Presentation on Waste Management
ICED

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Municipal Commissioner
Agartala Municipal Corporation
Agenda

- Introduction
- Current Status of MSW & Waste Generation in India
- Policy & Regulatory Framework
- Rural India model: Unakoti
- Urban model: Agartala
Introduction

- 62 million tonnes of MSW generated annually in urban areas,
- more than 80% is disposed of indiscriminately at dump yards in an unhygienic manner.
- This waste has a potential of generating
  - 439 MW of power
  - 1.3 million cubic metre of biogas per day or 72 MW of electricity from biogas and
  - 5.4 million metric tonnes of compost.
- 62 million tonnes annual generation of MSW will need 3, 40,000 cubic meter of landfill space everyday (1240 hectare per year) if continued to be dumped.
MSW Generation: Current Trends

As per CPCB data 2012 municipal authorities have so far only set up

• 279 compost plants,
• 172 biomethanation plants,
• 29 RDF plants and
• 8 Waste to Energy (W to E) plants in the country

(Many of the above are not even working)
68% of the MSW generated in the country is collected of which, 28% is treated by the municipal authorities. merely 19% of the total waste generated is currently treated. The remaining waste is disposed off at dump sites / landfill sites untreated.

The enormous quantity of MSW (62 million tonnes per year), generated if successfully managed will dramatically reduce the potential of disease burden and enhance public benefit.

Only 22 States/UTs have set up processing and disposal facilities and the rest of the States/UTs have made no effort till 2013
Urbanization

- India, the world’s second highest populated country of 1.21 billion (census 2011)
- The annual rate of growth of urban population in India is 3.35% (Census of India, 2011).
- The proportion of population living in urban areas has increased from 17.35% in 1951 to 31.2% in 2011 (Census, 2011).
- By 2020 Urban Population will be 50%
- High rate of population growth, declining opportunities in the rural areas and shift from stagnant and low paying agriculture sector to more paying urban occupations
- India has achieved multifaceted socio-economic progress during last 64 years of its independence.
- However, in spite of heavy expenditure by Civic bodies, Management of Municipal Solid Wastes (MSW) continues to remain one of the most neglected areas of urban development in India.
- Piles of garbage and wastes of all kinds littered everywhere have become common sight in urban life.
- For most of urban local bodies in India, solid waste is a major concern that has reached alarming proportions requiring management initiatives on a war-footing.
It is interesting to note that for the first time since independence absolute increase in population is more in urban areas than in rural areas.

Out of total increase of 181.4 million people during the last decade i.e. 2001-2011 90.4 million increase is in rural areas while 91.0 million is in urban areas.
Accelerating Development?

• Many Indian Cities/ States are targeting new generation development
  – IT/ ITES, BioTech
  – SEZs, Financial Hubs

• But - not a single designed and well operated MSW collection/ disposal facility in the Country
ENVIRONMENTAL AND HEALTH IMPACT OF URBANIZATION

Air Pollution

Release of Harmful Chemicals & Particles in the Air

Land Pollution

Spread of Disease-Causing Pathogens
Breeding of Disease Carriers and Pests

Water Pollution

Food Contamination
Health Effects of Open Dumping of Waste

- The health risks associated with illegal dumping are significant for ragpickers and residents living nearby.
- Areas used for illegal dumping may be easily accessible to people, especially children, who are vulnerable to the physical (protruding nails or sharp edges) and chemical (harmful fluids or dust) hazards posed by wastes.
- Rodents, insects, and other vermin attracted to open dumpsites may also pose health risks.
- Dumpsites with scrap tires provide an ideal breeding ground for mosquitoes, which can multiply 100 times faster than normal in the warm stagnant water standing in scrap tire casings.
Health Effects....

- Severe illnesses, including encephalitis and dengue fever, have been attributed to disease-carrying mosquitoes originating from scrap tire piles.

- In addition, countless neighborhoods have evacuated and property damage has been significant because of dumpsites that caught fire, either by spontaneous combustion or, more commonly, by arson. Illegal dumping can impact proper drainage of runoff, making areas more susceptible to flooding when wastes block ravines, creeks, culverts, and drainage basins.

- In rural areas, open burning at dumpsites containing chemicals may contaminate wells and surface water used as sources of drinking water.

(Source: Illegal Dumping Prevention Guidebook. US EPA. EPA905-97-001)
WASTE is Generated Daily by EVERYONE
State of our cities
Waste dumped at agricultural land
Organic Waste - Pondicherry Vegetable Market – no takers!
What is Done Currently

- Waste Generation
  - Un-segregated waste
  - Disposal at community bins
  - Collection and transportation
  - Disposal without any treatment
movie
Garbage Out...

• Waste generation of 0.2 to 0.45 kg/capita/day

• On an average, urban India generates
  – 285,000,000 x 0.3 = 85,500 MT of waste in a day
  – a mere trifle...
Waste Generation & Disposal Status in India...

- 36% (8 out of 22) cities generate more than 1000 TPD of waste (Ahmedabad, Delhi, Greater Mumbai, Jaipur, Kanpur, Lucknow, Pune and Surat)
- 13.6% (3 out of 22) cities generate waste between 500-1000 TPD (Indore, Ludhiana and Vadodara)
- 50% (11 out of 22) cities generate less than 500 TPD of waste (Agartala, Asansol, Chandigarh, Faridabad, Guwahati, Jamshedpur, Kochi, Kozhikode, Mangalore, Mysore and Shimla)
Movie satyamev
Evolution

- 1960 – GOI through Min. of Food and Agriculture provides loans for composting

- 1960 – Min. of Health and Family Welfare initiated National Mission on Environmental Health and Sanitation

- 1960 – Min of Urban Development through CPHEEO prepared a draft policy paper detailing funding issues and requirements for MSWM
1990 – A large number of PILs relating to MSWM

Late 1990s – increase in private role in composting and waste treatment

1999- Asim Burman Committee submitted report covering wide-ranging recommendations on institutional, financial, health and legal aspects. A key recommendation was to enable Private Sector Participation (PSP)

Rationale for PSP was potential funding, cost savings, improvement in efficiency and effectiveness in service delivery besides access to new technologies
Municipal Solid Waste (Management and Handling) Rules 2000

- Mandatory for ULBs to improve their waste management systems envisaged in the rules

- However, service levels in the sector continue to be below par

- Several reforms and guidelines, development of Model Municipal Bye-laws and making available financial assistance under various packages/schemes including 13th Finance Commission grants has not improved the situation
Urban Agglomerations/Towns by Class/Category: Census of India 2001

As per 2011 census, number of towns 7935, with 468 Class I cities of which 53 are 1,000,000 plus cities

<table>
<thead>
<tr>
<th>Class</th>
<th>Population Size</th>
<th>No.of UAs/Towns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>1,00,000 and above</td>
<td>393</td>
</tr>
<tr>
<td>Class II</td>
<td>50,000 - 99,999</td>
<td>401</td>
</tr>
<tr>
<td>Class III</td>
<td>20,000 - 49,999</td>
<td>1,151</td>
</tr>
<tr>
<td>Class IV</td>
<td>10,000 - 19,999</td>
<td>1,344</td>
</tr>
<tr>
<td>Class V</td>
<td>5,000 - 9,999</td>
<td>888</td>
</tr>
<tr>
<td>Class VI</td>
<td>Less than 5,000</td>
<td>191</td>
</tr>
<tr>
<td>Unclassified</td>
<td></td>
<td>10*</td>
</tr>
<tr>
<td>All classes</td>
<td></td>
<td>4378</td>
</tr>
</tbody>
</table>
Composition of Municipal Solid Waste (MSW)

Composition of MSW in India & Regional Variation

Source: Earth Engineering Centre, 2012
Devolution of 12th Finance Commission Grants for SWM

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particular</th>
<th>Amount ( in Crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Collection &amp; Transportation equipment &amp; Machinery</td>
<td>386.44</td>
</tr>
<tr>
<td>2.</td>
<td>Compost Plants</td>
<td>1001.23</td>
</tr>
<tr>
<td>3.</td>
<td>Sanitary Landfill Development</td>
<td>1056.88</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2444.55</td>
</tr>
</tbody>
</table>

Per Capita Investment Cost and Per Capita Operations and Maintenance Cost for Municipal Solid Waste Management in India.

- **Class IV+**: Per Capita Investment Cost: 113, Per Capita O&M Cost: 204
- **Class III**: Per Capita Investment Cost: 113, Per Capita O&M Cost: 204
- **Class II**: Per Capita Investment Cost: 113, Per Capita O&M Cost: 236
- **Class 1C**: Per Capita Investment Cost: 135, Per Capita O&M Cost: 410
- **Class 1B**: Per Capita Investment Cost: 189, Per Capita O&M Cost: 393
- **Class 1A**: Per Capita Investment Cost: 269, Per Capita O&M Cost: 900

Source: MoUD, (2011)
### Backlogs of Service Level Benchmarks

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Performance Indicator</th>
<th>Service Level Benchmark (in percent)</th>
<th>Current Average Performance (in percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Complaint Redressal</td>
<td>80</td>
<td>89.1</td>
</tr>
<tr>
<td>2.</td>
<td>Collection Efficiency</td>
<td>100</td>
<td>75.3</td>
</tr>
<tr>
<td>3.</td>
<td>Household Coverage</td>
<td>100</td>
<td>47.7</td>
</tr>
<tr>
<td>4.</td>
<td>MSW Recovery</td>
<td>100</td>
<td>31.7</td>
</tr>
<tr>
<td>5.</td>
<td>User Charges Collection Efficiency</td>
<td>90</td>
<td>31.4</td>
</tr>
<tr>
<td>6.</td>
<td>MSW Segregation</td>
<td>100</td>
<td>19.5</td>
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<tr>
<td>7.</td>
<td>Scientific Disposal</td>
<td>100</td>
<td>8.0</td>
</tr>
<tr>
<td>8.</td>
<td>Cost Recovery</td>
<td>100</td>
<td>17.3</td>
</tr>
</tbody>
</table>

Source: Karthykeyan, Aziz, Chatri, and Shah (2012)

![Service Backlogs Chart](chart.png)

Source: MoUD, (2011)
Policy & Regulatory Framework

- 74th Constitutional Amendment
- MSW (Management and Handling) Rules 2000
- Status of Implementation of MSW Rules
- National Environment Policy, 2006
- The Plastic Waste (Management and Handling) Rules 2011
- National Urban Policy, 2011
- Frame of MSW Rules, 2013
- Recommendations – Action Plan for Improvement
- Recommendations at Central, state and municipal levels
Recommendations: MSMW

- Develop and implement viable models of public-private partnerships for setting up and operating secure landfills, incinerators, and other appropriate techniques for the treatment and disposal of toxic and hazardous waste, both industrial and biomedical, on payment by users, taking the concerns of local communities into account.

- 2. Strengthen the capacities of local bodies for segregation, recycling, and reuse of municipal solid wastes recognizing inter-alia the positive impacts it may have on the welfare of safai-karamcharis, and setting up and operating sanitary landfills, in particular through competitive outsourcing of solid waste management services.

- 3. Give legal recognition to, and strengthen the informal sector systems of collection and recycling of various materials. In particular enhance their access to institutional finance and relevant technologies.
Central Government

- Establish an Authority or Mission on Solid Waste,
- Set up Special technical cell under the Authority that guide states on appropriate technologies of processing and disposal of waste in consultation with CPCB
- Allocate funds to states/ULBs for improving MSW systems and setting up waste treatment and disposal facilities.
- Support programmes of training and capacity building
- Central and State Governments may consider giving Tax holidays/incentives to waste processing and recycling industries for at least 10 years.
- Central and State Governments may promote use of compost or energy from waste
B. State Government

All the states should have a solid waste management authority with experts on various aspects of MSW, including contracting and financial management. This authority may be made responsible for the following:

i. Document the status of MSWM and create a mechanism for continuous update of the status.

ii. Assess the correct situation of MSW in the municipal areas in the state and identify the gaps that need to be bridged.

iii. Prepare norms for assessing the requirement of tools, equipment, vehicle, manpower for collection and transportation of waste and for setting up processing and disposal facilities as per guidance outlined in this report.
C. Municipal Level

All municipal corporations should have a MSW Management Department and other municipal authorities should have a MSW Management Cell and minimum technical and supervisory staff as per the yard stick prescribed by the State MSW Authority to ensure efficient MSW service delivery.

ii. Implement the integrated MSW management system recommended by the Task Force which consists of four streams of waste collection for all class of cities.

iii. Municipal authority may make serious efforts to educate the waste generators to minimize the waste and segregate the waste at source. It should make separate arrangements for collection, transportation of domestic, trade, institutional and market wastes and ensure that such waste is directly delivered at the waste processing facility meant for bio degradable and recyclable waste.
Incentives for MSW Management

Infrastructure Financing

- **Tax Exemption of Certain Bonds Issued by Local Authorities.** The central government has accorded a tax-free status to the interest on certain bonds issued by local authorities each year.

- **Tax Holiday for the Project Entity for Solid Waste Management.** The deduction equals 100 percent of such profits for 10 consecutive assessment years in the first 20 years of the project.

- **Tax Exemption for Income of Infrastructure Capital Funds and Companies.** Section 10(23G) of the Income Tax Act provides that any income of an infrastructure capital fund or an infrastructure capital company that takes in the form of interest, most types of dividends and long-term capital gains is not included in the calculation of total income for tax purposes.

- **Inclusion as Eligible Investments of Charitable Funds for Urban Infrastructure:** Section 11(5) (ix) of the Income Tax Act provides for inclusion as eligible investments of charitable funds (a) any deposits with a public company or (b) any investments in any bonds issued by such a company.

- **Availability of Funds by Sale of Carbon Credits:** Greenhouse gas (GHG) emissions are causing climate change.
Existing Financial Support from Government of India

- Support under erstwhile JnNURM and UIDSSMT Schemes of MoUD
- 13th Finance Commission Grants from Ministry of Finance
- Grants from MNRE for Supporting W to E Projects
- MNREGA and Nirmal Bharat Scheme Under MoRD
- TAC-Tariff Advisory Committee
- Viability Gap Funding from Ministry of Finance
- Support for Purchase of Compost from Ministry of Agriculture
MSWM – present status

- With economic growth and increase in per capita waste generation, current level of about 70 million tons of MSW to reach 370 million tons by 2030 (source: McKinsey Global Institute)

- Service levels in MSWM continue to be below par

- Major gaps are in coverage of collection services, scientific processing and disposal of the waste

- Diversion from landfill has been minimal because of compost which is highly contaminated with heavy metals processed from mixed MSW has almost no market.

- Most concessionaires only pay lip service to IEC or in the involvement of community of informal workers (rag-pickers), residents and internal stakeholders like sanitary workers and employees
Approach for Municipal Solid Waste Management as per MSW Rules

- Segregation at Source
- Collection & Transportation
- Treatment
- Scientific Landfilling of Inerts
Reality

• No or incomplete segregation / Informal recycling
• Composting
• RDF (at times)
• (Un) Scientific Disposal
Reasons for Weak Implementation

- Inadequate landuse planning and enforcement
- Lack of financial sustainability
- Lack of experience in private sector involvement
- Need for capacity building of elected local representatives
- Lack of environment awareness and weak enforcement
Technology Options

- Biomethanation for wet biodegradable wastes
- Conventional microbial- mechanized/ vermi composting for wet biodegradable wastes
- Preparation of briquette/ pellets/ fluff as Refuse Derived Fuel (RDF) from dry high-calorific value combustible wastes
- Incineration / Gasification / Pyrolysis for dry high-calorific value combustible wastes
- Plastic wastes to fuel oil
Justification for population cut-off at 5,000:
Villages and peri-urban centres which have population > 5,000 and more than 75% male population involved in non-agricultural activities are classified as “urban centres” as per the Census of India.

Figure 10a: Logic Diagram for Selection of Integrated Municipal Solid Waste Management Scheme for a given Local Self Government
Figure 10b: Integrated MSW Management System for the Population of more than 2 million
Figure 10c: Integrated MSW Management System for the Population Ranging from 1 to 2 million
Figure 10d: Integrated MSW Management System for the Population ranging from 1 to 10 lakh as well as for Hill Towns
Figure 10e: Integrated MSW Management System for the Population Less than 1 lakh
• Animated movie
MSW Treatment: Current Status

- **Composting**
  - Trivandrum, Vijayawada, Thane, Mumbai (3)
  - Kolkata, Asansol, Durgapur
  - Bangalore (3)
  - Delhi (2), Gwalior, Bhopal
  - Shimla, Shillong, Puri
  - Delhi (2); Ahmadabad
  - Air field Stn. (6)
  - Rajkot, Kanpur

- **Vermi-composting**
  - Mumbai (400 MT/d)
  - Suryapet, Ramagundam
  - Chalisgaon, Phaltan
  - Small scale plants across the country.

- **Biomethanation**
  - Lucknow, Chennai
  - Vijayawada
  - Small scale plants

- **Mass burn**
  - Timarpur, New Delhi (???)
  - Okhla, New Delhi (2011)

- **Refuse Derived Fuel**
  - Baroda, Mumbai, Jaipur
  - Bangalore, Guntur-Vijayawada
  - Hyderabad, Ahmadabad
  - Chandigarh
MSW Treatment: Failure Stories

- Composting Plant in Vijayawada
- Equipment failure in RDF Plant at Vijayawada
MSW Treatment: Success Stories

- The compost plant is running successfully since 1998 under PPP.
- Waste supply to the compost plant is 40 tons per day.
- The intake capacity of the compost plant is 100 tons per day.

<table>
<thead>
<tr>
<th>Year</th>
<th>Collection (MT)</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 - 08</td>
<td>6252</td>
<td>1130</td>
</tr>
<tr>
<td>2006 - 07</td>
<td>6582</td>
<td>1038</td>
</tr>
<tr>
<td>2005 - 06</td>
<td>6309</td>
<td>1399</td>
</tr>
<tr>
<td>2004 - 05</td>
<td>8111</td>
<td>752</td>
</tr>
</tbody>
</table>
Waste Management in Other Developing Nations
The per capita waste generation rate is strongly correlated to the gross domestic product (GDP) of a country.

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP (PPP) per capita estimated for 2007 (USD)</th>
<th>Waste generation (kg/capita/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>37,385</td>
<td>2.25</td>
</tr>
<tr>
<td>Japan</td>
<td>33,010</td>
<td>1.1</td>
</tr>
<tr>
<td>Singapore</td>
<td>31,165</td>
<td>1.1</td>
</tr>
<tr>
<td>Taiwan</td>
<td>31,040</td>
<td>0.667</td>
</tr>
<tr>
<td>South Korea</td>
<td>23,331</td>
<td>1.0</td>
</tr>
<tr>
<td>Malaysia</td>
<td>12,702</td>
<td>0.5-0.8</td>
</tr>
<tr>
<td>Thailand</td>
<td>9426</td>
<td>1.1</td>
</tr>
<tr>
<td>China</td>
<td>8854</td>
<td>0.8</td>
</tr>
<tr>
<td>Philippines</td>
<td>5409</td>
<td>0.3-0.7</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5096</td>
<td>0.8-1</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>5047</td>
<td>0.2-0.9</td>
</tr>
<tr>
<td>India</td>
<td>3794</td>
<td>0.3-0.6</td>
</tr>
<tr>
<td>Vietnam</td>
<td>3502</td>
<td>0.55</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>2260</td>
<td>0.7</td>
</tr>
<tr>
<td>Nepal</td>
<td>1760</td>
<td>0.2-0.5</td>
</tr>
</tbody>
</table>

Source: US EPA, 2006; Monni et al., 2006; IPCC, 2007
Waste Management in Developed Nations
Waste Management: Overview

- 100% collection coverage
- No open or illegal dumping
- Recycling and composting for more than 50% of MSW
- Waste to Energy more than 10% - no public opposition
- Incentives for renewable energy
- Taxes on disposal
- EPR (Extended Producer Responsibility) schemes in place for many streams
- Informal sector zero or illegal
Waste Management: Germany

Segregation at Source

Recyclable waste deposited at recycling centers

Waste Collection

Waste collection, recovery and disposal, with municipal companies accounting for a share of 35% in and private companies for a share of 65%.

Waste Treatment
Tanegashima, Japan

Capacity: 22 tons/24hr
Waste type: Municipal waste
Nishimonbetsu, Japan

Capacity: 13 tons/16hr x 2 units
Waste type: Municipal waste
To be delivered in 2012
Waste Management: Japan

Ito municipality, Japan

Capacity: 142 tons/24hr (71t/24hr x2)
Waste type: Municipal waste
To be delivered in 2015
Waste Management: Austria

Start: 1969
(Re-) Start up: 1989
Revamping boilers: 2012/2014
Site: City of Vienna
Technology: Grate firing
Fuel capacity: 85 MW
Efficiency: Upto 90 % (co-generation)
Steam production: 2 x 50 t / h (32 bar, 240° C)
Average waste throughput: Upto 780 t / d
Fuel: Municipal waste
Objective

Integrated Waste Management System

Maximize waste processing

Minimize landfill

Resource Recovery at lowest Cost

Driving Sustainability

Improving health and living standards
Community Issues

- Training and Awareness
- Ownership of the waste
- Responsibility
- Bad odor
- Burning of waste
- Littering
- Collection of waste
- Segregation
- Easy to implement in Rural areas
Rural movie
Rural model: Unakoti
Transportation

Secondary Collection

Houses

Hotels/Hospital

Market Yards

Roads

Waste Collection Bins

Primary Collection

Transfer Station

Secondary Collection

Waste Treatment Facility

Transportation

Processing

Sales

RDF for Sale

Compost for Sale
Municipal Council pays for Equipment and Management Costs
Collection and transport

- House to house collection by rickshaw (1p) (9no’s) into dustbins
- Garbage autos to empty the dustbins (3p) (5no’s) into tractor
- Tractor empties the waste in the factory site (6p) (2no’s)
Both nagar panchayats consist of 26 wards and 65 bins have been placed.

- 9 rickshaws are used in 2 shifts, 7 days a week.
- Road sweeping waste and special collection in market area is done.
- 5 autos are being used.
- 2 tractors are being used.
- 2 supervisors have been appointed to make sure collection is done.
Door to door garbage collection and Environmentally compliant transportation
Processing

The treatment process consists of the following stages:

- **Stage 1: Waste Segregation**
- **Stage 2: Composting**
- **Stage 3: Recovery of Dry Recyclables**
- **Stage 4: Sanitary Landfill**
- **Stage 5: Biomedical waste management**
Finished products

Waste Received
15 TPD

- 20% Compost
  - 3 TPD

- 25% RDF
  - 3.75 TPD

- 5% Recyclables
  - .75 TPD

- 10-20% Inerts, Sand, debris, stones,
Major cost involved

<table>
<thead>
<tr>
<th>Major cost Involved</th>
<th>Rs. In lacs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection and Transport (Bins, tricycles, hand equipments etc)</td>
<td>15</td>
</tr>
<tr>
<td>Collection and Transport Vehicles (5 Tata Aces)</td>
<td>20</td>
</tr>
<tr>
<td>Training and Awareness Programme</td>
<td>10</td>
</tr>
<tr>
<td>Civil Work and Scientific Land Fill</td>
<td>25</td>
</tr>
<tr>
<td>Segregation and Eco Brick plant</td>
<td>25</td>
</tr>
<tr>
<td>Compost plant</td>
<td>15</td>
</tr>
<tr>
<td>Bio Medical plant</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Rs. 130 lacs</strong></td>
</tr>
<tr>
<td>Balance Sheet</td>
<td>Per annum</td>
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<tr>
<td>---------------</td>
<td>-----------</td>
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<td>Expenditure</td>
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<tr>
<td>Particulars</td>
<td>Amount in Rs</td>
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<tr>
<td>Salaries</td>
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<tr>
<td>Collection and Transport</td>
<td>8856000</td>
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<td>Operational Cost</td>
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<td>Plant</td>
<td>500000</td>
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<td>Collection and Transport</td>
<td>150000</td>
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<td>AMC contract</td>
<td>1300000</td>
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<tr>
<td>Electricity</td>
<td>900000</td>
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<tr>
<td></td>
<td>11706000</td>
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<table>
<thead>
<tr>
<th>Sale</th>
<th>Tonnes Per Day</th>
<th>Sale Price per Tonne</th>
<th>Total Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Generated</td>
<td>100%</td>
<td>13</td>
<td>5000</td>
</tr>
<tr>
<td>Compost</td>
<td>20%</td>
<td>2.6</td>
<td>4000</td>
</tr>
<tr>
<td>RDF</td>
<td>25%</td>
<td>3.25</td>
<td>6000</td>
</tr>
<tr>
<td>Recyclables</td>
<td>5%</td>
<td>0.65</td>
<td>5000</td>
</tr>
<tr>
<td>EcoBricks</td>
<td>7%</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Rejects and Moisture</td>
<td>43%</td>
<td>5.59</td>
<td></td>
</tr>
</tbody>
</table>
Urban model: Agartala
Re-cycling Plastic
Compost Processing Machinery
RDF Processing Machinery
COMPOST

FINE GRADE
ECO PAVER BLOCKS
From sand, debris and Construction material.
Training and Awareness campaign created for:

1. Direct Stakeholders: Workers of the project
2. Indirect stakeholders: Residents of Unakoti
Increase the Usage/Awareness by PRIs

- Involvement of 3P (Private, Public and People) Sectors
  - Residents
  - Businesses
  - Schools
  - Grassroots organizations
  - Government agencies
  - Panchayat/NGOs/Media
Impact of Training

Before Training

After Training

[Images of people handling baskets and cleaning, showing before and after training scenarios]
**MSW collection and treatment methods**
(key municipal services, high budget allocation, low waste collection rate and mostly open dumping)

<table>
<thead>
<tr>
<th>Country</th>
<th>Average MSW collection rate (%)</th>
<th>Average Expenditure from municipal budget (%)</th>
<th>Waste treatment methods (average %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sri Lanka</td>
<td>42</td>
<td>20</td>
<td>Open dumping: 85 Sanitary landfill: 10 Composting and recycling: 5 Incineration: 0</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>55</td>
<td>20</td>
<td>Open dumping: 88 Sanitary landfill: 10 Composting and recycling: 2 Incineration: 0</td>
</tr>
<tr>
<td>India</td>
<td>73</td>
<td>25</td>
<td>Open dumping: 60 Sanitary landfill: 15 Composting and recycling: 10 Incineration: 5</td>
</tr>
<tr>
<td>Thailand</td>
<td>85</td>
<td>37</td>
<td>Open dumping: 62 Sanitary landfill: 35 Composting and recycling: 2 Incineration: 1</td>
</tr>
<tr>
<td>Indonesia</td>
<td>60</td>
<td>25</td>
<td>Open dumping: 58 Sanitary landfill: 40 Composting and recycling: 2 Incineration: 0</td>
</tr>
<tr>
<td>PR China</td>
<td>71</td>
<td>20</td>
<td>Open dumping: 48 Sanitary landfill: 56 Composting and recycling: 12 Incineration: 2</td>
</tr>
</tbody>
</table>

Source: Compiled by the author through the country studies, 2012
## Overview of Composting in MSW

<table>
<thead>
<tr>
<th>Scale</th>
<th>Small-scale (maximum 5 tonnes/day)</th>
<th>Medium-scale (5-100 tonnes/day)</th>
<th>Larger-scale (over 100 tonnes/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countries</td>
<td>Sri Lanka, Bangladesh, Thailand, Indonesia, India</td>
<td>Sri Lanka, Bangladesh, Thailand, Indonesia, India</td>
<td>India, China, Thailand Bangladesh (Waste Concern)</td>
</tr>
<tr>
<td>Waste inputs</td>
<td>Most commonly, separated waste from H/H, institute, street sweeping</td>
<td>Mixed or separated waste from H/H, markets and agro-production</td>
<td>Most commonly mixed organic waste from municipal waste collection stream</td>
</tr>
<tr>
<td>Composting methods</td>
<td>Vermin, simple windrow, box composting</td>
<td>Windrow with some specialized machines, aerated static pile, in-vessel</td>
<td>Windrow with heavy specialized machines, in-vessel</td>
</tr>
<tr>
<td>Labour/mechanical inputs</td>
<td>Labour intensive</td>
<td>Labour intensive with some mechanical inputs</td>
<td>Highly mechanical concentrated</td>
</tr>
<tr>
<td>Investment costs</td>
<td>Low</td>
<td>Medium/high</td>
<td>High</td>
</tr>
<tr>
<td>Operation costs</td>
<td>Low</td>
<td>Medium/high</td>
<td>High</td>
</tr>
<tr>
<td>Need of skilled workers</td>
<td>Not necessarily</td>
<td>Required trained workers</td>
<td>Required trained workers</td>
</tr>
<tr>
<td>Marketing of composting</td>
<td>Use/ market within community</td>
<td>Required proper marketing strategy</td>
<td>Required proper marketing strategy</td>
</tr>
<tr>
<td>Management model</td>
<td>CBO, NGO, Municipality</td>
<td>Municipality or PPP</td>
<td>PPP</td>
</tr>
</tbody>
</table>
## Cost/benefits analysis of selected composting plants

<table>
<thead>
<tr>
<th>Location</th>
<th>Composting method</th>
<th>Average volume (tons/day)</th>
<th>Compost production (tons/day)</th>
<th>Expenditure</th>
<th>Revenue</th>
<th>Net cost ($/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capital cost ($/ton)</td>
<td>O&amp;M cost ($/ton)</td>
<td>Compost ($/ton)</td>
</tr>
<tr>
<td>Kandy, Sri Lanka (LGU)</td>
<td>Windrow</td>
<td>15 (mixed)</td>
<td>1.5</td>
<td>40</td>
<td>108</td>
<td>95</td>
</tr>
<tr>
<td>Balangoda, Sri Lanka (LGU)</td>
<td>Windrow</td>
<td>20 (mixed)</td>
<td>1.5</td>
<td>25</td>
<td>158</td>
<td>80</td>
</tr>
<tr>
<td>Matale, Sri Lanka (NGO)</td>
<td>Box</td>
<td>2 (separated)</td>
<td>0.3</td>
<td>45</td>
<td>201</td>
<td>120</td>
</tr>
<tr>
<td>Surabaya, Indonesia (NGO)</td>
<td>Windrow/micro organism</td>
<td>1 (separated)</td>
<td>0.1</td>
<td>53</td>
<td>61</td>
<td>70</td>
</tr>
<tr>
<td>Pobsuk, Thailand (LGU)</td>
<td>Rotary drum</td>
<td>1 (separated)</td>
<td>0.5</td>
<td>102</td>
<td>47</td>
<td>170</td>
</tr>
<tr>
<td>BASA, Bangladesh (NGO)</td>
<td>Windrow</td>
<td>5 (mixed)</td>
<td>0.1</td>
<td>31</td>
<td>260</td>
<td>100</td>
</tr>
<tr>
<td>GRAMUS, Bangladesh (NGO)</td>
<td>Windrow</td>
<td>15 (mixed)</td>
<td>0.1</td>
<td>27</td>
<td>123</td>
<td>360</td>
</tr>
<tr>
<td>Nonthaburi, Thailand (LGU)</td>
<td>In-vessel</td>
<td>20 (mixed)</td>
<td>1.5</td>
<td>46</td>
<td>250</td>
<td>50</td>
</tr>
<tr>
<td>Temsi, Indonesia (NGO)</td>
<td>Aerated windrow</td>
<td>60 (mixed)</td>
<td>15</td>
<td>7</td>
<td>35</td>
<td>53</td>
</tr>
<tr>
<td>Waste Concern, Bangladesh (private)</td>
<td>Aerated windrow</td>
<td>100 (market waste)</td>
<td>10</td>
<td>83</td>
<td>63</td>
<td>85</td>
</tr>
<tr>
<td>Bantar Gebang, Indonesia (private)</td>
<td>Windrow</td>
<td>200 (market waste)</td>
<td>30</td>
<td>52</td>
<td>86</td>
<td>106</td>
</tr>
<tr>
<td>Bangkok, Thailand (private)</td>
<td>Rotary drum</td>
<td>1,000 (mixed)</td>
<td>300</td>
<td>26</td>
<td>42</td>
<td>184</td>
</tr>
<tr>
<td>Nangong, China (private)</td>
<td>In-vessel</td>
<td>1,000 (mixed)</td>
<td>65</td>
<td>100</td>
<td>157</td>
<td>120</td>
</tr>
</tbody>
</table>
MERITS OF THE TECHNOLOGY

 Makes perishable and stinky waste safe for handling.

 Avoids ground water contamination from leachates.

 Controls foul-smell, pathogens, flies, rodents, vectors.

 The processing technology itself is non-pollutant.

 Compost is useful for improving soil health & is key input for organic farming.

 RDF can be used as alternate fuel in Boiler, Steam turbines and furnace.

 Ensures substantial relief on landfill burden and future complications of land fill bioreactor.
What are the solution for India

**Short term priorities**
- Protect public health
- Improve quality of life

**Medium term priorities**
- Environmental degradation
- Better land use

**Long term priorities**
- Sustainability of our planet

ZERO WASTE
Thank you