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 Jhansi, 05-07 December, 2018

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National Institute of Urban Affairs (NIUA)
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Solid waste management exposure workshops at Jhansi (05-07 December 2018) 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 Jhansi**

At Jhansi, first workshop of 3-days was conducted from 05-07 December, 2018. A total of 34 participants from 26 ULBs were attended the workshop.

All the participants attended the 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 Jhansi to demonstrate centralized as well as decentralized waste management technologies such as faecal sludge management, plastic waste management, composting, 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 Jhansi held from 05-07 December, 2018, about 26 ULBs participated.

### 2.1 Number of Participants

<table>
<thead>
<tr>
<th>WORKSHOP</th>
<th>NO. OF PARTICIPANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jhansi II (05-07, December, 2018)</td>
<td></td>
</tr>
<tr>
<td>ULBs</td>
<td>34 from 26 ULBs</td>
</tr>
<tr>
<td>OTHERS</td>
<td>00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>34 (Annexure 2)</td>
</tr>
</tbody>
</table>

The details of participants from ULBs are as shown in the table 1.

<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>Fatehpur</td>
<td>Fatehpur (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>2.</td>
<td>Jhansi</td>
<td>Gursarai (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>3.</td>
<td>Hardoi</td>
<td>Hardoi (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>4.</td>
<td>Jalaun</td>
<td>Jalaun (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>5.</td>
<td>Jhansi</td>
<td>Jhansi Cantt.</td>
<td>Cantonment Board</td>
<td>01</td>
</tr>
<tr>
<td>6.</td>
<td>Mahoba</td>
<td>Kabrai (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>7.</td>
<td>Jalaun</td>
<td>Kalpi (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Jalaun</td>
<td>Konch (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>9.</td>
<td>Fatehpur</td>
<td>Kora Jahanabad (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>10.</td>
<td>Mahoba</td>
<td>Kul Pahar (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>11.</td>
<td>Lalitpur</td>
<td>Lalitpur (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>12.</td>
<td>Mahoba</td>
<td>Mahoba (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>13.</td>
<td>Jhansi</td>
<td>Mauranipur (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>14.</td>
<td>Jalaun</td>
<td>Orai (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>15.</td>
<td>Hardoi</td>
<td>Pihani (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>16.</td>
<td>Hamirpur</td>
<td>Rath (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>17.</td>
<td>Jhansi</td>
<td>Samthar (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>18.</td>
<td>Hardoi</td>
<td>Sandila (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>19.</td>
<td>Hamirpur</td>
<td>Sumerpur (NP)</td>
<td>Nagar Panchayat</td>
<td>02</td>
</tr>
<tr>
<td>20.</td>
<td>Ambedkar Nagar</td>
<td>Akbarpur (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>21.</td>
<td>Bareilly</td>
<td>Aonla (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>02</td>
</tr>
<tr>
<td>22.</td>
<td>Auraiya</td>
<td>Auraiya (NPP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>23.</td>
<td>Auraiya</td>
<td>Babarpur Ajitmal (NP)</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
<tr>
<td>24.</td>
<td>Bareilly</td>
<td>Baheri (NP)</td>
<td>Nagar Palika Parishad</td>
<td>01</td>
</tr>
<tr>
<td>25.</td>
<td>Jalaun</td>
<td>Nadigaon</td>
<td>Nagar Panchayat</td>
<td>01</td>
</tr>
</tbody>
</table>

**Table 1: ULBs participants list**

Participants came from different ULBs from Nagar Palika Parishad and Nagar Panchayat of the state Uttar Pradesh.
2.2 Profile of Participants

Of the 34 participants from ULBs, about 42% were Executive officers, 16% of computer operator, 10% of Sanitary and food Inspector (SFI) 6% Clerks and 3% Executive engineer, etc. Please refer graph 1 for the profile of participants.

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 05-07th December 2018. The feedback has been analyzed for the following:

i. Lectures delivered by various resource persons (Graph 2)

ii. Field visits organized in and around Aligarh regarding centralized and decentralized waste management technologies (Graph 3)

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

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- Importance of information and education in effective solid waste management, Segregation, collection and Transportation of solid waste, Integrated approach for solid waste management, Mainstreaming of unorganised sector in waste management, Centralised & Decentralised SWM- case studies, Swachh Survekshan, Swachhata Ranking, ODF, ODF+, ODF++, 7* Rating, biomethanation technology for waste management
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 3 shows the rating of the sites visit. Some of the most appreciated sites include- faecal sludge management plant at Bijoli, plastic waste management plant at Rajgarh, mechanical bio-compost plant at Mashigang, waste management facility at Jhansi and facility of manure preparation from household waste at Jhansi Cantonment.

![Graph 3: Rating of field visits](image)

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)

![Graph 4: Rating of workshop (arrangement, site visit and technical session)](image)
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.

<table>
<thead>
<tr>
<th>Profile of resource persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Organisation Experts: 75%</td>
</tr>
<tr>
<td>NGO: 13%</td>
</tr>
<tr>
<td>Independent Expert: 12%</td>
</tr>
</tbody>
</table>

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 (05th December, 2018) and day 3 (07th December, 2018) respectively of the workshop. In order to carry out smooth conduction of the activities, participants were placed in the 6 groups with average of 6 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
Group 01:

- Unaware of such technology to treat waste and to convert financial model from Waste.
- Insufficient skilled /technical employee.
- Water supply problem.
- Segregation and collection problem from door-to-door collection and maintaining cleanliness every day is problem due to less manpower.
- Lack of Co-ordination problem from common people.
- Interference of higher authorities which leads to un-progressive of wok in field.
- Transportation facilities by vehicles are not sufficient and proper.

Group 02:

- Approach roads to houses are narrow leading to restricted collection of waste.
- Transportation facilities by vehicles are not sufficient and proper.
- Insufficient employee for cleaning and maintaining cleanliness.
- Unaware of such technology to treat waste and to convert financial model from Waste.
- Dumping ground or land-filling sites absent.
- Interference of higher authorities which leads to un-progressive of wok in field.

Group 03:

- Dumping ground or land-filling sites absent.
- Composting area is very less and further to buy land cost is so high to afford.
- There should be regular training programs - say once in six months for awareness creation.
- Unaware of such technology to treat waste and to convert financial model from Waste.
- Lack of Co-ordination problem from common people.
- Insufficient employee for cleaning and maintaining cleanliness.
- Interference of higher authorities which leads to un-progressive of wok in field.
- Funding opportunity was not there to take initiatives.

Group 04:

- Funding opportunity was not there to take initiatives.
- Insufficient skilled /technical employee.
- Dumping ground or land-filling sites absent.
• Interference of higher authorities which leads to un-progressive of wok in field.
• Language barrier to define problems to authorities and to understand awareness programs.
• Lack of Co-ordination problem from common people.

Group 05:

• Fund utilization for toilet formation by common people was pending.
• After awareness programs no one is serious and still open defecation is taking place.
• After segregation wet and dry separately unaware of such technology to treat waste and to convert financial model from Waste.
• Insufficient skilled /technical employee.
• Interference of higher authorities which leads to un-progressive of wok in field.
• Plastic waste from packaging items solution is unaware.

Group 06:

• Unaware of such technology to treat waste and to convert financial model from Waste.
• Funding opportunity was not there to take initiatives.
• Insufficient skilled /technical employee.
• Fund utilization for toilet formation by common people was pending.
• There should be regular training programs - say once in six months for awareness creation in field.
• Targets given by government to different Nagar Panchayat /Nagar Nigam/Nagar praised should be taking by feedback from them, since work load is more as compare for less employees.
• Interference of higher authorities which leads to un-progressive of wok in field.

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 need technical training for waste management. In many ULBs (> 50%), there is a strong demand for manpower, awareness and dumping ground or landfill site. In the same range of percentage, the challenges regarding segregation, collection, transportation 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 (Annexure 3).

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 (Annexure 3).

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 Roquaiya, employee of NIUA inaugurated the workshop. In her inauguration speech, Ms Roquaiya 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 Roquaiya 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
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 eco-biotechnological 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 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 body (ULB), 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 had been involved in environmental impact assessment studies for various infrastructure projects and evaluated 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 Buddha 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 Biogas plant and others, I am with 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 Mr Sourabh Manuja

Mr Sourabh Manuja 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 and 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 walas). 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:

- Faecal sludge management plant
- Plastic waste management plant
- Mechanical bio compost plant
- Waste Management facility in Jhansi
- Process of manure preparation from household waste at Jhansi Cantonment

Faecal sludge management plant

Jhansi Nagar Nigam has installed the faecal sludge management plant (picture 1) in the Year 2017 at Bijoli industrial area, Babina road Jhansi for the treatment and disposal of faecal sludge generated for Jhansi city. The plant has installed and operated by M/S Purna Pro Enviro Engineers Pvt. Ltd. The descriptions of the plant are provided in Table 2.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Details</th>
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<tr>
<td>Capacity</td>
<td>Serves 557,000 people (de-slugging every 4 years)</td>
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<tr>
<td>Technology</td>
<td>Gravity-based Biological Treatment</td>
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<tr>
<td>Area</td>
<td>1000 m²</td>
</tr>
<tr>
<td>Priority</td>
<td>Sample and low cost technology</td>
</tr>
<tr>
<td>Structure</td>
<td>Mostly underground, completely covered, odourless</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>Rs 200 Lakh (Rs 35.90 per capita)</td>
</tr>
<tr>
<td>Operating Cost</td>
<td>Rs 31.20 Lakh per year (Rs per capita per year)</td>
</tr>
</tbody>
</table>

Table 2: Plant key information

Picture 1: Top view of Jhansi FSM plant

Process description:

This is a biological system with combination of sludge treatment and liquid treatment by the natural process. Planted drying bed is an extension of unplanted drying bed, but has the added benefit of transpiration and enhanced sludge treatment due to the plants. Filters do not need to be deslugged after each feeding/drying cycle. The liquid is further treated in plated gravel filter. The process flow diagram of the plant is shown in Figure 1.
Plant performance: The system capable to meet the prescribed norms for sewage in terms of physical and chemical parameters. The process outputs need to be ascertained for biosafety. The pathogens removal in the sludge requires inactivation through chemicals or destruction using heat. The gravel filtration of liquid can only reduce the count and would not remove completely. The technology is suitable for the treatment of all organic waste.

Technology key features:
- The end to end system comprises planted drying beds for solids and liquid separation, planted gravel filter and polishing pond for liquids treatment.
- Gravity based system, based on natural treatment with no use of chemicals or electricity
- Minimal and simple operations with no skilled operator required
- A nursery within the facility would facilitate in reusing the treated wastewater and sludge
- Minimal odor

Strengths:
- Low operation and maintenance cost
- No skilled labour required
- No human contact with waste

Plastic waste management plant:
The Municipal solid waste generated in Jhansi has approximately 11% plastic waste as per the study conducted by the R.R. Collective in 2015. This means that approximately 300 tons of municipal waste has approximately 33 tons of waste containing various kinds of plastics and recyclables. Process flow chart of plastic waste management in Jhansi city is given below.
Jhansi Nagar Nigam has installed the plastic waste management facility in the Year 2016 at Rajgarh, Babina road Jhansi. The total capacity of the plant is 5 ton per day. The plant is operating by M/S Jain Hydrolic Pvt. Ltd. Photographs of plastic waste management plant are shown in Picture 2.

Picture 2: Plastic waste management plant

Process description:
First incoming material will be fed to vibrator machine which will remove all dust material from lot and further pass material to vibrator o/p conveyor. Vibrator input conveyor is used for feeding vibrator machine and Vibrator Output conveyor is used to receive material from vibrator and feed sorting conveyor. Sorting Conveyor is a horizontal conveyor of 25metre length and has compartments on its both sides for different categories of dry waste like plastic, paper and metals etc.

Shredding Machine-The waste is charged into the shredder through a side top door, the loading chute is designed to enable the rotor of the machine to grab the material easily and the charged waste is not pushed out of the shredder. Once the waste is fed the rotor makes the material starts rotating inside the chamber and grinds it on one of the side faces of the machine, the grinding face is made of High quality Abrasion Resistant steel. After this the material comes in contact with the mesh which also grinds the waste and breaks it further into smaller pieces. The reduced size pieces falls through the mesh and any material which remains larger than the mesh keeps revolving in the shredder till it is not smaller than the mesh holes. Shredding machine is shredding all non-recyclable and non-commercial plastics so that it can get values and can use into Road construction.

Bailing Press- Bailing Press to bail paper and plastics so that its density can be increased and transportation can be reduced significantly. Process flow diagram of plant is shown in figure 2.
Use of plastic waste in road construction: Plastic Road of 1.20 KM was first built in Veerangana Nagar, ward no-39 of district Jhansi U.P. and also replicated the plastic road of length of 03.25 KM in district Fatehpur under Pradhan Mantri Gramin Sadak Yojana. Use of plastic waste in road construction is shown in Picture 3.

![Picture 3: Use of plastic waste in road making](image)

**Advantages of plastic waste management**
- Saving environment from land, air, water pollution and reducing health hazards like dengue, malaria, and habitat food chain spoiling.
- Saving of natural resources by recycling of waste.
- Cleaning of city/areas.
- Generation of income sources from waste.
- Employment generation.
- Women Empowerment by giving work.
- Change in Behaviour
- Improving living standard of people.
- Increasing public participation

Details of road made using plastic waste in Jhansi Nagar Nigam & JHPL are shown in table 4.
Table 4: Details of plastic road in Jhansi

Mechanical bio compost plant

Jhansi city got its first mechanical bio compost plant in October 2017 at Mashigang near Kanshi ram park sipri bazar, Jhansi for the treatment of organic waste generated from different city wards. The plant has installed and operated by M/S ARVA associates. The total waste treatment capacity of the plant is 5 ton per day. Photographs of composting plant are shown in Picture 4.

<table>
<thead>
<tr>
<th>Name of the road</th>
<th>Name Of Agency</th>
<th>Road Laid year</th>
<th>Type of Bitumen</th>
<th>Source of Plastics waste</th>
<th>Type of Plastics</th>
<th>Percentage of plastics</th>
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</thead>
<tbody>
<tr>
<td>Shivaji Nagar</td>
<td>Jhansi Nagar Nigam</td>
<td>Feb-17</td>
<td>80/100</td>
<td>Jhansi Municipal Waste</td>
<td>PE and PP Mix</td>
<td>8% of bitumen</td>
</tr>
<tr>
<td>Firojabad</td>
<td>PMGSY Firojabad</td>
<td>Nov-17</td>
<td>80/100</td>
<td>Jhansi Municipal Waste</td>
<td>PP mix</td>
<td>8% of bitumen</td>
</tr>
<tr>
<td>Bharda Gaon, Mau ranipur</td>
<td>PMGSY Jhansi</td>
<td>Mar-18</td>
<td>BG 10</td>
<td>Jhansi Municipal Waste</td>
<td>PE and PP Mix</td>
<td>8% of bitumen</td>
</tr>
<tr>
<td>Pathar wale Hanuman ji, Jhansi</td>
<td>Jhansi Nagar Nigam</td>
<td>Feb-18</td>
<td>80/100</td>
<td>Jhansi Municipal Waste</td>
<td>PE and PP Mix</td>
<td>8% of bitumen</td>
</tr>
<tr>
<td>Hardoi</td>
<td>PMGSY</td>
<td>Apr-18</td>
<td>BG 10</td>
<td>Jhansi Municipal Waste</td>
<td>PE and PP Mix</td>
<td>8% of bitumen</td>
</tr>
<tr>
<td>Galla Mandi</td>
<td>Jhansi Nagar Nigam</td>
<td>Apr-18</td>
<td>80/100</td>
<td>Jhansi Municipal Waste</td>
<td>PE and PP Mix</td>
<td>8% of bitumen</td>
</tr>
<tr>
<td>Srinagar, Hansari</td>
<td>Jhansi Nagar Nigam</td>
<td>Jun-18</td>
<td>80/100</td>
<td>Jhansi Municipal Waste</td>
<td>PE and PP Mix</td>
<td>8% of bitumen</td>
</tr>
</tbody>
</table>

Picture 4 Composting plant
Process description:
The source segregated organic waste is put into the machine, moisture content is sensed and the tank is heated if required. The moisture content in the organic waste gets evaporated and is vented out of the device through the exhaust. As organic waste consists of 80% to 90% liquid, the moisture content gets evaporated and there is a considerable decrease in the quantity of waste. Once the moisture content from the organic waste is removed, the microorganisms decompose the organic waste into compostable matter.

Details of composter:
- Made up of SS Component hence long Life and durability
- Consist of Automated Panel to control the temperature
- Negligible loss of volume
- Automated process and convert waste in to compost in 20Hrs
- No incineration only processing through bacteria/ culture.

Advantages:
- No manual intervention needed
- No pungent or putrid odour
- Scalable from 25 kg to 10 ton
- Noiseless, aerobic and eco-friendly process
- 80 to 90% volume reduction
- No recurring cost of bacteria refill
- Elegant compact design

Process of manure preparation from household waste at Jhansi Cantonment:
The waste is collected from households of the Cantonment area in segregated form (dry and wet). For the purpose, pick up vans and tri-cycles equipped with two compartment bins are being used. Waste is then collected at sorting station, which is then transferred to trenching ground by two different vehicles. At trenching ground, waste is further segregated into different components. Bio-degradable waste is then processed for composting. Waste is arranged in windrows form. A solution of EM is periodically sprayed on the windrows. After 7 days of that, EM powder is sprayed on these windrows. Photographs of composting plant are shown in Picture 5.
On the 15th day, windrows are turned upside-down for proper aeration and EM is once again sprayed. The total processing time for conversion of the waste into manure is 45-50 days. The compost so prepared undergoes different screening processes in SWM plant, where compost is allowed to filter through a defined size of sieves (trommel). Material of larger particle size is collected separately and pulverise into smaller particles. This small size material is reprocessed for manure preparation again using the above method.

In addition to this the plastic waste is also collected from the segregated waste, which primarily comprises of polythene bags. These bags are washed, dried and compressed with the help of a compacting machine. Bales of compressed plastic are then handed over to NGO engaged in the plant. The left over material like sand, soil etc. is dumped in low-lying areas.

The plant is situated in the trenching ground of Jhansi Cantonment between Mavanipura and Bhagwantpura. The plant was installed in January 2018.

**Waste Management facility in Jhansi**

The Muskan Jyoti Samiti, Lucknow is a leading social organisation working in the areas of solid waste management and helping for upliftment of economic status of deprived communities. To curb increasing waste management issues and spreading awareness in waste collection system, Muskan Jyoti has started channelized waste management system in Jhansi in association with Nagar Nigam:

- Horizontal waste processing centre for 100,000 population
- Vertical waste processing centre for 200,000 population

For this the following steps has been adopted for the waste management:

I. **Door to Door collection:**

Muskan Jyoti, has started collecting households waste door to door and distributed two dustbins and bags for waste collection. Source segregation is given priority and for these workers of company has been being trained.

II. **Transportation to Waste Processing Centre:**

The waste collected from households is being transported to waste processing facilities with the help of rickshaw trolleys.

III. **Final Segregation**

Garbage brought by trolleys and vehicles are further segregated in waste processing units. Biodegradable waste is directly send for composting and non-biodegradable waste further
segregated in other segments. Additionally recycling waste has been sent for selling in the markets.

**IV. De-composting bed for biodegradable**

De-composting may take 30-50 days depending upon the season and technique. In de-composting wastes are de-composting by aerobic methods in specially prepared beds. Finally once the compost is ready, it is then packed and sends to markets. Picture 6 shows the photographs of different steps of composting.

![Photographs of different steps of composting](image)

**Picture 6:** a) Door to door collection; b) Waste segregation; c) De-composting bed for biodegradable and d) Final compost

**3.7 Technical Session IV**

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

Nagendra Kumar loudly 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 one 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 at Jhansi 05th-7th December, 2018

A. Inauguration and context setting

Fig 01: Glimpse of Inauguration and context setting
B. Technical sessions

Fig 02: Glimpse of Technical sessions
C. Field visit

Fig 3.1: Glimpse of Field Visits
Fig 3.2: Glimpse of Field Visits
D. Valedictory session

Fig 04: Glimpse of Valedictory session
<table>
<thead>
<tr>
<th>Sl. No.</th>
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<td>Mr Sushil Kumar Dohare</td>
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<td>Mohd Irfan Mansoori</td>
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<td>Rakesh Kumar Gourav</td>
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## Annexure 3: Winners of group and quiz activities

**Winners of activities**

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**Winners of group activity**

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<th>Position</th>
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