Solid waste management exposure workshop for urban local bodies of Uttar Pradesh under Swachh Bharat Mission of the Government of India

Proceeding of workshop at Agra, 27-29 November, 2018

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Solid waste management exposure workshops for ULBs of Uttar Pradesh


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1. Introduction

The Swachh Bharat Mission (SBM), an ambitious cleanliness campaign of the Government of India, was launched by the Hon’ble Prime Minister, Mr Narendra Modi, on October 2, 2014. The mission was launched through the length and breadth of the country as a national movement. In order to identifying and ranking the cleanest cities, a survey based monitoring system called “Swachh Survekshan” is being used by the Ministry of Housing and Urban Affairs (MoHUA) for achieving the SBM objectives for the years from 2016 to 2018. Swachh Survekshan has triggered the interest of various stakeholders of the society like Government agencies, Non-Government Organisation, research organisations, social workers, environmentalist and people at large, whose overwhelming participation has turned this campaign into a great movement.

Having understood the need of strengthening the capabilities of Urban Local bodies for making SBM a great success, MoHUA with its lateral agency National Institute of Urban Affairs (NIUA) has been conducting “Solid Waste Management exposure workshops” for ULBs across India for last three years. NIUA is conducting these workshops through identified and trained trainers.

The Energy and Resources Institute (TERI) is an autonomous, not-for-profit, research institute established in 1974 with the purpose of tackling and dealing with the immense and acute problems of the gradual depletion of the earth’s finite energy resources. Over the years, the Institute has developed a wider interpretation of this core purpose and its application. Consequently, TERI has created an environment that is enabling, dynamic and inspiring for development of solutions to global problems in the fields of energy, environment and current patterns of development, which are largely unsustainable. TERI is deeply committed to every aspect of sustainable development. In the waste to energy sector in particular, TERI facilitates the development of sustainable policies for the management of urban waste, development of biogas standards for large scale biogas plants in India, provides decentralised solution for organic waste treatment in partnership with relevant stakeholders and external agencies. The range of activities undertaken includes feasibility studies, preparation of project report, implementation of Anaerobic Digestion (AD) based technology, monitoring and evaluation, training and capacity building, exchange of experiences concerning best practices and options, and information dissemination.

TERI has been selected by NIUA through “Request for proposal” (RFP) process, as a training entity to train minimum 120 ULBs out of 176 ULBs of Uttar Pradesh. As per agreement, TERI conducted six SWM workshops in three cities- Agra, Aligarh and Jhansi (two workshops in each city). The list of ULBs was provided by NIUA to TERI which was already sent to the State Mission Director of Uttar Pradesh by MoHUA as well as well by NIUA. TERI, then established communication with the state mission Director and dates of workshops were finalized mutually. TERI also established contact with municipal corporations of all the three cities for duly inviting them to the workshops and also to discuss the best practices adopted in their respective cities. Although the invitation letters were sent by state mission directors to ULBs for participating in the workshops, TERI team rigorously followed up with each and every ULB for attending these workshops.
TERI conducted these workshops in a pre-defined format developed by NIUA. The format of workshops is as follows:

Each City Cluster Workshop is designed for 3 days. The broad design details are as follows:

A. Day 1- Technical session covering the following aspects of SWM
   - Orientation on SBM objectives and guidelines, waste management rules 2016,
     Importance of IEC, decentralised Waste Management, Composting, Recycling,
     involvement of the informal sector in Door to Door segregated collection, secondary
     sorting and transportation and role of Material Recovery Facility (MRF) for
     maximum recovery and utilization of dry waste, C&D waste etc.
   - Various practices and technologies available for SWM: Centralised and Decentralised
     waste processing

B. Day 2- Exposure Visit to SWM sites (as per availability)
   - The exposure visits on day 2 should include site visits covering any relevant
     technologies as approved in the SWM Rules, 2016

C. Day 3- technical session and group activities for SWM plan for ULB
   - Technical Session – Economics of Solid Waste Management, fulfilling conditions for
     accessing Swachh Bharat Mission Funds, Wealth from Waste concept and EIA
     requirements for setting up SWM processing plants, landfill etc.
   - Swachh Survekshan including documentation, Emphasis on ODF, ODF+, ODF++,
     Swachhta Ranking
   - Group Activity 1 (Challenges and Issues of ULB in managing solid waste), Group
     Activity 2 (SWM Plan for ULB), Quiz etc. and feedback from participants.

1.1 Workshop at Agra

At Agra, first workshop of 3-days was conducted from 27-29 November, 2018. A total of 37 participants comprising of 31 ULB Officials attended the workshop.

All the participants attended the attended lectures and discussions that took place on the first day and the third day of the workshop. The first group activity involved groups comprising of members from different ULBs and presenting their common and unique issues and challenges associated with solid waste management was also conducted on day 1. They were taken on field visits on the second day. The site visits were organized at many places in Agra to demonstrate centralized as well as decentralized waste management technologies such as composting, Construction and Demolition Waste Recycling Plant, waste collection through compaction machine, decentralized waste processing. On day 3, apart from the technical sessions, group activities and individual quiz were conducted. The second group activity required them to select approaches and technologies that they would
select for their city or town to make their ULB a **land-fill free and self-sustaining ULB** and, scoring the highest ranking under swachh survekshan.
2. Proceedings

In the workshop at Agra held from 27-29 November, 2018, about 23 ULBs participated apart from some other participants.

2.1 Number of Participants

<table>
<thead>
<tr>
<th>WORKSHOP</th>
<th>NO. OF PARTICIPANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agra - I (27-29, Nov., 2018)</td>
<td>ULBs 32 from 23 ULBs</td>
</tr>
</tbody>
</table>

Table 1: Number of participants

The details of participants from ULBs are as shown in table 2.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>District</th>
<th>Name of ULB</th>
<th>Type of ULB</th>
<th>No of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agra</td>
<td>Agra</td>
<td>Municipal Corporation</td>
<td>04</td>
</tr>
<tr>
<td>2.</td>
<td>Agra</td>
<td>Fatehpur Sikri (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>3.</td>
<td>Agra</td>
<td>Kiraoali (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>4.</td>
<td>Agra</td>
<td>Achnerna (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>5.</td>
<td>Agra</td>
<td>Etmadpur (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>6.</td>
<td>Agra</td>
<td>Shamsabad (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>7.</td>
<td>Agra</td>
<td>Kheragarh (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Bareilly</td>
<td>Dhaura Tanda (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>9.</td>
<td>Bareilly</td>
<td>Fatehganj Pashchimi (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>10.</td>
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<td>Richha (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>11.</td>
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<td>Shishgarh (NP)</td>
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<td>01</td>
</tr>
<tr>
<td>12.</td>
<td>Budaun</td>
<td>Dataganj (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>13.</td>
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<td>Aliganj (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>14.</td>
<td>Etah</td>
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<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>15.</td>
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<td>Jalesar (NPP)</td>
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<tr>
<td>16.</td>
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<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>17.</td>
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<td>Mohammadabad (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
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<tr>
<td>18.</td>
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<td>01</td>
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<tr>
<td>19.</td>
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<td>01</td>
</tr>
<tr>
<td>20.</td>
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<td>Pilibhit (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>21.</td>
<td>Jyotiba Phule</td>
<td>Ujhari (NP) (AMROHA)</td>
<td>Nagar Panchayat</td>
<td>02</td>
</tr>
<tr>
<td>22.</td>
<td>Jyotiba Phule</td>
<td>Dhanaura (NPP) (AMROHA)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>23.</td>
<td>Agra</td>
<td>Agra</td>
<td>Others</td>
<td>05</td>
</tr>
</tbody>
</table>

Table 2: Details of ULBs and its participants
Participants came from different ULBs from Nagar Palika Parishad and Nagar Panchayat of the state Uttar Pradesh.

2.2 Profile of Participants

Of the 37 participants from ULBs, about 35% were Executive officers and SBM officers and 24% were from administrative staff (clerk, Assistant, accounts officers etc.), 11% from AMC. Please refer graph 1 for the profile of participants.

![Profile of participants at Agra workshop, 27-29 November, 2018](image)

Graph 1: Profile of participants

2.3 Consolidated Feedback

The graphs below depict the overall picture of the feedback provided by the participants regarding the exposure workshop organized on 27-29 November 2018. The feedback has been analyzed for the following:

i. Field visits organized in and Agra regarding centralized and decentralized waste management technologies (Graph 2 and Graph 3)

ii. Overall logistic arrangements of the workshop (Graph 4)

iii. Lectures delivered by various resource persons (Graph 5)

### I. Technical Session

The graphs 2 show the overall feedback of the participants for all the activities of the workshop. From the graph, it is evident that most of the presentations organized for the participants were liked by them. These presentations were made to give the participants an idea about the current scenario of solid waste management and the different aspects to the existing problem.
The most liked lectures include: Integrated approach for solid waste management, Segregation, collection and Transportation of solid waste, Mainstreaming of unorganised sector in waste management, Centralised & Decentralised SWM- case studies, Swachh Survekshan, Swachhata Ranking, ODF, ODF+, ODF++, 7* Rating, Making Wealth from Business Models.

Participants also liked group activity very much. In group activity, different groups were given an exercise on preparation of “plan for development of landfill free and garbage free ULB” with revenue models.

**Graph 2: Rating of workshops activities and lectures**
II. Field Visits

Apart from the lectures, the participants rated the field visits as well. Graph 2 shows the rating of the sites visit. Some of the most appreciated sites includes - Innovative composting of dry leaves, House hold composting at Dayal Bagh, Twenty ton per day (20 TPD) waste composting, Kuberganj, Flower waste composting plant (02 ton per day) and Door To Door Collection in Taj Ganj zone Agra.

Graph 3: Rating of field visits

III. Arrangement of SBM Exposure Workshop

The logistics and arrangements for the workshop specially the accommodation, kits and facilitation and the site visit transportation were the highly rated too (as shown in the graph 4)
IV. Resource Persons

Resource persons were varied with as many numbers of eminent research organisation, Independent consultant (retired expert from corporate organization), and NGO (profile shown in graph 5). All the speakers gave theory as well as practical examples, demonstrations, exhibited videos and answered innumerable questions, discussed viability, sustainability and social relevance of the technologies, SWM approaches, rules, swachh sarvekshan etc. described by them.

Graph 4: Rating of workshop (arrangement, site visit and technical session)

Graph 5: Profile of resource persons

Speakers imparted knowledge on various subjects related to waste management like integrated solid waste management, SWM technologies, E-waste management, integration of waste pickers, C&D waste management, source segregation, Waste Recycling, Faecal Sludge Management, waste-based business model, swachh sarvekshan (ODF, ODF+, ODF++, star rating), developing document for swachh sarvekshan and several such topics citing best practices and grass-root examples. Most
Importantly they shared ground level issues and challenges associated with various waste management aspects.

V. Group Activities

**Group activity 1: Issues and challenges of SWM in participating ULBs**

The participants actively participated in Activities 1 and 2 on Day 1 (27th November, 2018 and 3 (29th November, 2018) respectively of the workshop. In order to carry out smooth conduction of the activities, participants were placed in the 5 groups with average of 7 members in each group. All groups were given a name by the respective group members. On day one of the workshop, all the groups were asked to list down the issues in their ULBs and, expectations from the workshops. This activity was very important to keep on day 1 to understand the need of the ULBs so that no important topic is left out and, also to modify the agenda (if required).

The issues of the ULBs and expectations from different groups are listed below in graph 6

**Group 01:**

- Insufficient employee for cleaning and maintaining cleanliness.
- Awareness program should be take place at regular intervals in the form of rallies and proper monitoring should be there.
- There should be competition by means of prize distribution to best clean area/ward/house at regular intervals
- Unaware of such technology to treat hazardous waste and medical waste to convert financial model.

**Group 02:**

- Approach roads to houses are narrow leading to restricted collection of waste.
- Transportation facilities by vehicles are old and insufficient of fund rage new vehicles.
- Cleanliness program is wide such that work divided into regions.
- Insufficient employee for cleaning and maintaining cleanliness.
- Awareness program should be take places regularly at schools and colleges.

**Group 03:**

- Dumping ground or land-filling sites absent.
- Segregation and collection problem from door-to-door collection and maintaining cleanliness every day is problem due to less manpower.
- Awareness program should be take places regularly since Swachh Bharat mission program can take place smoothly.

**Group 04:**

- Segregation and collection problem from door-to-door collection and maintaining cleanliness every day is problem due to less manpower.
- Public participation absence – waste disposed of on roads
- Dumping ground or land-filling sites absent
- Infrastructure to store wastage and take initiatives for making financial model is absence.
• Lack of skilled labor and fund flow throughout the complete, to smoothly complete a work.

Group 05:

• Nagar Panchayat/ Nagar Palika are devoid of any power.
• Nagar Panchayat/ Nagar Palika should have a regular meeting to meet these issues
• Absence of authority with Panchayat or Nagar Palika to get work done and make their payments.

The pattern of issues and challenges shared by participants are shown in the graph 5. It is evident from the graph that most of the ULBs are either not aware about the technology or lack of technology to suit their need. In many ULBs (> 50%), there is a strong demand for dumping ground or landfill site. In the same range of percentage, the challenges regarding segregation, collection and need of regular training are being faced by ULBs.

**Issues and challenges of participating ULBs**

The pattern of issues and challenges shared by participants are shown in the graph 6. It is evident from the graph that most of the ULBs are either not aware about the technology or lack of technology to suit their need. In many ULBs (> 50%), there is a strong demand for dumping ground or landfill site. In the same range of percentage, the challenges regarding segregation, collection and need of regular training are being faced by ULBs.
Graph 6: Pattern of issues and challenges

**Group Activity 2: Preparation of plan to make ULB a landfill and garbage free ULB with revenue model**

The second group activity required participants to prepare a plan for a real ULB (not hypothetical). They were asked to take up a real city with actual population and select technology/ies to process and treat the municipal solid waste generated in that city, in such a way that it not only removes the waste but also generate the revenue from the waste. The technologies to be selected may be centralized or decentralized as per the city’s requirements. They were asked to create a material recovery facility. They were also asked to allocate a budget regarding capital expenditure and operation and maintenance charges for waste management in the city and, evolve revenue model. Plans were then presented by each of the group to the jury and participants. Jury includes the members from NIUA, Organiser, independent expert and a NGO. Out of eight plans presented in the workshop, best three plans were given a special certificate for group activity.

**VI. Quiz activity:**

All the participants were asked to play a quiz at individual level on the third day after group activity 2. Questionnaire was designed to gauze their understanding and knowledge on different issues of
SWM and other lessons taught during the workshop. Best three contestants were given a special certificate and prize for quiz activity.

VII. Green features of the Workshop

Organiser tried to adopt the principle- “Practice what we preach” to the best of their effort to reduce the waste generation during the entire duration of workshop so that the event could be cited as the green event. The workshop kit provided to the participants was having jute bag, pen, manuals and note books made from recyclable paper. No paper or plastic bottles and crockery were used during the event. Participants were provided with re-usable water bottles (metal bottle) for drinking water during the class room lectures as well as during the field visit. Natural organic products in re-usable plastic or recyclable cardboard were used as gifts/ prizes. Participants appreciate the practices and mentioned that in three days we have developed the habit of conservation of resources as well as how to minimize the waste generation.
3. Details from the Workshop

3.1 Inauguration and context setting

Workshop was formally started with the welcome address by Dr D C Pant, TERI by welcoming the participants, speakers and members of NIUA. Dr Pant also detailed out the three-day program of workshop along with different aspects of green events and practices to be adopted during the workshop to make the even green.

Ms Tavishi, employee of NIUA inaugurated the workshop. In her inauguration speech, Ms Tavishi set the context of the workshop and activities being undertaken by the NIUA in the direction of Solid waste management and urban planning. Citing the importance of SWM exposure workshops, Ms. Tavishi also explained in detail about the SBM- SWM exposure workshop being carried for last three years.

3.2 Bio-notes of the speakers

Dr P Raman

Dr Raman, a post graduate and Doctors in Energy Management from Puducherry University, is a Senior Fellow in TERI in the renewable energy area of work. He has over 37 years of experience in these fields. He specializes in biomass energy (both electrical and thermal), solar, biomass cook-stoves, IC Engines, etc.

He has designed and developed biomass gasifier systems for power generation and thermal applications. A dual fired biomass gasifier system with dry gas cleaning equipment was developed and applied for patent. This innovative system does not generate waste water as it happens in conventional gasifier systems. He has also developed a mathematical model for estimation of efficiency of the I.C. engines, in part-load conditions.

Dr Raman was principle Investigator of cookstove projects and has designed and developed “Forced draft Clean Combustion Cookstoves”, which uses external power source by photovoltaic system. He has designed and developed “Thermo electric generators (TEGs)” to produce power to operate the forced draft cook stoves, mobile phone charging and LED lights.

He has several papers to his credit published in prestigious journals as also has several published patents. He is also a reviewer of renowned journals and has reviewed over 100 research papers.

Dr Suneel Pandey

Dr Suneel Pandey is presently Senior Fellow and Director, Environment & Waste Management Division, TERI. In addition, he also teaches at TERI School of Advanced Studies. He has more than 25 years of consultancy/ research experience in the areas of municipal, industrial and hospital waste management, plastic waste management, waste-to-energy issues, impact assessment, air, water and soil quality monitoring, site assessments, performance evaluation of ETP and institutional strengthening and capacity building. He has obtained his Ph. D. degree in hazardous waste characterization from Nagpur University while working as Project Fellow at NEERI, Nagpur. He has MSc, Analytical Chemistry,
Banaras Hindu University, India and did his BSc, Chemistry from Banaras Hindu University, India.
Prior to joining TERI, Suneel has worked for ERM India as Consultant for two years where he was working on projects related to hazardous and hospital waste management, environmental site assessments and institutional strengthening and capacity building. Suneel has also worked as Research Assistant at Hong Kong University of Science and Technology on development of landfill liner for containment of land disposed hazardous waste and University of Hong Kong on deriving material balances and associated environmental pollution for Hong Kong region as part of Post-Doctoral Research

Dr Dinesh Chander Pant
Has more than 24 years of working experience in research, development and consultancy services in the field of solid waste management. His specific experience in research includes development of patented technology for organic waste treatment and development of ecobiotechnological strategy for enhanced recovery of energy from wet waste. Dr Pant has also installed more than 30 biogas plants across India and Bhutan. Experience in consultancy services includes preparations of DPRs and evaluation of technical due diligence, biomethanation plants, technical and quality inspections of compost plants. He possesses the excellent evaluation skill and has evaluated waste to energy projects across India. Dr Pant has also commendable experience in institutional strengthening and capacity building. He has provided training to more than 80 municipal corporation/councils’ officials under SWACHH BHARAT MISSION on biogas technology through series of lectures and site visits; in association with NIUA on behalf of Ministry of Urban Development (MoUD); conducted a short term training on biogas development for NBPE, Ethiopia; short term training on Design and development of TEAM technology for faculties and students of College of Science and Technology, Royal University of Bhutan; Workshop on Best Practices for Solid Waste Management in Indian Cities under Climate and Clean Air Coalition Municipal Solid Waste Initiative.
He received his Ph.D. degree in Environmental Science from TERI University, New Delhi and, has been working with TERI for 24 years in the “Renewable Energy Technologies” division.

Mr Nagendra Kumar
Mr Nagendra Kumar is an Associate Fellow in the Renewable Energy Technology Application (RETA) group of TERI, New Delhi, India. He received his M. Tech degree in Natural Resource Management. Mr Nagendra has technical and research experience of about 9.5 years in the fields of biogas and bio-methanation, solid/municipal waste management/conversion. Mr Nagendra is the consultant of HAREDA for the evaluation of all bioenergy (biomass, biogas, waste to energy and biofuel) DPR’s. He has intensive experience of designing and installation of more than fifteen biogas plant based on TERI’s TEAM technology in different parts of the country. He also possesses experience of coordination with local and international agencies and other public sector undertakings for conducting training programme in biogas sector. Mr Nagendra has closely worked with national Institute of Urban Affairs (NIUA) for sharing knowledge with more
than 200 Municipalities through a series of workshops sponsored by Ministry of Urban Development (MoUD).

Mr Praveen Nayak

Mr Praveen Nayak, the founder of Garbage Clinic in NOIDA, has a rich experience in implementing Solid Waste Management solutions & related services, having worked in the implementation of Swachhata Model for large municipal co-operations through his company Garbage Clinic.

Mr Nayak has worked for Solid and Liquid Resource Management Model at Ambikapur under Swachh Bharat Mission and has an IEC Certification for ODF Cities. He is a Member of an Expert Committee for Solid Waste Management and Plastic Waste Management of Central Pollution Control Board of India and Plastic Waste Management Innovative Invention of National Physical Laboratory providing end to end solution of waste plastic.

Mr Nayak is credited to have executed Yamuna Vihar Swachhata Model for 15,000 HH with approximately 25 MTD MSW Solution along with revenue Generation Model and also has completed a project for Beed Municipal Corporation with 2,00,000 population waste management project including resource recovery, resource marketing, revenue generation. He has also done a Swachhata Prerna Udyan in Sector-47, Noida - it is a small micro centre developed at sector level to provide the 2 MTD MSW solution.

Mr. Rakesh Solanki

An expert in all streams of waste management with an experience spanning more than 2 decades and covering almost all major cities and states in the country. Having worked as a consultant or an advisor or on management committee for major corporates in the field, Mr. Solanki is now an independent consultant with quite a few firms and NGO's of his own working on the waste management issues plaguing the country. Being the foremost expert in Plastic Waste Management, he is also the only expert empaneled by ‘Swachh Bharat Mission’ for Plastic Waste Management and Source Segregation. Bio-Medical Waste Management, C&D Waste Management, Landfill remediation, E-waste management solid waste management and now Waste to Energy, Integrated Municipal Solid Waste management, Plastic Waste Management and Source Segregation are all the streams of waste management that he has been and is currently involved with. A visionary with an inherent passion to work to eradicate the issue raised by improper waste management practices in the country, Mr Solanki is one of the known experts of source segregation and plastic management in SBM.

Mr Sarvesh Devraj M.Tech -Renewable Energy. B. Tech - Mechanical Engineering

With TERI Mr. Sarvesh Devraj is involves in research and development of several Renewable Energy technologies with special focus on biomass and solar energy. He is with TERI for more than three years working and involved in projects like biomass assessment of selected districts of Gujarat, Waste optimization in Waste to Energy, Indo-Finnish R&D solar project, MNRE-CST project on industrial heating and cooling, roadmap preparation for ISA signatory countries, etc. Apart from regular research he is a regular contributor to peer reviewed research journals and publications.

Mr Sourabh Manuja
Mr. Manuja has more than thirteen years of work experience in the field of environmental engineering. He has experience of working on the development of a Greenhouse gas emission model for emission inventory and mitigation strategies in the waste sector; formulating workplans to reduce short-lived climate pollutants for the waste sector for urban local bodies (ULBs), audit of mechanized road sweeping operations for ULBs, detailed project report preparation for solid waste management for cities of Aligarh and Mainpuri in Uttar Pradesh; designing of water and wastewater treatment plants using submerged aerobic fixed film (SAFF), moving bed biological reactor (MBBR), bio towers and anaerobic digester technology. He has also worked on solid liquid separation through conventional sedimentation as well as high rate solid liquid separation technologies like tube settlers, plate settlers, and fly ash membrane filters. He has been instrumental in designing pretreatment units for desalination plants with high rate settling units. He has been involved in environmental impact assessment studies for various infrastructure projects and evaluated the performance of effluent treatment plants. He has published 26 research papers in journals, seminars, and conferences and also authored a chapter in a book. Prior to TERI, he had worked for MM Aqua Technologies Limited, Tetra Tech (India) Limited, and Global Environmental Control Systems. He has a B.Tech (Environmental Engineer) from Gautam Buddh Technical University (formerly U.P.T.U.) and M. Tech (Environmental Science and Engineering) from Jamia Milia Islamia University, New Delhi.

Mr Ankit Rath
B. Tech (Civil Engineering)
In TERI, Mr Ankit Rath is involved in research and implementation as well as in design of structures part from which project managing, monitoring, and load evolution in different projects of biomethanation plant and others. I am TERI for 4 years and mostly working on civil construction as well as designing of structures part. I am also involved with few good value projects of R&D with REEEP and REC, roadmap preparation and feasibility study on provision of basic electricity for lighting and productive needs of villages in Mayurbhanj, Odisha (India), etc. Apart from this, I have good knowledge of waste to energy and biomass-related technologies. I am also contributing in publication of articles in the.

3.3 Technical Session I

Introduction and Current Scenario of Solid Waste Management in India by Dr Suneel Pandey

Dr Suneel Pandey made a presentation on the current scenario of waste management situation in India. He elaborately discussed and explained the situation of waste generation, collection, and current practices of waste disposal of different types of wastes such as MSW, electronic waste, C&D waste, hazardous waste (biomedical and small scale industrial waste). He also illustrated the many examples through videos on integrated waste management and C&D waste management.
**Integrated approach for solid and liquid waste management by Dr D C Pant**

Dr Pant made a presentation on the holistic approach for developing an integrated plan for solid and liquid waste management. He explained that integration is required at three fronts like technological integration, policy integration and stakeholders’ integration. He explained the importance of integration of various stakeholders and policy together to achieve the target of Swachh Bharat Mission. Citing the real problems of ULBs, he explained that if one ULB is unable to solve the problem of solid and liquid waste management, then that ULB can approach to the surrounding ULBs to make a plant or implement the plan of solid and liquid waste management. On technological integration, Dr Pant elaborated on designing and development of many solid and liquid waste treatment technologies of the ULBs’ interest such as STP, Karnal, Root zone treatment system, Up-flow Anaerobic Sludge Blanket (UASB) reactor, biogas technology. He also explained how liquid waste treatment technology can be integrated with the solid waste treatment technology with the mechanism for energy and manure recovery. For implementation of any such plan, Dr Pant also focused on the financing of these projects along with source of funding. His session lasted for more than 2.5 hours.

**Segregation, collection and transportation of solid waste. Plastic waste management. Video on Plastic Waste Management. By Mr Rakesh Solanki**

Mr Solanki eloquently explained the need of segregation through connecting nature with human being. He emphasised on the need of returning natural waste (organic waste) to the nature and avoid mixing of organic waste with the other wastes. By processing the organic waste, organic manure can be given to farmers for application in the agricultural fields. On plastic waste, Mr Solanki elaborated on the type of plastic waste and how different types of plastics can be collected and channelized for recycling. Citing the example of plastic waste management in Jhansi Municipal Corporation, which Mr Solanki has developed on its own, he told that rag pickers are integrated into the mainstream of waste collection, segregation and sale of plastic to run their livelihood. In this model, rag pickers (kabadi wala) are also provided with shops where they store the plastic waste and then sale that plastic to recyclers. The plastic which is not bought by the recyclers, is sent to those companies who are responsible for that particular waste through an agreement under Extended Producer responsibility (EPR). Even after that if some waste is left, that is used in the road construction. This way, all the plastic is managed, told Mr Solanki to the participants. He also showed picture and videos on the segregation and plastic waste management.

**Solid Waste Management Rules, 2016; E-waste Management Rules, 2016; C&D Management Rules, 2016; Relevant parts of Biomedical Waste; Plastic Waste Management Rules, 2016; Hazardous Waste Management Rules, 2016 by Mr Sourabh Manuja and Mr Nagendra Kumar.**

Mr Manuja covered the key features of each of these rules except C&D waste management rules which was covered by Mr Nagendra Kumar. Quoting the examples, Mr Manuja explained about the compliance of these rules by individual, residents’ welfare association (RWAs), bulk generators, municipalities, and industries. He also elaborated on the roles and responsibilities of different stakeholders’ right from individual to Municipal Commissioner.
and to state /central government. He also touched upon the disposal techniques of all the wastes particularly hazardous waste, E-waste, biomedical waste. Mr Nagendra explained, in detail, about the C&D waste rules. Starting with the constituents of waste, he explained its social, environmental and economic impacts on our society. How C&D waste be recycled for making various products (tiles, bricks, blocks, etc.) and aggregates (sand and stones).

3.4 Technical Session II

Mainstreaming of unorganised sector in waste management; livelihood generation; protective equipment for waste collection by Mr Nagendra Kumar.

Mr Kumar made presentation on the importance of integration of unorganised sector (rag pickers and safai wals). Citing the real time experience, he explained that these sectors are very important to be recognised not only for the upkeep of cities but also to improve their socio-economic status in the society. He also told that people can be assisted by developing some revenue model along with arranging micro-finance for their entrepreneurship development around waste management activities. They can be helped for availing benefits of government’s schemes like life insurance, benefits under National Urban Livelihoods Mission, housing schemes, health and education benefits to their children etc. For taking care of the health of these people, they should be provided with all the safety measures like helmet, gloves, face mask, shoes, mosquito repellent creams etc. If they are not using these measures, they should be consulted for the reasons of avoidance and, they should be provided with user-friendly equipments. They should have also regular medical check-up for which a tie-up with Government hospitals can be done. He strongly advocated the use of mechanical scavenging for cleaning the septic tanks and sewer lines.

3.5 Technical Session III

Decentralized composting technology/ies for wet organic waste by Mr Sourabh Manuja

Mr Manuja discussed all the types of composting technologies in detail. He chalked-out the importance of composting for reducing the load on landfill sites, replacement of chemical fertilizers, reduction in Greenhouse Gases (GHGs), remediation of contaminated soil, Carbon sequestration, aids in reforestation and habitat revitalization etc. Then he explained about the Aerated (Turned) Windrow Composting, Aerated Static Pile Composting, In-Vessel Composting and Vermi composting. Advantages and disadvantages of these technologies were also discussed by comparing parameters like Capital Cost, Operating Cost, Land Requirements, Control of Air, Operational Control, Sensitivity to Cold or Wet Weather, Control of Odour and Potential Operating Problems. Operating parameters and importance C:N ratio was discussed in detail. An excel-based exercise was given to participants for calculating and achieving the optimum ratio of carbon and Nitrogen using different types of organic waste.

Decentralized System for Waste Recovery – Dry Waste management by Dr. P Raman

Dr Raman made a presentation on low moisture waste like, dry leaves coconut shells, saw dust, fallen tree branches, rice husk etc. He explained that these types of waste are useful for the recovery of resources (heat, electricity, fuel and charcoal) through thermo-chemical processes (mass burning, gasification, pyrolysis). Dr Raman discussed these processes in...
detail. These wastes can be pre-processed to make a homogenous form of uniform size. Then it can be converted in the form of pallets and/or briquettes. These pallets or briquettes can be subjected to either gasification, or pyrolysis depending on the end use application of the energy or pyrolysis oil. Dr Raman showed the case of combined power and refrigeration project implemented in Uttar Pradesh for running a cold storage and supplying electricity to the village. Through these technologies, one can run the small to medium level industry also. The pyrolysis oil can be used in boiler to replace the furnace oil/diesel. Dr Raman also demonstrated the application of these pellets for cooking purpose using an improved cook-stove. The stove was also exhibited in the workshop.

**Bio-methanation Technology for wet waste management by Dr D C Pant**

Dr Pant explained the principle of anaerobic digestion for biogas generation from biodegradable organic waste. He explained the various steps involved in biogas generation, role of different bacteria, factors affecting the biogas production (pH, TS, loading rate, temperature, C:N ratio etc). Different types of biogas technologies (national/international, single/multiphase, mesophilic/thermophilic etc) were also discussed in detail. Dr Pant also discussed the TEAM technology for food waste/organic waste conversion in the shortest retention time of 7 days with minimum resources. He also discussed the CO₂ and H2S scrubbing processes for enrichment of biogas (Bio-CNG). BIS standard for biogas upgradations were also discussed. He also showed many pictures of different biogas and bio-CNG plants.

**Centralised & Decentralised SWM- case studies by Mr Nagendra Kumar**

Nagendra Kumar gave a presentation on different case studies of centralised and decentralised Solid waste management practices. He also told about the advantages and disadvantages of both-centralised and decentralised application of different technologies for SWM.
3.6 Field visits
Field visit was undertaken on second day of workshop. They were given exposure of the following practices
1. Innovative composting of dry leaves, Agra Cantt., Agra
2. Household composting at Dayal Bagh at AGRA
3. Twenty ton per day (20 TPD) waste composting at Agra
4. Integrated solid waste management activities

Innovative composting of dry leaves
Municipal Corporation of Agra has engaged two Ngo’s Eco-friend and Green hands for creating awareness and propagating home composting at individual house-hold level. This initiative has started in 2015 and so far it has been implemented in 25 households and the details of house hold where home composting is being practice as follows:
1. Mrs. Rekha Varshney, Address:406 Anupam Omerian Heights
2. Mrs. Kanchan Mulani, Address:407 Anupam Omerian Heights
3. Mrs. Deepti Arora, Address:507 Anupam Omerian Heights
4. Mrs. Anju Dehlani, Address:H.no.-35, Kamla Nagar Tankiwali Road Agra
5. Mrs. Rekha Hassija, Address: Anupam Apartment (green hands)
6. Mrs. Meeta Kulshreshtha : Address:-Bagh Farjana Agra(unfold foundation)

Increasing population and percentage of increasing household wastes have stipulated “GREEN HANDS (AGRA)” forum to come up with green and clean waste management solutions. Based in Agra, Green Hands is a newly formed group, which is involves in promoting plantation, creating awareness for garbage segregation, installations of leaf composters within the city.
Green hands have initiated plantation of trees along the road sides by creating awareness among the citizens. Till now Green Hands have planted numbers of trees in Agra.
One of the innovative activities started by the Green hands is LEAF Composting. In lieu of this the group has started installing Leaf Composters (figure 1) at parks and temples where huge numbers of leaves and flowers being used to convert into compost. By doing this group have emphasized to prevent people burning dry leaves and throwing flowers into River Yamuna. Currently LEAF composting has been done at following places in Agra:

1. Anupam Omarion Heights,
2. Hanuman Park (Kamla Nagar)
3. Dayanand Park (Kamla Nagar),
4. Bachha Park (Kamla Nagar).
Apart this group has been working extensively in increasing the number of installations in Agra. As of now three more proposed places are Rahul Vihar, Paliwal Park and G- Block Park (Kamla Nagar).

**House hold composting at Dayal Bagh at AGRA**

- **House hold waste composting: - 3 Tier Small Kambha Type**

The Kambha technology for the home composting is a very popular and convenient means of household composting. The benefits of the 3 TIER small Kambha composting (figure 2) has been summarised in following points:

- Suitable for individual homes to compost in flats, apartments and tight spaces.
- A small family of 4 people can utilise one 3 T Kambha type for composting
- This can reduce daily generated organic waste by 80% in volume.
- It can consume approximately 15 kgs of waste from landfill / month (180 Kgs / year).
- A small quantity of Remix Powder mixing with organic waste can handle odour.
- It is suitable for balcony, terrace/garden.
- Requires a sheltered area away from direct rain (or use our Kambha raincoat Large).
- Holes made on the surface of pot allow moisture and airflow to regulate optimally.
- Compost harvesting cycle is around 6 weeks.
- Rodent free.

![Image of composting pots]

**Figure 2*: Three Tier Small Kambha type composting**

*Source: [https://www.greenmylife.in](https://www.greenmylife.in)

- **House hold waste composting: - Leave It Pot Small Type**

It is the simplest way of producing home compost for large homes and small communities to manage their own wastes without any extra efforts of lifting and shifting. The benefits of having Leave it Pot Small (figure 3) at homes are as follows:

- It is suitable for individual homes like flats, apartments and tight spaces to prepare compost.
- Suitable for composting in independent homes or as a compost storage container.
- A family of 4-5 is requires 3 Leave it Pots (Small) to manage waste comfortably for life. Thus in this way household waste can be reduced drastically by 80%.
- A small quantity of Remix Powder mixing with organic waste can handle odour.
- It is suitable for balcony, terrace/garden.
- Holes made on the surface of pot allow moisture and airflow to regulate optimally.
- It can consume approximately 30 kgs of waste from landfill / month (360Kgs / year).
- Rodent free.
- It is very quick methods of harvesting compost (every 1.5 months).
- Handcrafted terracotta which is provided by local artisan communities.
Twenty ton per day (20 TPD) Vegetable market waste composting at Agra
Agra municipal corporation has implemented a pit-based composting for wet waste generated from Basai vegetable market, Sikandra vegetable market, Awas Vikas Vegetable market at Kuberpur landfill site. The waste is being collected by local NGO engaged in door to door collection and waste is then transported in 20 TPD capacity vehicles to Kuberpur landfill site and being processed through pit based composting. The resulting semi-matured compost is further proceeded in 20 MTD processing plant where city compost is coming out as final product.

Two ton per day Flower composting plant
Under central government’s ambitious cleanliness initiative “Swachh Bharat Mission”, Agra Municipal Corporation has installed a 2 TPD flower to composting plant (figure 4) in Rajnagar on March 2018. This facility utilises the flower waste coming from different places like Temples, Mosques, Gurudwara’s & wedding venues and till date around 28.80 MT compost has been prepared. The lists of few places from where primarily flowers waste of 2 ton coming are:

- Mahadev Temple, Ravali
- Hanuman Temple, Langde Ki Chauki
- Radha Krishna Temple, Vijay Nagar
- Radha Krishna Temple, Rawatpara
- Ram Temple, Moti Katra
- Kailash Temple
- Hanuman Temple, Saint Jones
- Pathwari Temple, Pathwari
Door To Door Collection in Taj Ganj zone Agra

“Arva Associate” has started its Door to door collection work in Taj Ganj Zone of Agra in the month of Jan 2018 keeping in mind the various challenges faced by the previous companies which were not able to do the work for even 3 months and were failed to do the collection of waste due to complex condition of the area. Initially the work has been started with extrapolating demography of area followed by identifying waste generation sources and its classification were carried out. The primary assessment helped in designing most efficient plan for tackling waste from various vulnerable points, vehicle requirements, manpower need, different collection scenarios, and resources optimizations to start the collections of the waste at household level.

Once the collection plan get ready an awareness campaign to educate the citizen about type of waste and waste segregation, hazards of throwing waste on roads, home composting etc. has started. To ease the waste collection from door to door a mobile app has been developed which gives the relevant monitoring information to company.

Door to door collected waste either is segregated or being segregated before disposing at secondary collection points. To ensure the segregation at source the biodegradable bags has been distributed to many households to encourage them for segregation. Dedicated staffs continuously educate the people about importance of waste management. Also regular health check-up of staffs is done on regularly basis.

Figure 4: Flower to compost

Figure 5: Door to Door collection at Tajganj
3.7 Technical Session IV

*Importance of information and education in effective solid waste management by Nagendra Kumar*

Nagendra Kumar expressed the importance of IEC program for making a village ODF. He gave the example of Ludhiana case study where a village was successfully declared as ODF village by IEC program. He highlighted the problems and challenges being faced for changing the attitude and mind-set of people to adopt cleanliness practices. He also told the audience about how ULBs can save on time and fuel by optimizing the route of waste collection using a GPS system. He also spoke about the creation of awareness programs using school and college students and, how commercial hoardings can be used for spreading the message of cleanliness.

*Swachh Survekshan, Swachhata Ranking, ODF, ODF+, ODF++, 7* Rating; by Mr Pravin Nayak*

Mr Pravin Nayak cracked down the Swachh Survekshan (SS) to such an extent that every participant applauded him for making it so easily understandable. He explained each and every component of SS in detail to secure even 1 mark including ODF, ODF+ and ODF++. He explained how the ULB can secure the maximum marks under SS2019. He also made ULBs understand how they rank themselves under star rating of SBM. He also discussed the form to be uploaded on websites of SS2019 and what preparatory work is required to be done.

*Making Wealth from Business Models by Mr Pravin Nayak*

Mr Nayak illustrated the Ambikapur model in detail and explained how waste can be converted into wealth. He showed the videos of the models and explained each and every components of the model.

3.8 Valedictory Session

The Valedictory session involved distribution of prizes, certificates and mementoes to the participants from ULBs. Individual activities and resource persons honoured at the end of the workshop. The session was ended with the vote of thanks and finally ended with a group photograph of the participants and organisers.
Annexure 1: Photographs of workshop

A. Inauguration and context setting
B. Technical sessions :- Pictures
C. Field visit
D. Valedictory session

Fig 04: Glimpse of Valedictory session
# Annexure 3: List of participants

## Table 1: List of participants

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Name of participant</th>
<th>Name of ULB/ Organisation</th>
<th>Contact details</th>
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<tbody>
<tr>
<td>1</td>
<td>Mukesh Kumar</td>
<td>Nagar Palika Fatehpur Sikri</td>
<td>9936391040</td>
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<tr>
<td>2</td>
<td>Krishna Kr Pandey</td>
<td>Nagar Nigam Agra</td>
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<td>3</td>
<td>Rekha Hassija</td>
<td>Green Hands</td>
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<td>Payal Dawar</td>
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<td>5</td>
<td>Sangeeta Jain</td>
<td>Green Hands</td>
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<td>6</td>
<td>Vinod Solanki</td>
<td>Shamsabad Agra</td>
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<td>7</td>
<td>Karanpal Singh</td>
<td>Pilibhit</td>
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<td>8</td>
<td>R K Mishra</td>
<td>Kiraoali Agra</td>
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<td>9</td>
<td>Lokendra Singh</td>
<td>Jalesar Etah</td>
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<td>10</td>
<td>Afaq Ali</td>
<td>NPP Jalesar</td>
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<td>Shree Ram Chaurasiya</td>
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<td>12</td>
<td>Ashutosh Tripathi</td>
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<td>Daya Sagar</td>
<td>NP Nyoria Husainpur</td>
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<td>Trivendra Kumar</td>
<td>NPP Dataganj (Budaun)</td>
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<td>Devendra Gautam</td>
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<td>Maninder Kaur</td>
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<td>Achhnera (NPP), Agra</td>
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# Annexure 3: Winners of group and quiz activities

Table 2: Winners of group and quiz activities

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<th>Third position</th>
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<td>1 Mr. R.K Mishra</td>
<td>1 Mr. Devendra Pratap Gautam</td>
<td>1 Mr. Trivendra Kumar</td>
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<tr>
<td></td>
<td>2 Ms. Sucheta Arora</td>
<td>2 Mr. Mukesh Kumar Mishra</td>
<td>2 Mr. Karan Pal Singh</td>
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<td></td>
<td>3 Mr. Shri Ram Chaurasiya</td>
<td>3 Mr. Trilock Nath Yadav</td>
<td>3 Mr. Afaq Ali</td>
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<tr>
<td></td>
<td></td>
<td>4 Mr. Daya Sagar</td>
<td>4 Mr. Mukesh Kumar</td>
</tr>
<tr>
<td><strong>Winners of quiz competition</strong></td>
<td>First position</td>
<td>1 Mr. Sunil Kumar</td>
<td>2. Mr. Devendra Pratap Gautam</td>
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<tr>
<td></td>
<td></td>
<td>2. Mr. Devendra Pratap Gautam</td>
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