressed on the need for integrated waste management which encourages the waste to be processed differently after segregation. Biodegradable waste should not be burnt as they are low on calorific value; C&D waste does not facilitate combustion so should be removed and recycled into different products.
- There are different waste management models existing in the country like Pune, Ahmedabad wherein not only collection, transport and segregation is focused but also worker's skill enhancement is kept in mind for a better environment which will motivate them to remain committed to their profession.
- PPPs like in Kanpur but at the cost of a fee to the government and a collection of such fee is critical for the success of such activities.
- He illustrated the benefits of decentralised plants which deal with local biodegradable waste. There are around 200 plants working across the country. He said that it is a onetime investment which reaps benefits throughout. Like in Delhi Secretariat where the biogas produced is used for cooking purposes and other places where it is used for electricity.
- He highlighted the role of communities and their cooperation which is the prime factor for the success of an initiative which require sensitising the citizens too.
- The chosen technology should optimise on certain important criteria like lowest cycle cost, least land area requirement, to meet land, air, water, pollution requirement, produce more power with less waste and maximum volume reduction so that landfills needed are of manageable size. Though there is no single technology which fulfils of the criteria but these criteria provide a framework for technology to be used.
- He also raised a point on PPP which need a careful evaluation and by looking at various models and their commercial potential. There is a need to define the project and its scope of work clearly before entering into partnership.

Shri K M Chandrasekhar, Vice Chairman, State Planning Board, Kerala

- He mentioned that Kerala state has been able to manage the solid waste but still there is a need to understand the entire field of SWM so that waste can be managed efficiently.
- The cities in the past were able to manage waste, but the increasing amount has led to the issue of its management. Home grown solutions have been seen to be a success in India and need to be explored further.
- In Kerala, increasing waste heaps are lying within city limits because earlier the Municipality used to dump the waste outside the municipal limits, and eventually the panchayat in the proximity protested. The technology to treat MSW for a particular area should be chosen keeping in mind the local conditions. Repeatedly, local solutions have been found by the urban local bodies to cope with the stress.
- As the cities grow vertically, rather than with a horizontal spread, the problem of solid waste management is bound to increase.
- He mentioned that there are a large number of available technologies, and to choose between them is a difficult task, as many of these technologies have been tried in the past. Some have been succeeded and some have failed. Technology is just one aspect of it; it also lacks clarity regarding finances. Finances like JNNURM are available which gives 80% from central assistance, 10% from state government and the rest 10% from Local Bodies.
- He shared his views on the viability of any project which is dependent on many factors. The choice of technology is dependent on quantity of waste, quality of waste, moisture content, composition of waste etc.
- He highlighted the findings of the technical committee headed by Prof. Rajshekran Pillai, VP Council of Science Technology and environment, and other various experts. They concluded that aerobic composting is the most feasible technology and next will be biomethanation which is most appropriate for certain conditions. Vermicomposting was also considered a viable decentralised feasible option by self help groups.
- He outlined a few steps that needed to be followed for SWM. First is the location specific technology based on quality and quantity of waste, and then decide on technology to be

used. The last will be the availability of resources, subsidies, and grants. Then, after the finances are established, the PPP mode can be looked into.

Shri Oommen Chandy, Honorable Chief Minister, Government of Kerala

- The Honorable Minister expressed his concern regarding the rapid economic growth which has lead to waste accumulation in our cities. He mentioned that the problem is more acute for Kerala with high population and lower availability of unoccupied land. Also, with changing composition of waste i.e. increasing use of plastics and non biodegradable packing materials, municipal waste has become increasingly difficult to treat and dispose
- Extended monsoon, high amount of humidity in the air make normal process of waste management ineffective and inefficient for Kerala. The government is trying to find solutions for the waste management issue in the state. There is no successful model in the state that can be replicated in all urban areas.
- Kerala is faced by increasing population density and low land availability thereby increasing waste problems in the state. This has weakened the faith of citizens in the Urban Local Bodies.
- The rural and urban areas of Kerala exhibit almost the similar consumption pattern, hence rural areas are also being faced by waste management issues too. Capacity building and awareness generation for all the stakeholders will help in finding waste management solutions for all.
- The state of Kerala requires both deliberation and action to achieve solid waste management in the state.

Dr. Sudhir Krishna, Secretary, Urban Development, Government of India

- Dr. Krishna in his concluding remarks said that there is a very high correlation between development and urbanization which justifies as to why we should be focusing on urbanization. He said we have never focused on planned urbanization and it's only

recently that we have been talking about issues like making sanitation plans, guidelines on issues like solid wastes etc.

- More innovative ways are needed to tackle the pressure on the cities. JNNURM has yielded good results, but other sources also need to be explored other than JNNURM. JNNURM should be looked as a “big push” which has already been provided.
- Finances will definitely remain the major challenge, but one cannot wait for allocations from the higher tiers of the government. Ways of self financing need to be explored so that projects are self sustained.

Session II: Experiments in Waste-to-Energy

Mr. Soumya Bhattacharya, Concord Blue Technology Pvt. Ltd.

- Mr. Soumya Bhattacharya, who represented *Concord Blue Technology Private Limited*, gave a detailed presentation on their technological expertise in the field of MSW management, the technological aspect of treating MSW, and provided a case study of Pune and its experience with Waste-to-Energy.
- He introduced the Concord Blue System. It is a Gasification technology which is employed in what is called the ‘Concord Blue Tower’. He stressed on the minimal land requirements of the system, as well as the fact that the by-product of the process – Bottom Ash - can be used in cement kilns. The Waste-to-energy plant in Pune, a PPP model, currently generates 1.5 MW as opposed to planned 10 MW.
- He delved into the technical aspects of the technology, explaining the process by which waste was converted to SYNGAS, which could then be used to produce electricity. The mixed composition of MSW in India, its suitability for this gasification technology, feasibility of the Concord System given the current scenario was also discussed. Provision of green combustible gas, minimal space requirements, sealed treatment of MSW, more efficient segregation are some of the salient features of the technology.
- A flash presentation was also screened showing the operations – from waste segregation, waste treatment, gas creation, ash collection, and generation of green power- of a fully functioning Concord Tower.

- In order to address the environmental concerns, he clarified that the process was clean and did not lead to formation of any persistent organic pollutants. He further reiterated the benefits of the using the proposed technology; the capacity to handle multiple types of wastes, short implementation time, and utilizing waste from existing dumps leading to clearing of those areas.
- The plant receives MSW all 365 days and the Pune Municipal Corporation ensures the quality of waste being supplied to the plant i.e. free of inerts (construction and demolition waste). The plant uses no auxiliary fuel and captive heat is being used to dry the waste initially in pre conditioning.
- The cost of producing electricity is Rs 15 – 16 crore/MW
- The plant is scale neutral but a minimum quantity of 80 ton is required to evacuate power.

Mr. Amit Mittal, A2Z Infrastructure Ltd.

- Mr. Mittal started his presentation by referring to the factors that are needed to be considered for choosing the appropriate technology. The factors are nature of waste, quantity of waste generated, availability of equipment for treatment on site, regulation constraints and cost considerations.
- He gave an overview of the technologies available that depend upon moisture, organic content, total inert component etc. in the waste. There are three basic principles of waste treatment that can be applied.
 - First type is based on segregation of MSW into the compostable and the Refuse Derived Fuel (RDF) parts. Fuel preparation with drying and destining is carried out using the RDF part. A2Z Infrastructure Limited is currently using this method of composting and combustion. The waste steam should have moisture content below 45% and organic content should be higher than 40%.
 - Second involves decomposition of combustible (organic matter) by the action of heat. This process of thermo-chemical conversion can be carried out via

Incineration (eg. Jindal Okhla Plant), Pyrolysis, or Gasification (eg. Rochem Green Energy Pvt. Ltd.)

- Third type of technology is based on bio-chemical conversion is based on the decomposition of organic matter by microbial action. This is done by anaerobic digestion (biomethanation) and is currently in use at various decentralised bio-mechanization plants near Pune.
- The plant does not produce harmful gases like NO_x, SO_x etc as it is run on moderately high temperatures.
- Any one technology may not satisfy all of the criteria. The best compromise needs to be identified among various factors such as least life cycle cost, least land area requirement, no air and land pollution, more power production with less waste, and maximum volume reduction.
- According to Mr. Mittal, the approach of combustion and composting is the optimum way of using MSW. The most important part of this process is the fuel preparation. The moisture content in the segregated RDF must be reduced from 40% to 12-15% using a Hot Gas Generator and Dryer, while stones must be removed using a Ballistic Separator. The fuel obtained can be used very efficiently in boilers like CFBC for plants more than 15 MW, while plants less than 15 MW can use Reciprocating grade boilers which cost Rs. 8 crore/MW. Thus, by focusing on correct fuel preparation A2Z avoids using technologies such as pyrolysis and anaerobic digestion which cost at least Rs. 20-25 crore/MW.

Dr. Isher Judge Ahluwalia, Project Leader and Chairperson, ICRIER

- She presented a case study on ‘Municipal Solid Waste Management and Energy Recovery: Jindal Okhla SWM project’. The waste-to-energy technology being employed at the Okhla plant, New Delhi was shown.
- Waste-to-Energy technologies have faced a lot of failures in the past and thus technology selection is the crucial part for handling Indian MSW which is high in inert content and moisture.

- Okhla waste to energy plant is a public private partnership venture with the Government of NCT Delhi. It was awarded to Jindal Urban Infrastructure Ltd. in January 2012 after international competitive bidding.
- The data from the plant shows that the waste reaching the facility was less than expected so the plant was operating under capacity.
- Public Interest Litigation was filed by the residents residing nearby the plant as the air quality around the area was bad. According to the investigation by CPCB, SPM and dioxins/furans were found to be high beyond the admissible range.
- Corrective actions were taken to address the high levels of dioxins and furans. Also, an action plan had been prepared jointly with DPCC and MoEF.

Discussion:

- Dr Ahluwalia began the discussion by stressing the importance of factors like location of the plants, the technology used, and the public perception of these projects. Then she posed three questions to the different panellist.
 - First question to Mr. Mittal was whether their technology was scale neutral and if not, what was the critical MSW required to make it economically viable.
 - Second question was regarding the capital cost per ton of unsegregated MSW delivered, based on the 3 plants there was data on.
 - Third question was regarding the price of one unit of electricity generated through the 3 plants. She also inquired about the costs of these methods (capital cost + O&M+ Environmental costs).

Response to the questions on Scalability and Capital cost (point 2 and 3)

- Mr. Mittal responded to the question of scalability by stating that dried RDF with a high calorific value (more than 3000) could be used anywhere between 3MW to 24MW, so scalability was not a problem. It could also be used along side with coal in big thermal plants. He stressed that, more than technology, it is the right method of segregation which matters. Correctly segregated waste and burning at the appropriate temperature would not lead to creation of harmful gases.

- Mr. Saumya addressed the question regarding scalability and capital costs. Since their technology is modular, they would need to simply build more towers to process increased quantum of waste (no upper limit defined). The capital cost is about 15-16 crore a MW. For about 80 tons of unsegregated waste, they could produce 1000 units of net saleable electricity.
- Then Dr Kasturirangan addressed Mr. Saumya and the audience regarding the composition of the waste used. Giving the example of Delhi, he highlighted the high ratio of construction and demolition (C&D) debris in the waste. The presence of these components hampers the efficiency of the combustion process and also leads to high ash content in the final gas. He suggested the need for carbon absorption process to counter this problem. He also stressed the need to hold the waste provider responsible to ensure that C&D waste does not constitute the MSW provided. There is need to assign as much responsibility to the operator of the plant, as to the state. His second point was the urgent need for a system of review and evaluation between the state pollution board and the plants. Equally helpful would be bodies like a Green tribunal as a long term solution to introduce transparency and improve public perception.

Then the questions were opened to the audience.

- Prof. Kale started by commenting how mass burning is not a very scientific method, and the important thing was to reduce, recycle, and decentralize the processing. Turning to the question of technologies, he disagreed with Mr. Saumya that the technology was not scale neutral. He contended that only the few metropolitan cities in the country were producing waste at the scale of 100 tons or more per day. Then a policy which is formulated keeping these cities can't be applicable across the country. He added to Dr. Ranjan's point about C&D waste being a part of MSW, given that the country was rapidly redeveloping. He also inquired from the panellists about the difficulties (not just technological, but logistical) faced by operators.

- He also raised questions regarding the details of the area around the projects which are supposed to be free of human settlements, given the possibility of large proportion of SPM. He then enquired about the tipping fee expected by the Pune municipality, the working details of the Pune plant etc. He suggested the need for a national level mission to study these projects for at least 3 years, and weigh their benefits and problems before formulating a policy.
- Mr. Saumya responded to Dr. Kale's question on scale neutrality followed by a response pertaining to the SPM. He clarified that, even though they were executing projects of lesser tonnage, from a techno-commercial perspective, it is scale neutral provided there is a captive buyer. To answer the question regarding SPM, he referred to his presentation, and also elaborated on their technique of treatment as an explanation for low SPM, gases, pollutants. He clarified that even though they have the best pre-conditioning sections, they do face problems, since it is a new technology, but it is an improving exercise.
- Mr. Saumya also added that the Pune Municipal Corporation had been actively involved in ensuring that C&D did not come get mixed in the MSW.
- Mr. Gajendra then asked a question about the bidding process for the plants, whether the technology requirements were specified prior to calling for bids. Given that the tariff was not pre determined, and that it was a capital intensive project, he asked if it was to be considered economically and financially viable.
- To Mr. Gajendra's question, Mr. Saumya replied in an affirmative. However, he added that it was the capital cost of these projects which was hurting them.
- There were two more questions directed towards Mr. Saumya asked by people in the audience. The first question was regarding the role of the municipalities in the environmental clearance process. The second one was regarding the details of the electricity generated from the Pune project.
- Mr. Saumya answered both the questions. With regards to the environmental clearances, he accepted that it was their responsibility to secure the clearances, but it was always helpful to know the municipal body was supporting them, so as to ensure timely clearance. He gave examples of a project where they secured a quick clearance, as opposed to the Pune project which took about 3 months.

- He then answered the question regarding electricity generation at the Pune plant and their purchase agreement with Tata power. However, the Tata agreement requires them to produce minimum of 5MW.
- Dr. Suneel Pandey raised a few questions regarding the technical aspects of the plant.
 - a. He inquired how long it would take to take the plant till its rated capacity.
 - b. He also asked how they dealt with the tar which is generated during the gasification process and is hazardous.
 - c. He suggested that the process of RDF processing and electricity generation could be decoupled, so as to bring down the cost of processing.
- Mr. Saumya stated that by August 2014, they expected the project to go full capacity at 10 MW. He responded to the question about the tar by explaining the technology they employ to ensure that the tar is broken down into its elemental form. He then explained why the suggestion regarding decoupling of the RDF processing and electricity generation was not feasible, since their whole system was automated and coupled together for technical and economic reasons.
- Mr. Saumya clarified that the ban on Waste-to-Energy projects was on the subsidies for these projects, and not the projects themselves.

Session III: Public Private Partnership in Solid Waste Management

Mr. Gajendra Haldea, Adviser to Deputy Chairman, Planning Commission

- No single PPP model is suitable for the whole country and PPP agreements have to be context based.
- The main reason for having a PPP type of an arrangement is that the financial requirements for urban infrastructure is quite huge. There are different kinds of risks involved. So it is obvious that people would be reluctant to invest on urban infrastructure. Also, given that the health of the ULBs in India is usually quite poor, people fear that they may not get proper returns. Hence, a PPP model works better.

- PPP is helpful in transferring community risk to private sector and a bankable framework should be created to adopt PPP mode. There should also be a proper dispute resolution mechanism as well.
- Clarity of the PPP agreements is a very important issue. Since risks in urban infrastructure financing are diverse, even the minutest details should be properly addressed. Mr. Haldea cited the case of Hyderabad where they have a long PPP agreement but there is lack of clarity. He also cited cases where tariff structures lacked clarity.
- Apart from clarity, a proper framework is also necessary. Mr. Haldea, in his speech, repeatedly emphasized on a “bankable framework”.
- Mr. Haldea also stressed on the need to have proper surveys done on the locations for PPP projects to make a proper assessment of the costs, for having a suitable technology (although PPP models should always be “technology neutral”).
- A PPP model is complex and constitutes of certain small components. It is important to lay adequate importance to each one, since if one fails it could lead to the failing of the whole PPP model.
- The waste to energy has very high potential that is untapped in the country. Around 4000 MW of energy can be generated but only 200 MW is being tapped till now.
- There is also a need to have a strong dispute resolution mechanism. There should be provisions for proper arbitration. Such a structured dispute resolution mechanism would imply more confidence on the part of the investors.
- He also mentioned that the various PPP models in the country failed because of different reasons like either the concessionaire quoted over price, the tipping was too high, the waste to be transported at greater distances. Also in some cases the private partner was involved in door-to-door collection which threatened revenue insecurity because of no/low assured revenue due to poor collection

Discussion

- Dr. Ahluwalia stressed on the need for the ULBs to focus on the own revenues. Keeping the huge finance requirements in mind own revenues need to be increased by 1 per cent of the GDP (from what they are currently). After raising their own revenues, the ULBs can have greater claim to the states for the transfers.
- On Dr KausturiRangan's question on how successful could a PPP model be in India and whether one could expect the same success as has been experienced in Germany, Mr. Haldea responded that different countries would have different models, but by and large some amount of commercialization of services is called for. If not levying user charges, at least the thought of such charges, has to be introduced. By introducing charges in such a manner, we could make things self sustainable.
- Dr Haldea argued that most countries have commercialised the infrastructure. If there is no commercialisation, then a high level of subsidy is needed.
- He mentioned that there are no short cuts i.e. people should pay taxes in order to make municipal functions operational. As the revenue generation from taxes is very low, thus PPP plays a very critical role in attracting private investment.
- In the end, he concluded that if more investments are needed and/or reduced cost of operations and efficiency then PPP is the option which can bring in revolution into SWM.