Schemes proposed under Strategic Action Plan

for

Integrated Solid Waste Management Plan Pune

(Volume II)

Prepared for
UNEP DTIE IETC
and
Pune Municipal Corporation (PMC)

Prepared by
Dr. Prasad Modak
Consultant

With Support from
Environmental Management Centre
India

August 2007

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This assignment is a demonstration of a participatory and consensus driven strategic planning approach to developing an Integrated Solid Waste Management Plan for Pune city for Pune Municipal Corporation in India.

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INTRODUCTION

The Strategic Action Plan for ISWM for Pune is a result of the strategic planning process outlined in Strategic Action Plan - Volume I. The building blocks to the Action Plan have been Schemes that address project/programmatic issues to come up with a rounded intervention that considers institutional, financial as well as implementation aspects. Schemes present a blue-print for the Pune Municipal Corporation (PMC) to put the ISWM into action.

The Schemes were generated through a group work process at Environmental Management Centre and then classified using a thematic approach. This process was guided by the Vision and Mission statements and was further channeled through goals and objectives to address the gaps identified in the Situation Analyses. **Sections 1.1** provide details of the Schemes. **Figure 1** presents the "evolution process".

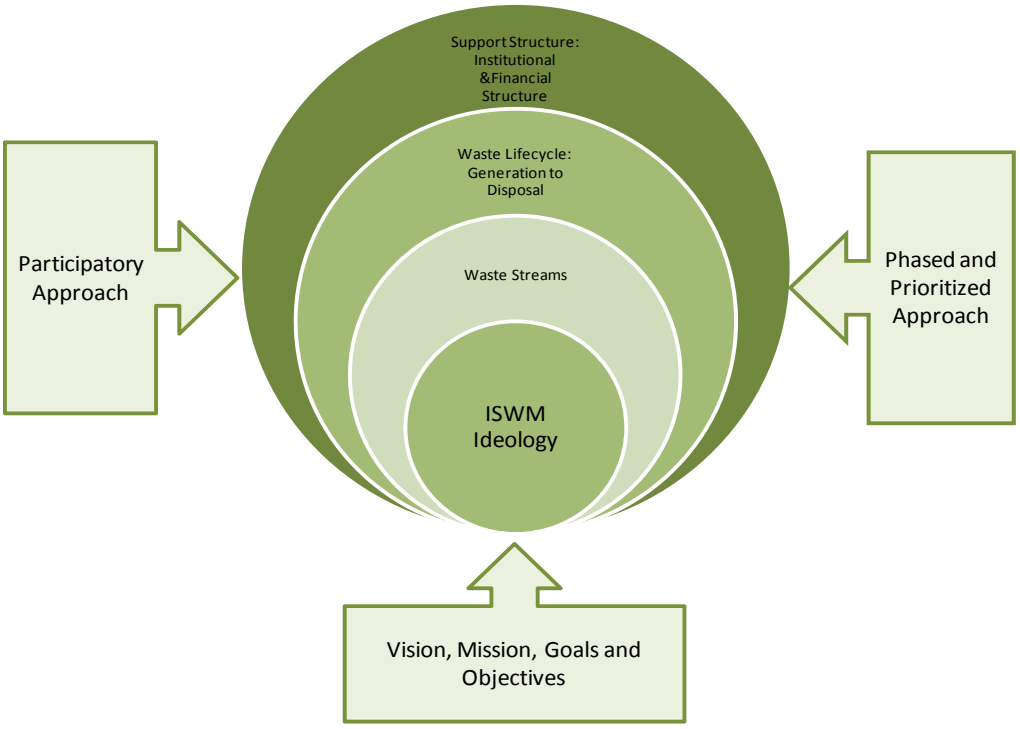

Figure 1: Evolution of Schemes under the ISWM Action Plan – The Conceptual Process

In order to provide a focus to the Schemes, a prioritization approach was followed. Prioritization was considered both over "time and space" i.e. Schemes were identified as high priority or for immediate implementation with priority locations (i.e. Wards) where piloting of the Scheme could be done. **Section 1.2** describes such a process of prioritization. The outcomes of such analyses was factored in the formulation of the appropriate Schemes as presented in **Section 1.3**.
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1.1 Characteristics of the Proposed Schemes

The Schemes for Strategic Action Plan were generated to support the goals and objectives (see **Table 1**)

Table 1: Goals and objectives for ISWM Plan

	Goal 1 **Reduce Risk to Public Health and Ecosystems**	**Goal 2** **Achieve Compliance with solid waste related regulatory requirements**	**Goal 3** **Strengthen PMC in order to achieve the above goals**
Objective 1	Minimize human exposure to solid wastes (G1O1)	Achieve Compliance with MSW (M&H) Rules (G2O1)	Build internal capacity of human resources in terms of adequacy and competency (G3O1)
Objective 2	Minimize exposure of environmental components (air, water, soil, flora and fauna) to solid wastes (G1O2)	Achieve Compliance with Biomedical (M&H) Rules (G2O2)	Improve internal SWM infrastructure (G3O2)
Objective 3	Minimize the quantum of solid waste generated, transported, treated and disposed (G1O3)	Achieve Compliance with Hazardous Waste (M&H) Rules (G2O3)	Make operations of SWM department transparent, accountable, efficient and cost-effective (G3O3)
Objective 4		Achieve Compliance with Other Legislation (Plastic recycling, Batteries etc.) (G2O4)	Forge synergistic partnerships with stakeholders (G3O4)

Table 2 provides listing of the various Schemes with linkages to Goals and Objectives.

In order to categorise the Schemes at operational level, five themes were identified based on the "functional nature". These themes include,

- Assessment and Development
- 3R Initiatives
- Infrastructure Development
- Awareness and Promotion
- Capacity Building and Partnerships

Such a thematic classification of Schemes is shown in **Table 2** and **Figure 2**.

Table 2: Link between Goals/Objectives and the Schemes Identified in the ISWM Action Plan

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
Assessment and Development	**Inventorisation of Solid Wastes**	To develop a detailed waste inventory for Municipal Solid Waste, Construction and Demolition waste and Biomedical Waste.	Project	Strengthen PMC in order to achieve the above goals	Minimize the quantum of solid waste generated, transported, treated and disposed
		To develop "Waste Generation Factors" for the above mentioned waste streams			
		To assist PMC in benchmarking the waste generation in the waste streams			
Assessment and Development	**Development of a Model for Municipal Solid Waste Management**	To develop a model for Municipal Solid waste management in Pune	Project	Strengthen PMC in order to achieve the above goals	Minimize the quantum of solid waste generated, transported, treated and disposed
Assessment and Development	**Securing Carbon Credits through CDM**	To acquire Certified Emission Reduction (CERs) through the process of CDM	Project	Strengthen PMC in order to achieve the above goals	Minimize the quantum of solid waste generated, transported, treated and disposed
Assessment and Development	**Assessment of Existing Waste Disposal Sites and Evaluating Management**	To carry out an assessment of existing waste disposal sites and evaluate management options for the same.	Project	Reduce Risk to Public Health and Ecosystems	Minimize exposure of environmental components (air, water, soil, flora and fauna) to solid wastes

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
	Options				
Assessment and Development	**Identification and Preliminary Design of New Waste Disposal Sites**	To find new waste disposal sites in Pune.	Project	Reduce Risk to Public Health and Ecosystems Achieve Compliance with solid waste related regulatory requirements	Minimize human exposure to solid wastes Achieve Compliance with MSW (M&H) Rules
3 R Initiatives	**Optimatisation and Strengthening of MSW Collection Systems**	To suggest and investigate various methods for optimizing and strengthening of the MSW Collection systems.	Project	Strengthen PMC in order to achieve the above goals	Build internal capacity of human resources in terms of adequacy and competency Improve internal SWM infrastructure
3 R Initiatives	**Establishment of Community Sorting Centres (CSC)**	To form CSC's which will serve as waste segregation and sorting facilities as well as a waste exchange centre.	Project	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed
3 R Initiatives	**Pilot Projects for Recycle and Reuse of C&D Waste**	To enlist several methods of recycle and reuse of C&D waste in Pune to avoid disposal of C&D waste at the landfills.	Project	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed
3 R Initiatives	**Recycling of Plastic Waste**	To enlist the possible recycling potential of plastic waste. To investigate the use of plastics to diesel and its implementation	Project	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
		with reference to Pune.		Strengthen PMC in order to achieve the above goals	Forge synergistic partnerships with stakeholders
3 R Initiatives	**Establish E-Waste recycling facility**	To introduce recycling facility for recycling electronic waste so as to deal with the problem of increasing electronic waste and hazards posed by it on human health as well as environment.	Project	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed
3 R Initiatives	**Establish a CFL recycling Programme and Common facility**	To establish a CFL Recycling programme and common facility for the same	Programme	Reduce Risk to Public Health and Ecosystems	Minimize human exposure to solid wastes
Infrastructure Development	**Establishment of Environmental Awareness Centre**	To form an Environmental Awareness Centre (EAC)	Project	Strengthen PMC in order to achieve the above goals	Make operations of SWM department transparent, accountable, efficient and cost-effective
		To strengthen existing and on-going PMC initiatives such as *Chakachak Mission*			
		To support new PMC awareness initiatives			
Infrastructure Development	**Private Partnerships in**	To introduce the Private sector participation in solid waste management involving the following activities:	Project	Strengthen PMC in order to achieve the above goals	Make operations of SWM department transparent, accountable, efficient and cost-

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
	the Current Waste Collection System	To privatize the collection mechanism by provision of vehicles or heavy equipment for the collection of waste and thereby increase the collection efficiency of waste collection.			effective
		Optimization in the transportation costs			
Infrastructure Development	**Private Partnerships in Decentralised Treatment System**	To introduce the Private sector participation in solid waste management involving the following activities:	Project	Strengthen PMC in order to achieve the above goals	Make operations of SWM department transparent, accountable, efficient and cost-effective Forge synergistic partnerships with stakeholders
		Provision of vehicles or heavy equipment for the collection of waste and thereby increase the collection efficiency of waste collection. (The current efficiency of Municipal Solid Waste in Pune is 88%, however no efficient collection systems have been developed for BMW and C&D wastes)			
		Collection and transfer of the municipal solid waste(commercial wastes from hotels, offices, markets or stores, household waste, street sweepings)to the centralized treatment facilities and the disposal sites.			
		Operation and management of the transfer stations and the collection centres.			

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
		Provision and maintenance of the waste bins with appropriate colour coding and labelling.			
Infrastructure Development	**Establishment of a Compost collection and managing centre**	To promote the use of compost in and around Pune city	Project	Strengthen PMC in order to achieve the above goals	Make operations of SWM department transparent, accountable, efficient and cost-effective
		To undertake compost enrichment studies			
		To develop guidelines for compost quality with the help of Organic Farming Certification process			
Infrastructure Development	**Demonstration Projects for Hotel Waste Management**	To promote decentralized treatments to process the hotel waste in the city.	Project	Reduce Risk to Public Health and Ecosystem Strengthen PMC in order to achieve the above goals	Minimize the quantum of solid waste generated, transported, treated and disposed Forge synergistic partnerships with stakeholders
Infrastructure Development	**C&D Waste Management**	To find better disposal techniques and system for C&D waste management.	Project	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed
Awareness and Promotion	**Design and Launch of a Comprehensive Awareness Campaign on**	To introduce structured awareness programmes about waste and waste related issues for various stakeholders.	Programme	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
	ISWM				
Awareness and Promotion	**Taming Consumption of Non-biodegradable Plastic**	To reduce the usage of plastics Influencing the packaging waste generated through consumers as well as industries To promote the use of biodegradable plastics	Project	Achieve Compliance with solid waste related regulatory requirements	Achieve Compliance with Other Legislation (Plastic recycling, Batteries etc.)
Awareness and Promotion	**Imparting Awareness and Training for BMW Management**	To create awareness among entire medical fraternity To ensure BMW rules are complied. To ensure continual efforts being made to protect public health. To train medical staff, medical students on the health hazards of BMW and their proper segregation and management	Programme	Achieve Compliance with solid waste related regulatory requirements	Achieve Compliance with Biomedical (M&H) Rules
Awareness and Promotion	**Initiating Schools involvement in Waste Management**	To set up various initiatives to educate and involve school children in waste management activities	Programme	Reduce Risk to Public Health and Ecosystems Strengthen PMC in order to achieve the above goals	Minimize the quantum of solid waste generated, transported, treated and disposed Forge synergistic partnerships with stakeholders
Awareness and Promotion	**Introducing Awards**	To introduce annual/biannual awards for the administrative wards in the city of	Programme	Strengthen PMC in order to achieve the	Make operations of SWM department transparent,

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
	Schemes	Pune to encourage better solid waste management.		above goals	accountable, efficient and cost-effective
Awareness and Promotion	**Improving Waste Management during Festivals**	To introduce a sustainable recycling programme for managing festival/ special events wastes especially during the Ganesh festival	Programme	Reduce Risk to Public Health and Ecosystems	Minimize the quantum of solid waste generated, transported, treated and disposed
Capacity Building and Partnerships	**Establishment of Standardized Guidelines for Operating Decentralised Treatment Plants**	To evaluate the decentralised treatment technology procedures and establish standardized procedures for Decentralised Treatment Plants	Project	Strengthen PMC in order to achieve the above goals	Make operations of SWM department transparent, accountable, efficient and cost-effective
Capacity Building and Partnerships	**Establishment of a Cadre of Certified Operators for Decentralized Treatment**	To form a proper cadre of operators who can take up this job of running decentralized plants sustainably.	Project	Strengthen PMC in order to achieve the above goals	Build internal capacity of human resources in terms of adequacy and competency
Capacity Building and Partnerships	**Introducing Industry - University Partnerships**	To introduce certain areas where Industry – University (I/U) partnerships can be taken up in the field of solid waste management for Pune.	Programme	Strengthen PMC in order to achieve the above goals	Forge synergistic partnerships with stakeholders
Capacity Building and	**Establishment**	To form a WEC which will serve as an	Project	Strengthen PMC in	Forge synergistic partnerships

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
Partnerships	**of a Waste Exchange Centre**	online network to allow for the exchange of materials between different industries, companies, other stakeholders such as the recycling businesses, markets and the citizens of Pune; based on their requirement.		order to achieve the above goals Achieve Compliance with solid waste related regulatory requirements	with stakeholders Achieve Compliance with Other Legislation (Plastic recycling, Batteries etc.)
Capacity Building and Partnerships	**Establishment of an ISWM Cell**	To formulate an Integrated Solid Waste Management Cell for Pune to assist PMC as an institutional body for managing the wastes and also to make an ISWM website. This website will work as an information portal for Pune's waste management aspects	Programme	Strengthen PMC in order to achieve the above goals	Build internal capacity of human resources in terms of adequacy and competency
Capacity Building and Partnerships	**Develop and Introduce Policy for C&D Waste Management**	To introduce specific guidelines for management and disposal of C&D waste generated within the city of Pune.	Policy	Achieve Compliance with solid waste related regulatory requirements	Achieve Compliance with MSW (M&H) Rules
Capacity Building and Partnerships	**Improving Health and Safety of PMC Workers, Rag pickers and citizens in proximity of the landfill**	To introduce programme for improving the health and safety of PMC workers, rag pickers and citizens in proximity with the landfill.	Programme	Reduce Risk to Public Health and Ecosystems	Minimize human exposure to solid wastes Minimize exposure of environmental components (air, water, soil, flora and fauna) to solid wastes

Theme	Scheme or Core Actions	Targets	Type of Action	Goal	Objective
Capacity Building and Partnerships	**Strengthening of PMC Rag picker Co-operatives**	To carry out an inventory of the rag pickers working in Pune and to increase their numbers in the PMC co-operatives	Programme	Strengthen PMC in order to achieve the above goals	Build internal capacity of human resources in terms of adequacy and competency
		To impart vocational training to be given to the Rag picker Cooperatives			
		To provide incentives and benefits to such cooperatives			
		To provide for Medical insurance system			
		To impart awareness amongst rag-pickers to encourage the independently working rag pickers to join co-operatives and work at the Community sorting centres.			
		To promote rag pickers to work at CSC, spread awareness at EAC, promote sale of crafts sold at EAC and communities, gardening etc for various community gardens/ PMC gardens etc.			

Figure 2: A Thematic Categorization of Generated Schemes in the ISWM Action Plan

The Schemes identified cover the entire waste flow i.e. from generation to disposal. **Figure 3** shows a mapping of the Schemes across the "waste cycle".

Some of the Schemes are waste stream specific while others are applicable to all the waste streams. (See **Figure 4**) All the schemes are however interlinked in some way or the other with some schemes actually depending on the implementation of others. Hence, percentage of Schemes across the waste streams is high.

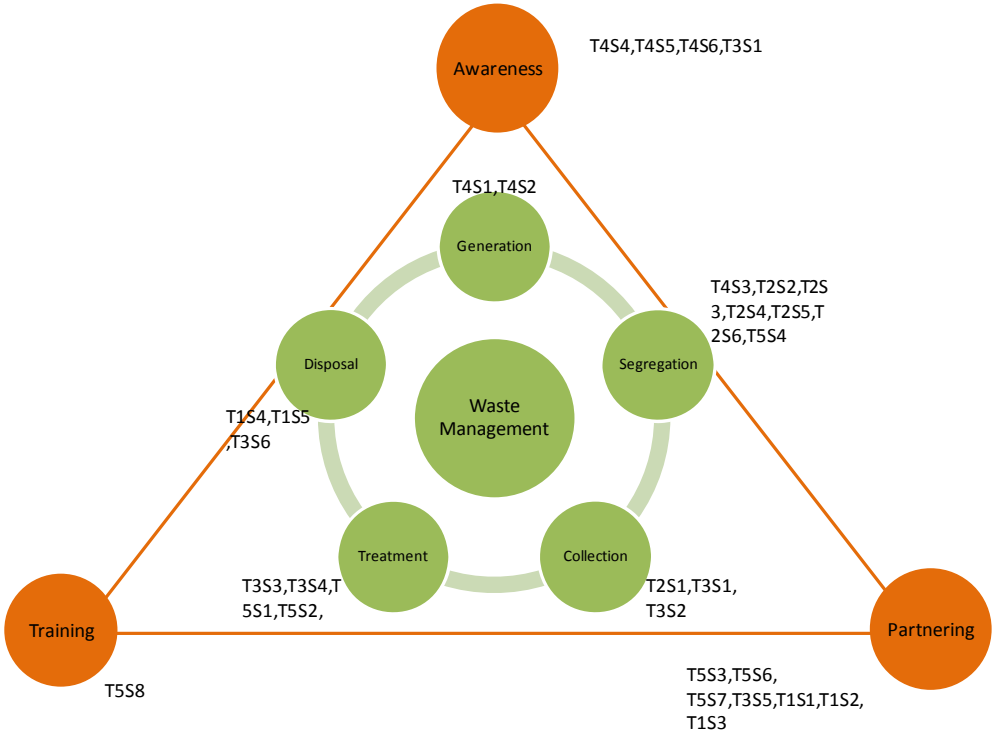


Figure 3: Schemes as Mapped across the "Waste Cycle"

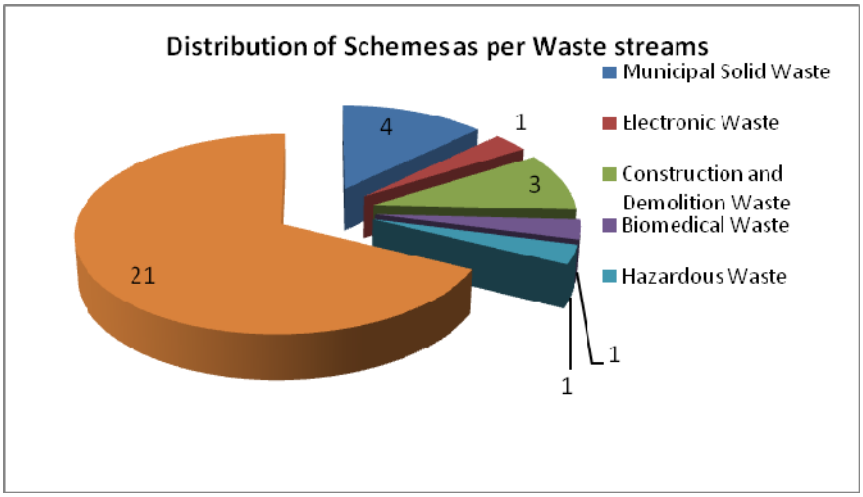


Figure 4: Schemes as mapped across waste streams

1.2 Prioritization across Wards for adoption of Schemes

While many of the Schemes identified are applicable across the Pune City, some Schemes need to be tested or piloted at few locations. Further, a phased approach of implementation is recommended for some Schemes that are resource intensive or need a policy change or compilation/analyses of primary data. To prioritize such locations, prioritization of wards was attempted and reflected accordingly in such Schemes.

The parameters considered for ward prioritization include Municipal Solid Waste (MSW) generated in MT/day, MSW storage capacity in bins, MSW collection capacity, number of rag pickers and amount of MSW treated in a decentralized manner. Based on these parameters, various indices were computed. Collection capacity index of the ward for instance was calculated on the basis of the number of collection vehicles allotted to each ward, capacity of the type of vehicles and the waste generated. **Table 3** and **Table 4** provide calculation of various indices across all the wards.

Table 3: Ward Prioritization in Pune for SWM

Wards	Waste generation in MTPD	Storage capacity index = Waste generated/ Storage capacity	Collection capacity index = Waste generated/ Collection capacity	Index for ragpickers' number = Waste generated/Number of ragpickers	Index for Decentralized Treatment of waste = Waste generated/ Waste treated at Ward
Aundh	63	0.43	2.63	0.59	33.51
Ghole rd	55	0.28	1.91	0.58	16.47
Warje Karvenagar	37	0.37	2.00	0.47	30.83
Karve Road	70	0.57	3.79	1.00	35.90
Dhole Patil Road	35	1.51	1.50	0.40	9.21
Hadapsar	56	0.33	1.81	0.50	86.15
Sangamwadi	52	0.39	3.86	0.24	3.91
Yerwada	58	0.55	2.22	0.29	8.29
Kasaba Peth	75	0.98	3.27	0.93	441.18
Vishrambagwada	92	0.45	2.71	0.69	57.50
Bhavani Peth	73	0.92	2.97	0.39	347.62
Tilak Road	67	0.36	2.46	0.48	33.50
Sahakarnagar	63	0.38	3.05	0.50	14.38
Bibvewadi	89	0.34	2.63	0.47	29.37

Table 4: Catagorization of Wards based on Various indices

Storage capacity index	Collection capacity index	Index for ragpickers' number	Index for Treatment of waste
0 to 0.4	1 to 2	0 to 0.4	1 to 30
0.4 to 0.8	2 to 3	0.4 to 0.8	30 to 100
above 0.8	above 3	above 0.8	above 100

Based on above, following observations can be made

- The storage capacity index is highest for Dhole Patil Road ward as the number of containers is less as compared to the waste generated. In the Scheme for strengthening the collection system, more focus should be given to Dhole Patil ward in terms of provision of additional bins.
- The higher indices for Collection show the lower collection capacity in the Karve Road, Sangamwadi, Kasaba Peth and Sahakar Nagar. The fleet of vehicles in these wards is thus not adequate. Hence, balancing of vehicles should be explored amongst the wards.
- More ragpickers should be introduced in Karve Road and Kasaba Peth on a priority.
- Higher decentralized treatment index shows need for promotion of decentralized treatment system. These Schemes should be prioritized in Kasaba Peth and Bhavani Peth ward. However considering paucity of space, these treatment systems may be set up in the neighbourhood wards with suitable transportation arrangements.

1.3 Profile of the Proposed Schemes

A detailed description of each Scheme has been presented below. The detailed description consists of introduction, purpose, description, implementation steps, lead and support agency, location, budget and timeframe. The sections on description and implementation have been explained in detail. Several examples of successful implementation of similar actions/interventions are provided. Finally, for each Scheme, inter-linkages with other Schemes have been listed to get a rounded perspective.

Figures 5, 6 and 7 and 8 show the distribution of Schemes based on Goals, Themes, priority and budget. Based on this analyses following observations could be drawn:

- The Schemes are equally distributed across protectionary as well as compliance related Goals with emphasis on Schemes for capacity building. This distribution underscores a need to build capacity of PMC for ISWM for effective implementation of the Action Plan.
- The Schemes are well distributed across the Themes demonstrating a rounded and balanced approach to plan development. An analyses based on budget allocated however shows emphasis on 3R Theme which is logical given the formulation of vision i..e *to make Pune City without Landfills*
- A number of Schemes fall under immediate priority implying relevance of the ISWM for Pune.

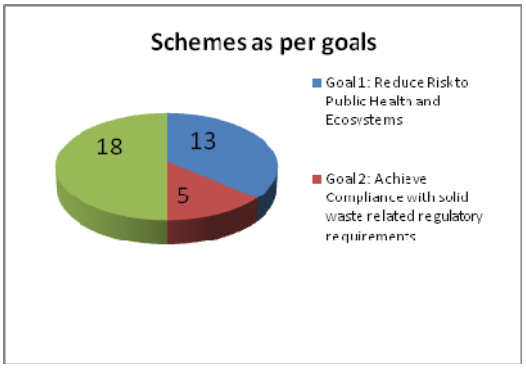


Figure 5: Distribution of Schemes based on Goals

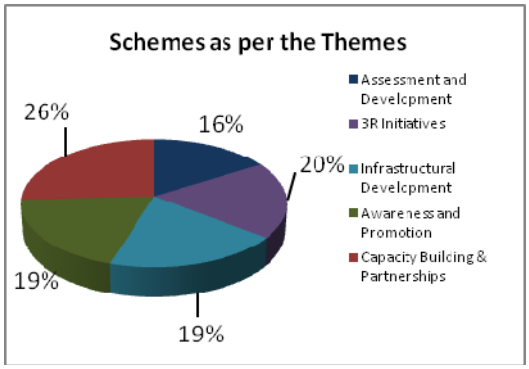


Figure 6: Distribution of Schemes as per Themes

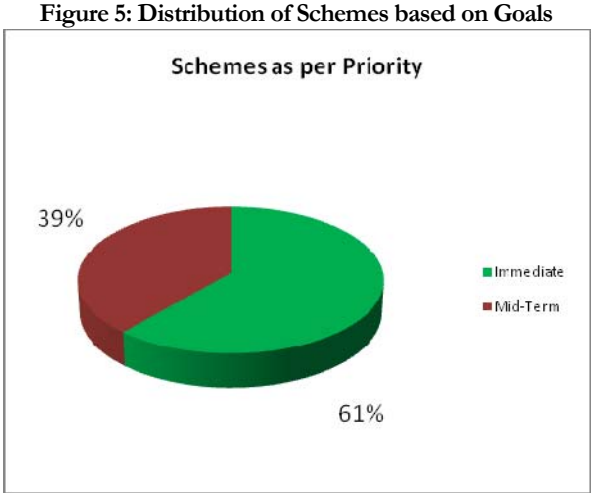


Figure 7: Distribution of Schemes based on the priority

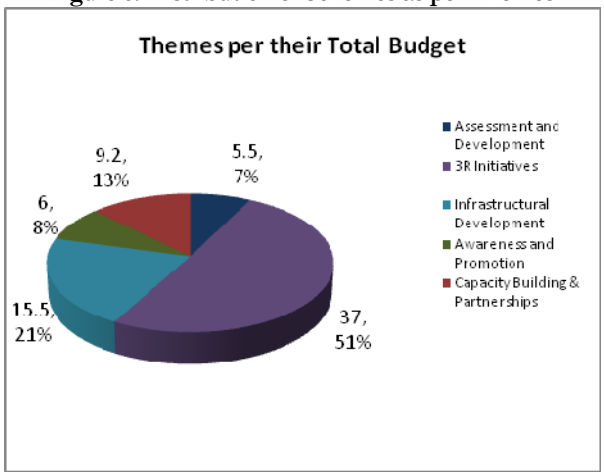
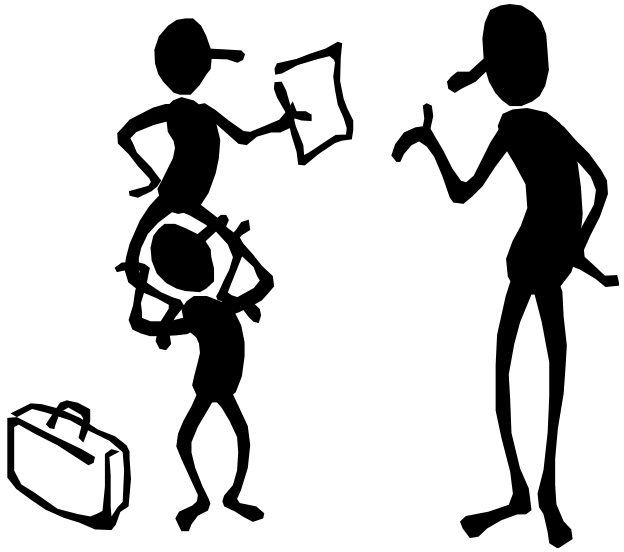


Figure 8: Distribution of Schemes based on the budget (Rs Million and Percentage of Total)

Theme 1
Assessment and Development

1. Inventorisation of Solid Wastes
2. Development of a Model for Municipal Solid Waste Management
3. Securing Carbon Credits through CDM
4. Assessment of Existing Waste Disposal Sites and Evaluating Management Options
5. Identification and Preliminary Design of New Waste Disposal Sites



1. INVENTORIZATION OF SOLID WASTE

1. **Introduction:** Integrated Solid Waste Management refers to a strategic initiative for the sustained management of solid waste through the use of a comprehensive integrated format. Understanding the overall situation as it exists, both in terms of waste related concerns and its institutional mechanisms is the first step of strategic planning process. The outcomes of the Situation Analysis have resulted in the identification of gaps related to compliance, institutional capacities, data and fiscal resources. Data related gaps emerged as one of the major constraints while preparing the Strategic Action Plan. The adequacy of accurate data adds to the uncertainties in the action plan thereby hampering its efficiency and reliability.
   Most of the waste-data related studies have been primarily done for MSW. However the sources of information are multiple, leading to duplication and inconsistencies in the data. Inventorization for Hazardous Waste and E-Waste has been recently undertaken by the MPCB. However, for newer waste streams such as C&D waste and BMW the information is very sparse and scattered.

2. **Purpose:** The data gaps in MSW, C&D and BMW are large and need to be bridged. The inventorization of solid waste lays the basis for the quantification of waste streams. The reliability of the entire Strategic Action Plan depends upon the accuracy of data and hence the inventorization process becomes a critical priority project.

3. **Target**: The scheme has been developed to achieve the following targets
   - To develop a detailed waste inventory for Municipal Solid Waste, Construction and Demolition waste and Biomedical Waste.
   - To develop "Waste Generation Factors" for the above mentioned waste streams
   - To assist PMC in benchmarking the waste generation in the waste streams

4. **Type:** Project

5. **Lead Agency:** PMC

6. **Support Agency:** The services of an Environmental Consultant shall be hired for this project

7. **Location (Suggested):** This project will be implemented at the city level.

8. **Budget (Estimated):** Rs. 2.5 Million

9. **Time Frame (Estimated):**

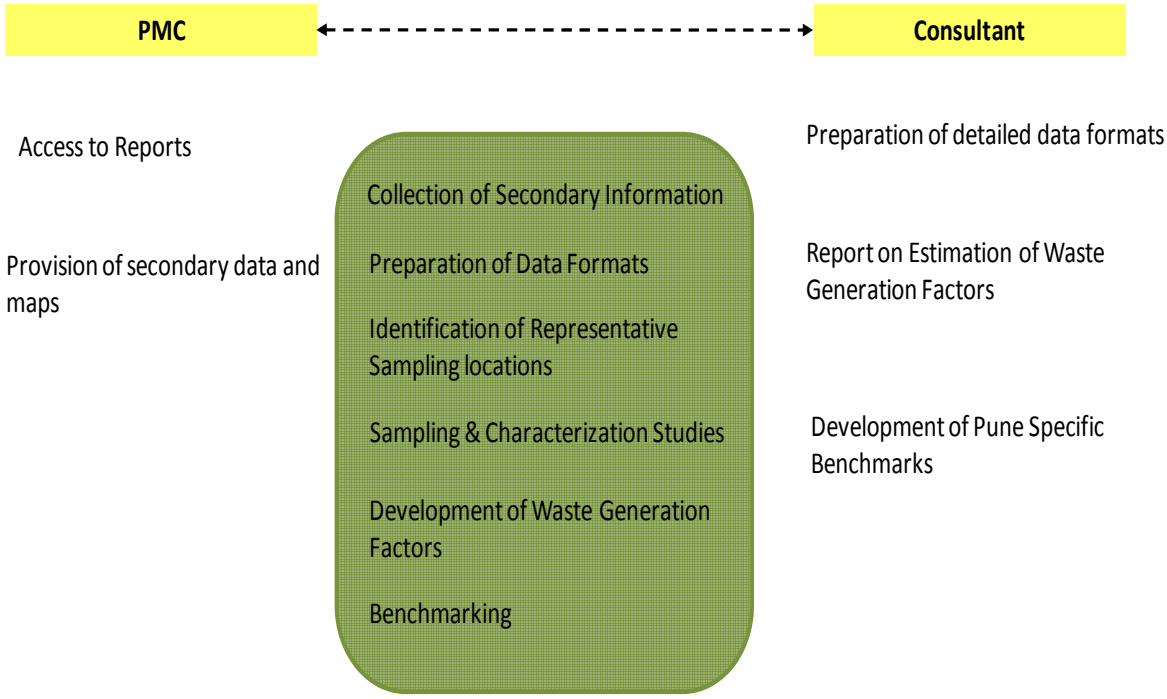
Activity	Oct-Dec	Jan-Mar	Apr-Jun	July-Sept
Secondary Information Collection regarding land-use and activities, Preparation of Data Formats, Identification of sites for sampling	3 months			
Sampling and Characterization Studies conducted at identified locations		6 months		
Analysis of acquired and sampled data, Formulation of Waste Exchange Factors and Benchmarking			3 months	

10. **Description:** Each waste stream such as MSW, BMW and C&D waste is generated through various sources. The generation of MSW primarily results from residential areas, commercial establishments, hotels, hostels, wedding halls and slaughter houses. MSW characteristics primarily depend upon the population and its socio-economic status. Similarly the generation of BMW and C&D waste result through various sources, such as hospitals, dispensaries, medical institutions, pathological labs and various construction activities. In order to capture the relative importance of influencing parameters on the waste generation, a detailed inventorization needs to be undertaken. The first step will includes the collection of data through secondary sources. Design of data formats for capturing the existing data efficiently is another important step. The data formats prepared and used during the preparation of the Strategic Action plan may be used as a basis.

In order to validate and strengthen several hypothetical inter-relationships between waste quantity and other variables, a detailed and planned sampling and characterization study needs to be undertaken. The sampling exercise will be carried out at representative locations and include sampling of key indicating parameters. In order to avoid the effects of seasonal variations, the sampling studies should be typically planned in the non-monsoon months, preferably during the post-monsoon season. The study shall be done in order to collect statistically representative samples.

The final step in the inventorization process will include the compilation and analysis of the obtained data. On the basis of the secondary information as well as the sampling exercise, analysis should be made to arrive at "**Waste Generation Factors**". This can be undertaken through various regression analysis studies on the collected data. **Benchmarking** for the collected data can be undertaken in order to standardize the waste generation and quantification procedure.

11. **Implementation:** The implementation of the project will be facilitated through the appointment of a consultant. The consultant will have to follow the following steps to deliver a detailed waste inventory for MSW, C&D and BMW.



12. Benefits:

- Better understanding of the quantities of different waste streams
- Accurate data would help reduce the data gaps and assumptions, thereby making the waste prediction models much more robust and reliable.
- Understanding the infrastructural gaps in the light of the actual data
- The distilled information at the Centralized Information Centre will help the citizens or any interested stake-holder to get a clear picture of the existing waste management scenario, the waste generation quantum, characteristics as well as information on collection, disposal and treatment.
- Such a waste inventory will help in the development of waste model that be used to understand the impact of all the schemes on the Solid waste management from generation to disposal, the cost factors and the savings.
- Such a waste inventory will help in the optimizing and strengthening of MSW collection systems

13. Links to other ISWM Pune Schemes:

- Establishment of Integrated Solid Waste Management Cell
- Development of Model for MSW Management
- Assessment of existing waste disposal sites and evaluating management options
- Optimizing and Strengthening of MSW collection systems
- Private Partnerships in Decentralized Treatment Systems
- Establishment of Community Sorting Centre

2. DEVELOPMENT OF A MODEL FOR MUNICIPAL SOLID WASTE MANAGEMENT

1. **Introduction:** Integrated Solid Waste Management refers to a strategic initiative for the sustained management of solid waste through the use of a comprehensive integrated format. Realizing the difficulties and ambiguities associated with the long-term predictions of waste quantities and characteristics the ISWM plan has been proposed for a short period of 5 years. In order to effectively capture the inter-linkages and the synergy between various parameters on the solid waste and especially MSW, a material-balance was developed during the preparation of the Strategic Action Plan. This material-balance is a concise representation of the entire waste management scenario from generation to disposal.

2. **Purpose:** The ISWM plan developed following the Strategic Planning process follows a scenario-based approach to tackle waste management issue. In order to assess the benefits accrued through the plan, there is a need for developing an assessment tool. The proposed MSW model can be developed as a yard-stick for estimating the impacts of the several waste management interventions. Further, the model should be equipped with forecasting tools in order to accurately speculate the quantum of waste generation under various scenarios.

3. **Target**: To develop a model for Municipal Solid waste management in Pune

4. **Type:** Project

5. **Lead Agency:** PMC

6. **Support Agency:** Environmental Consultant (PMC can hire the services of consultant for developing the model)

7. **Location (Suggested):** This will be a city based initiative.

8. **Budget (Estimated):** Rs 1 million

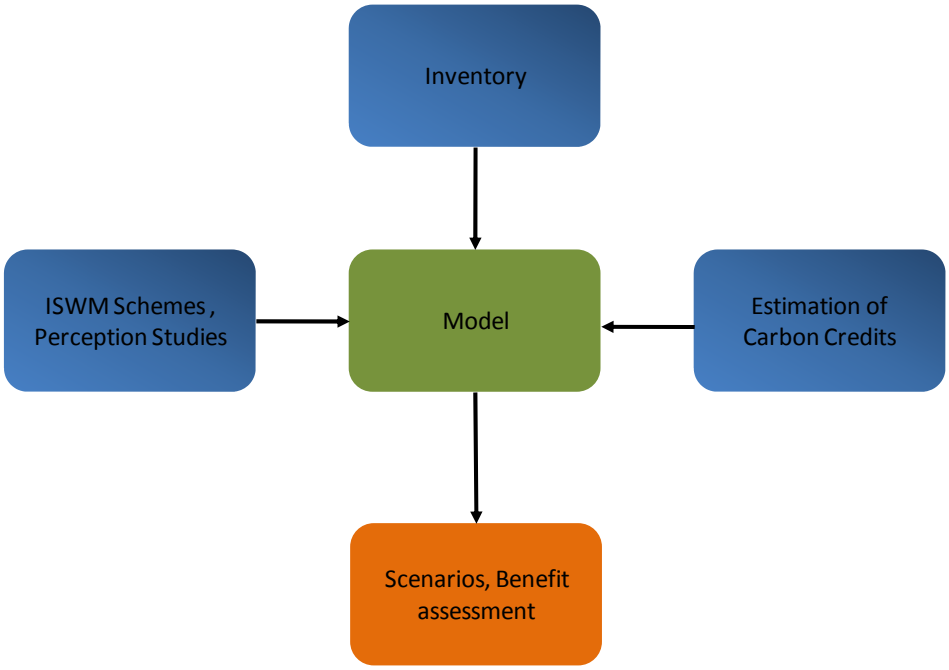
9. **Time Frame (Estimated):**

Activity	Oct-Dec			Jan-Mar			Apr-Jun			Jul-Sept			Oct-Dec		
Conceptualizing the model based on Material-balance															
Conducting Perception Surveys															
Preparation of Model															
Integration with GIS															

10. **Description:** The MSW model should be developed with aim of formulating an assessment tool for estimating the benefits of the ISWM plan. The MSW model should be developed to capture the inter-dependencies and the synergy between various influencing parameters and stake-holders. The model should be able to conduct a sensitivity analysis in order to identify the key parameters. This study will help in promoting the right parameters through the ISWM plan and thereby achieve maximum efficiency.

The ISWM plan has been developed for a horizon period of 5 years. The success and strength of plan rides on the accuracy of predicting waste quantities as well as characteristics. The inventorization of MSW if conducted prior to this model development can hence form a basis for this project. However, in order to speculate the changes in waste scenario as a result of various policy and infrastructural interventions, perception studies will have to be undertaken. These perception studies will help in identifying the overall trends related to issues such as segregation of waste etc. Through the integration of advanced tools such as GIS, the model should be able to spatially represent the various waste management scenarios. Through scenario-building approach the model should be able to generate crucial indicating parameters defining the success of the entire MSW management process such as landfill life, extent of decentralization and carbon credits. Thus this model should be developed as an optimum combination of assessment and forecasting tool capable of predicting and assessing the overall impact of ISWM plan.

11. Implementation:



12. Benefits:

- Understand the impact of the schemes on the waste management scenario of Pune.
- Checks inconsistencies in inventorization of the wastes
- Several other models exist typically for specific waste streams. However, these models are typically prediction or benefit-assessment models. A combined model has not been developed so far.
- Provides suggestions for improvement in waste management (Location Specific)
- Since this is would be a user friendly model, it can be a good source for citizens to understand their role in the integrated solid waste management for Pune
- Development of robust model
- The success of this model can be replicated in other waste streams.

13. Links to other ISWM Pune Schemes:

- Inventorization of Solid Wastes
- Private Partnerships in Decentralised Treatment System
- Establishment of Community Sorting Centre
- Optimization and Strengthening of MSW Collection Systems
- Establishment of Environmental Awareness Centre

3. SECURING CARBON CREDITS THROUGH CLEAN DEVELOPMENT MECHANISM

1. **Introduction:** The Kyoto Protocol signifies the global commitment towards climate change process occurring due to the emission of Greenhouse Gases (GHGs). The GHGs lead to trapping of solar heat and thereby resulting in increased temperature globally. CO2, CH4, N2O are some of the most common GHGs. The MSW sector is an important source of greenhouse gas emissions. According to recent national estimates the waste sector, comprising of solid waste disposal and wastewater, produces on average 2.4 per cent of national greenhouse gas emissions (UNFCCC, 2005). Landfills and open dumps cause anaerobic degradation of organic material occurs, causing methane emissions. In developed countries such as United Kingdom and Germany, the methane emissions from landfills amount to 24.6% and 28.6% of the total EU emissions.1Methane emissions from landfills depend on waste characteristics (composition, density, particle size), conditions in landfills (moisture, nutrients, microbes, temperature, and pH). Landfill gas (LFG) is about 50.60% methane with the remainder CO2 and traces of non-methane volatile organics, halogenated organics and other compounds (IPCC, 2006; IPCC, 2001b).

   India's ratification to the Kyoto Protocol in 2002 and announced its commitment to the objective of stabilization of Greenhouse Gas Concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. However, India, being a developing (Non Annex I) country is not required to reduce carbon emissions at the present agreement. It can be benefited in terms of transfer of technology and related foreign investments because of promulgation of Clean Development Mechanisms (CDM) techniques. Clean Development Mechanism (CDM) is one of the flexible mechanisms following the Kyoto Protocol. The CDM offers industrialized countries the possibility to engage in economically and environmentally competitive emission reduction projects in developing countries.

2. **Purpose:** Solid waste management is one of the leading areas in CDM activity. Two waste management areas which already have attracted attention are landfill gas recovery and waste to energy. However other areas concerned with recycling are in exploration stage. In the context of MSW, therefore projects which have positive impact on the GHG emissions but is not driven by regulations as well as which are not routine activities could be undertaken to obtain advantage from the CDM mechanism. These projects include:
   a. Landfill Gas Recovery: Methane capture
   b. Biomethanation: Methane capture
   c. Recycling: Reduction in usage of virgin inputs, thereby resulting in reduction in usage of coal
   d. Waste to Energy Projects: Alternative sources of energy, resulting in avoidance in usage of coal

3. **Target**: To acquire Certified Emission Reduction (CERs) through the process of CDM

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation

6. **Support Agency:** Certified CDM Developers and Verifiers, Designated National Agency (DNA)

7. **Location (Suggested):** The ISWM plan proposes several decentralized treatment centres. Each of these centres can be looked at as potential CDM projects. Through "bundling" of projects PMC may bundle or combine the several separate projects to accrue carbon credits.

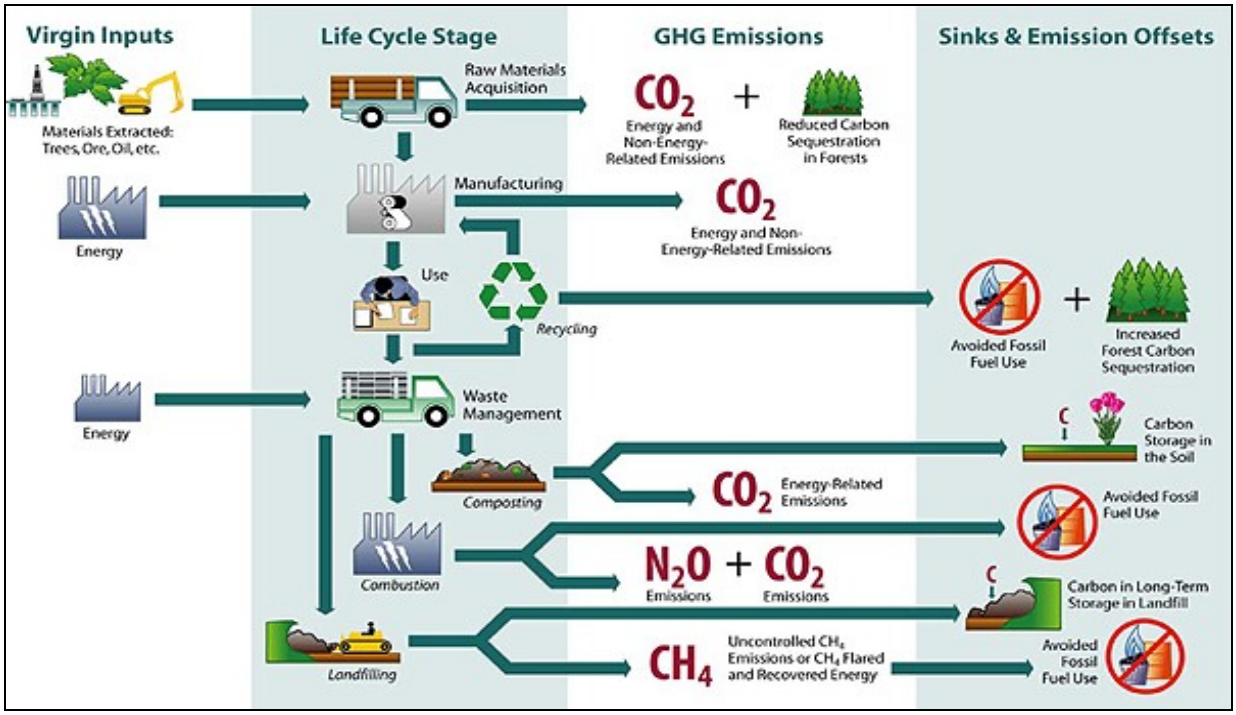
8. **Budget (Estimated):** Rs. 1 Million

1 Supporting Document for the determination of methane emissions from landfill sites as adapted from http://eper.cec.eu.int/eper/documents/Supporting%20Document%20determination%20of%20emissions%20of%20landfills.pdf, March,2007

9. **Time Frame (Estimated):**

Activity	Oct-Dec			Jan-Mar			Apr-Jun			Jul-Sept			Oct-Dec			Jan-Mar		
Project Design and Approval of Participation																		
Validation and Registration																		
Implementation and Monitoring																		
Verification and Certification of CERs																		
Issuance and Distribution of CERs																		

10. **Description:** The various mechanisms by which solid waste management can alter the emissions can be showed in Figure below.



Amongst the various methods to slow the potential for climate change are measures to reduce the emissions of carbon dioxide (CO_2) from energy use, decrease emissions of methane (CH_4) and other non-carbon dioxide GHGs and promote long term storage of carbon in atmosphere and soil.

GHG offset through 3R: The increasing resource consumption in urban areas has been the paradigm of development and prosperity. And with this, the generation of waste from the city also is increasing. Also another offshoot of the increasing resource conservation is changing characteristics of the waste.

The implementation of the ISWM plan is expected to resource intensiveness on one hand as also the quantity of waste needing disposal. In other words the increasing recycle and reuse of waste will contribute in resource conservation. This in turn also gives GHG emission reduction. The 3R approach impacts the GHG emission a all the stages of product. And therefore life cycle analysis is increasingly being used for quantifying the GHG impacts of private and public sector decisions. IFC international along with US EPA has created various excel-based tools to quantify the energy impacts of waste management practices. One such tool is an Excel based model, **Waste Reduction Model**, **WARM**.

GHG Reductions in Pune based on 3R

A recent study on the waste generation and collection by rag-pickers was undertaken by the Kagad Kaach Patra Kashtkari Panchayat. This report presents the current scenario of Pune in terms of quantities of waste collection and recycling. On the basis of the data presented in this report a sample run was carried out using the WARM software to gauge the GHG emissions potential.

Some of the assumptions made for the analysis are as follows:

Out of the total collected waste of 884 MTPD, the collected dry waste amounts to 122 MTPD. Assuming that the entire dry waste is recyclable and comprises of an equal percentage of plastics, paper and metal, an analysis was made considering that the total dry waste is recycled as against the present scenario of partial recycling. No provision is made for landfill gas capturing and default distances of 20 miles have been assumed.

The entire process resulted in a total reduction of 85,532 $MTCO_2E$ per year. Considering the quantum of benefits generated from recycling alone, irrespective of landfill gas management, there is a significant potential for introducing CDM techniques in the waste management regime. Currently there is an absence of a scientific landfill for Pune city. No methane capturing mechanisms are currently in place. In view of the various financial constraints, looking at the possible CDM benefits by properly capturing this untapped potential can be one of the solutions to implement the sustainable ISWM plan.

WARM is an Excel based spread-sheet model that has been developed by the EPA for waste managers to quantify the GHG emissions of various waste management scenarios. This simple model is available freely over the internet. The model takes into consideration 34 types of materials and analyses for 5 management options such as Source Reduction, Recycle, Composting, Combustion and Land filling. The tool calculates the GHG emissions in terms of MTCE (Metric Ton of Carbon Equivalent) or $MTCO_2E$ (Metric Ton of Carbon Dioxide Equivalent).
The model calculates the change in emissions of GHG gases based on Carbon sequestration, non-energy emissions as well as transportation emissions. The emission factors for various management strategies have been calculated based on the theoretical calculation method of IPCC National Greenhouse Gas Inventories.
The input parameters for the model include:

- Total quantity of waste generated
- Quantity in terms of different categories of waste such as recyclables (further split into paper, metals, glass and plastics) and organic/biodegradable matter
- Choice of alternative management strategy
- Details of landfill mechanism (Efficiency of capturing landfill gas)
- Distances to be traveled by the waste to reach to waste recycling / disposal facility

Methane Capture and Methane Avoidance project activities: As the population of Pune is on the rise, the pressure on the existing landfill at Urali Devachi is increasing leading to the proposal of three new disposal sites at Punawale, Pimpri Sandas & Yevalewadi around Pune to mange this waste. The present site at Urali Devachi is a dumpsite and no scientific technique of disposal is executed barring the spraying of EM (Effective Micro organism). The waste reaching the site is of mixed nature due to the lacunae in the present management practices. This results in the uncontrolled emission of landfill gas which is a contributor to the GHGs.

However under the proposed ISWM, the proposed interventions would contribute substantially to the reduction of these GHG emissions. The measures could be divided in two categories –

- **Methane avoidance** – Project activities like composting and bio-methanation of solid waste reduce the emission of methane from waste that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery.
  In ***composting*** activities, anaerobic decay is prevented through aerobic treatment by composting and proper soil application of the compost. The project activity does not recover or combust methane, and does not undertake controlled combustion of the waste.
  In ***bio-methanation*** processes, the biogas produced from the processing of municipal solid waste (MSW) can be used to to generate electricity. This electricity replaces the fossil fuel dominated grid electricity thus contributing to further GHG emission reductions.
  In ***refuse derived fuel,*** waste is processed before burning. Typically, the non-combustible items are removed, separating glass and metals for recycling. The combustible waste is shredded into a smaller, more uniform particle size for burning. The RDF thus produced may be burned in boilers on-site, or it may be shipped to off-site boilers for energy conversion. The project activity would result into GHG emission reduction by avoiding methane emission otherwise released due to anaerobic decomposition of MSW in uncontrolled landfill site.

- **Landfill Gas Capture** – The project activities that capture and combust methane from landfills used for disposal of solid wastes containing biodegradable organic matter under controlled conditions to generate heat or electricity, reduce the GHG emissions to the atmosphere.

11. **Implementation:** For projects to qualify as CDM project activities there are certain requirements. The major requirements among them are:

- The party (country) should be a party to the Kyoto Protocol
- The project activity should be a voluntary activity
- The carbon emissions reductions should be additional to any that would occur in the absence of the CDM project activity
- The approach for assessing the potential emission reductions by type of project should be approved by the executive board of the UNFCCC.

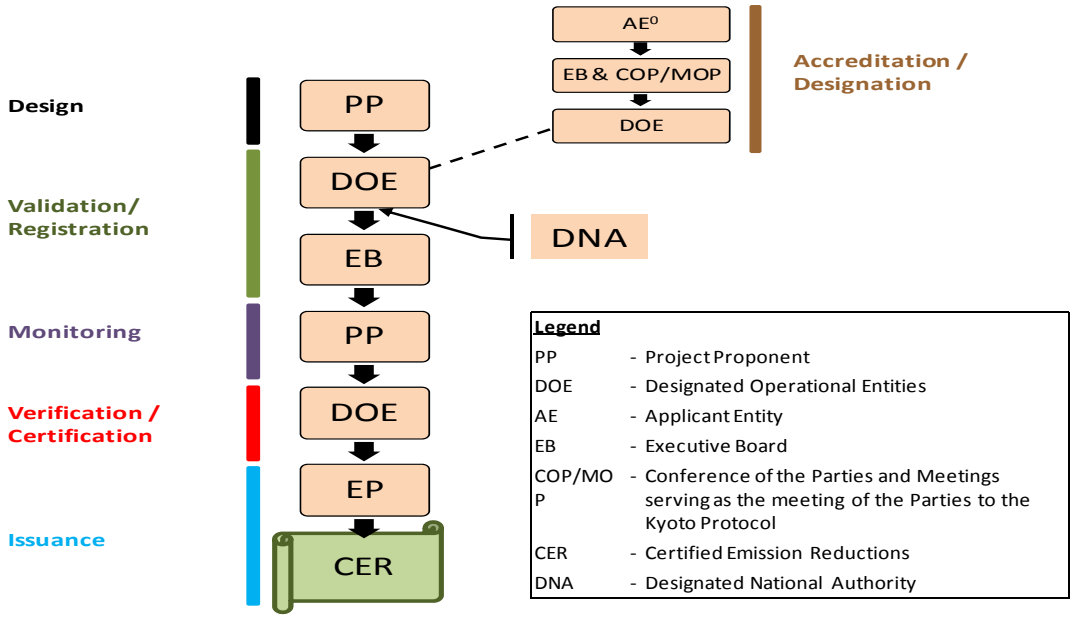
To get it accredited as a CDM project several requirements must be fulfilled, such as following a pre-defined project cycle, preparation of certain documents (PCN, PDD, Monitoring plan etc.), highlighting certain characteristics like additionality criteria in terms of emission reductions, social and economic aspects, approval from certain institutions in the host country (DNA - Designated National Authority), validation and contacting buyer country DNA. To facilitate the whole process of a CDM project development, it is recommended to contract a consulting company that helps to develop all the required documents and may guide through this time consuming process.

The ***Project Concept Note*** (PCN), that already demonstrates a complete planning of a project in terms of all required CDM criteria, is given to interested parties that may buy/invest in or CERs from the project. In the case, that it seems interesting to them, the buyer/investor will sign a letter of intention to buy all or a certain amount of emission reductions (ER).

Project Design Document (PDD) is the principal document used by project participants to get a CDM project approved. Its format is outlined in Appendix B of the Modalities and Procedures of the CDM. Its contents are

evolving, and may change over time as the Executive Board (EB) of UNFCCC is continuously working on improving the modalities and procedures of the CDM.

CDM Project Cycle includes the following steps:



Step 1 - Project design and approval of participation: Project participants need to prepare a PDD of a CDM project activity. Prior to validation, project participants submit the report to the DNA of host and invest Party, and DNA confirm that the project activity achieve sustainable development and approve this project

Step 2 - Validation and Registration: Validation is the process of independent evaluation of a project activity by a DOE (Designated Operational Entities) selected by project participants. Project participants willing to validate / register a CDM project activity shall:

- use a methodology previously approved by the Executive Board
  or
- propose a new methodology to the Executive Board for consideration and approval, if appropriate (please see below to propose a new methodology)

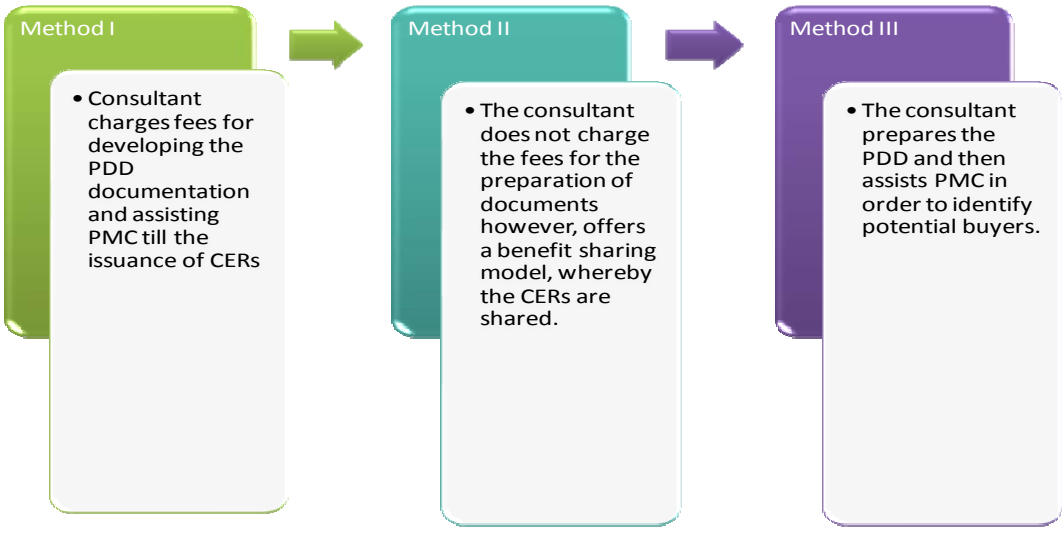
A DOE shall review the PDD against the requirements of the CDM, and validate proposed CDM project activity. Registration is the formal acceptance by the EB (Executive Board) of a validated project.

Step 3 - Implementation and Monitoring: Projects participants shall launch the project, and implement the monitoring plan that contained in the registered PDD. By monitoring, project participants shall get valid data to calculate the reductions in anthropogenic emissions.

Step 4 - Verification and Certification of CERs: Project participants shall report the monitored reductions of anthropogenic emissions as a result of this project activity to the DOE. The DOE shall determine and verify the reduction ex post. Certification is the written assurance of verified emission reductions / enhancement of removals this project activity achieved by the DOE.

Step 5 - Issuance and distribution of CERs: The CDM registry administrator instructed by the EB, shall issue the specified quantity of CERs promptly. Project participants and host country shall distribute the quantity of CERs after subtracted two and little extra percent for developing countries and administrative costs.
The actual implementation of the CDM process can be undertaken in the following three methods:

Implementation of CDM Process



12. **Other similar experiences:** The Ministry of Environment & Forests in India have taken up projects with a concentration on climate change and benefiting from CDM. Some of those projects include:

- ***Development of high-rate biomethanation processes as means of reducing GHG emissions***

Implementing agency: United Nations Development Programme
Project details: This project is designed to assist India in controlling emissions of methane and thereby protecting the global and local environment. This is achieved through use of state-of-art high rate biomethanation technology to recover methane from the wastes generated in the agricultural, municipal, industrial, and food processing sectors. This project also provides technical assistance and institutional preparation for formulating a national strategy for biogas generation and utilization. In addition, it introduces, demonstrates, standardizes a wide variety of technologies, and brings about awareness among policy makers, waste generators, agricultural communities and the public the environmental and economic significance of recovery of methane as a valuable energy resource. The benefits from the project include: improved quality of environment (air and water) both at the local and global levels, better health and sanitation, improved quality of life of woman in the rural area, and an alternative clean fuel source.

- ***"Methane Avoidance by Municipal Solid Waste Processing in the city of Chandigarh, India"***

In the project activity, Jaiprakash Associates Ltd. (JAL) is setting up one Municipal Solid Waste (MSW) processing plant near Chandigarh. The facility entails MSW processing to derive Refuse Derived Fuel (RDF), which shall be used in a thermal power plant of JAL group at Bagheri in Himachal Pradesh. MSW for processing would be received from various collection centres in Chandigarh city. JAL has signed an MOU with Municipal Corporation of Chandigarh (MCC) for establishing the MSW processing facility. MCC would be responsible for collection, transportation to the facility and JAL would be undertaking the processing of MSW on Build, Own, Operate and Transfer (BOOT) basis.

MCC currently disposes the collected MSW directly at designated dump site at Dadu Majra, Chandigarh without any processing. The estimated quantity of MSW currently available for processing in the RDF plant is 350 TPD and is expected to reach up to 500 TPD in coming years. The proposed processing plant has the capacity to treat 500 TPD of MSW.

MSW processed in the proposed facility would be converted into RDF fluff/ pellets. RDF fluff/ pellets would be sent to a captive power plant of the project proponent for its controlled burning in a boiler. The estimated

cost of RDF plant is ~Rs.240 million. The technology for the RDF plant is from Andhra Pradesh Technology Development & Promotion Centre, APTDC.

The project activity would result into GHG emission reduction by avoiding methane emission otherwise released due to anaerobic decomposition of MSW in uncontrolled landfill site, which is the current practice of disposal for MSW in the city.

The project is a small scale CDM project activity and is based on Appendix B of "Simplified Baseline and Monitoring Methodologies for Selected Small Scale CDM Project Activity Categories"

- ***Landfill Gas Extraction and Utilization at the Matuail landfill site Dhaka, Bangladesh***

The project aims to realise a landfill gas extraction and utilisation project at Matuail landfill site near the capital Dhaka in the Peoples Republic of Bangladesh. The extracted gas will be used on-site for electricity generation by gas-engines. The project comprises the design and engineering of the extraction system according to modern standards, all equipment delivery (wells, piping, compressor(s), flare, gas-engines, grid connection, etc.). It is the intention of the project proponent to reshape the landfill (in order to extent the lifetime of the landfill) and introducing proper landfilling techniques such as a.o. leachate collection.
Based on investigations and calculations the project will realise 566,000 tCO2e equivalents over the 7 years period 2006 – 2012 (first crediting period). The investments will be realised mainly during the period 2005 till 2007. Delivery of CERs will start from mid 2006.
The project does not use any scarce resources (like fuel, water); nor does it produce any waste or emissions to water and soil. The gas engines do produce local combustion gases. The main environmental negative component can be NOx that is an acidifying gas. The engines however, will comply with US and
Western European emission standards; therefore the amount emitted is very limited. It is noted here that elsewhere inefficient and polluting electricity production is prevented. This results overall in a net reduction of combustion gases including NOx.
Extracting the landfill gas has a local environmental impact, mainly reduction of several side effects like odour- and dust emission, fires, etc. No negative impact will occur. The compressor(s) and gas engines will be placed in enclosed acoustic housings (sound reducing containers), so no noise pollution will occur.

- Government of India has been willing to fulfil its responsibility under the CDM. It has developed an interim criterion for approval of CDM project activities which is now available to stakeholders. It has undertaken various capacity building activities like holding of workshops, initiation of various studies, and briefing meeting with the stakeholders. A World Bank sponsored National Strategy Study on CDM is scheduled to start in month of October 2002. India has been actively participating in the CDM regime and has already endorsed projects for further development. One of them is:

World Bank: Prototype Carbon Fund: Prototype carbon fund is a programme of the World Bank. Government of India has approved a municipal solid waste energy project 'SWERF' in 2001 for implementation by EDL India Limited in Chennai which proposes to use the state of art technology for extracting energy from any solid waste irrespective of the energy content.

13. <u>Benefits:</u>

- Carbon credits can be claimed by implementing CDM projects. Carbon Credits are a tradable permit scheme. They provide a way to reduce greenhouse gas emissions by giving them a monetary value.
- Attract capital for projects that assist in the shift to a more prosperous but less carbon-intensive economy.
- Encourage and permit the active participation of both private and public sectors.
- Provide a tool of technology transfer, if investment is channeled into projects that replace old and inefficient fossil fuel technology
- Help define investment priorities in projects that meet sustainable development goals.
- Transfer of technology and financial resources.
- Increasing energy efficiency & conservation.

- Poverty alleviation through income and employment generation; and
- Local environmental side benefits.

14. Links to other ISWM Pune Schemes:

- Establishment of the ISWM Cell
- Assessment of Existing Waste Disposal Sites and Evaluating Management Options
- Identification and Preliminary Design of New Waste Disposal Sites
- Private Partnership in Current Waste Collection Systems
- Establishment of Environmental Awareness Centre

4. ASSESSMENT OF EXISTING WASTE DISPOSAL SITES AND EVALUATING MANAGEMENT OPTIONS

1. **Introduction:** The MSW generated in the city of Pune, after having passed the stages of segregation, decentralized treatment and sorting & recyclable removal by the rag-pickers is disposed off in the landfill. The waste is collected from all the collection points and brought to the 5 transfer stations situated in the city. Some recovery of recyclables by formal and informal sector also takes place at transfer stations. The waste from the transfer stations is sent to the disposal site by Compactors and Bulk Refuse Carriers (BRC).

   The waste reaching the disposal site presently is mixed waste comprising of biodegradable and non-biodegradable matter including inerts. The Pune Municipal Corporation is disposing off the MSW collected at an abandoned stone quarry near to the village of *Urali Devachi* located outside the PMC limits. Presently about 163 acres of land has been notified for landfilling purposes. The existing site is presently being operated as 'over the ground' facility.

2. **Purpose:** The regulatory requirements for disposal sites as per the Municipal solid Waste (Management & Handling) Rules, 2000 are not adhered to with respect to the *Urali Devachi* waste disposal site. Notably the following are the major regulatory gaps:

   - The site suitability assessment studies for environmental approvals and clearances not available
   - No buffer zone of no-development around the site has been notified
   - The site is not fenced or hedged. No proper gate and manpower is allocated for monitoring incoming vehicles or other modes of transportation
   - No facilities exist at the site for record keeping of incoming waste
   - The dumping of waste is being carried out on the part of the site where there is no liner system or leachate collection system in place.
   - No rainwater diversion mechanism exist at the site
   - No green belt development has been done on the site.
   - Rag pickers operate on the site to collect recyclable / reusable material from the waste being dumped. However there is no use of personal protective equipments by the rag pickers.

   The contamination of the groundwater in the surrounding areas has also been reported. Also the issues of odor and bird nuisance have been reported. However, no concrete action plan is available to address these issues. Further, there are problems associated with acquiring new sites for ISWM. Public Information Litigations (PILs) have been filed for most prospective locations on the basis of Not In My Back-Yard (NIMBY) concept. Hence it becomes essential to assess and management the existing landfill sites.

3. **Target**: To carry out an assessment of existing waste disposal sites and evaluate management options for the same.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Town Planning Department.

6. **Support Agency:** Consultant, NGO's, generators and housing societies.

7. **Location (Suggested):** The existing landfill site at *Urali Devachi*

8. **Budget (Estimated):**
   - For Consultation - Rs. 5 Million
   - For Monitoring - Rs. 1 Million

9. Time Frame (Estimated):

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Site Assessment by consultant	12 months							
Plan to improve Compliance		6 months						
Feasibility studies for increasing capacity through landfill mining			4 months					
Feasibility studies for Landfill Gas Recovery				6 months				
Preparation of Detailed Project Reports						3 months		
Bidding of Documents							3 months	
Assessing and granting of Contracts								3 months

10. Description:

The Figure below shows the sorting activities that happen around the current dumping ground/landfill in Pune.

Sorting of Waste at Disposal (Landfill) Sites

The MSW reaching the disposal site are unloaded on designated areas. These areas are fixed based on experiences of the site personnel. The unloaded wastes from the BRCs are spread by bull dozers. Except for the compaction happening due to the heavy machinery movement and the self weight of the wastes, no waste compaction practices are adopted at the site. There are 2 to 3 bull dozers and 2 excavators used at the site on a routine basis.
EM (Effective Micro organism) solution is sprayed over the waste at disposal site to enhance degradation of the biodegradable waste disposed. However, no practice of daily cover laying is practices at the site. A part of the degraded waste from the disposal site is reported to be mined and taken by the farmers as soil conditioners for farm applications. However no report of their quality was available.
A portion of the land parcel in the area notified for landfilling had been converted to a secured landfill site, with bottom liner and lechate collection system. This portion was in use as the disposal site, post 2002. However, with no addition to the cells, the designed site got exhausted. Presently again open dumping is being practiced.

Operation of the existing Landfill: The existing landfill site will have to be remediated and converted to a secured landfill site. Boreholes will have to be drilled for recovery of leachate samples from the base of the landfill and collection of subsoil samples beneath the base of the landfill for evaluation of permeability and soil properties. Also recovery of waste samples for waste characterization should be carried out.

Boreholes should be drilled for each acre of landfill area. The quality of leachate samples have to be compared with (a) the ground water quality in existing borewells 2 km away from the landfill and (b) the Central Pollution Control Board (CPCB) norms for limits of contaminants in leachate. If the leachate quality and the permeability of the subsoil strata is observed to be satisfactory, the existing landfill can continue to operate with bi-annual monitoring of leachate quality in the drilled boreholes till the time a new landfill site is developed.
If the leachate quality is observed to be of poor quality with respect to the local ground water quality or with respect to the CPCB norms, steps will have to be taken to close the existing landfill site immediately and remedial measures adopted. All future landfilling will be undertaken in properly designed and constructed new landfills. The assessment of present landfill site should be carried out to evaluate the following

1. Waste inventorization and characterization of the waste entering the landfill
2. Current practices
3. Waste disposal pattern at the landfill
4. Leachate quality and monitoring
5. Landfill gas monitoring
6. Soil sampling
7. HSE issues around the landfill

In order to reduce the pressure exerted on the present landfill, two main options can be undertaken:

- Landfill Mining
- Landfill Gas Recovery and Utilisation

Landfill Mining: The existing landfill site spread over an huge area of land should be explored for the possibility of landfill mining approach. This would expand municipal solid waste (MSW) landfill capacity and avoid the high cost of acquiring additional land. Landfill mining costs could be offset by the sale or use of recovered materials, such as recyclables, soil, and waste, which can be converted to RDF. Other important benefits may include avoided liability through site remediation, reductions in closure costs, and reclamation of land for other uses.

Landfill reclamation projects have been successfully implemented at MSW facilities in various developed countries since the 1980s.

The process: Landfill mining or reclamation is a site specific activity designed based on the waste dump to be reclaimed. The equipment used for reclamation projects are adapted primarily from those already in use in the

mining industry, as well as in construction and other solid waste management operations. The following are the major steps followed for landfill mining:

- ***Excavation -*** The contents of the landfill cell are excavated and bulky material is separated out. The excavated waste is then organized into manageable stockpiles.
- ***Soil Separation (Screening):*** Screening is done using a trommel or vibrating screens to separate out soil in the excavated material. The size and type of screen used depends on the end use of the recovered material. Generally smaller mesh screen is used to remove small pieces of metal, plastic, glass, and paper.
- ***Processing for Reclamation of Recyclable Material or Disposal:*** Depending on conditions, either the soil or the waste could be reclaimed. The separated soil could be used as fill material or as daily cover in a SLF. The excavated waste can be processed at a materials recovery facility to remove valuable components (e.g., steel and aluminum) or converted to RDF which then can be used for producing energy.

Landfill Gas Recovery and Utilization:

- The under laying landfill gas abstraction and control strategy must be based upon continuous operation at a rate sufficient to eliminate hazards and nuisance
- Exploitation of the energy available in landfill gas should always be considered because, with careful design, even small site can provide sufficient energy to warrant a survey of possible nearby users.
- In order to justify gas exploitation schemes, an indication or forecast of the rate of gas generation must be obtained
- Landfill gas exploitation may be classified as either:
    - Direct use of gas or
    - Conversion to electricity

Direct use of gas

- Include brick-klin firing, boiler firing and cement-klin firing
- It is also technically feasible to clean-up the gas (i.e. remove the carbon dioxide and other gases) and compress the remaining methane which can be put into cylinders and sold, used as a vehicle fuel or put into natural gas systems.

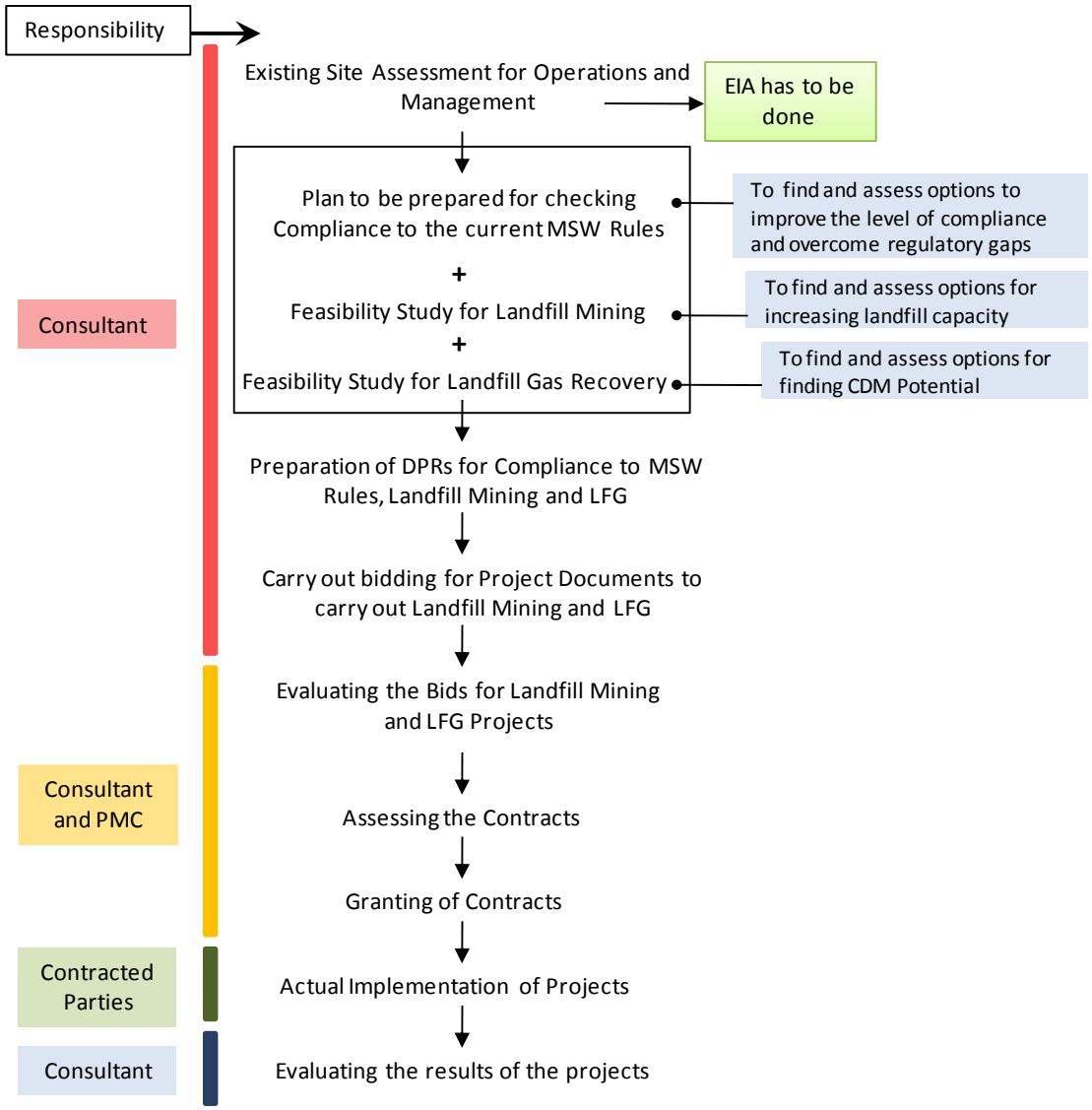
Conversion to electricity

- Spark ignition and diesel engines can both be converted to operate on landfill gas
- Small sites, with less than 1 million tonnes waste in place are often considered to be below the threshold of exploitation viability but many in the UK are being investigated to assess these as well as larger sites in order to provide an estimate of national landfill gas resource.

Urali Devachi is a 'over the ground' landfill; therefore LFG recovery should be done at the edges and the areas which were converted to a secured landfill site. Consolidation can be done for these areas and then the following steps can be taken up:

- Feasibility study should be taken up to calculate potential of methane emission from landfill.
- Estimation of the project cost
- Look for the investing parties which in return would get carbon credits.
- All the formalities to execute a CDM project to be done according to UNFCCC.

11. **Implementation:** PMC can use the services of a consultant to carry out an assessment of the existing landfill site, find and assess options for improved compliance to MSW Rules, increase landfill capacity and find options with CDM potential.



12. Other similar experiences:

Feasibility Studies on Landfill Mining: The dumpsites at Kodungaiyur and Perungudi, near Chennai were taken up for feasibility studies on mining of decomposed material.

The study indicated that about 65% of the samples recovered from the dumpsites of about 10 year old was fine particles. The fill at these dump sites were shallow with a depth of about 3 m and no significant variation in waste characteristics was noticed with depth of the fill. This fine fraction of the samples can be used as compost for non-edible crops or as cover material to future landfills after determining the geotechnical suitability. In dumpsites with uncontrolled dumping, the degradation process is not uniform and the recovery of fine fractions is not possible. A few heavy metals in the recovered material exceed the Indian standard for compost but well within the USEPA limits for compost. There is significant difference in the concentration of heavy metals such as Cu, Cr, Ni, Pb and Zn between leachate from the dump sites and water extract of the fine fraction of solid samples. However, this is not significant in the case of As, Cd and Hg.

The studies support the feasibility of dump site mining for lifetime expansion and remediation. Site-specific conditions will determine whether or not landfill mining and reclamation is feasible for a given location. The key conditions to be considered include

- composition of the waste initially put in place in the landfill
- historic operating procedures
- extent of degradation of the waste

- Types of markets and uses for the recovered materials.

13. Barriers:

Potential Drawbacks of Landfill Mining

Cell excavation raises a number of potential problems related to the release of gases. Methane and other gases, generated by decomposing wastes, can cause explosions and fires. Hydrogen sulfide gas, a highly flammable and odorous gas, can be fatal when inhaled at sufficient concentrations. These necessitated adequate protection for the people involved in the Landfill mining activity

The dumpsite integrity could be affected by the mining activity, which can create collapse of the dumps.

Potential Barriers of LFG Utilization:

- Landfill site located at *Urali Devachi* is not an engineered landfill site for landfill gas or gas to energy projects
- Energy potential of landfill gas underestimated
- Difficulties in getting co-operation of local authorities
- Under-estimation of long-term activities

14. Benefits:

Potential Benefits of Landfill mining:

- Landfill mining extends the life of the current facility by removing recoverable materials and reducing waste volume through combustion and compaction.
- Recovered materials, such as ferrous metals, aluminum, plastic, and glass, can be sold.
- Generation of revenues from the sale of reclaimed soil:
- Combustible reclaimed waste can be mixed with fresh waste and converted to RDF which then can be burned to produce energy.
- Reducing Landfill Closure Costs and Reclaiming Land for Other Uses:
- Liners and leachate collection systems can be installed at older landfills, once the mining of major portionof the dumped MSW is done. Also, hazardous waste can be removed and managed in a more secure way.

Potential Benefits of LFG Utilisation:

- Gas collection can improve the safety by reducing the explosion hazards for gas accumulation in structures on or near the landfill site.
- Generating electricity from existing MSW landfill is also a cost-effective way to provide new renewable energy capacity to supply community power needs an can create jobs that can help build the local economy.
- Directly reduces GHG emissions
- Indirectly reduces the air pollution by off-setting the use of non-renewable resources
- LFG utilization projects generate revenue from the sale of the gas
- LFG can be used to create jobs associated with the design, construction and operation of energy recovery systems
- Reduces landfill odor
- Reduces possible health risks

15. Links to other ISWM Pune Schemes:

- Private Partnerships in Current Waste Collection system
- Establishment of Environmental Awareness Centre
- Establishment of Community Sorting Centre
- Securing Carbon Credits through CDM

5. IDENTIFICATION AND PRELIMINARY DESGIN OF NEW WASTE DISPOSAL SITES

1. **Introduction:** The MSW generated in the city of Pune, after having passed the stages of segregation, decentralized treatment and sorting & recyclable removal by the rag-pickers is disposed of in the landfill. The waste is collected from all the collection points and brought to the 5 transfer stations situated in the city. Some recovery of recyclables by formal and informal sector also takes place at transfer stations. The waste from the transfer stations is sent to the disposal site by Compactors and Bulk Refuse Carriers (BRC). The waste reaching the disposal site presently is mixed waste comprising of biodegradable and non-biodegradable matter including inerts.

   The Pune Municipal Corporation is currently disposing off the MSW collected at an abandoned stone quarry near to the village of *Urali Devachi* located outside the PMC limits. Presently about 163 acres of land has been notified for landfilling purposes. Presently open dumping is being practiced. The contamination of the groundwater in the surrounding areas has been reported. Also the issues of odour and bird nuisance have been reported. The regulatory requirements for disposal sites as per the Municipal solid Waste (Management & Handling) Rules, 1999 are not adhered to with respect to this site.

2. **Purpose:** Several tons of mixed wastes are received at this dumping ground. PMC also has to spend a lot in the collection and transportation of C&D wastes. The improper management of solid waste significantly affects health of the waste workers as well as citizens. It also has an adverse impact on the Environment.

   Also with the increasing waste load, the pressures on the existing landfill increase the need to find new waste disposal sites.

3. **Target**: To find new waste disposal sites in Pune.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Town Planning Department

6. **Support Agency:** MPCB, Consultants who would identify the exact locations with discussions with MPCB, surrounding areas municipalities, Promoters and Builders Association of Pune (PBAP), Builders and Contractors, NGO's, generators and housing societies.

7. **Location (Suggested):** The office of the Town Planning Department of Pune and ISWM Cell would carry out the assessment. PMC would have to collaborate with neighboring municipalities like PCMC and PCB and collectively find a site shared by all municipalities.

8. **Budget (Estimated):** Rs. 5 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Preliminary Work for site selection	3 months							
To carry out an EIA for selected sites		12 months						

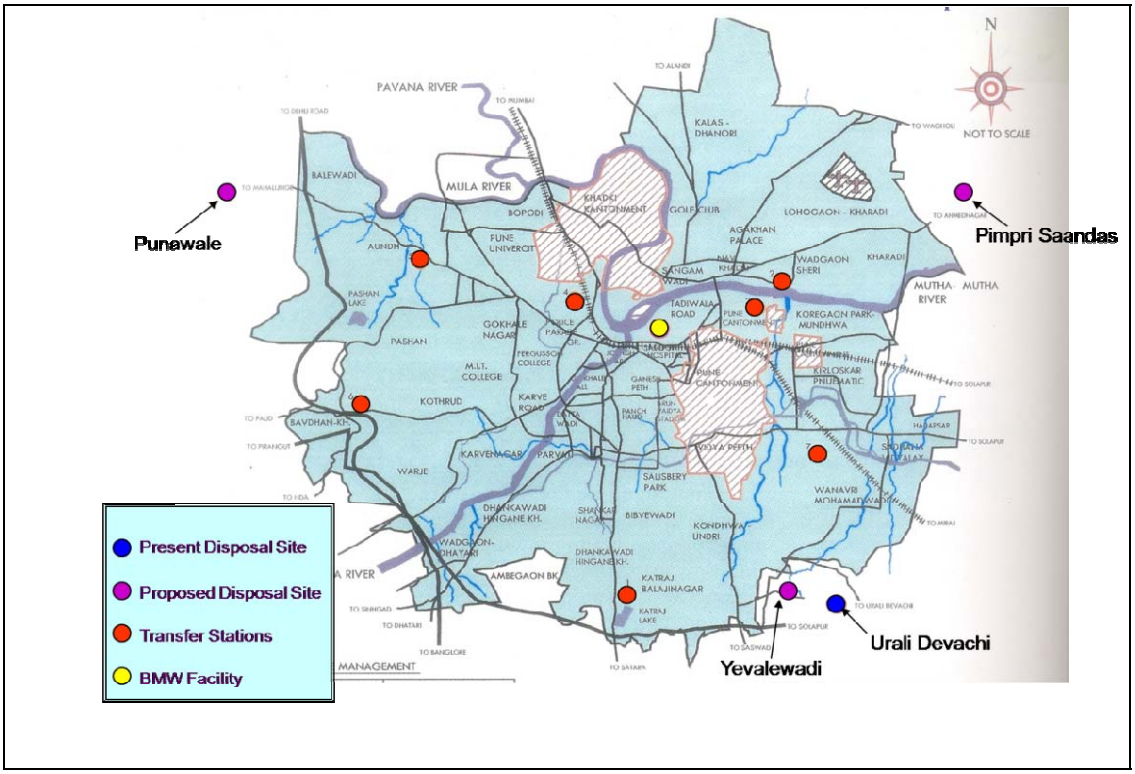
To obtain approvals for Selected Sites						3 months		

10. Description:

The Figure below shows the sorting activities that happen around the current dumping ground/landfill in Pune.

Sorting of Waste at Disposal (Landfill) Sites

Realising the pressures and health hazards of the present disposal system, the Figure below shows the location of the disposal sites as well as the Transfer Stations in Pune including the proposed new waste disposal locations.



Location of the Existing and Proposed Disposal Sites and Transfer Stations

Considering the health hazards related to landfills, there have been problems in acquiring new landfill sites. For most of the cases, Public Information Litigation (PILs) have been filed on the basis of the NIMBY (Not In My Backyard) concept.

Therefore, disposing solid waste on land should be without nuisance or hazard to public health or safety. Utilizing engineering principles to confine wastes to the smallest practical area and to reduce it to the smallest practical volume and cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary.

Points to be kept in mind before selection of new sites:

- New Waste Disposal Sites should not come under the no-development zone.
- The regulatory requirements for disposal sites as per the Municipal solid Waste (Management & Handling) Rules, 2000 should be adhered to with respect to the new sites.

The planning of a new landfill is performed in several steps:

- Waste Management conception
- Landfill site selection
- Environmental Impact Assessment
- Design of the landfill: Including features such as leachate collection and treatment mechanisms, landfill gas capture mechanisms

The first step in planning has to deal with following topics:

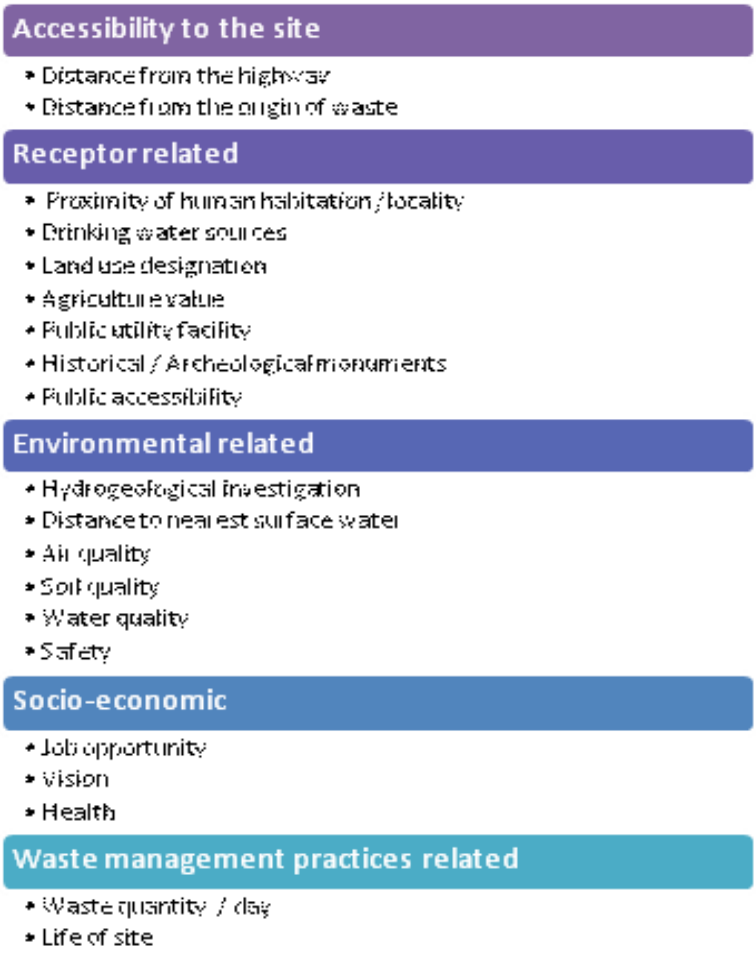
- Type and volume of waste to be disposed
- Operation time, and
- Type of transportation

The GIS based tool can be used for site selection. The usage of GIS based modeling has been explained for optimization of collection systems scheme. The design guidelines should follow the CPCB guidelines in order to select the area, size, place and other requirements. The study should also involve estimation of study from other areas.

Siting of a Facility for Disposal of Municipal Solid Waste:

The main purpose of the siting process is to make the best use of the land resources available. The siting for disposal of solid waste and disposal facilities requires the synthesis of two distinct selection procedures, i.e. a technical screening process based upon economic, engineering and environmental suitability, and public approval process. A general listing of various factors to be considered for siting is shown in the table below. The relative importance of these factors depends on the site consideration as well as the chosen method of disposal.

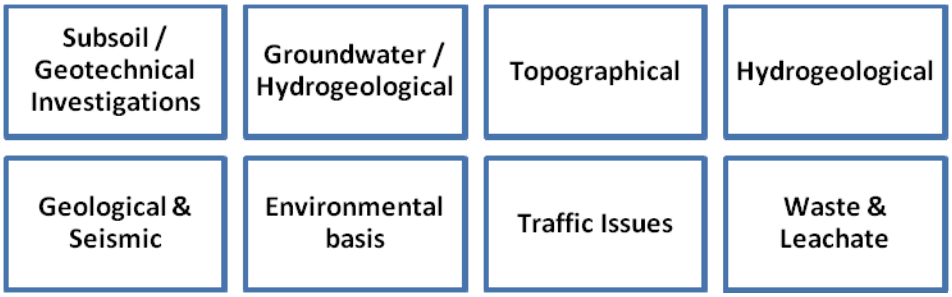
Factors in Siting of Municipal Solid Waste Disposal Facility



The goals of siting facility are to:

- Minimize health risk
- Minimize adverse environmental impact
- Minimize costs of the development, construction, operation and closure
- Maximize public acceptability of the project

Site Investigation and Site Characterization: The figure below indicates the types of investigations to be carried out for site characterisation.



Design of the New Landfill: The Secured Landfill Facility has to be designed as per the norms given in the Municipal Waste (Management & Handling) Rules, 1999. The seven essential components of a MSW landfill are:

- A liner system at the base and sides of the landfill which prevents migration of leachate or gas to the surrounding soil.
- A leachate collection and control facility which collects and extracts leachate from within and from the base of the landfill and then treats the leachate.
- A gas collection and control facility (optional for small landfills) which collects and extracts gas from within and from the top of the landfill and then treats it or uses it for energy recovery.
- A final cover system at the top of the landfill which enhances surface drainage, prevents infiltrating water and supports surface vegetation.
- A surface water drainage system which collects and removes all surface runoff from the landfill site.
- An environmental monitoring system which periodically collects and analyses air, surface water, soil-gas and ground water samples around the landfill site.
- A closure and post-closure plan which lists the steps that must be taken to close and secure a landfill site once the filling operation has been completed and the activities for long-term monitoring, operation and maintenance of the completed landfill.

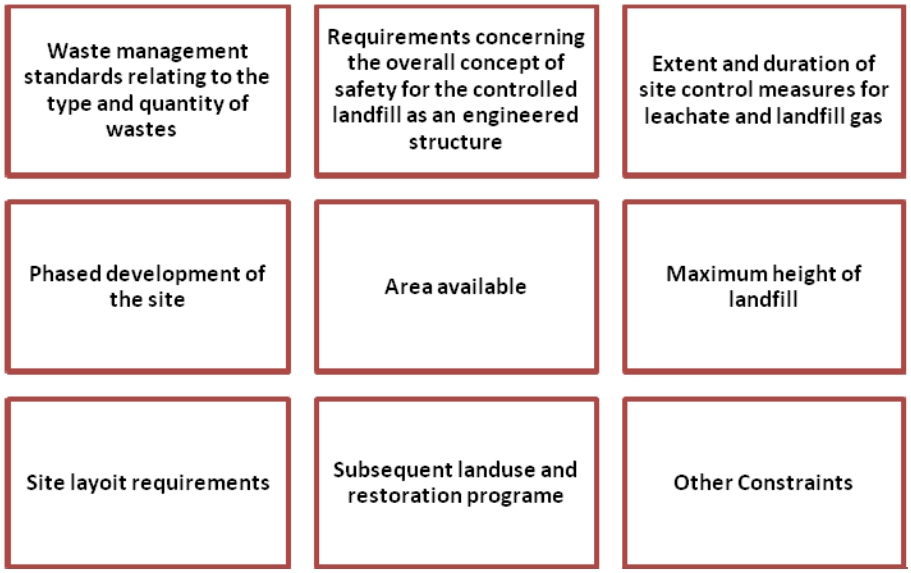
For the landfill site layout other than the demarcated area in which the waste will be filled, there has to be provisions for support facilities. Within the area to be filled, work may proceed in phases (as cells) with only a part of the area under active operation.

In a typical site the following facilities must be located in the layout:

Access roads, equipment shelters, weighing scales, office space, location of waste inspection and transfer station (if used), temporary waste storage and/or disposal sites for special wastes, areas to be used for waste processing (e.g. shredding), demarcation of the landfill areas and areas for stockpiling cover material and liner material, drainage facilities, location of landfill gas management facilities, location of leachate treatment facilities; and location of monitoring wells.

The operation of the landfill will require planning and execution of daily activities like daily waste filling plan and demarcation, waste discharge and inspection, waste placement, waste compaction, daily covering of waste, prevention of pollution and fires.

Design Preparation: Points to be given particular consideration:



Design Consideration: Points to be given particular consideration:

Construction

- Protection of components already constructed; in particular, sealing layers and drainage blankets;
- Minimum dimensions required for construction work;
- Simple and non-sensitive design and construction;
- Climate conditions;
- Availability of construction materials.

Landfill Operation

- Stability analyses of the waste body;
- Waste placement techniques, phasing and supervision,
- Settlement and other types of deformation, checked by monitoring programmes;
- Operating facility, buildings and roads;
- Gas management and monitoring programmes;
- Surface water and drainage;
- Leachate management and groundwater control;
- Environmental concerns, i.e. dust and noise emissions, etc.

Closure of the Landfill

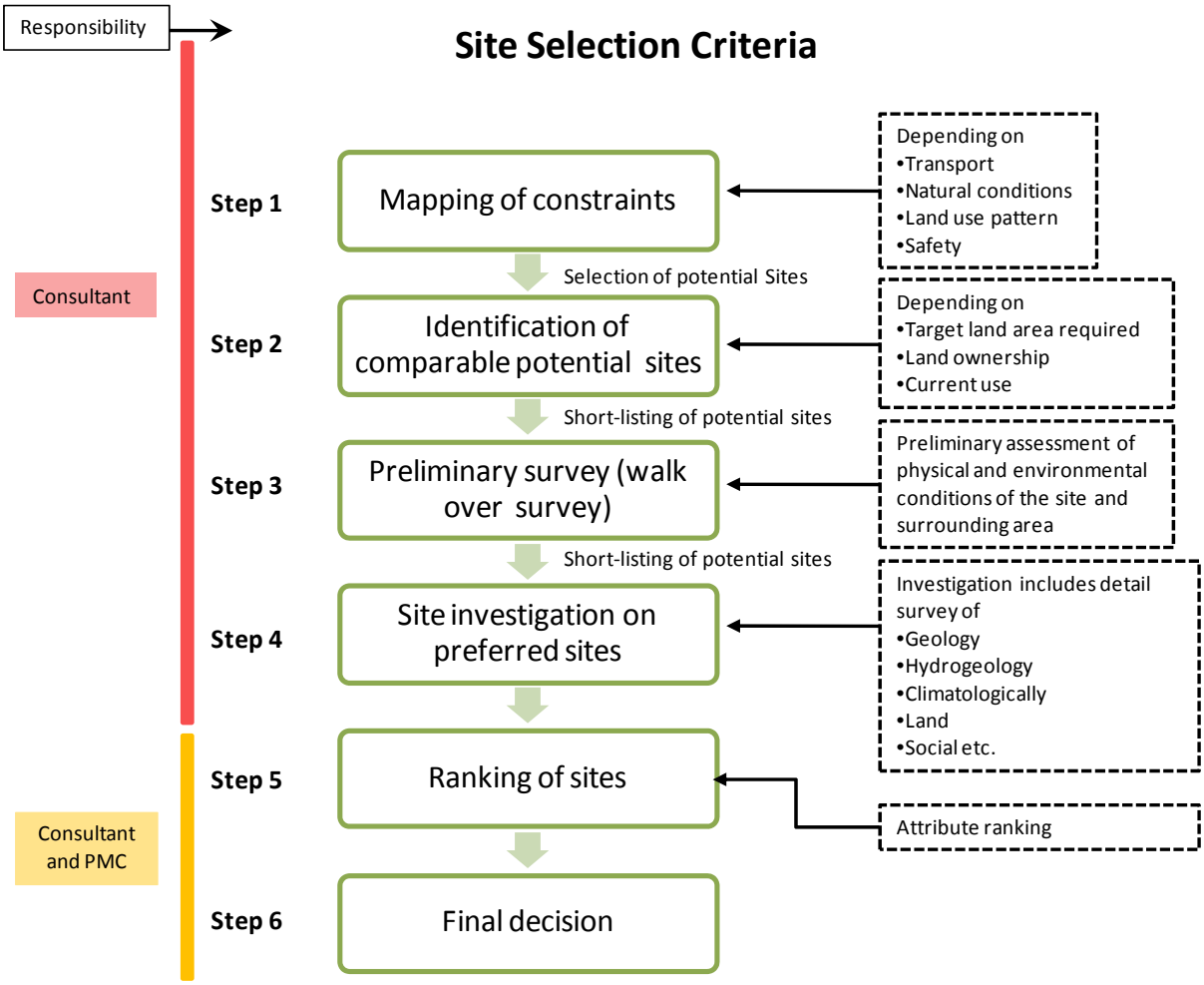
- Programme for measures to seal the surface and restore the site to the required after use, taking account of settlement, drainage and gas emission;
- Supervisory measures (type and frequency of monitoring and reporting, review of the monitoring and control programmes, ect.);
- Post closure measures

11. **Implementation:** PMC can use the services of a consultant to select the potential sites and prepare a preliminary design for the same. The consultant would have to
    - Carry out preliminary work for site selection as per the CPCB guidelines
    - Do the EIA for the selected site

- Ensure public acceptability of the selected site
- Obtain approvals for the selected site
- Prepare a preliminary design

Selection of Candidate sites: This phase is very crucial in the siting process and can be carried out through multi-level screening process.

Level I – Constraint Mapping: Constraint mapping eliminated environmentally unsuitable sites and narrows down the number of sites for further consideration. Certain features termed as "exclusionary factors" identified for constraint mapping are given in Figure below.



Level II – Potential Site Selection: the level II factors include land use and infrastructure facilities. Land use includes target land area required, land ownership and its current use. Infrastructural facility includes major highway access, sites of existing/former waste disposal and land designated for industrial use. These provide the basis for industrial use. These provide the basis for highlighting promising sites within the candidate areas remaining after level I analysis.

Level III – Preliminary Survey: The sites selected in level II are further scrutinised to eliminate areas which fail to meet additional socio-economic and environmental concerns at the site and surrounding areas. The objectives of the walkover survey (preliminary survey) are to identify sufficient constraint to reduce the number of possible sites. This may be carried out b surveying the areas and collecting data regarding:

- Existing zones of development
- Agricultural land preserves
- Areas of mineral development

- Freshwater wetlands
- Visual corridors of scenic rivers
- Riverine and dam-related flood hazard areas

Ranking of Site Alternatives: The next stage of site selection involves comparison of candidate sites based on evaluation of each site for more detailed environmental impacts. The methodology for ranking of site alternatives comprises following steps:

- Select attributes for evaluation of site alternatives
- Apportion a total score of 1000 between the assessment attributes based on their importance through ranked pairwise comparison technique
- Develop Site Sensitivity index (SSIs) using Delphi Technique
- Estimate score for each attribute for various candidate site alternatives using SSIs
- Add the scores for individual site alternatives, to rank the alternatives based on total score

Confirmation of Public Acceptability of the Site: For ensuing public acceptability of the site, target audience which includes community leaders, municipal authorities, environmental groups, government departments, transporters, educational institutions, local social services, planners and site-specific groups should be addressed.

Regulatory Approval: The site should be in accordance with the specification prescribed in the schedule III of the Municipal Solid Wastes (Management and Handling) Rules, 2000 and require approval from regulatory agencies for all facilities related to disposal of municipal solid wastes.

12. Other similar experiences:

A New Approach to Landfill Site Selection in Ireland using GIS Technology[1]

There have been major advances made in landfill site location in Ireland over the last ten years, particularly with the enactment of the Waste Management Act, 1996. Local authorities are now armed with extensive new powers and have greater responsibility for the collection, recovery and disposal of waste within their functional areas. In developing strategies and plans for waste management in Ireland, it is important that all new technologies be considered so that an efficient integrated approach to waste management can be adopted. The government policy statement on waste "Changing Our Ways" states that with very few exceptions, local authorities have not so far developed or applied innovative technological solutions for waste management (DOELG, 1998). The landfill GIS model will provide a new tool and a methodology for landfill site selection to local authorities in Ireland, which will enable them to conduct their own GIS landfill site selection screening process. The landfill GIS model goes a step further than other GIS site selection studies hitherto carried out in Ireland, (Cantwell, 1999; P.J. Tobin & Co. Ltd. et al., 1995), by using Saaty's method for pairwise comparison, and by incorporating a standalone extension for calculating the weights.

Using the landfill GIS model as part of the site selection process can make the selection of a potential site for a landfill facility more transparent, helping local authorities to adhere to Ireland's commitments under Agenda 21. Public opposition to landfill site location can be reduced if the public can be reassured that site selection is based on acceptable criteria. There is a need for public confidence in the scientific basis for the selection of landfill sites. The methodology used in the landfill GIS model ensures that there is a clear and scientific rationale behind the choice of a site.

Finally, the development of technologies such as the landfill GIS model, in hand with new policies and waste management legislation, represent a step in the right direction for the management of waste, and more specifically for landfill site selection in Ireland. However, there is an urgent need, in line with government policy, to reduce the significant volumes of waste that we produce as a society. It will take time and a major

1 As referred to http://cmrc.ucc.ie/publications/conf_proceedings/Rio_Landfill.pdf

commitment to reach a situation where waste prevention, waste reduction and waste recovery ultimately reduce the need for landfill and other waste disposal methods.

Locating Potential Landfill Sites Using Geographic Information Systems[2]

Regulations and public opposition can make siting municipal solid waste landfills difficult. The siting of a landfill not only requires diverse geological, geotechnical, and environmental considerations, but also must satisfy legal locational restrictions and other social and cultural factors. In this article a Geographic Information System-based method has been presented that identifies potential landfill areas for preliminary assessment. The regulatory restrictions, area attributes, and site assessment criteria provided by experts and/or users have been taken into account. The proposed method has been demonstrated by applying it to a landfill site selection study for the Nilgiri block of Balasore district of Orissa in India.

13. Benefits:

- Management of Wastes especially MSW would become more convenient and easy to handle
- Nuisance due to improper disposal of waste would be avoided
- C&D Wastes would not get mixed with MSW and avoid the use of landfill space
- Disposal of wastes will be done in a more environmentally and technically sound manner.
- The new landfill sites would be more socially acceptable
- Carbon advantage can be obtained from such new landfills

14. Links to other ISWM Pune Schemes:

- Assessment of Existing Waste Disposal Sites and Evaluating Management Options
- Inventorization of Solid Waste
- Establishment of Environmental Awareness Centre
- Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
- Improving Health and Safety of PMC Workers, Rag pickers and citizens in proximity of the landfill
- C&D Waste Management
- Securing Carbon Credits through CDM
- Optimization and Strengthening of MSW collection Systems

2 As referred http://baywood.metapress.com/app/home/contribution.asp?referrer=parent&backto=issue,3,5;journal,13,121;linkingpublicationresults,1:300323,1

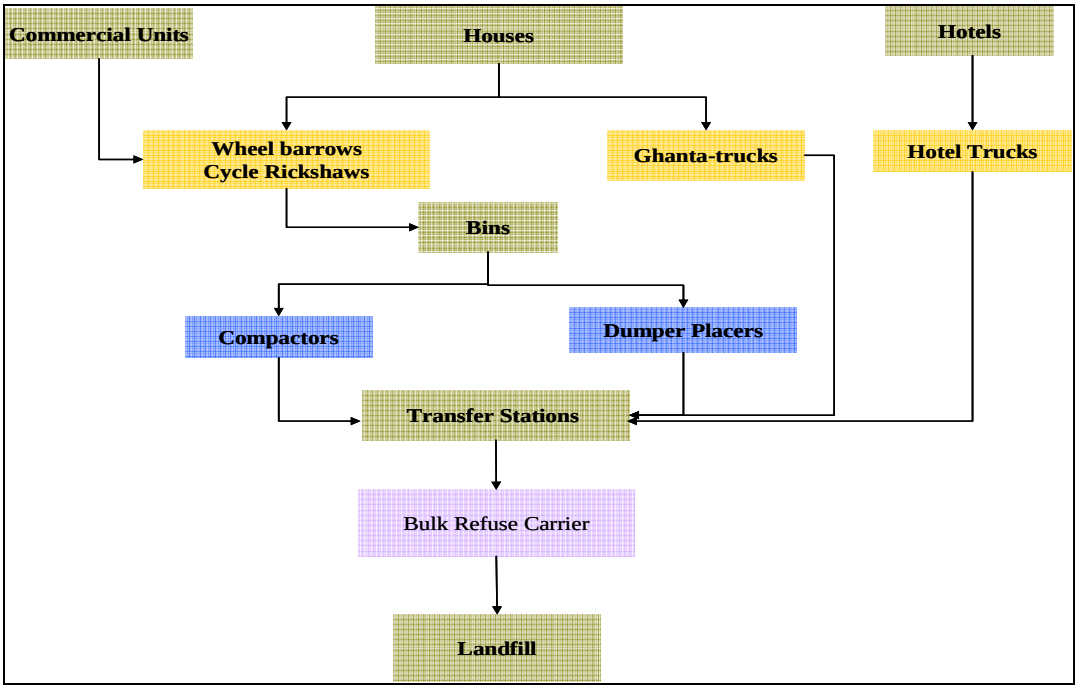
Theme 2
3R Initiatives

1. Optimatisation and Strengthening of MSW Collection Systems
2. Establishment of Community Sorting Centres (CSC)
3. Pilot Projects for Recycle and Reuse of C&D Waste
4. Recycling of Plastic Waste
5. Establish E-Waste recycling facility
6. Establish a CFL recycling Programme and Common facility

1. OPTIMISATION AND STRENGTHENING OF MUNICIPAL SOLID WASTE (MSW) COLLECTION SYSTEMS

1. **Introduction:** The Municipal Solid Waste consists of household waste, waste from hotels and restaurants, garden waste as well as street sweepings. Solid waste collection is done in 1 to 3 shifts using different types of vehicles. The daily generation of MSW is around 1093 MT. The waste from households and commercial premises is primarily collected through community collection bins. The container bins for collection of waste are placed at designated locations in the streets and along the roads across the city.
Door to door collection has also been introduced in all wards with the help of *Ghanta trucks*[1], cycle rickshaws and wheel barrows. Collection through cycle rickshaws and wheel barrows are offered to the areas which are not easily accessible to *Ghanta* Trucks.The waste lifted from bins is transported to the nearest Transfer Station. Generally, Compactors and Dumper Placers are used for this purpose. The waste is lifted from the Transfer Station and transported to the Disposal Site at *Urali Devachi*. The Bulk Refuse Carriers are being employed for this purpose.

   The transportation system for different types of waste from various sources to the disposal sites in Pune are as shown in the figure below:

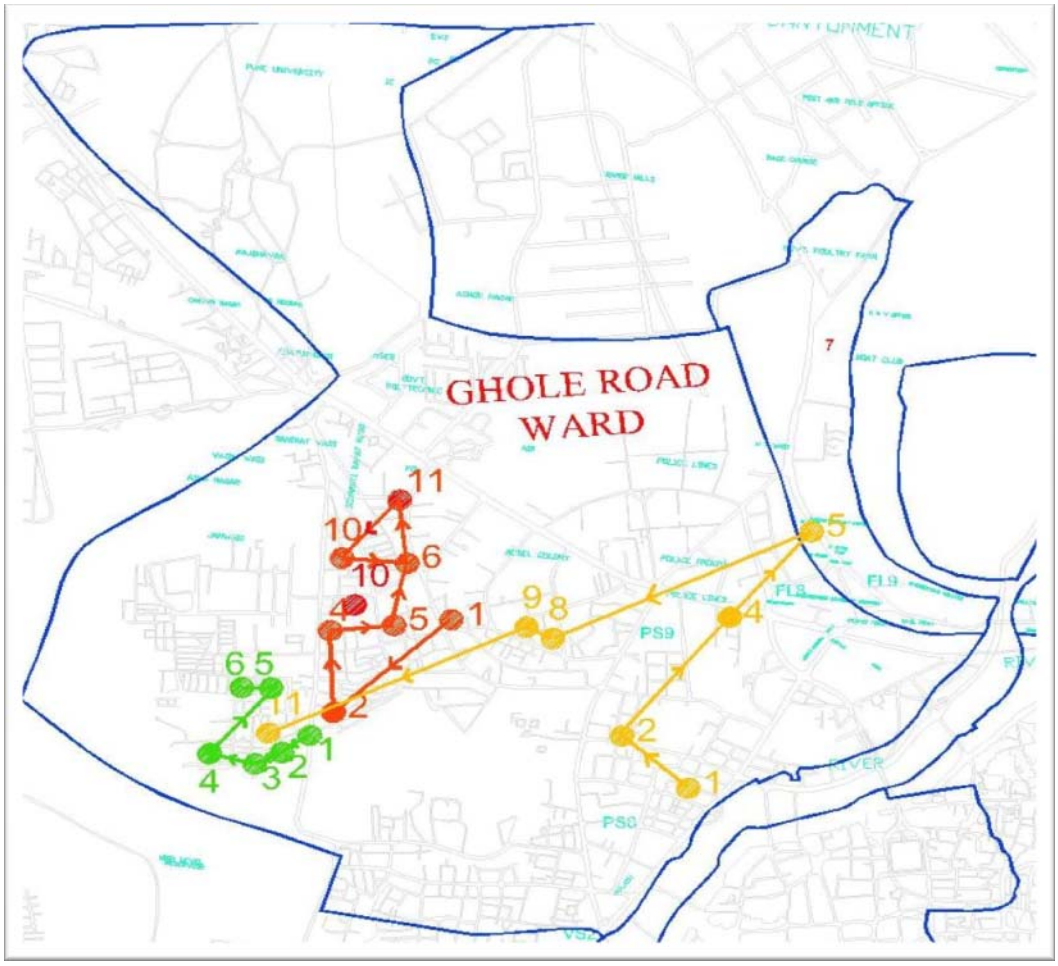


Typical Waste Collection System in Pune

2. **Purpose:** About 1500 containers with different sizes have been spread across the city for MSW collection. The placement is however not optimal. These containers are open and hence cause nuisance in terms of odour, and disease vectors that thrive in the accessible waste. Also the vehicles carrying the waste are not covered thereby spreading the waste during transportation. The analysis of waste collection and waste generation information available for Pune, the uncollected waste can be deduced to be in between 8 to 9 %. In terms of quantity this would mean about 95 MTPD of waste is probably remaining unattended.

   Consider the following Figure which depicts of the travel of a G*hantagadi* in the Ghole Road ward in pune.

1 Vehicles with bells



Travel of a *Ghantagadi* in Ghole Road Ward

The figure shows that the route crosses itself too many times showing that the vehicle has not taken the best possible path considering the least travel path. This shows the necessity of the involvement of a vehicle routing application which can aid to select the best and the most optimum route. The placement of collection bins, the vehicle routing, the condition of bins and vehicles and capacities etc are all important factors which are responsible for sound and defined collection systems. The following points would need to be covered to improve the collection systems.

- To improve the house to house collection
- Other waste streams such as C&D Wastes, E-Wastes, and horticultural wastes can be collected separately
- To avoid the overflow of the bins and containers
- To make proper use of the Ghanta trucks which are currently under utilized
- To restore the broken down DPs and compactors with proper maintenance
- To suggests different types of waste collection system as compactors which have the advantage of handling larger quantity of wastes are not able to move through old parts of the city which have narrow lanes.

3. **Target**: To suggest and investigate various methods for optimizing and strengthening of the MSW Collection systems.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Transport Department and Town Planning Department

6. **Support Agency:** ISWM Cell, PMC and use the service of consultants, NGO's, generators and housing societies.

7. **Location (Suggested):** City wide – taken up for the entire city of Pune. GIS based models can be prepared and implemented throughout Pune for properly defined collection systems. Implementing may be done in phases based on the ward prioritization.

8. **Budget (Estimated):** Transportation and collection of MSW accounts to almost 60-70 % of the total expenditure on SWM in Pune, its optimization is extremely important.
   - For auditing present assets – Rs. 2 Million
   - For Consultation process and preparing a model for optimized collection systems – Rs. 8 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Auditing the present assets and operational patterns								
Tools for optimisation of collection								
Bids for optimisation study to PPP								
Cost Estimation								
Bids evaluation								

10. **Description:**

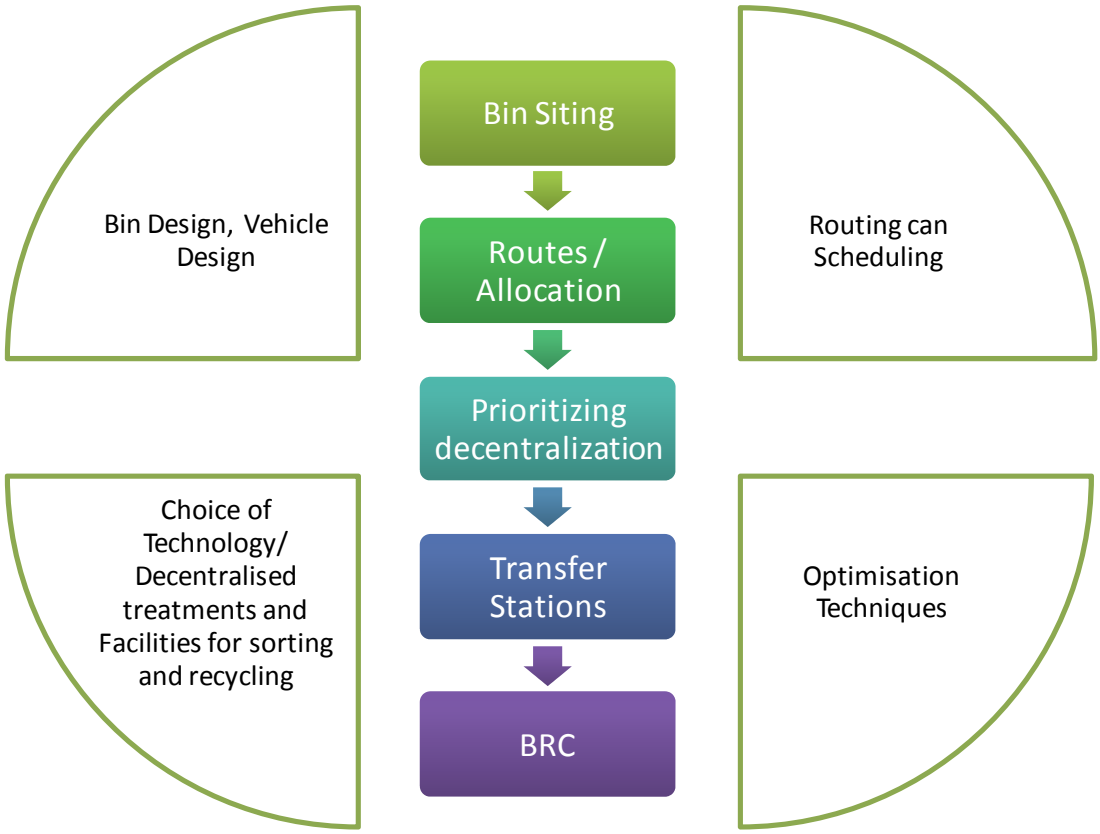
Factors needed for route optimization: The following factors need to be considered in planning the waste collection system and further to optimize:

- Population distribution and density
- Overall topography and road layout
- Characteristics of waste generated and quantity
- Disposal methods used
- Type and number of vehicles used
- Number and location of transfer stations
- Road design

Some of the above factors mentioned above e.g population distribution and characteristics of waste generated determine the frequency of collection and also whether sorting at source is beneficial over segregation at a later stage. The right kind of planning can help decide allocation of available of labour i.e human resources as well as equipments to be used and the municipal budgetary allocation. It can also be used for forecasting the future demand for SWM.

Aspects of Route optimization:

Various Aspects of route optimization are depicted in Figure below**.** The figure depicts the various levels which decide route of a waste carrier (shown in colored boxes) and the factors which need to be considered for efficient route management (shown in white boxes). The further details are described subsequently.



Aspects of waste collection to disposal

PMC should use the services of a consultant to develop a model for optimized waste collection systems.

The consultant can investigate several waste management collection models available (example as shown in box below) and then shortlist the model which is most suitable for Pune city.

However, in order to implement such a model, various factors like the distance between stops, number of bags at each stop, number of refuse containers at each stop, number of personnel involved, and waste characteristics etc. would have to be measured and calculated. Therefore, manual methods adopted for analysis of many factors would be a lengthy and tedious work. Also there are possibilities of errors while merging the spatial and non spatial data.

The tracking of the waste from source to the end disposal site can be done with the help of Geographic Information System aided with Global positioning system. In GIS, as the work is carried in layers, there are least chances of confusion or error and the system is capable enough to coordinate between spatial and non spatial data. GIS is a good decision support tool for planning waste management.

A Waste Collection Model

The efficiency of waste collection or productivity depends on many factors like distance between stops, number of bags at each stop, number of refuse containers at each stop, number of personnel involved, and waste characteristics, etc. Stearns (1982) developed a model to evaluate the efficiency of waste collection by a two-person crew working with a rear-loading compactor as follows:

$$P = 0.0033D + 0.16N + 0.09T + 0.03S + 0.02,$$

Where

P = productive collection time required per stop including the driving time from the previous stop (min)
D = distance between stops (m)
N = number of refuse containers at a stop
T = total number of throw-away items at a stop
S = number of services collected at each stop.

For one operator, using a rear-loading compactor, the equation is modified to:

$$P = 0.0165D + 0.15N + 0.089T + 0.08.$$

However, this model does not consider other factors like non-productive time, waste characteristics and so on, but is based on route-related factors only.

Stone and Stearns (1969) have proposed a more detailed model which incorporates both route-related parameters and other factors associated with the set of activities normally occurring during an entire work day of a collection crew:

$$X_1 = Vt\varrho/Q + B + K + D$$

Where

X_1 = total time requires to complete one trip (collection and disposal of one full load) (min)
V = volumetric capacity of vehicle (m^3)
t = average time per collection stop and travel time to the next stop (min)
ϱ = average density of refuse in vehicle (kg/m^3)
Q = average quantity of refuse per collection stop (kg)
B = one-way average driving time between route and disposal site (min)
K = total non-productive time (min)
D = Average disposal time (min/load)

To determine the number of trips that can be made by the crew many factors need to be defined or set. For example, what is the minimum load allowed before the crew returns to the disposal site? Also to be fixed is the duration allowed for overtime.

In general, when **n** is the total number of trips made by the truck per day, then

$$X_1 = (n+a-1)\, Vt\varrho/Q + (2n-1)\, B + K + nD$$

Where

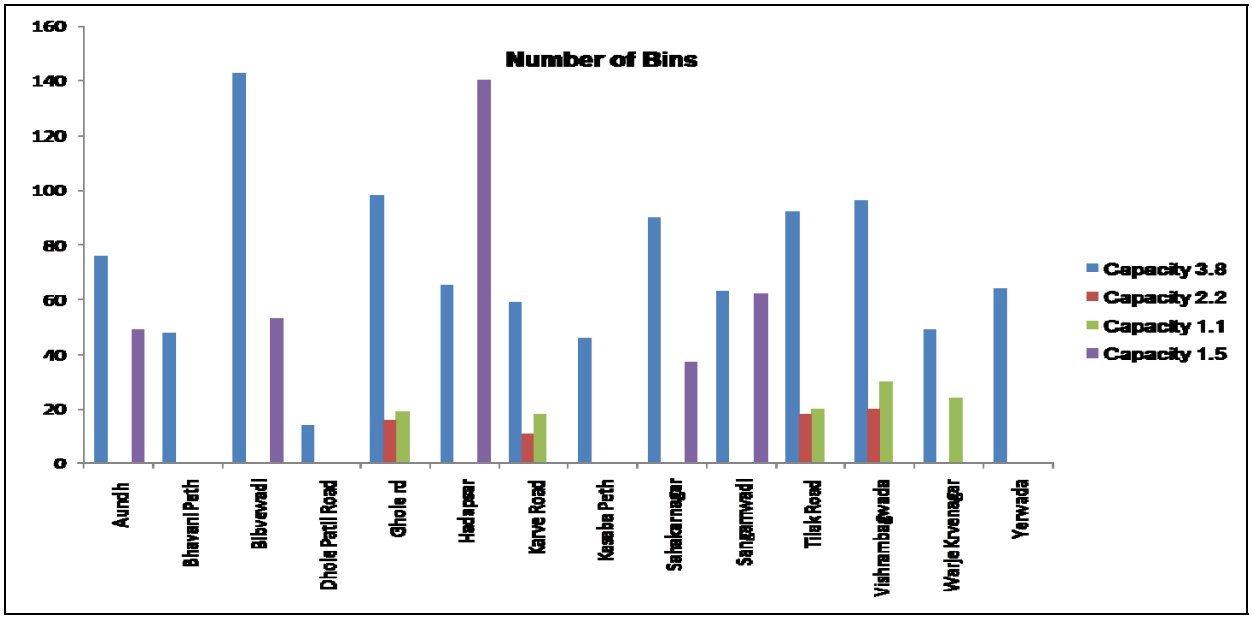
a = minimum partial load stipulated, for example a > ¼ if the truck is allows to return to the disposal site when it is only ¼ full
and for an eight hour shift (480 min), $X_n < 480 < X_{n+1}$

Setting n = 1, 2, etc., the model could be used to predict the number of trips the truck could make in a working day. Based on this information and other data on waste collection and characteristics, etc., it is possible to extrapolate the total cost of operation and the cost per tonne, which will determine the minimum amount to be collected from households.

Bin and Vehicle Design:

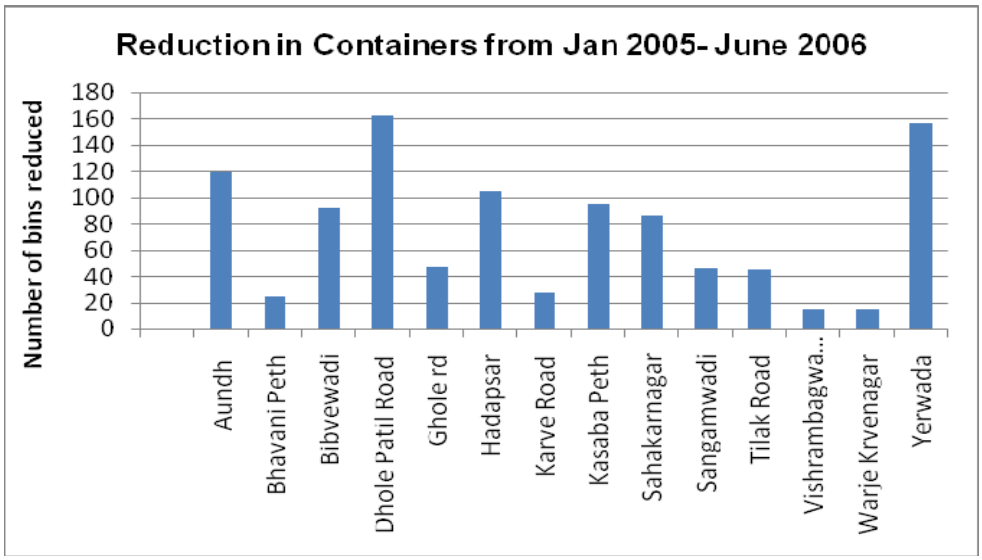
In Pune, the ward-wise allocation of different capacity containers in each ward is indicated in **Figure** below. The containers are of different sizes as indicated below:

- Containers handled by dumper placers - 3.8 cu.m.
- Containers handled by compactor vehicles - 2.2 cu.m., 1.1 cu.m. and 1.5 cu.m.



Waste Collection Containers in Pune[2]

With the increase in door to door collection system the numbers of containers in Pune have significantly reduced.



Reduction in Number of Containers from Jan 2005- June 2006[3]

The vehicles used for the transportation of solid waste are managed by the transport department of PMC in coordination with the Health & SWM dept of PMC. The Table below shows the various vehicles used by PMC for vehicle transportation and waste collection.

Type of PMC Vehicles for Waste Collection and Transportation[4]

Sr. No	Type	No.	OEM, vehicle model	Nos.	Capacity

2 As per data obtained from PMC

3 IBID

4 Data obtained from PMC

Sr. No	Type	No.	OEM, vehicle model	Nos.	Capacity
01.	Dumper Placer	93	Tata 709	81	3.8 m^3
			Ashok Leyland Cargo 759	12	3.8 m^3
02.	Compactor	34	Tata – City Cleaner (Single Axel)	12	12 m^3
			Eicher With Hopper (Double Axel)	4	20 m^3
			Tata - With Hopper (Double Axel)	18	14 m^3
03.	Hotel *Gadi*	51	Tata	51	6 m^3
04.	*Ghanta Gadi*	25	Eicher	15	4.5 m^3
			Tata	10	6 m^3
05.	BRC	66	Tata (Double Axel)	36	30 m^3
			Ashok Leyland (Double Axel)	10	20 m^3
			Single Axel*	16	
06.	Refuse Truck	09	Tata	05	6 m^3
			Ashok Leyland	04	
07.	Wheel Barrows	1208	-	-	-
08	Cycle Rickshaws	136	-	-	-

So in order to overcome the shortcomings in the design of vehicles and bins, the following vehicle and bin design is listed below:

Vehicle	Collection Container Type	Typical range container capacities m^3
Hauled-container Systems		
Tilt-frame	Open-top, also called debris boxes	8-40
	Used in conjunction with stationary compactor	10-30

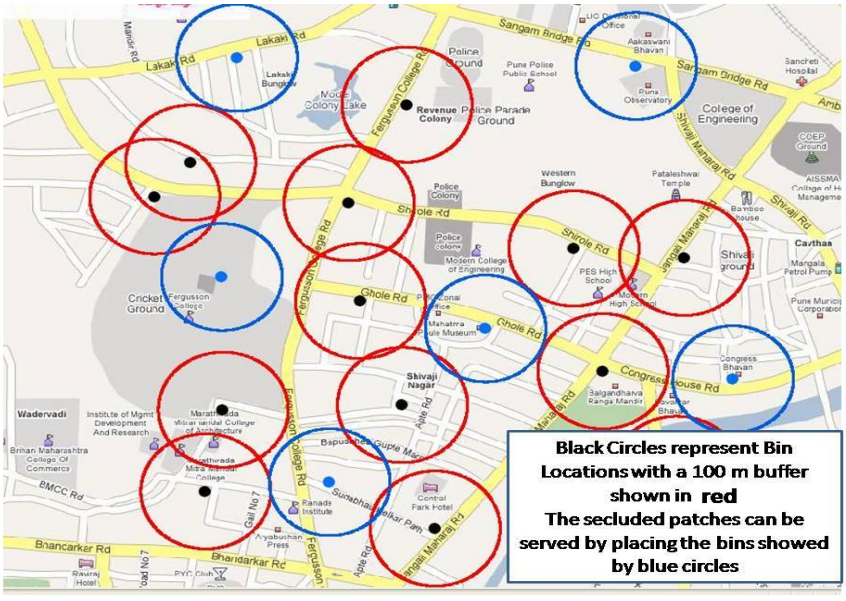
	Equipped with self-contained compaction mechanism	15-30
Truck-tractor	Open-top trash-trailers	10-30
	Enclosed trailer-mounted containers equipped with self-contained compaction mechanism	15-30
Stationary-container System		
Compactor, mechanically loaded	Open top and enclosed top and site-loading	0.6-8.0
Compactor, manually loaded	Small plastic or galvanised metal containers, disposal paper and plastic bags	75 – 200*

75 – Small plastic or galvanised metal containers, 200*L

* Liters L Loaded mass of container should not exceed 30kg.

For types of bins, another option is the installation of new recyclable waste bins in some areas. For the allocation of the recyclable waste collection bins, the location is preferred to be close to the existing municipal waste bins. This would make it convenient for users to know about the placement of the recyclable waste bin and it is more practical to use. It is seen that at places where segregation bins are placed, people bring their waste to the bins and separate it at the waste bin before dumping it and it seems to be feasible also. So in the analysis whichever area demands the requirement of a recyclable waste bin should be provided with a recyclable waste bin next to the organic waste bin.

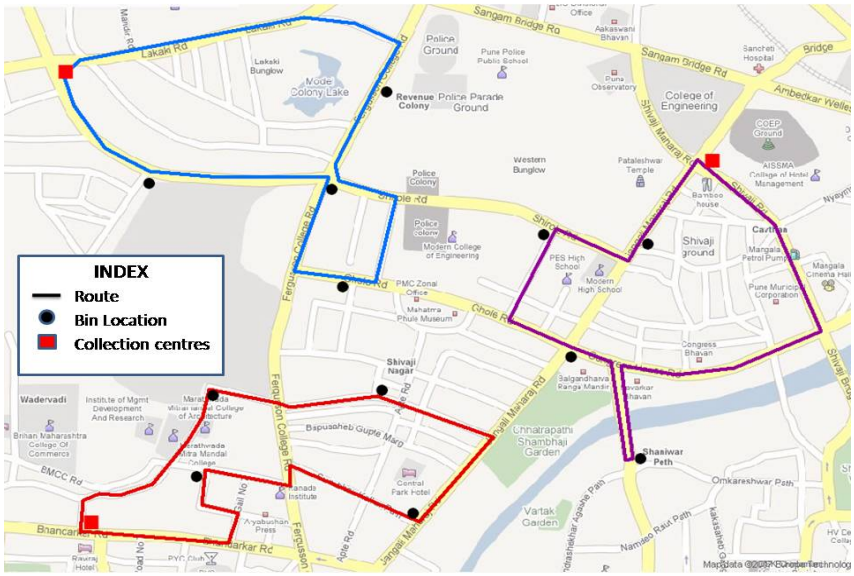
Bin Siting: The population distribution of a city can help build a solid waste generation database by calculating the waste generated both by monitoring and theoretical calculations. This database can further spatially modelled viz. using population from each ward and theoretical solid waste generation. Accordingly location of bins can be decided. **Figure** below gives an idea of location of bins and area it covers, it also suggests the areas where new bins are required. Highlights can also be provided to locate the bins which need to be replaced.



Location of Old bins and proposal for new bins

Route Allocation / Optimization: The transportation of waste from the bins to the collection centres and further to the landfill disposal site is done by vehicles. These can be dynamically monitored using GPS (Global positioning systems) for tracking them. This will help to determine real time vehicle location and operational status. Optimized routes thus can lead to efficient transport mechanisms considering time-cost factors. Figure below shows optimized routes for collection of waste from the bins to the collection centres.

A Management Information System of the vehicles can be used in case private firms are involved in transportation so that the vehicle logs can be automatically generated.



Optimized routes for transfer of waste from bins to collection centres

Prioritizing Decentralization: The waste in its entirety should not travel the entire path. It can be either segregated at the source or sorted out before being sent to disposal sites. Organic waste can be diverted to compost pits which are community level as well as central which are built for sorting at the later stage.

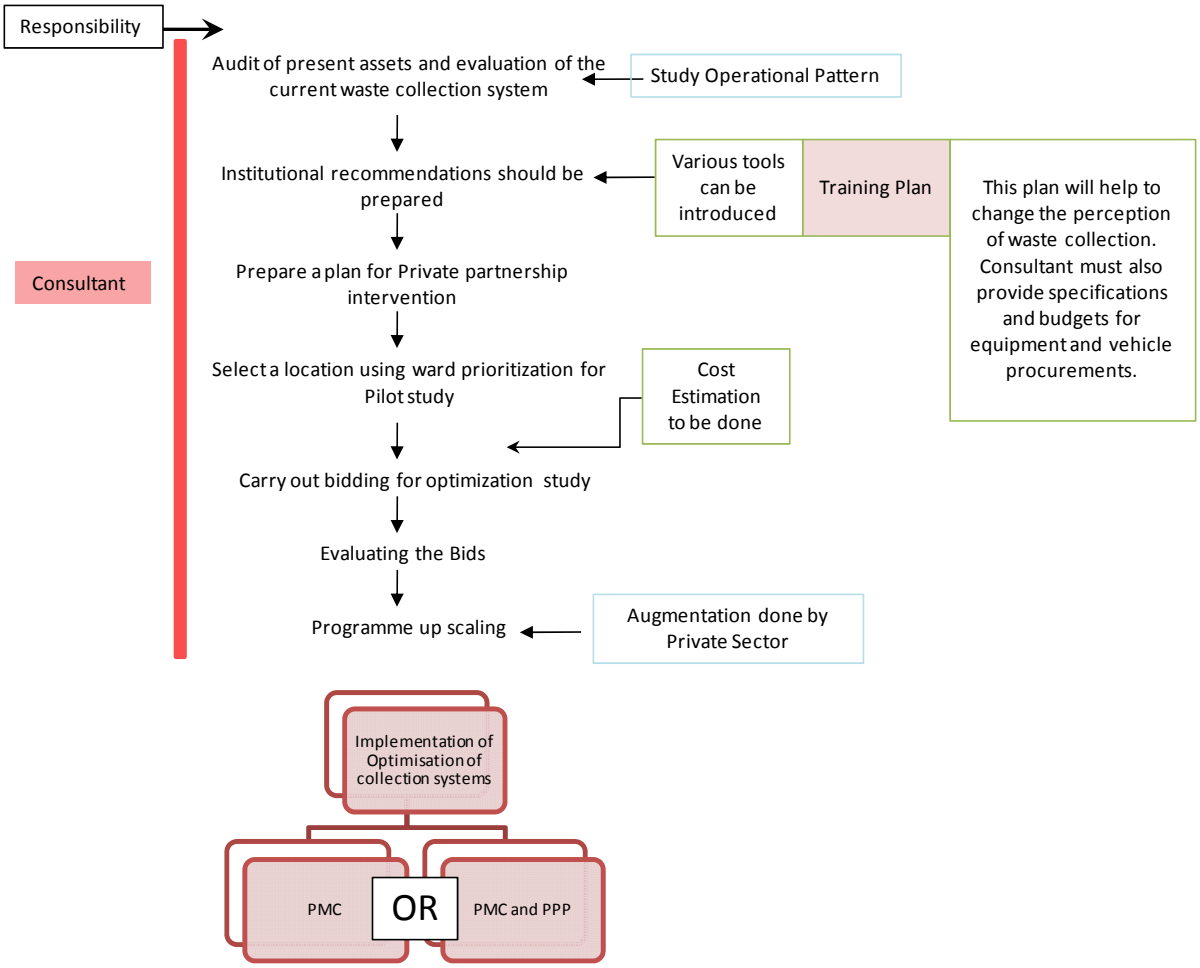
Community level compost pits can be marked by the operating individuals on a web based map so as to spread awareness and inform people about its location. Figure below shows a map which has been marked with compost pit.

Map showing location of compost pits

Transfer Stations and Bulk Refuse Carriers:

The transporting of waste from the transfer stations to the landfill site involves all available bulk refuse carriers in the city. The routes have to be fixed considering the cost-time functions for the vehicle travel as well as the quantity of waste in the transfer stations. Optimum jurisdiction of transfer stations and BRCs can be done by zoning of transfer stations.

11. **Implementation:** PMC can hire the services of a consultant to carry out an assessment of the present scenario and formulate a plan for implementation which can be undertaken in the phased approach method. Consultants can use the ward prioritization done in the Strategic Action Plan. Consultant should prepare a training programme, carry out asset evaluation, prepare a plan to identify points for Private Partnership intervention and PPP models.



12. **Other similar experiences:**

GIS-GPS system for solid waste management system[5]:

Good municipal solid waste management practices requires collection of critical information which is not just for keeping the records up to date but used effectively for taking corrective measures as well as proper planning for the future. There is also a need for integration and assimilation of information from various levels of

5 As referred to wgbis.ces.iisc.ernet.in/energy/paper/Solidnew/issues.html

jurisdiction. GPS-GIS systems can be powerful tools that can revolutionise the waste management systems in Bangalore. A management information system is required to manage large amount of spatial and attribute data related to the wards and generate reports (daily, weekly etc) at various levels levels (city, zone, range etc.) with details of the waste, types of vehicles etc. In Bangalore, trucks are the only means of removing garbage and other waste materials from the city. These vehicles perform multiple trips in a day and it is essential to monitor and track these trucks to improve efficiency. In this regard, global positioning system (GPS) would be helpful and cost effective. It also helps in optimising truck routes there by increasing the efficiency of the transport mechanism. Analysis of spatial data i.e. land use and land cover pattern, transport network, collection network etc., along with information related to quantity related to quantity and quality of wastes (through GIS) enable the authorities involved in waste management to come out with feasible options. These tools have been selected because 80% of information used by the health official has spatial components (city,zone, range and health ward level). These systems can be installed in BMP and zonal offices and establish monitoring centers in Bangalore. Training can be imparted to personnel in handling and updating the data.

GIS System for Waste Management in IISc Campus **:** A GIS system has been developed for Indian Institute of Science campus. The campus limits are enclosed within 13.01055° to 13.02083°latitude and 77.55944° to 77.57388° longitude. IISc is located in the northern part of Bangalore City having lush vegetation and campus has green canopy of trees covering the buildings. The main campus covers around 150 hectares. IIS chas 40 departments,2 banks, 1 school, 4 canteens, 1 restaurant, 4 guest houses, 400 faculty members, 800 supporting staff, 1500 students and 450 residential quarters representing a typical urban community. The institute generates all kinds of waste arising from residential, commercial, education, open area and vegetative area. Waste bins of different types are distributed around the campus. Collection of waste is done by one truck, one tractor and mini pick up trucks. The frequency of collection is 1 to 3 days. Collected wastes are dumped or burnt at common dumping site about 12kms away from IISc. Regular street sweeping and roadside garden trimmings are done and wastes are dumped in bins. Transferring of waste to vehicles is done manually. The route followed is currently one convenient to the driver rather than from the collection point of view or from type and composition of wastes. All sensitive bins are not given priority in this method of collection. There is a need to evolve an optimal route evolved on the basis of waste composition and quantities generated in each bin. Integrating spatial information along with corresponding attribute information was part of the study. Map info 5.5 was used to create vector layers from the Survey of India (SOl) toposheets of scale 1:1000. Digitised vector layers include boundary, road network, building distribution, distribution of bins, open dumping sites, land use and land cover, optimal routing etc.

GIS System used for SWM Model for Aurangabad City[6]: There has to be appropriate planning for proper waste management by means of analysis of the waste situation of the area. This paper would deal with, how Geographical Information System can be used as a decision support tool for planning waste management. A model is designed for the case study area in an Indian city for the purpose of planning waste management. The suggestions for amendments in the system through GIS based model would reduce the waste management workload to some extent and exhibit remedies for some of the SWM problems in the case study area. The waste management issues are considered to solve some of the present situation problems like proper allocation and relocation of waste bins, check for unsuitability and proximity convenience due to waste bin to the users, proposal of recyclable waste bins for the required areas and future suggestions. The model will be implemented on the Aurangabad city's case study area data for the analysis and the results will suggest some modification in the existing system which is expected to reduce the waste management workload to a certain extent.

PPP for SWM Collection in Chennai[7]: In March 2000, C.E.S. Onyx, a Chennai-based company set up by Onyx, won a contract with the Chennai Municipal Corporation to "manage" the garbage and street litter from three key areas of the city. At a cost of Rs. 650,000 (US$13,700), the company collects and disposes at least 1000 tons of garbage every day in and around the freshwater wetlands of Pallikaranai towards the south of the city.

6 As referred to www.diva-portal.org/diva/getDocument?urn_nbn_se_liu_diva-6470-1__fulltext.pdf

7 As referred to http://www.spectrezine.org/global/Water.htm

13. **Barriers:** Implementation of GIS and GPS for route optimization would mean a change in the waste management is being handled. This change needs to become a system which means that old data and addition data need to be incorporated and regularly updated. This if not performed properly would lead to failure of the change.

    Another important factor is the cost implication. The involvement of new technology would require a large capital investment. The accurate systems would be more costly. For e.g. a differential GPS would be ten times costlier than a normal GPS. This involves strategic placement of a combination of costly and cheaper alternatives for the best possible solution. The achievement of such combination involves understanding of the entire process and the role of technology at each step.

14. **Benefits:**
    - Monitoring the waste at every stage
    - Improved operation and cost efficiency for waste management
    - Planning for strategic bin location that serves the local population
    - Route optimization from collection point to the landfill site which can save fuel cost and the reduction in trips and time for the waste travel
    - Tool as a decision making for future investment in infrastructure
    - Maximizes the use of all infrastructure facilities.
    - Provide a transparent working system thus helpful for involvement of stakeholders

    Benefits of vehicle tracking:

    - To increase efficiency of the transport logistic
    - To prevent rogue drivers from straying off way-points
    - To pin-point location of vehicle in event of emergency
    - To give assurance to customers on safe transportation of the waste
    - To ensure contractor transport waste to destination
    - To ensure "cradle-to-grave" responsibility is carried out
    - Accountability of licensed contractors
    - Higher esteem for the scheduled waste industry

15. **Links to other ISWM Pune Schemes:**
    - Inventorization of Solid Waste
    - Establishment of Community Sorting Centres
    - Private Partnerships in waste collection and management system
    - Establish Take back policy for E-Wastes
    - Demonstration Projects for Hotel Waste Management
    - Introducing Industry-University Partnerships
    - Strengthening of PMC Rag picker Co-operatives
    - C&D Waste Management

2. ESTABLISHMENT OF COMMUNITY SORTING CENTRES (CSC)

1. **Introduction:** The daily generation of MSW in Pune is around 1093 MT. This is collected in two or three shifts to be disposed of at a landfill/dumping ground called *Urali Devachi* located outside the city limits. Sorting of wastes does occur at the source but not in an organized manner leading to various problems such as nuisance, health and safety issues, etc. Sorting is also practiced to a limited extent at the transfer stations and the landfill/dumping ground site. This however does not reduce the cost of collecting and transporting the waste. The sorting is conducted primarily by the informal sectors (rag-pickers). Out of the 382 MT of dry waste only 30 MT is being collected by the rag-pickers.

2. **Purpose:** Community Sorting Centres would provide for an organized manner of sorting and segregating the waste addressing four key issues - problem of mixed wastes sent to the landfills, recyclable valuables which get landfilled, working conditions for the ragpickers and cost of collection and transportation of the waste. ***Community Sorting Centres*** in Pune city will help to increase the amount of sorting which is important to reduce the amount of waste being sent to the landfill, reducing the raw materials consumption and increases waste recovery and recycling activities. The increased efficiency of sorting will eventually increase the potential for setting up of waste to energy plants. The viability of these plants is dependent on the extent of sorting (segregation) or Material Recovery Techniques applied to separate various waste types. Hence a platform such as Community Sorting Centre will greatly enhance the possibility of applying such a facility in Pune city. Further this will facilitate the strengthening and institutionalizing of the rag-pickers.

3. **Target**: To form CSC's which will serve as waste segregation and sorting facilities as well as a waste exchange centre.

4. **Type:** Project

5. **Lead Agency:** PMC

6. **Support Agency:** NGOs Waste picker co-operatives, decentralized treatment technology providers, Recyclable collection centre/ recycling units/ personnel and residential society associations (Residential Welfare Associations (RWAs) of the local area).

   The Management Body, which will include representatives from PMC and other support agencies, shall be responsible to track the performance of the CSC supervisors and rag pickers and will take necessary action to achieve maximum satisfactory compliance and sorting. This body with the help of PMC and other Central Government Schemes for the people living under poverty shall provide for the medical insurance and other facilities to the rag pickers.

7. **Location (Suggested):** City wide pilot project which will be evaluated. After successful operation, CSCs will be up scaled and set up in all the wards based on the waste quantum.

8. **Budget (Estimated):** In an ideal CSC the elements of costs will be as follows:
   - Cost incurred in the construction of CSC
   - Awareness materials/ training of rag pickers.
   - Provision of safety equipment to the rag pickers.
   - Organizational expenditure.

   Elements of revenue will be as follows:

   - Sales of recyclables
   - User fee
   - Savings on transportation cost

For Location and construction – Rs. 5 Million
For other costs such as consulting, operating design etc- Rs. 10 Million

9. Time Frame (Estimated):

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Identification of locations/ options etc.								
Preliminary Design/construction								
Rag Picker Institutionalisation								
Pilot Plant Operation								
Evaluation								
Plan for upscale – involve PPP								

10. Description: In order to move towards the final vision of reducing the overall wastes reaching the landfill sites, sorting or segregation of waste plays a significant role. The efficiency of various waste treatment, recycle and reuse are indirectly linked to the efficiency of segregation. As per the current situation in Pune, segregation of waste remains a mammoth task which is presently being handled by the informal sector comprising of the rag-pickers to a certain extent. The overall extent of segregation in the city amounts to a meager 35 %. The CSC aims to provide a platform to equip the informal sector to effectively undertake the waste sorting. The community centre equipped with safe and protective measures will result in increasing the efficiency of waste segregation and sorting. In order to promote the segregation and sorting of waste, PMC has adopted the policy of institutionalizing rag-pickers. These will become the workforce at the sorting centers.

Workforce: The workforce at the CSC will comprise of a supervising staff and the rag pickers. The supervising staff may be a PMC official or a selected member from the ISWM Cell or a trained certified member of the rag picker co-operative. The responsibilities of the supervisors and the rag pickers have been listed below:

The management body will comprise of 2 representatives from PMC (1 from town planning and 1 from MSW management), 2 NGOs, and 1 representative of the rag-pickers.

Responsibilities of the supervisors:

- They will act as an interface between, the management body and the rag pickers.
- They will monitor the performance of the working of the rag pickers and report the same to the management body.
- The supervisors shall take necessary action to achieve 100% satisfactory compliance and sorting.
- They will prepare and maintain a proper inventory of the activities in the CSC including the waste materials brought in, the segregated waste materials, materials sent for recycling and decentralized treatment, the cost of each, equipment management and the finances of the CSC.
- Maintain the CSC savings.
- Distributing the profits after deducting for maintenance etc. to the rag pickers.

Responsibilities of the Rag Pickers:

- Weighing of waste that has been collected.
- Sorting and segregating the recyclable portion at the CSC.

- Selling the recyclables portion to the collection centre under the management of the supervisor.
- Giving the organic portion of the waste to the decentralized treatment plants under the management of the supervisor.
- Infrastructure and hygiene maintenance of the CSC.

Space and Equipments requirement: The initial investment and provision of space for a CSC will be done by the municipality. Existing available space should be utilized. In case of new space is acquired then, the following things will be kept in mind during the construction and the equipments used in the CSC:

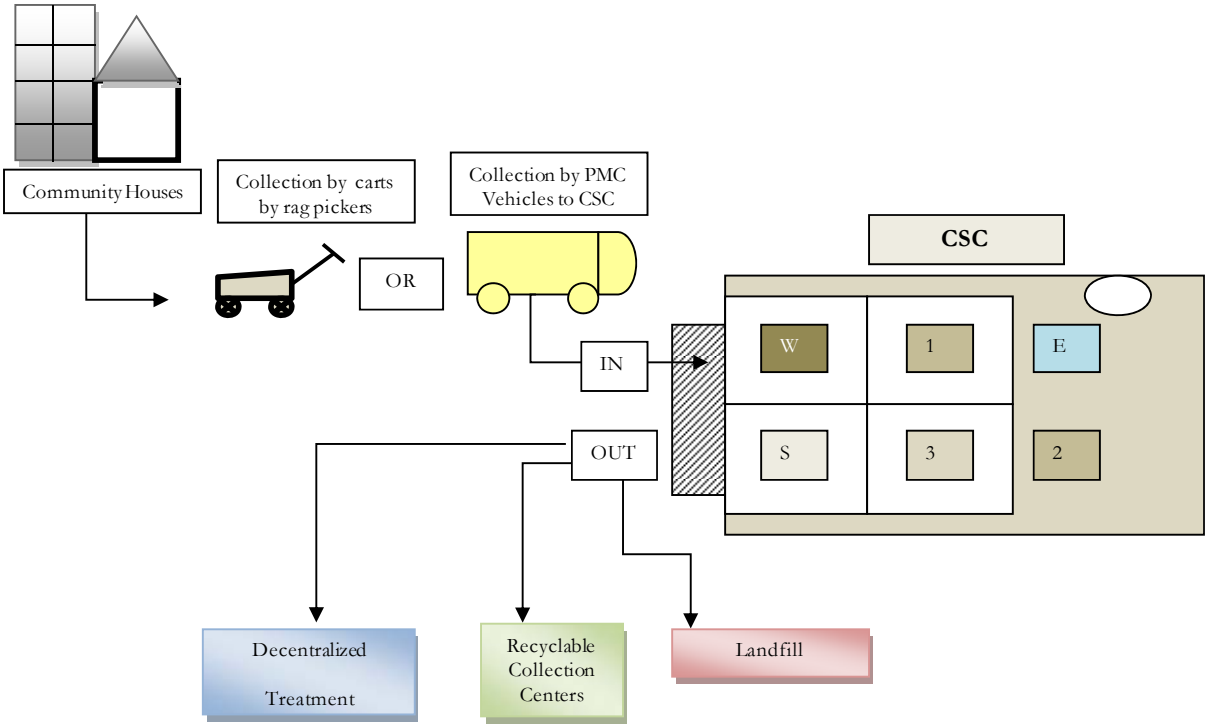
- Enclosed area (with appropriate sign posts)
- Use of wind screen/barriers – blown papers
- Provision should be made to restrict the entry of rain water into the CSC.
- Proper ventilation and lighting should be provided.
- The space should be appropriately designed so that it can store maximum amount of recyclables.
- Provision of certain equipments such as sorting tables, magnetic separators etc should also be done.
- Provision of ID cards for waste pickers, safety equipments, cleaning material, etc.
- Moreover, eco-friendly construction practices will be followed in the construction of the CSC. Constructed of materials that are easy to clean. Following may be mentioned in this regard:
  - Minimum 25% replacement of cement by weight of fly ash or ground-granulated blast furnace slag in absolute volume of structural concrete.
  - Use of C&D waste and industrial waste based bricks/blocks for non-structural/infill wall systems.
  - Minimum use of wood as a natural material for interior works.
  - Use of paints, adhesives, and sealants that have low VOC (volatile organic carbon) contents.
- A high capacity weighing balance should be provided for weighing the waste.
- Provision of basic facilities such as water supply, sanitation and electricity supply etc. will be taken care of from total profits earned.

Several assumptions have been made to describe the process at a CSC. This data would vary based on the ward and waste generation patterns.

Assumptions made:

Element of a CSC	**Assumption**
Number of households in one community for one CSC	10000
Number of rag pickers for 100 households	1
Total rag pickers for one CSC	100
Number of supervisors	2
Total amount of Waste collected per day if the per capita generation is taken the average of Pune as 0.41 kg	4100 Kg
Total Waste to be segregated per waste picker	41 Kg
Total Organic Waste for decentralized treatment	2500 Kg
Total Non-Organic Waste	1600 Kg
Area required for sorting center	1000 sq. ft.
Average Earning of one rag picker	Rs. 3000 per month

Process at a CSC:

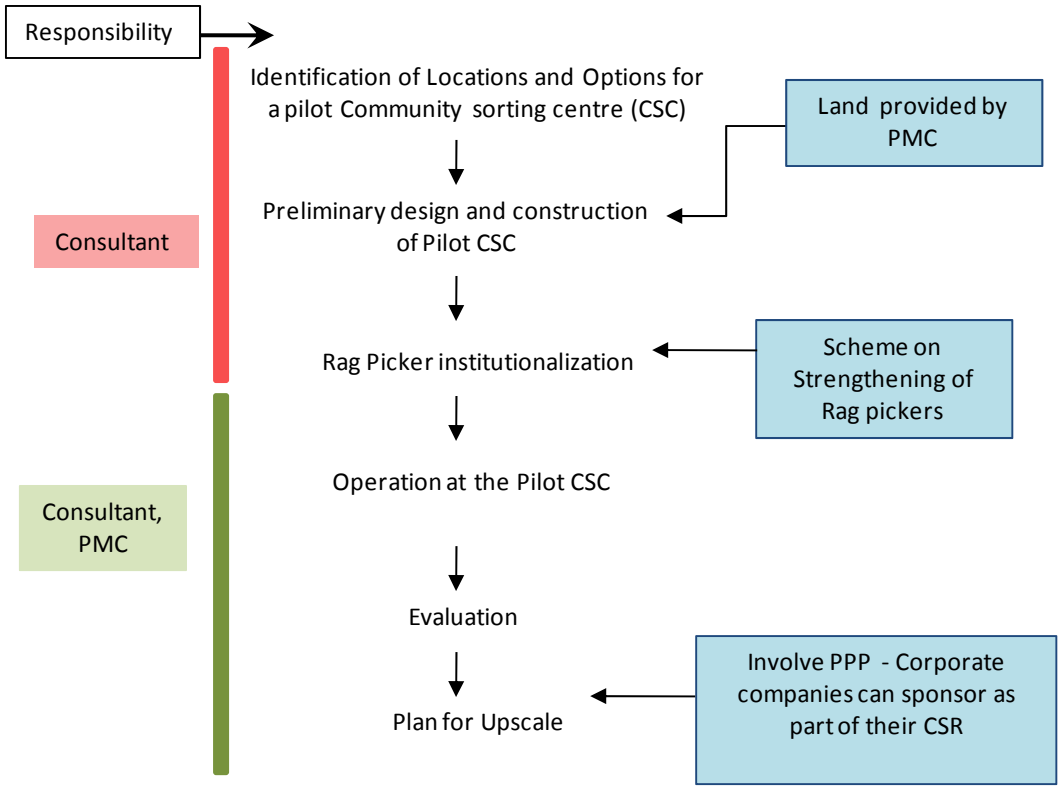


W	***Weighing Area***
1	***Rough Sorting***
2	***More Detailed Sorting***
3	***Further Sorting***
E	***E-Waste Sorting***
S	***Storage***

Other Steps to be Taken by PMC

- Collection of waste and transportation to the sorting centers.
- Collection of the waste from sorting center to be sent to the landfill.
- Formation of recyclable collection centers/ recycling units
- Formation of decentralized treatment plants

11. **Implementation:** PMC can use the services of a consultant to carry out an assessment and design a preliminary pilot CSC. This project after implementation can be up scaled by involving PPP and corporate companies can sponsor as part of their CSR. This project would then become a programme and therefore the consultant should make a plan in a phased way.



12. **Other similar experiences:** Several organizations in Pune such as *Kagad Kaach Patra Kashtakari Panchayat* (KKPKP) is an organization striving hard for the benefits of the rag-pickers. This organization is a registered trade union with 5200 registered members working to represent collective identity and interests of the scrap collectors. Founded a decade ago, this organization functions on the principles of "Collective Ownership", "Participation" and "Empowerment". This organization has undertaken several problems such as:
    - Addressing the individual grievances of the rag-pickers.
    - Creating platforms for social and cultural renewal.
    - Market interventions in scrap trade.
    - Lobbying for legislative protection.
    - Developing institutional mechanisms for social security.
    - Fighting for seeking state assistance in claiming Medical Insurances.
    - Promoting Education and safe-guarding human health.
    - Prevention of child labour.

13. **Barriers:** Willingness of rag pickers to train and utilize the space provided, co-operation from the residential societies, space and organizational constraints.

14. **Benefits:** Institutionalization of the informal sector will be done to ensure the following:
    - **Greater social acceptance***:* Awareness will be developed in the community about the contribution of the waste pickers and their importance in the society. This change in perception will be a great motivation for the rag pickers.
    - **Reduced harassment***:* the rag pickers will be legitimized by the law and they'll be provided with ID cards etc. so that they don't face harassment from any civic authority.
    - **Assured livelihood**: The rag pickers will able to follow a proper work culture and earn from the assured profits earned through the sorting centre.
    - **Education and Training**: Educational and training meetings will be organized to train the rag pickers to take proper precautions and care while dealing with the waste.
    - **Provision of safety equipments**: Safety equipments, such as gloves, masks, uniforms etc. will be made available to the rag pickers.

- **Medical facility**: regular medical checkup of the waste pickers (maybe on a monthly or half yearly) will be conducted. Provision of some medical insurance (by the municipal authority) may also be incorporated.
- Reduction in cost of collection of waste by PMC.
- Reduction in utilization of landfill space thereby increasing the life of the landfill.
- Increase in source segregation and awareness.
- Increase in recycling and reuse.
- **Enhanced Segregation:** Rag-pickers or informal sector are currently capable of collecting only 30 MT out of 382 MT of dry waste which finally gets mixed and ends up in the landfill. The implementation of a community sorting centre will enhance the segregation and sorting of waste thereby reducing the pressure on the existing landfill site.
- **Enhancing Treatment Efficiencies:** The efficiency of the treatment processes for dry as well as wet waste is a function of the extent of segregation of the total waste. The CSC will result in improvement in the overall waste treatment efficiencies.

15. <u>Links to other ISWM Pune Schemes:</u>

- Optimizing and Strengthening of MSW Collection Systems
- Recycling of Plastic Waste
- Private Partnerships in Decentralized Treatment System
- Establishment of Waste Exchange Centres
- Improving the Health and Safety of PMC workers, Rag-pickers and Citizens in Proximity of Landfill
- Strengthening PMC Rag-pickers Co-operatives

3. PILOT PROJECTS FOR RECYCLE AND REUSE OF CONSTRUCTION AND DEMOLITION (C&D) WASTE

1. **Introduction:** The construction and demolition activities generate huge quantum of debris which finally ends up in the landfills or is dumped in low-lying areas including river banks & beds. These activities shorten the life of landfills on one hand and on the other changes the topography of land, thus affecting surface water drainage and ground water percolation Many of these materials can be reused or recycled, thus prolonging our supply of natural resources and potentially saving money in the process. The MSW Rules, 2000 prohibit the dumping of C&D waste in the sanitary landfills owing to the interference caused by their presence in the overall treatment process. The unauthorized dumping of C&D wastes as well as un attended silt left in public after de-silting operations, is a major cause of nuisance, environmental degradation and pollution. Currently no systematic management of C&D wastes is practiced in Pune.

   The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) has also sanctioned several large scale infrastructure projects in Pune. This would give rise to the amount of construction waste generated.

2. **Purpose:** C&D waste constitutes about 40.6% of the total garbage generated in the city. The quantity of C&D waste generated is gradually increasing. This when received at the dumping grounds, gets mixed with the organic and other types of MSW. PMC has to spend a lot in the collection and transportation of C&D wastes.

3. **Target**: To enlist several methods of recycle and reuse of C&D waste in Pune to avoid disposal of C&D waste at the landfills.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Town Planning Department

6. **Support Agency:** C&D Waste Management sub-division of the ISWM Cell including Promoters and Builders Association of Pune (PBAP), Builders and Contractors, Maratha Chamber of Commerce, Industries and Agriculture (MCCIA), National Building Construction Company and Housing Urban Development Corporation, NGO's, generators and housing societies.

7. **Location (Suggested):** The selected designated disposal sites for C&D Wastes by PMC – Town Planning Department can be used for the recycle and reuse projects.

8. **Budget (Estimated)**
   - For five demonstration projects – Rs. 5 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Assessment of Pilot Projects	4 months							
Implementation of Pilot Projects			10-12 months					

10. Description: C&D waste typically comprises of inert materials which cannot be further treated. Hence recycling and reuse is one of the best methods of managing these wastes. Recycling operators could recycle the C& D waste at the disposal sites which will help to create more space for future wastes and disposal sites never get exhausted. For this a proper collection and disposal system would have to be designed by PMC along with the selection of disposal sites. Proper guidelines for managing C&D wastes need to be introduced by PMC and also a proper disposal system needs to be designed. The typical components of C&D waste generated from various activities and their potential recycle and reuse is demonstrated in Table 1.[1]

Activity	Materials Separated	Possible Re-use/Recycling
Road reconstruction		
	asphalt	crushed and mixed with new asphalt; fill
		material; road subbase
	concrete (without rebar)	road subbase; re-used in concrete;
		concrete blocks; fill material; rip-rap on
		roads/lagoons
	concrete (with rebar)	fill material; rip-rap
	separated rebar; metal	re-use for original purpose, processing at a steel
	signs; sign posts; guardrails;	mill
	culverts	
	fill materials (earth, gravel, sand)	clean fill material; landscaping material; landfill
		cover
Excavation/leveling	topsoil	landscaping; residential fill; landfill cover;
		agricultural
	sand	fill; residential; road construction
	stones	rip-rap; fill; landscaping
	earth contaminated with wood;	fill; landfill cover; disposal at landfill
	buried utilities	
Site clearance	trees and brush	firewood; landscaping chips; composting; landfill

[1] Source : http://www.se.gov.sk.ca/environment/protection/land/Construction%20and%20Demolition%20PDF.pdf

Activity	Materials Separated	Possible Re-use/Recycling
		disposal
	soils	landscaping agricultural and residential fill
	mixed concrete, rubble, sand and	land reclamation fill; landfill disposal
	steel	
Building C&D Material	clean bricks; whole cindercrete	re-use for original purpose; landscaping;
-Reusable	blocks; concrete or stone facades;	permanent roadway construction in landfills
	tiles; ceramics; concrete roofing	
	tiles	
	undamaged windows, roofing	resale for re-use
	and metal/vinyl siding; wooden	
	cabinets, counters, flooring,	
	staircases/trim; plumbing/electrical	
	fittings; carpeting; clean insulation;	
	wooden beams/facades	
Building C&D Material	broken bricks, cindercrete blocks,	landscaping; crushed clean fill for road subbase,
-Recyclable	concrete roof tiles, concrete/stone	roadways and rip-rap; use for stabilization of
	facades, tiles/ceramics	roadbases or fill at landfills;
		clean fill for land reclamation
	broken window glass, glass	recycle at glass recycler (Canosphere); recycle for
	fixtures	glasphalt mix; recycle for use with rubber crumb
		(Magnum Industries)
	broken wooden beams; trim;	chipping or shredding for landscaping; composting;
	wood scrap; trees	fuel source
	metal girders, supports, rebar,	recycle at a steel mill (Ipsco)

Activity	Materials Separated	Possible Re-use/Recycling
	damaged metal siding, roofing	
	scrap aluminum door and window	sell to scrap dealer; recycle at an aluminum smelter
	frames	
Building C&D Material	mixed waste not suitable for	disposal at an approved waste disposal ground (no
-Disposal	separation; materials which	waste dangerous goods)
	cannot be re-used or recycled;	
	asphalt shingles; linoleum flooring	
	waste dangerous goods including	manifesting under Dangerous Goods Transportation
	asbestos	legislation, treatment or disposal at approved sites
		using approved methods only

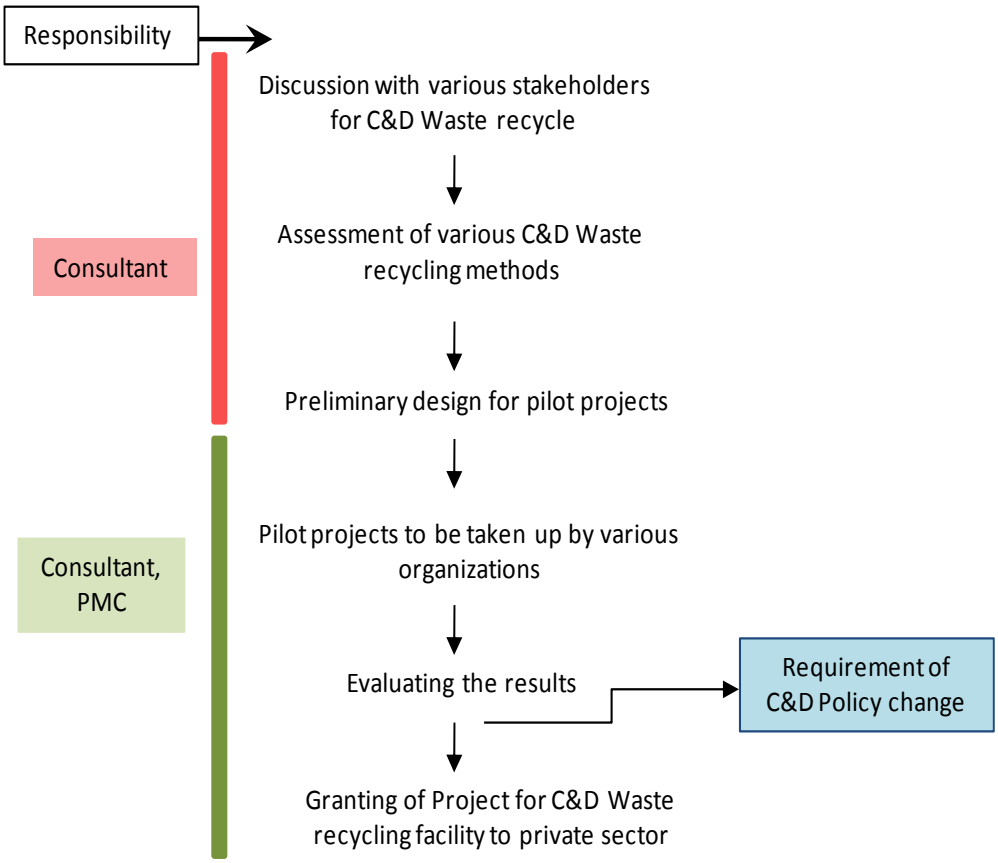
There are several methods that can be adopted for C&D Waste Management for promotion of recycle and reuse of C&D Wastes:

- Tenders could be floated for the conversion of debris to private bodies who could work out all the possible ways to market their products.
- PMC should promote the research through various local and national research institutions on testing the quality and the applicability of recycled C&D waste.
- All the machinery is available in the Indian Market right from crushers to interlocking pavers making hydraulic machines.
- PMC should encourage use of recycled debris in making pavements and bricks for the road and foot-path construction
- If a developer wishes to salvage the waste produced in situ, then smaller machines are available which could convert the waste to useful products like bricks and interlocking pavers. The machines will stay till the time the construction is over then the machine could be moved to another location this will ensure that no constant plant is operational and any nuisance is created to the residents in that vicinity.
- Silt should be utilized as landfill cover for garbage or compost rejects. Vegetation should grow well on drain silt. Drain silt should never be transported along with MSW in the same vehicle as this makes composting impossible at the waste-processing and disposal point.
- *Recycled gypsum* which is mainly produced from waste plasterboard from construction and demolition sites can be used to enhance the growth and quality of the potato crop. It is not simply crushed-up or shredded, but carefully processed to remove all other materials and contamination. It is usually a sand-like powder and is comparable to agricultural gypsum, safe to handle and use[2]. Although gypsum boards may not be used on a large-scale in Indian construction scenario, this can be looked as a probable alternative.

11. **Implementation:** PMC can use the services of a consultant to initiate five demonstration projects on C&D Waste recycling which will be taken up by research organizations and corporate construction companies. Based on the results of the Pilot projects, PMC may involve a private party to set up a C&D Waste recycling facility in

2 As referred to www.wrap.org.uk/plasterboard

Pune. The scheme on inventorisation of waste would be beneficial in evaluating the recycling methods as the current C&D waste generation and management would be measured.



12. Other similar experiences:

Recycled Debris

Debris is recycled to make new construction-related products like bricks, interlocking pavers. City and Industrial Development Corporation (CIDCO) and YUVA, an NGO, have collaborated on this effort to convert the debris and reduce the load on dumping grounds. Presently, the plant in Navi Mumbai converts three tonnes of debris per day. Set up in 1999, this plant is one of its kinds in the whole of India and has been successful in developing products conforming to Indian Standard Codes of practice of the Central Government. The plant has successfully completed recycling 1,000 tonnes of debris till date[3].

This garden bed was made using recycled bricks. These can be found at building demolition yards[4].

Salvaging Debris

In Mumbai, the rocks excavated from the widening of roads are taken to a site which breaks it down into aggregates. These aggregates are then used in the sub grade of the new roads which are done. The site where the stone crusher plant has been set up is next to the highway between Kandivali and Borivali close to Thakur complex well in the vicinity of the residential area. A suggestion is to have these kind of crushers at the disposal

3 As referred to http://www.bcpt.org.in/solidwaste.pdf.

4 As referred to www.planetark.com/.../80/newsDate/10/story.htm

sites for large quantity recycling, these disposal sites if equipped with these crushers then the salvaging of debris is possible and will be sustainable and also provide a long term solution for the MCGM[5].

Recycled gypsum

Recycled gypsum was applied using standard farm spreading equipment – a lime spreader – calibrated to apply 3t/ha. Some plots were given two applications at 3t/ha to achieve 6t/ha in total, to compare the results from different application rates. Once the gypsum was applied, normal farm practices continued to prepare the ground, plant the seed, and maintain and harvest.

The overall quality of the potatoes grown with recycled gypsum was higher than those in the untreated soil growth cracks were significantly reduced in occurrence and size; and skin finish and bloom appeared much improved, leading to a brighter and more marketable product. As a result, growers may be able to achieve a higher premium for the potato crop, especially those targeting the prepacked market[6].

Potatoes grown in soil with recycled gypsum | Potatoes grown in untreated soil

Other positive results are:

- The gypsum also increased the available sulphate in the soil, which was previously depleted. It is possible that longer term use, or use on heavier soil types, could improve soil bulk density; and
- Standard spreading equipment can be used to apply recycled gypsum. No changes are required to the operations which follow – bed forming, planting, crop maintenance and harvest. The farmer who undertook the trial was impressed by the performance of recycled gypsum and is committed to using it in future. Seeing the final crop convinced him of the benefits through its effects on the soil, the crop and skin finish quality.

13. **Barriers:** Co-operation from all stakeholders for changing methodology of disposing C&D wastes to recycling and reusing it as well as the lack of awareness regarding C&D waste management. This can be overcome by the various awareness raising programmes proposed with this Action plan.

14. **Benefits:**
    - Management of C&D Waste would become more convenient and easy to handle
    - Nuisance due to C&D Waste would be avoided
    - C&D Wastes would not get mixed with MSW and avoid the use of landfill space
    - Cost Benefits of reusing Construction Materials

15. **Links to other ISWM Pune Schemes:**
    - Develop and Introduce Policy for Construction and Demolition (C&D) Waste Management
    - Construction and Demolition Waste Management
    - Establishment of Waste Exchange Centre
    - Introducing Industry-University Partnerships

5 As referred to http://www.karmayog.com/cleanliness/desiltingwastecd.htm

6 As referred to www.wrap.org.uk/plasterboard

4. RECYCLING OF PLASTIC WASTE

1. **Introduction:** The catastrophic rainfall and flooding in Mumbai during 2005 catapulted the implementation of the state level rules entitled "Maharashtra Plastic Carry Bags (Manufacture and Usage) Rules, 2006. Although plastics contribute to around 7% of the total waste in Pune, owing to their indiscriminate usage, non-degradability and lack of efficient end of life management, disposal of plastic wastes is becoming of increasing concern.

2. **Purpose:** Film packaging and polymer plastic bags are the major contributors to the plastic waste being dumped into municipal solid waste stream. Plastics owing to their non-degradability keep accumulating at the landfill sites, thus hampering the treatment of the other biodegradable waste as well. Further, the lack of defined regulations to prevent the usage of this non-biodegradable product makes matters worse.

3. **Target:** To enlist the possible recycling potential of plastic waste. To investigate the use of plastics to diesel and its implementation with reference to Pune.

4. **Type:** Projects to recycle Plastics.

5. **Lead Agency:** Pune Municipal Corporation (PMC)

6. **Support Agency:** Plastic Waste Management sub-division of the ISWM Cell, PMC, Research Institutions such as the National Chemical Laboratory, Polymer manufacturers and users, NGOs', generators and housing societies.

7. **Location (Suggestions):** Science and Technology Park of University of Pune(UoP). The National Chemical Laboratory or University of Pune may also take up the project on assessing the recycling potential of plastic to diesel/oil.

8. **Budget (Estimated):** Rs. 5 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Assessment of Pilot Projects	4 months							
Implementation of Pilot Projects			10-12 months					

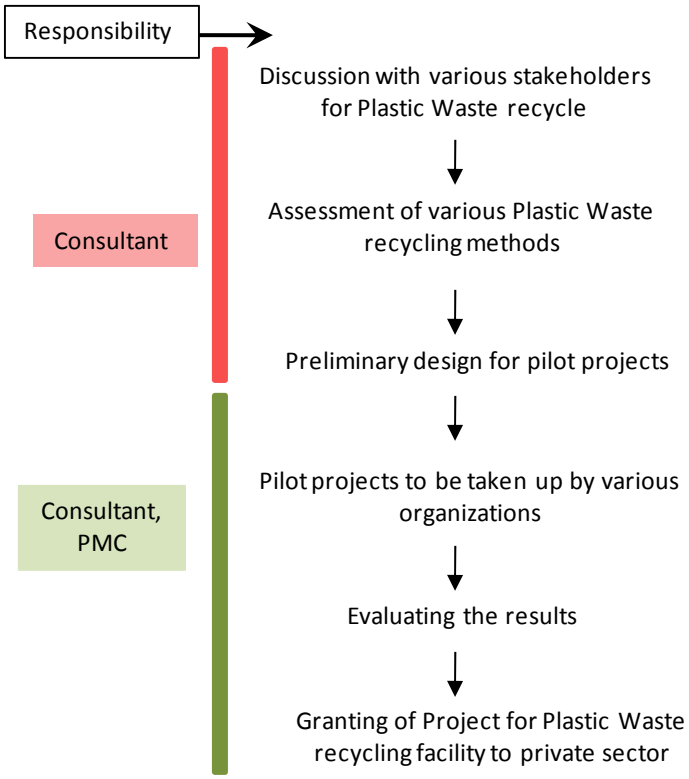
10. **Description:** With a view to better manage the ever increasing problem of plastic wastes; PMC has introduced a ban on the usage of polymer bags below thickness of 50 m^2. Recycling of plastic wastes for exploring possibilities of refuse derived fuel such as plastic to petroleum/diesel needs to be examined. Proper collection and segregation of waste is a precursor to the successful application this waste to fuel project. RDF or refuse derived fuels are essentially segregated MSW with low moisture content. The calorific value of MSW which is a function of the waste composition (fraction of plastics, paper and wood and moisture) is an important factor in identifying the feasibility of RDF projects. India has typically low calorific value owing to lower plastic content in the overall MSW. The chlorinated plastics mainly PVC dominate over almost 20% of the world demand for plastics. The combustion of chlorinated plastics results in the emission of harmful dioxins and furans which

have carcinogenic effects. Sorting and remoulding of chlorinated plastics can be sought as an alternative towards prevention of furan emissions. The other solution includes utilization of RDF gasification process which involves the treatment at high temperatures thereby reducing the chances of harmful emissions. Another method of dioxin suppression in flue gas is by removal of Hydrogen Chloride using Foaming Water Glass (which is a type of Sodium Silicate Hydrate [$lNA_2\_mSiO_2\_nH_2O$]). A centralized RDF facility for treating 400 MT of waste is under consideration for Pune city. However the application of RDF shall need to be assessed for its techno-economic feasibility keeping in mind the remedial methodologies to avoid further environmental hazards.

There are several methods that can be used to recycle and reuse Plastic wastes:

- Tenders could be floated for the conversion of debris to private bodies who could work out all the possible ways to market their products.
- The community sorting centers at each of the wards will be used to sort the plastic waste. The sorted plastic material can then be used for recycling as well as refuse derived fuel (RDF) uses.
- The overall economics in terms of recycling and RDF needs to be assessed involving the view points from PMC and the interested stakeholders.

11. **Implementation:** PMC can use the services of a consultant to initiate demonstration projects on Plastic Waste recycling which will be taken up by research organizations and corporate companies. The Science and Technology Park of UoP can be the consultant contracted by PMC. Based on the results of the Pilot projects, PMC may involve a private party to set up a Plastic Waste recycling facility in Pune. The proposed community sorting centres would be useful to collect various types of plastic waste. These pilot projects would be able to demonstrate recycling and technology. However, Environmental Assessment would have to be carried out.



12. **Other similar experiences:**

Oil generation from plastics waste using pyrolysis: case study

Developing countries are generating more and more plastic waste, particularly polyvinyl chloride (PVC), for which no treatment method is satisfactory other than disposal in landfills. More recently (UNEP-IETC, 1997) Toshiba's Environmental System Engineering and Construction Department has established a method of

converting plastic waste to oil. The system allows for continuous treatment of plastic waste, without separation of PVC. No harmful by-products are generated.

The process involved crushing or powdering the thermo-plastic waste, which is then introduced into the dechlorination apparatus and heated to 300°C with agitation. Hydrochloric acid generated is absorbed into water and collected. The mixed dechlorinated thermo-plastic material is then pyrolysed at 400-450°C using thermal degradation to break down the long molecular chains of the polymers. The product variety depends on the material input. The oil obtained is distilled to kerosene, diesel oil, and heavy oil based on flash point, viscosity, distillation profile and specific gravity as for commercial fuel oil. The yield ranges between 50-80% when the PVC content is 10-50%. The heating value of the oil produced is 11kcal/g which is equivalent to that of commercial fuel oil.

In all pyrolysis units there is a net energy gain. The products of pyrolysis could be easily stored unlike the products of incineration. Air pollution from pyrolysis is less while proper destruction of waste is achieved[1].

Students Crack a Hard Nut, Turn Plastic into Fuel[2]: A team of students at Velammal Engineering College has discovered a method of producing quality petrol from one of the most problematic pollutants of modern times - non-biodegradable plastic. Through several experiments with a `secret catalyst' that prevented plastic from melting into a mass when heated, and instead generated petroleum products - petrol, diesel and kerosene. Waste polythene and polypropylene - consisting mainly of discarded bags and biomedical waste - are subjected to `catalytic cracking' or breaking down the carbon chain. The correct ratio of the catalyst and the plastic materials are taken in the reaction flask to get greater yield. When heated at 400 degrees Celsius, the plastic yields a distillate crude. Fractional re-distillation yields a type of petrol at between 100 to 120 degrees C and kerosene at between 150 to 180 degree C. Finally, the process leaves diesel as residue. In about two hours, the students were able to generate around 2 litres of crude from 2.5 kg of plastic waste and through distillation one litre of petrol and half a litre each of kerosene and diesel. The cost works out to roughly Rs. 22 for petrol and Rs. 26 each for diesel and kerosene. By heating plastic in the absence of oxygen, toxic dioxin emissions are also avoided, making the fuel eco-friendly. Even the left over paraffin mass (approximately 500 gm) can be made into candles. The fuel, developed by the team, has been certified by the Indian Oil Corporation's Regional Laboratory at Korukkupet.

Plastic to Petrol: A Case-Study in Nagpur[3]: Nagpur, G.H. Raison College of Engineering has signed an MOU with the Indian Oil Corporation (IOC) for setting up a pilot plant for manufacturing and marketing petroleum products generated from waste plastics. The method includes shredding of plastics and burning without presence of oxygen with cola and special component to obtain coke, fuel range of liquids and LPG range gases. Approximately 1 kg of plastic with 100 gm of coal results in 1 litre of fuel. The process can be carried out in smaller, low investment plants and does not lead to emission problems. This process has received a patent from World Intellectual Property Organization (WIPO).

Plastic Waste Aphalting in Bangalore[4]: Following the success in increasing the durability of several stretches of roads that have been asphalted with plastic waste, the Bangalore Mahanagara Palike (BMP) has decided to use polyblend for upgrading over 40 per cent of roads in the city to be taken up under World Bank assistance this year.

Over 140 km along 41 roads will be upgraded at a cost of Rs. 140 crores under the Karnataka Municipal Reforms Project this year. The civic body has used plastic waste to asphalt over 300 km of road so far.

[1] Agamuthu, P. (2001), Solid Waste: Principles and Management: with Malaysian case studies, printed at University of Malaya Press, Kuala Lumpur

[2] As referred to http://www.indiafirstfoundation.org/archives/news/05/march/s&t_m.htm, ***Courtesy: The Hindu, March 19, 2005***

[3] As refrred from: Environmetnal Concerns: Converting Plastic Waste to Petrol, T. Jahnavi

4 As referred to http://www.hindu.com/2005/09/21/stories/2005092117280300.htm

The BMP, which is seriously planning recycling of dry waste in its new garbage contracts likely to implemented from next year, has initiated talks with the city-based KK Plastic Waste Management Private Limited for supply of the company's patented "KK Polyblend."

Plastic waste is melted and mixed with bitumen in a particular ratio, roads laid with plastic waste mix are found to be three times better than the conventional ones. This technology will result in lesser road repairs. Rainwater will not seep through because of the plastic in the tar. And as each km of road with an average width requires over two tonnes of polyblend, using plastic will help reduce non- biodegradable waste.

13. **Barriers:** Analysis for economic and technical feasibility of recycling plastics on a large-scale. Co-operation from various stake-holders for ensuring the proper collection and segregation of waste.

14. **Benefits:**
    - Management of Plastic Waste would become more convenient and easy to handle
    - Nuisance due to Plastic Waste would be avoided
    - Plastic Wastes would not get mixed with MSW and avoid the use of landfill space
    - Cost Benefits of recycling Plastic Waste
    - Preventing the pollution possibility due to improper handling of plastic wastes
    - Generation of refuse-derived fuel.

15. **Links to other ISWM Pune Schemes:**
    - Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
    - Establishment of Waste Exchange Centre
    - Establishment of Environmental Awareness Centre
    - Design and Launch of a Comprehensive Awareness Campaign on ISWM

5. ESTABLISH ELECTRONIC WASTE (E-WASTE) RECYCLING FACILITY

1. **Description:** E-waste is amongst the fastest growing waste streams around the world today, fuelled by the exponential growth in the use of electronic equipments, especially Personal Computers (PCs) and their rapid rate of obsolescence.

   Pune city has emerged as an IT hub of the country. A large number of IT companies, commercial and educational institutions use IT and communications equipments in Pune. As per country level Waste Electrical and Electronic Equipment (WEEE) assessment study, Mumbai and Pune fall under the top ten cities that are generating maximum quantities.

   The MPCB has recently conducted inventory studies to quantify E-waste, under the project "Rapid Assessment of E-waste in the Mumbai-Pune Region"[1] sponsored by UNEP. This is the first reported data on e-waste for Pune. The concern for e-waste is increasing due to the hazardous contents such as Lead, Cadmium, Mercury, Hexavalent Chrome, Plastic including PVC, Brominated Flame Retardants, Barium, Beryllium, Toners, Phosphor and Additives etc.[2] E-waste mainly comprises of old, end-of-life electronic appliances such as computers, laptops, TVs, DVD players, mobile phones, mp3 players etc. Three categories of E-waste account for almost 90% of the generation in various Indian cities including Pune[3]:

   - Large household appliances: 42.1%
   - Information and Communications Technology equipment: 33.9%
   - Consumer electronics: 13.7%

   The total WEEE waste generation in Maharashtra is 20270.6 tons, out of this Pune is 2584.21 tons[4].

2. **Purpose:** In India E-waste recycling is done mainly in the unorganized informal sector, where operations are rudimentary and no environmental and safety norms are not followed. Disposal of E-waste without proper treatment poses health hazards, affecting human beings, soil and ecosystem. Therefore there is an urgent need for an environment-friendly and simple technology for recycling of these wastes. There is also a need to create awareness amongst entrepreneurs and workers in E-waste recycling units.

   In Pune, the E-waste recycling market area is very limited and also very small amount of dismantling activity occurs. Analyses also show that E-waste of PCs, mobile phones from Pune is sent to Mumbai market for dismantling from where it is supplied to other parts of India. Some part of the e-waste is again sent to Delhi for further processing and dumping to the land fill site. This increases the need to transport the waste[5]. No mechanism exists in to monitor and track the E-waste inventory, collection, transportation and disposal.

   As no scientifically designed facility exists for its safe dismantling and disposal, dismantling and recycling facilities should be introduced in Pune for better E-waste management.

3. **Target**: To introduce recycling facility for recycling electronic waste so as to deal with the problem of increasing electronic waste and hazards posed by it on human health as well as environment.

4. **Type:** Project

5. **Lead Agency:** Maharashtra Pollution Control Board

6. **Support Agency:** Pune Municipal Corporation, PCMC, PCB should combine to form this E-Waste recycling facility. Other stakeholder such as Software Technology Parks of India, Software associations in Pune as Software Exporters" Association of Pune (SEAP), India, Maratha Chamber of Commerce, Industries and Agriculture (MCCIA), NGO's, generators and housing societies can contribute the wastes to such a facility.

1 http://www.unep.fr/pc/pc/waste/e_waste_in_India.htm

2 Exporting Harm report prepared by Basel Action Network with Toxic Link.

3 http://www.e-waste.in/weee_basics/weee_statistics/

4 As referred to http://mpcb.mah.nic.in/ewaste/ewaste.php

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7. **Location (suggested):** The sales of computers and other electronic items are mainly scattered all around Pune. However, some of the important commercial areas of Pune are given below[6]:
   - Budhwar Pheeth (Electrical Market)
   - Naryan Pheeth
   - Shaniwar Pheeth
   - Ravivaar Pheeth
   - Shivaji Nagar
   - M.G. Road
   - Deccan Gymkhana
   - Nigdi

Major hubs of E-waste (collection & transportation) in Pune, Pimpri Chinchwad Region are as follows:

Major Location	Business Area	Type of E-Business
Pune, Pimpri Chinchwad Region	Chikhali	Collection and transportation of TV, PC, Refrigerator, PCB/PWB and wires
	Kuddalwadi	Collection and transportation of TV, PC and Refrigerator
	Pawarwasti	Collection and transportation of PWB/PCB
	Jadhavwadi	Collection and transportation of PC and refrigerator
	Moshi	Physical extraction of copper wire from cables, collection and transportation

Chikali in Pimpri Chinchwad area acts as a major hub for collection, transportation and trading of E-waste in Pune and Pimpri Chinchwad region. Kuddalwadi, Pawarwasti, Jadhavwadi and Moshi acts as sub hub for e-waste. E-waste from these sub-hubs is collected at Chikhali and transported to Mumbai for dismantling. Since most E-waste is currently being transported to Chikhali, PMC can form an MOU with surrounding municipal authorities such as PCMC and PCB to treat the E-waste. Therefore, a recycling facility could be set up at Chikali in Pimpri Chinchwad. Such recycling facilities can be introduced near the transfer stations or landfill area.

8. **Budget (Estimated):**
   - For Consultant – Rs. 1 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Site Assessment	4 months							
Preliminary Design			6 months					
Bidding of projects					6 months			

10. **Description:** Electronic waste recycling is a highly technical task. MPCB will need a lot of initial investment and infrastructure to set up a recycling plant for electronic waste recycling. This task could take some years to come to reality. But as an immediate action there could be an intermediate place where the collected Electronic waste will come and get sorted. This can be proposed at the location of the community sorting centre. Some preliminary treatment could also be done there. But importantly detailed sorting of the electronic waste should

6 IBID

happen at these intermediate sorting centre for electronic waste. The sorted waste should then be sent to the specialized recycling plant for each material.

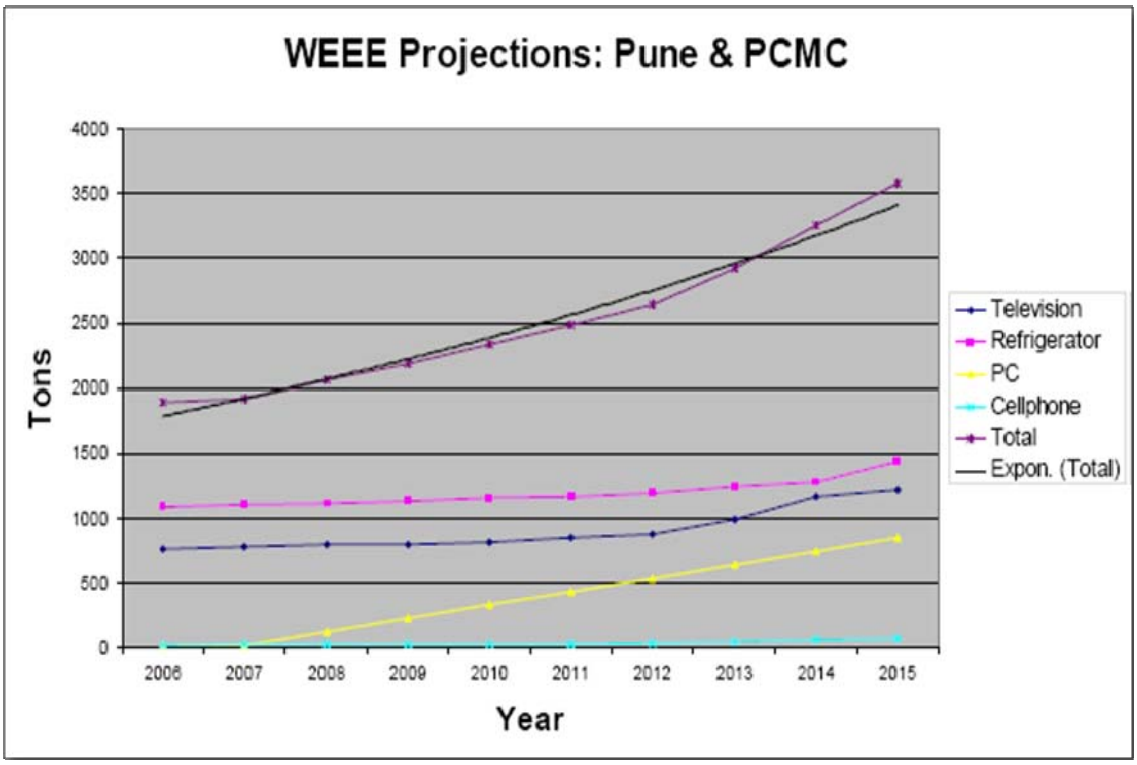
For carrying out the above the proper characterization and understanding should be there for Electronic Wastes. This information can be gathered having consultative sessions between all the stakeholders and PMC. The Environmental Awareness Centre and the Community Sorting Centres can play an important role in spreading awareness of E-Wastes management and issues and the later can be helpful in sorting E-Wastes.

The total waste generation in Pune according to their type is as follows:

Items	Waste in tons per year
Cell Phones	24.262
Personal Computer	17.057
Refrigerator	1102.165
Television	776.497
Total	**23218.581**

The Waste Electrical and Electronic Equipment Directive (WEEE Directive)[7] is the European Community directive on waste electrical and electronic equipment. This directive sets collection, recycling and recovery targets for all types of electrical goods. The directive imposes the responsibility for the disposal of waste electrical and electronic equipment (WEEE) on the manufacturers of such equipment. The **Restriction of Hazardous Substances Directive** (**RoHS** is simply a directive which restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. It is closely linked with the Waste Electrical and Electronic Equipment Directive (WEEE).

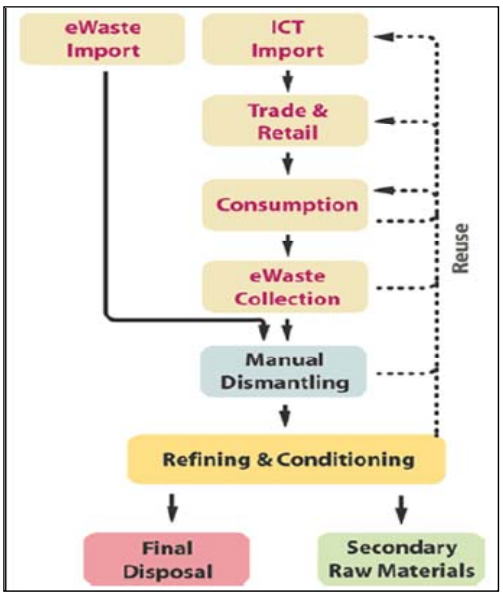
WEEE/ E-Waste projections till 2015 for Pune, Pimpri Chinchward Region and are shown in the figure below:

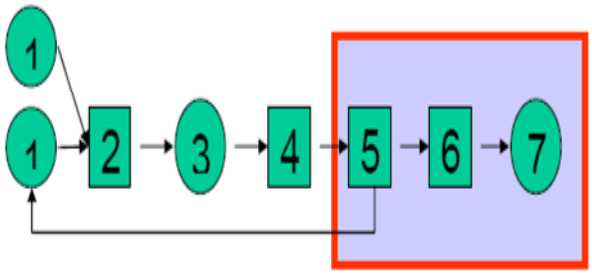


As per the MPCB report on E-Wastes, the Conventional E-waste Value chain for e-waste as established is shown in the Figure below followed by the conceptual version of this chain in the next figure[8]:

7 As referred to http://en.wikipedia.org/wiki/E-waste

8 As referred to http://mpcb.mah.nic.in/ewaste/ewaste.php



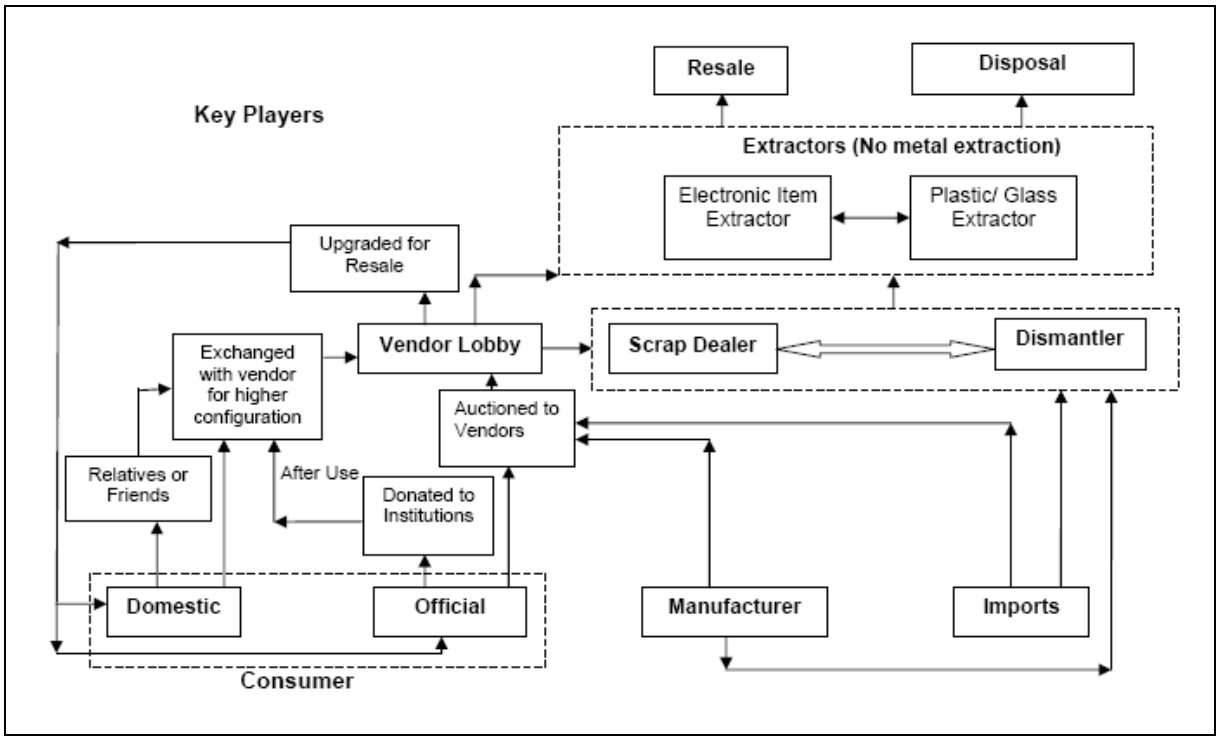


Conventional E-Waste Value Chain **Conceptual E-Waste Value Chain**

In the second figure, each number denotes a step in e-waste generation chain as:

1. EEE generation: import & manufacturing of EEE
2. EEE sales
3. EEE consumption (stock)
4. WEEE generation
5. Re-use / down cycle
6. Re-cycle
7. Secondary raw material / disposal

The conventional E-waste trade value chain has been modified and shown in the figure below. It is a five-step value chain covering the following aspects - Generation and Stockpiling, Collection, Handling & Brokering, Processing, Production

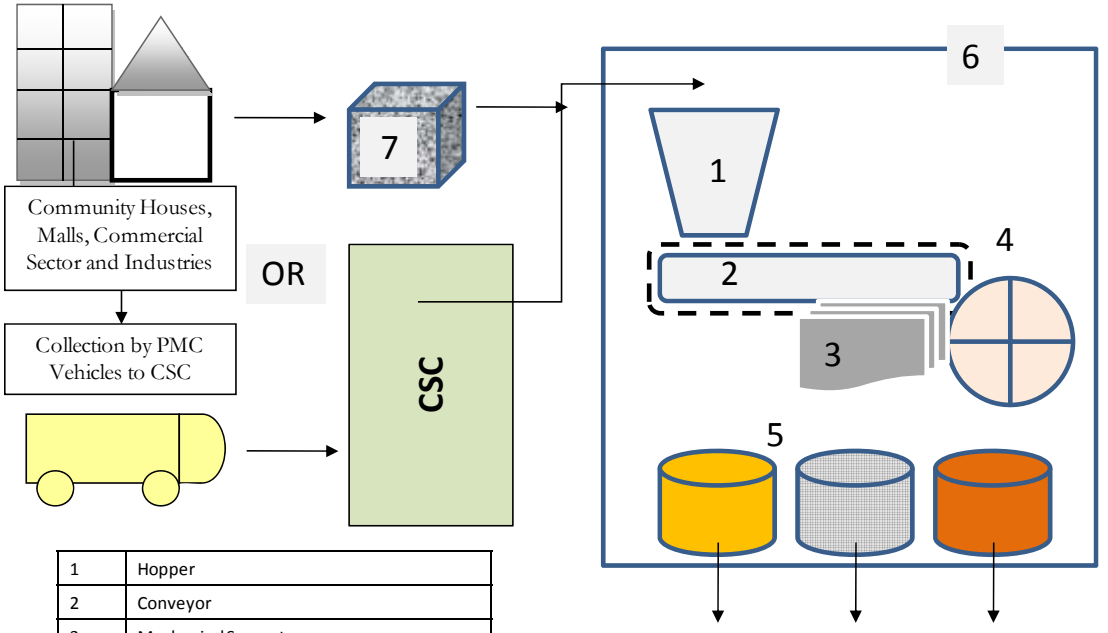


Realizing the gravity of the e-waste management problem, several initiatives have been taken by other cities such as Bangalore and Delhi which are also e-waste generation hubs owing to the large-scale proliferation of IT and electronic companies.

Role of MPCB:

- MPCB to initiate and formulate an institutional mechanism for tracking and monitoring E-waste inventory, generation, collection and transportation in association with other stakeholders like Pune Municipal Corporation, industry associations.
- MPCB should initiate a multi stakeholder study tour in countries where collection, transportation, dismantling and disposal of E-waste is working efficiently. This tour should study the best practices adopted in these countries with respect to each of the element in E-waste management.
- Informal/ unorganized sector should be made a part of collection and transportation system to facilitate their integration into the system.
- MPCB should catalyze development of E-waste dismantling facility by bringing it under infrastructure development project and subsequently taken by state infrastructure development agency or MPCB. Further, it could also be promoted under public private partnership.
- Capacity building of all the stakeholders including MPCB officials, local municipalities, existing dismantlers, customs and port authorities and NGOs.
- Appoint a officer responsible for implementation
- Officer in charge should approve other sites other than the designated disposal site
- Inspection of premises where any E- waste generation activity is being undertaken for review of compliance with the approved relevant waste management plan.
- Weekly reports of the various E- waste generation activities at ward level should be submitted in each ward.

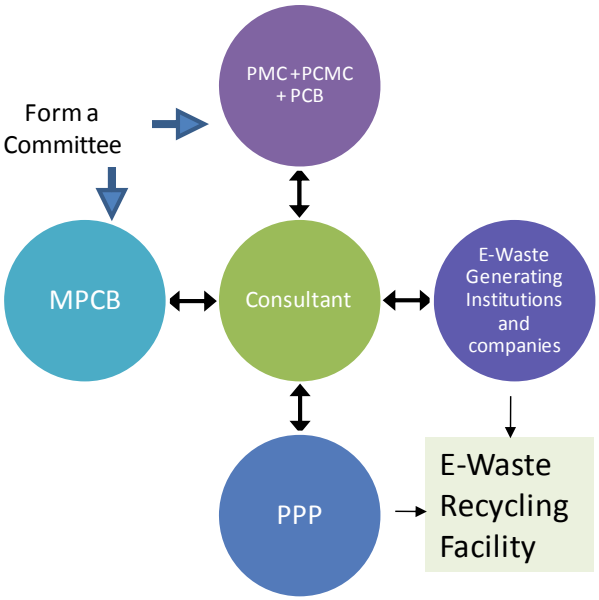
Typical Electronic Waste Recycling Plant: A typical electronic waste recycling plant as found in some industrialized countries combines the best of dismantling for component recovery with increased capacity to process large amounts of electronic waste in a cost effective-manner. Material is fed into a hopper, which travels up a conveyor and is dropped into the mechanical separator, which is followed by a number of screening and granulating machines. The entire recycling machinery is enclosed and employs a dust collection system[9].

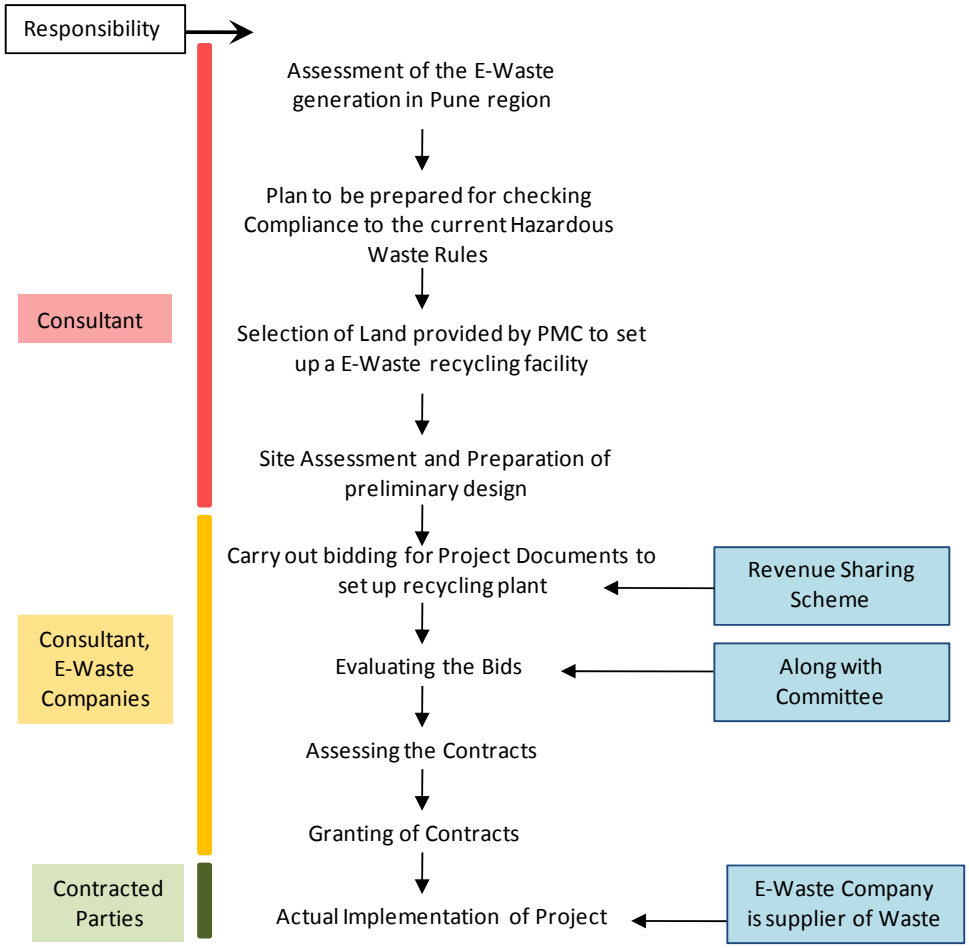


1	Hopper
2	Conveyor
3	Mechanical Separator
4	Screening and Granulating Machines
5	Various granulated components of E-Waste
6	Recycling unit with dust control system
7	E-Waste Collection Depot
CSC	Community Sorting Centre

9 As referred to http://en.wikipedia.org/wiki/E-waste

11. **Implementation:** In order to set up a facility for recycling E-Wastes, PMC, PCMC and PCB will have to combine and provide for the land for such a facility. The services of a consultant can be used to collaborate with all the stakeholders and find a Public Private Partnerships (PPP) to provide technology for recycling and operate such a recycling facility. The Consultant will have to collaborate with the E-Waste generating institutions and companies and suppliers which will be the organizations making the contract with private sector guarantying waste supply.



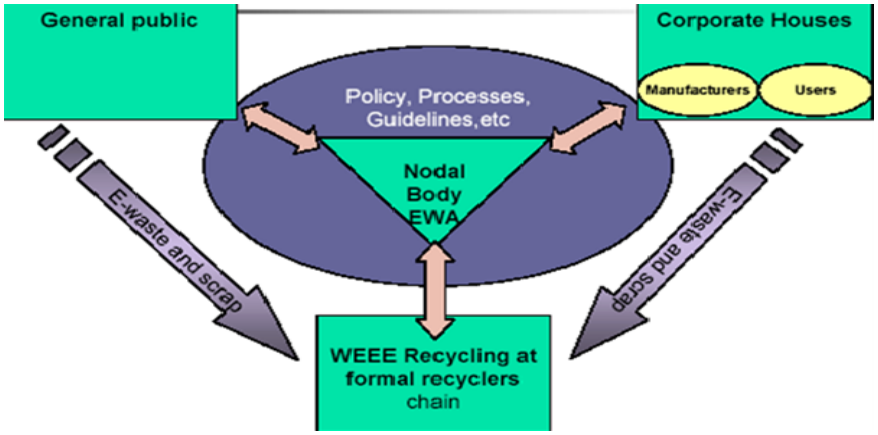


12. **Other similar experiences:** E-parisara, India's first scientific e-waste recycling unit is located in Bangalore and is one of the only two authorized recycling units in the country[10]. The facility was started in August 2005 and it gests abouty 250 tonnes of e-waste per year. That is just over three percent of the total e-waste that the city produces and the facility can process nearly two tonnes of e-waste per day.
According to the Saahas, an NGO in Bangalore working on e-waste management, everyone agrees this is urgent and important but very few are ready to step up. Saahas, along with E-parisara has been working with the informal recycling sector to educate them on scientific methods. Since a majority of the e-waste ends up there, there is a need to equip them with knowledge to handle this better.

Few companies however have taken the cue and taken the initiative to address the issue of e-waste. Wipro was one of the first Indian companies to set up a take-back system for its products. Dell and HP too have similar initiatives. WeP Peripherals, one of the largest manufacturers of printers and printer consumables in the country, is another company that has joined the e-waste task force. As per an executive at WeP Peripherals, "We as a company have decided to be more responsible with our products. We have put up bins across the city and ask people to drop e-waste in it. We then collect it all and either reuse it here itself or send to the authorised recycler. The response has been phenomenal."

IT major Wipro will become the first domestic company to introduce a range of restriction of hazardous substances-compliant laptops and desktops. The range of desktops and laptops that Wipro's personal computing division will be launching adhere to the European Union's RoHS rules that prohibit the use of substances such as lead, mercury, cadmium and hexavalent chromium. A preliminary investigation by the WEEE Taskforce estimates that total WEEE generation in India is approximately 1, 46, 000 tonnes a year[11].

E-Waste Agency Bangalore[12]: EWA was created and is active in Bangalore as a model institution for the management of e-waste for the entire country since 2005. EWA was established on 12 May 2005 by a group of IT industries, HAWA-GTZ-KSPCB, CPCB, CSD and NGOs. It is encouraged by MoEF, CPCB, SPCBs.



13. **Barriers:** Extra cost which consumers might have to pay for the collection and the other infrastructure could be an important barrier. The lack of awareness among the denizens and the lack of co-operation from electronic manufacturing industries and companies could be an issue.

14. **Benefits:**
    - The electronic waste will get collected separately and will not get mixed with municipal solid waste. The environmental and health problems which could arise due to mixing of waste could be avoided.
    - The amount of waste going to landfill will be reduced and thereby also avoiding the impacts on health and safety and toxic components entering the environment can be reduced.

10 As referred to http://news.indiainfo.com/2005/04/10/1004e-waste.html

11 As referred to Rediffnews.com - Wipro goes green with PCs, laptops, Bibhu Ranjan Mishra in Bangalore, June 14, 2007 02:18 IST

12 As referred to http://www.e-wasteproject.org/docs/blr4jurgen.pdf

- If the training is given to informal sector for sorting and intermediate recycling the damage due to illegal recycling could be avoided.

15. <u>Links to other ISWM Pune Schemes:</u>

- Establishment of Community Sorting Centres
- Design and Launch of a Comprehensive Awareness Campaign on ISWM
- Introducing Industry-University Partnerships
- Establishment of a Waste Exchange Centre
- Improving Health and Safety of PMC Workers, Rag pickers and citizens in Proximity of the landfill

6. ESTABLISH A COMPACT FLUORESCENT LIGHT (CFL) RECYCLING PROGRAMME AND COMMON FACILITY

1. **Introduction:** Pune is being looked at as a model city for implementing various Environmental initiatives. One such initiative is the development of an eco-city model within the prevailing city. The eco-city would promote the utilization of energy efficient methodologies in order to prove as a sustainable model. As a part of this initiative energy efficient lighting systems will be promoted. Compact Fluorescent Light Bulb is a type of fluorescent lamp designed to replace an incandescent lamp because CFLs are more energy efficient than standard incandescent light bulbs. Further, Maharashtra Energy Development Authority (MEDA)[1] proposes to reduce the domestic and commercial power consumption through the introduction of CFL. However, CFLs contain a small amount of mercury, usually about 4 milligrams per bulb, although a range of concentrations exists. Mercury is a neurotoxin that can affect the function of nerves in the brain and can disrupt brain development in fetuses and young children.

   The safe recycling and handling of the CFL bulbs is the major hurdle for large-scale promotion of this energy efficient practice. The energy savings due to adoption of CFL can further be utilized for accruing Carbon Credit through Clean Development Mechanism. Hence a successful application of this facility can lead to long term economic benefits.

2. **Purpose:** CFL's are currently disposed off along with the other waste and end up landing in the landfills. Mercury in landfills is emitted to the soil by landfill leachate and to the air in the form of methyl mercury gas. A CFL recycling program would decrease the number of bulbs dumped in landfills thereby reducing the volume of mercury emitted to the soil and atmosphere - directly improving the environment for human health and ecosystem protection in the Pune communities.

3. **Target**: To establish a CFL Recycling programme and common facility for the same.

4. **Type:** Programme

5. **Lead Agency:** Pune Municipal Corporation (PMC) and Maharashtra Pollution Control Board Regional Office (Pune)

6. **Support Agency:** CFL Manufacturers, Suppliers and Vendors of electrical materials, MCCIA, ISWM Cell and NGO's, generators and citizens of Pune. Certain Industries especially CFL Manufactures can take up the management of CFL recycling as part of their CSR e.g. Phillips.

7. **Location (suggested):** A CFL Facility may be set up near the landfill area.

8. **Budget (Estimated):**
   - For consultant – Rs. 1 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Site Assessment	4 months							

[1] www.iea.org

Preliminary Design			6 months						
Bidding of projects					6 months				

10. **Description:** CFLs contain a small amount of mercury, usually about 4 milligrams per bulb, although a range of concentrations exists. Mercury is a neurotoxin that can affect the function of nerves in the brain and can disrupt brain development in fetuses and young children. Mercury is also prone to biomagnifications– increasing its concentration in animal tissues as it moves up the food chain. With respect to the growing application of CFL as an energy efficient device, there exists an immediate need to develop safe recycling project for handling these wastes. The rising concerns over mercury pollution caused due to exposure to broken CFL have now forced the Government to focus its attention on their safe disposal. The Bureau of Energy Efficiency along with Ministry of Environment and Forests (MoEF)[2] has planned to set up 50 facilities across the nation where fused CFL can be disposed. In line with this national programme and in order to better equip the city a safe recycling facility has been proposed. The safe recycling and handling of the CFL bulbs is the major hurdle for large-scale promotion of this energy efficient practice. The energy savings due to adoption of CFL can further be utilized for accruing Carbon Credit through Clean Development Mechanism. Hence a successful application of this facility can lead to long term economic benefits.

A meeting should be convened between the key organizations that will be involved in this programme to discuss the work put forth in this proposal. A list of potential participants includes: PMC, ISWM cell, Waste Exchange Centre, Environmental awareness Centre, companies that manufacture CFLs to enlist their endorsement and support the programme. Manufacturers have a critical role to play in the recycling of their product and can also be a valuable resource of information. Estimates of the total cost of CFL processing based on the estimated quantity of bulbs should be obtained. The manufacturers should discuss about the expected growth in the industry and how such a programme would bring and find ways that would make CFL recycling more profitable to expand its net benefit to society. The business development aspect can be used to bring development-related participants such as the city and regional development commissions to the program. The meeting attendees will act as a steering committee for the project and will be reported monthly.

Assess the Flow of CFLs: Research the flow of CFLs in Pune and surrounding areas. Start by obtaining data for CFL sales in the region and for the number of CFLs that have been or can be diverted from landfills by the various recycling opportunities. Based on the data obtained, the number of CFLs in geographic region, the number that are being sent to landfill currently and projection of the future trends of CFL sales and disposal in the region may be calculated. This will enable to forecast the quantity of CFLs that such a programme can expect to handle.

Evaluating and building capacity for CFL recycling: In India, there are no fluorescent lamp or mercury recycling facilities that are available.

Building capacity for recycling fluorescent lamps:

- **Ownership of such facility:** Support from the manufacturers may be seeked to establish such plants. Further, other national or international private players may be convened to come up with such facility.
- **Financial sustainability of the plant:** Fluorescent lamp and mercury recycling facilities are prevalent in most of the developing countries and are self sustainable.

Prepare Case for Expanded Sponsor, Partner and Stakeholder Engagement: Other sponsors, partners and stakeholders may be engaged by researching and developing a strong case for supporting and joining the program. Sponsors would include an expanded group of organizations that could offer financial and other support to the program; partners would include a range of public and private players important to the operation

[2] www.punescoop.com

of a program; and stakeholders would include technical and supporting organizations with an interest in the success of the program. A strong outreach will continue to be made to manufacturers of CFLs to enlist their support in the recycling program. Partners would include retailers that can act as collection sites for CFLs. Information should be gathered on the increased revenue brought to stores that participate in collection programs, the geographic distribution of stores in the region that could serve as collection sites and the legal and regulatory issues that apply to stores that act as universal waste collection sites.

Execution of the recycling program: The execution of the program may be done in phases. In the first phase, engage potential team members to join the CFL Stewardship Team. There are at least three categories of team members to include: Sponsors, Partners and Stakeholders. As part of the work conducted during the discussions with the potential stakeholders, there will be an initial sense of the most likely and qualified team members. The pilot project should be well scrutinized and observed during its run in the first phase (which may extend for a period of say 6 months) by the CFL Stewardship Team. The loopholes and deficiencies noticed during this period should be reviewed and plugged in during the second phase execution of the project.

Handling and transportation of the spent fluorescent bulbs: There are two ways in which the lamps may be transported to the recycling facility:

- In the non-crushed form: the lamps should be transported carefully and any breakage should be strictly avoided.
- In the crushed form: In this form they should be treated as hazardous waste and should be taken to the facility with proper documentation and the required precautions for handling such a waste should be abided with. However this is not the preferred mode of handling and should be avoided.

Responsibilities of the recycling unit towards staff:

- To provide all employees with the necessary safety equipment to perform their duties in a safe manner. This includes, but is not limited to, safety glasses, half-mask respirators, steel-toed boots, gloves, and coveralls or other covering.
- Train employees on the safe handling of mercury, PCB bearing materials, and any other potentially hazardous materials.
- Train employees on the proper labeling, manifesting, and bill of lading paperwork required for transporting and storing of mercury and PCB bearing materials.
- Train the Environmental Compliance Manager in the proper inspection techniques required for weekly hazardous waste inspections.

Employee Responsibilities at the recycling unit:

- Report to the supervisor immediately if an injury occurs on-the-job regardless of the degree of severity of the injury.
- Always apply the principles of Accident Prevention in daily work and wear proper safety devices and protective equipment.
- Properly care for all personal protective equipment and other company equipment.
- No torn or loose clothing shall be worn around machinery.
- Study and observe all safe practices governing the work environment. Offer safety suggestions, wherein such suggestions may contribute to a safer work environment.
- Follow all guidelines and procedures for performing hazardous waste management, in compliance with the central and State hazardous Waste Regulations, pertaining to the daily handling of mercury and PCB bearing waste materials.

Material Handling:

Mercury: The principal hazard that will have to be managed at any such facility will be an ongoing one involving broken lamps. When a fluorescent or HID lamp is broken, the mercury contained in the lamp becomes exposed to the ambient environment and has the opportunity to evaporate. The quantity of vapor increases in direct proportion to the number of lamps broken. As a practical matter, lamps are likely to be

received broken or broken in the course of handling at the facility as a result of improper packaging or rough handling. The following identification and breakage precautions are to be used for all incoming shipments:

- Incoming containers are inspected for breakage. Those containing broken bulbs are to be opened only by employees wearing appropriate respiratory protection.
- Crates and other large containers are inspected for damage prior to unloading.
- Pallets of lamps are inspected and restacked as required to prevent collapse.
- Any lamps broken during handling or unloading are immediately swept up and placed in a drum or collected using the vacuum handling system.

Specific safeguards to protect employees handling broken bulbs are as follows:

- Employees must be required to wear protective closed toed work boots, gloves, and safety glasses at all times. In addition, coveralls or lab coats are provided for employee wear. None of these items should be removed from the facility.
- When working with broken lamps, employees must be required to wear appropriate protective clothing and half-face respirators.
- Employees should properly store the half-face respirators in a plastic, sealed container when not in use. The respirators must be cleaned daily using clean cotton swabs and rubbing alcohol before they are worn.
- Employees must not be allowed to eat, drink, or smoke in the processing area or warehouse.
- Employees must be required to wash hands when leaving the production floor for breaks and at the end of shift.

Specific procedures for containment of mercury vapors are as follows:

- The key procedure is to avoid breakage by careful handling.
- Identify and mark containers with broken bulbs for special handling.
- Keep facility doors closed at all times.
- Clean floor with trisodium phosphate solution regularly.
- Mark and seal all drums of collected phosphate powder.
- Monitor vacuum system exhaust levels to detect system malfunction.

Polychlorinated Bi-Phenyls (PCB): The principal hazard associated with PCB lighting ballasts is the potential of leakage of PCBs from the ballast during handling or storage. Ballasts should be handled carefully to prevent them from being crushed or broken. The following precautions should be used for all shipments of ballasts:

- Incoming containers and individual ballasts are inspected for leakage.
- Individual ballasts are inspected for a NO-PCB sticker. Those that say NO-PCBs are set aside for recycling in a non-PCB designated drum. Those that have no identifying labels are assumed to contain PCB's and are placed into a properly labeled PCB double-lined drum.
- Leaking ballasts without non-PCB labels should be placed in a plastic bag in the PCB drum. Any clothing, including gloves, which have been exposed to leakage from ballasts, should be placed in the drum for disposal as PCB contaminated waste.
- The drums of PCB ballasts are to be placed inside the hazardous waste containment berm.

Specific safeguards to protect employees handling PCB ballasts are as follows:

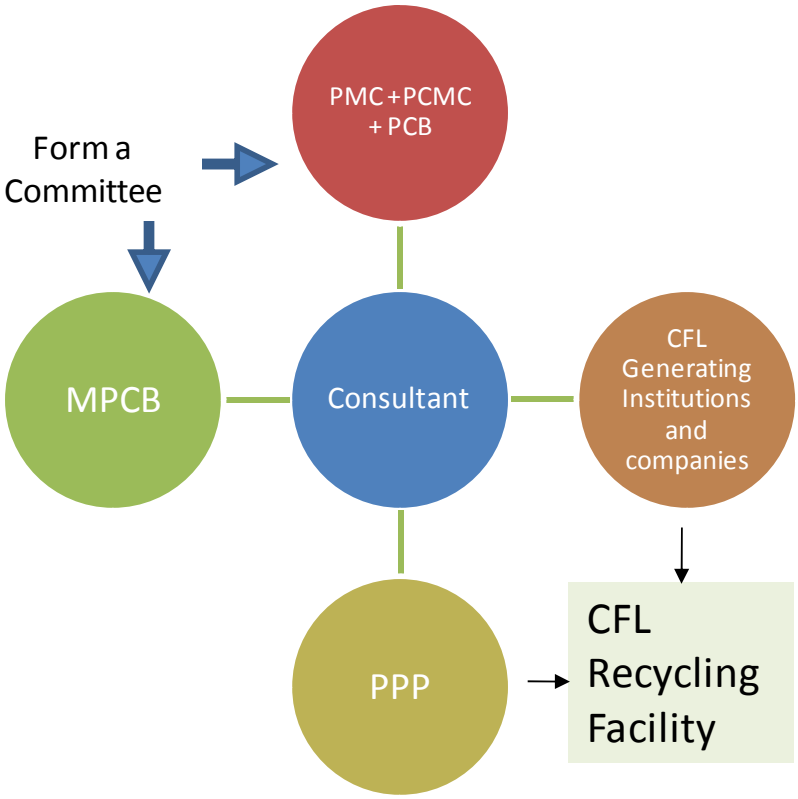
- Employees should be required to wear protective work boots, gloves, safety glasses, and coveralls at all times.
- A forklift may be used to move drums of PCB ballasts.
- Employees should not be allowed to eat or smoke in the handling or storage areas.
- Employees should be required to wash hands before breaks or at the end of shift.

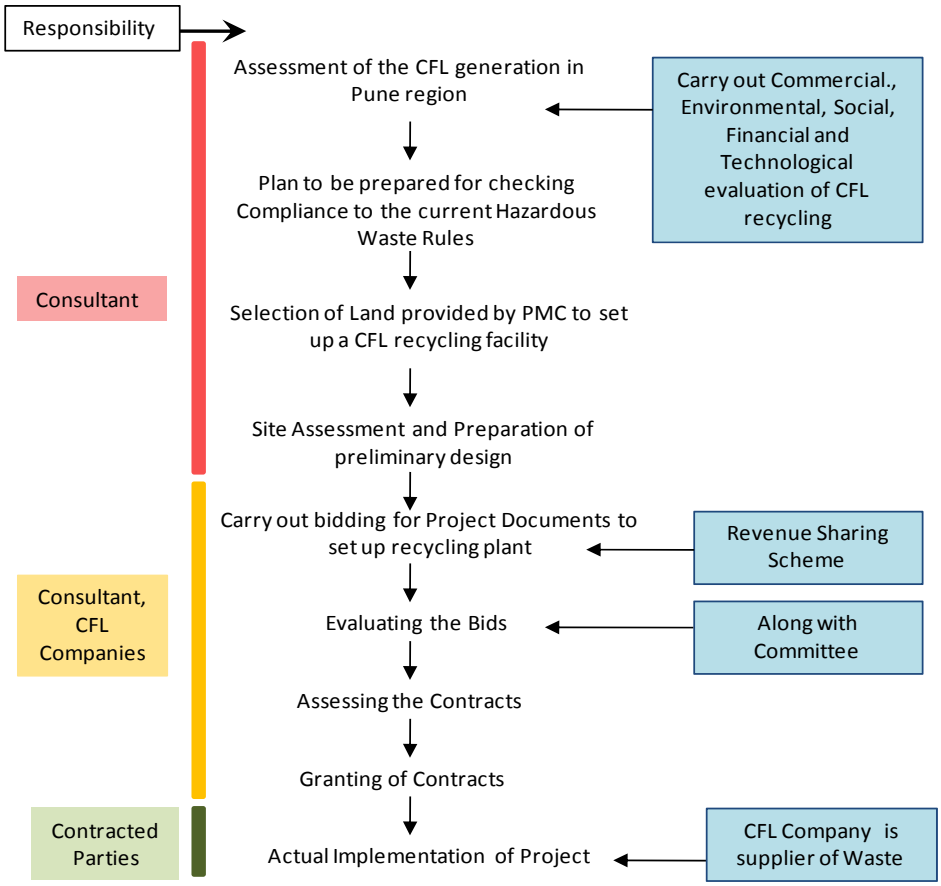
Weekly Hazardous Waste Inspections: Each week a hazardous waste inspection must be completed by the Environmental Compliance Manager of the recycling facility. The following areas must be inspected:

- Count of PCB ballasts and Mercury Phosphor Powder in hazardous waste berm
- Labeling of PCB ballasts and Mercury Phosphor Powder
- Satellite accumulation area for Mercury Phosphor Powder
- Storage of bulbs waiting for processing
- General housekeeping of the bulb processing area.

Once the inspection is complete all information is to be written in the Hazardous Waste Inspection Log. In addition it is the responsibility of the Compliance Manager to make any notes of corrections necessary and have the processing staff make any necessary changes to the storage or labeling of the waste. The Compliance Manager should also responsible for determining if any waste needs to be sent off site for further recycling or hazardous waste disposal. This determination is made once there are 10 drums of any one material or if the 90 day accumulation date is within 15 days of expiring.

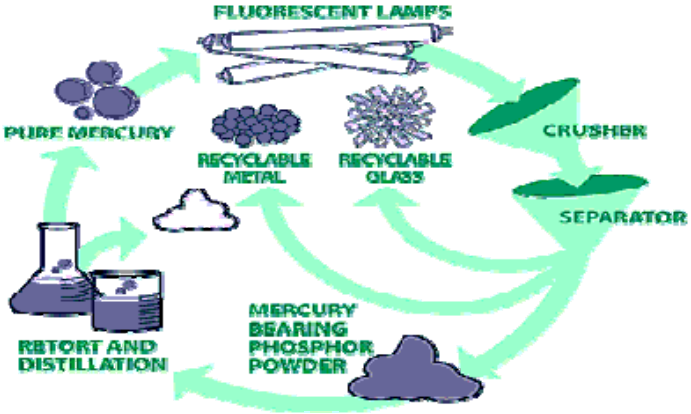
11. **Implementation:** In order to set up a facility for recycling CFL, PMC, PCMC and PCB will have to combine and provide for the land for such a facility. The services of a consultant can be used to collaborate with all the stakeholders and find a Public Private Partnerships (PPP) to provide technology for recycling and operate such a recycling facility. The Consultant will have to collaborate with the CFL generating institutions and companies and suppliers which will be the organizations making the contract with private sector guarantying waste supply. Such companies will benefit from such an activity by getting incentives in the form of tax redemption for example.





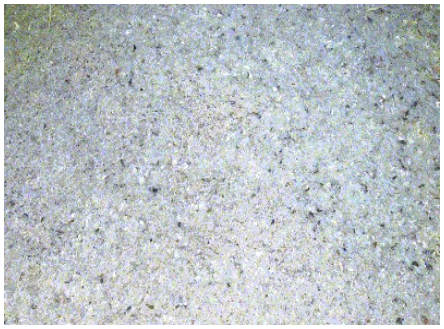
12. **Other similar experiences:** Other CFL recycling programs, most notably in Minnesota, America collect CFLs through a network of retail outlets. Minnesota's program is a partnership between a utility company, a mercury recycler, municipal hazardous waste collection facilities and several retail stores. This system allows fluorescent bulbs to be recycled easily and inexpensively at numerous locations throughout the state, and appears to be the broadest and most successful single program for recycling CFLs.

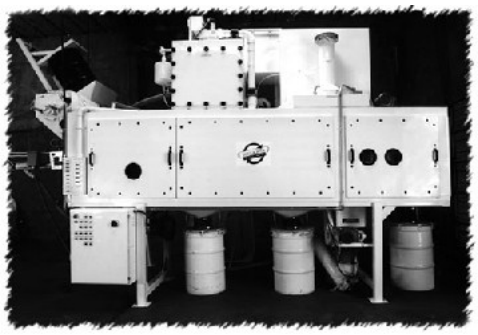
Case study of Ecolights Northwest[3]: Ecolights Northwest is a sister company of U.S. based recycling giants total reclaim Inc. It transports, receives and recycles spent lamps containing mercury vapour and phosphor powered. The processing facility is as follows:



3 As referred to www.ecolights.com

Ecolights Northwest's safe recycling system allows for responsible use, and reuse, of mercury now and into the future. The system utilizes hermetically sealed equipment, constructed from heavy-duty steel, and state-of-the-art environmental controls for safe operation; including fail-safe features that are automatically activated in case of an environmental breach. The equipment features a negative pressure air recirculation system that minimizes the overall amount of air required for processing. Discharged air is pre-filtered, HEPA-filtered, and carbon treated for particulate and mercury vapour. As a result, mercury vapour emissions are significantly below OSHA standards.





13. Benefits:

Immediate: A sound, technical and financial basis for considering a CFL recycling program.

- The creation of a results oriented group - the CFL Stewardship Team - who will be motivated to cooperate to create a strong CFL recycling program in the city.
- A clear process to evaluate alternatives, their costs and benefits, to effectively adopt a CFL recycling program model and secure the commitment of the team members.
- The timely design and launch of a pilot project to test the concept, generate momentum and support for the CFL Recycling Program.
- An experience base from the pilot project to intelligently consider the implementation of an economically and environmentally sound and publicly endorsed CFL Recycling Program.

Long Term:

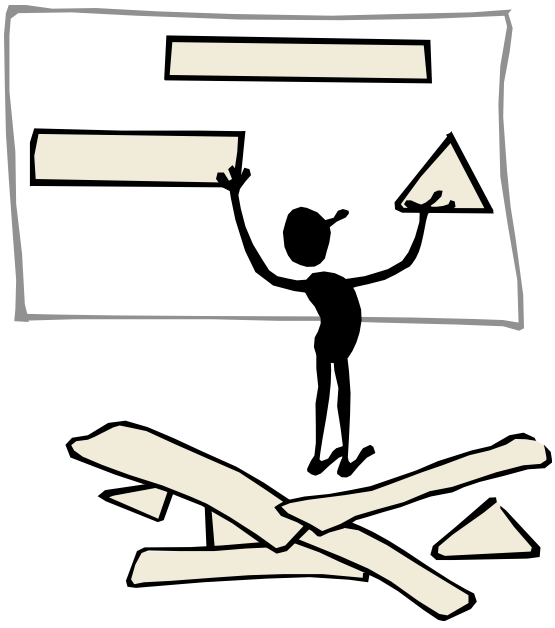
- An increase in economic activity from CFL recycling.
- The reduction of one of the sources of mercury to landfills in the city.
- Improvement in the environment for human health and ecosystem protection in city communities.

14. Links to other ISWM Pune Schemes:

- Securing Carbon Credits through CDM
- Establishment of Community Sorting Centers
- Improving the Health and Safety of PMC workers, Rag-pickers and Citizens in Proximity of Landfill

Theme 3
Infrastructure Development

1. Establishment of Environmental Awareness Centre
2. Private Partnerships in the Current Waste Collection System
3. Private Partnerships in Decentralised Treatment System
4. Establishment of a Compost collection and managing centre
5. Demonstration Projects for Hotel Waste Management
6. C&D Waste Management



1. ESTABLISHMENT OF ENVIRONMENTAL AWARENESS CENTRE (EAC)

1. **Introduction:** Raising awareness amongst the stakeholders is an important step in achieving successful implementation of the Strategic Action Plan. Although, several awareness initiatives have been undertaken for various waste streams, a concerted effort through the establishment of a dedicated centre is essential for promoting environmental awareness in the waste management sector. Such a centre has not been initiated in any of the Indian cities and hence such a model can prove to be an ideal model for other urban waste management authorities.

2. **Purpose:** The core purpose of this centre will be building up an environmentally aware and well-informed community-an essential first step in developing an improved environmental ethic within the community. It will provide services for the public with easy access to environmental information and it will be a venue for environmental education programmes for schools, community organizations, businesses and residents. There will be one such centre in the city. Environmental Awareness Centre will facilitate as a venue in the city of Pune which will be utilized by PMC, all other stakeholders like industries, NGO's, educational institutions and the citizens for spreading information and awareness about various waste management techniques and issues.

3. **Target**:

   - To form an Environmental Awareness Centre (EAC)
   - To strengthen existing and on-going PMC initiatives such as *Chakachak Mission*
   - To support new PMC awareness initiatives

4. **Type:** Project

5. **Lead Agency:** PMC shall be responsible for the formation of the EAC and monitoring its activities

6. **Support Agency:** ISWM Cell, NGOs, Schools and Residential welfare, society associations and industry associations like MCCIA

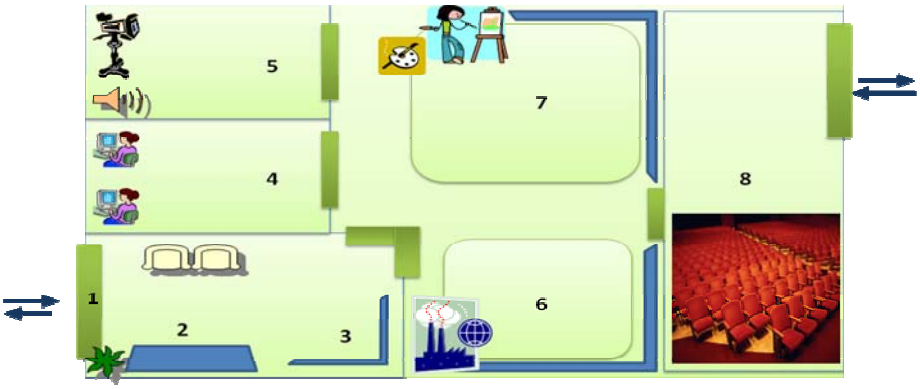
7. **Location (Suggested):** This project may be cited as a part of the River Front Development project. New alternative locations may be selected through consultative process.

8. **Budget (Estimated):** Rs. 9 Million

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Preparation of Plan and Identification of Site and Partners															
Detailed Project Plan, Preparation of Building Drawings, Institutional Structure, Identification of Staff and Services															
Construction and Finishing with installation of fixtures and equipment															
Procurement and Recruitment of Staff															

10. **Description:** The following layout can be proposed for setting up of the EAC:



1	**Main Entrance**	**5**	**Audio visual Room**
2	**Reception Area**	**6**	**Section for Industries**
3	**Information Hall**	**7**	**Waste to Art Section, Display and Exhibition Hall**
4	**Computer Room**	**8**	**Lecture and Discussion room**

The various features which have been incorporated in the EAC have been described as below:

Information hall: Leaflets and publications from the government, Environmental Committees, green groups and other related organizations will be available. Also, there will information regarding the activities of the EAC in the past month and also in the coming month. The MSW scoreboard for each ward will also be displayed on the monthly basis.

Computer Room: Computers for CD-ROMs on various environmental and conservation issues will be made available to the visitors. Provision of a television set for videos, sound-slide programmes, laser discs and VCDs will also be made.

Audio visual room: This room will have a sound-slide projector, a television set with video cassette recorder and laser disc player particularly suitable for organizing environmental talks and seminars.Also there'll be regular screening of good movies and documentaries based upon the environmental issues.

Separate section for the industries: There will be a separate section for the industries to facilitate show casing of environmentally sound technologies, products, initiatives to achieve waste minimization, cleaner production technologies etc. The industries will be charged for the space which they'll be provided. This will help to enhance the financial sustainability of the EAC's. The section will attract the industries as it will help them in marketing their product or brand and also will enhance their image in the eyes of the people.

Exhibition Hall: The colorful exhibition hall with exhibition panels, interactive games and models will be divided into various thematic display zones, such as:

Zone dedicated to the issues related to the solid waste: This zone will introduce how wastes are reduced, recycled and disposed of. There will be Exhibitions on recyclable materials, recycling process and final products will also be shown. There'll be provision for the people to play interactive games, which will encourage them to adopt Waste Reduction and apply the 3R concept.
There will be similar kind of zones related to other environmental aspects such as energy conservation, air pollution, water resources, noise pollution, etc. The EAC will showcase the various initiatives already undertaken by the PMC such as the "*Chakachak* Mission" which actively involved school children for spreading waste management related awareness.

Waste to art section: There will be a separate section devoted to waste crafts, which will exhibit craft and art pieces developed from the waste. The items displayed in this section will be contributed from various competitions at different levels (schools, colleges, housing communities, rag pickers etc.) which will be conducted by the EAC's with support from other organizations and stake holders. These competitions will help to encourage this type of art and to make the people aware about the importance of waste utilization and reduction. Apart from these competitions, independent contributions will also be allowed. Also the art pieces displayed in this section will be available for sale and will help in generating funds.

Reference library: A collection of books, magazines, information leaflets, booklets, teaching kits and other publications produced by government departments, local and overseas green groups, community groups and other organizations on various environmental topics will be made available here. Local and overseas environmental journals and press cuttings in different categories will be made available. Access to environmental information through the Internet will also be provided.

Lecture Room:
The lecture room will have the capacity to hold around 80 people and will be well-equipped with audio-visual equipment. It will be suitable for holding workshops on environmental protection and other related issues. Schools and non-government organizations will be allowed to apply to use the lecture room for the organization of environmental workshops or seminars free-of-charge.

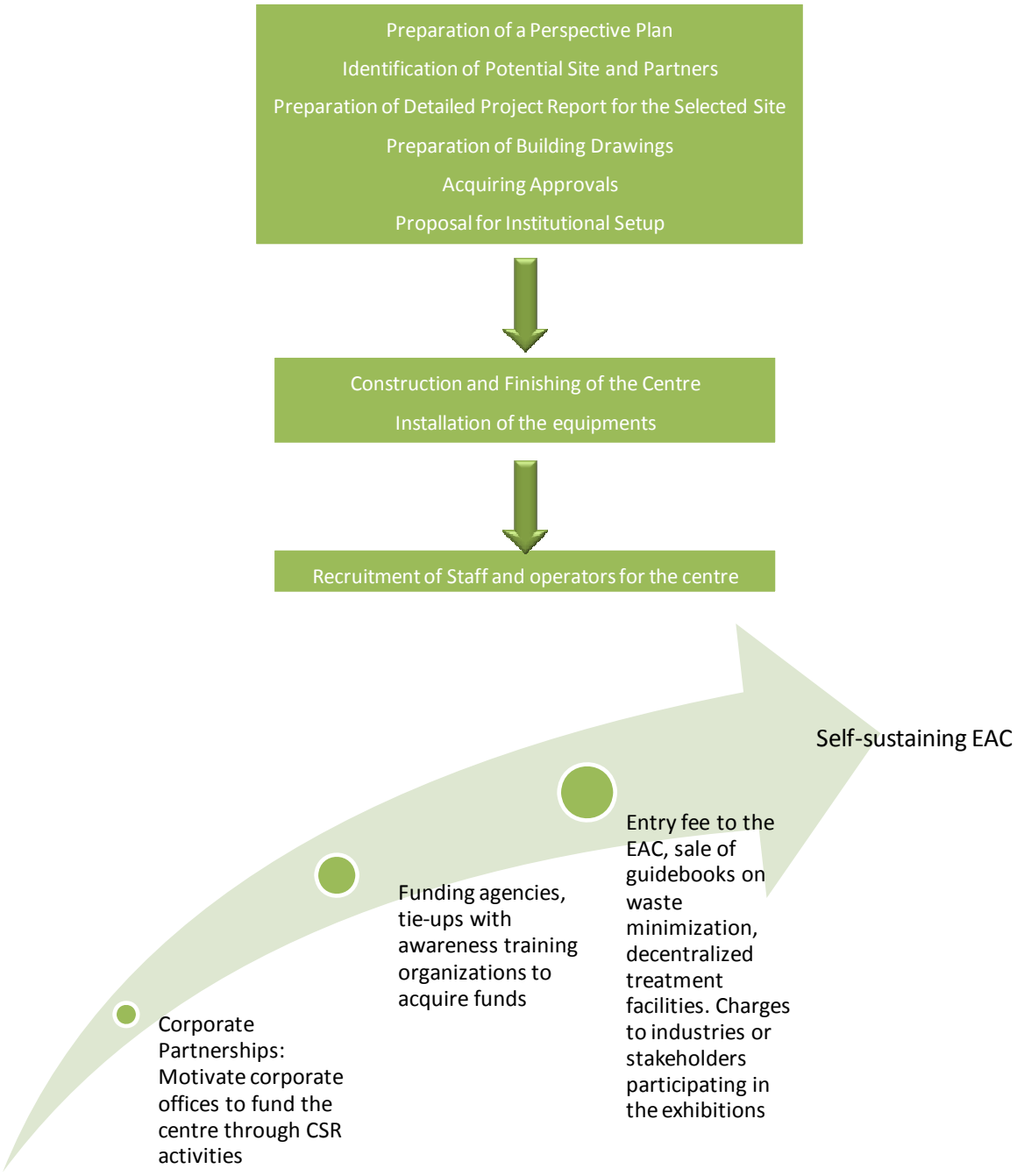
Some of the other features which may be included in the EAC are:

Mobile EAC: The Mobile Environmental awareness Centre will visit schools, housing estates and commercial centers. Through this convenient gateway, citizens will easily obtain resource materials and messages on environmental protection. The mobiles EAC could be any PMC vehicle or van which may be converted to look attractive to draw attention. It should always be accompanied with resource materials on awareness raising, interactive games, brochures, etc. for schools. It can be equipped with a screen and projector to show videos. This mobile EAC should be accompanied with one or two trained PMC officials to impart waste management related information.

Public relations cell: This cell will be responsible for interacting with different organizations and stakeholders and thus will keep the EAC informed about the needs and accordingly scheduling of various activities could be done. In short this cell will act as an interface between the various stakeholders in the city and the EAC.
Technical support cell: This cell will provide technical support to the various environmental initiatives (such as composting, Vermicomposting, Bio-Methanation plants, recycling activities etc.) that'll be going on in the city and will also encourage such initiatives.

11. Implementation:

The services of a consultant may be hired for the development of this centre. The operational as well as financial implementation of the EAC is shown in following diagrams.



Other Steps to be Taken by PMC

- Space to be provided by PMC. Other alternatives may be to convert an Arogya Koti into an EAC. A certain amount of space in all the malls at Pune may be converted as EAC with a few or more features.
- Policy change in order to make all stakeholders and industries in and around Pune to actively participate.
- EAC in Pune may be linked with similar international centres to encourage waste awareness and innovation on a global scale.

12. **Other similar experiences:** Currently, three similar kinds of centers are operational in Hongkong. The first one was started in Wan Chai way back in 1993. Among the other two, one is in Tsuen wan and the other is in Fanling.

Fanling Environmental Resource Centre provides services for the public with easy access to environmental information and it is a venue for environmental education programmes for schools, community organizations and residents in New Territories North. The total floor area of the Centre is about 400 square metres. Environment-friendly materials are widely used in internal fitting out, and the furniture in the Centre is largely made from recycled materials. Following the success of the first and second Environmental Resource Centers in Wan Chai and Tsuen Wan, Fanling Environmental Resource Centre is the third and the largest Environmental Resource Centre of the Environmental Protection Department.

Promoting Green Business[1]:

As rapid growth in India continues, demand for energy and natural resources to fuel expansion escalates as well. The U.S. and India are working together to promote small and medium enterprises (SMEs) – one of the most promising segments of the economy – that spark growth as they "green" industries and supply chains. A new public-private partnership aims to help green businesses realize their potential and develop a pipeline of profitable SMEs that build momentum for a new kind of "green revolution" in India. Alliance partners include the World Resources Institute (WRI), the Confederation of Indian Industry-Sohrabji Godrej Green Business Centre (CII-GBC) and the United States Agency for International Development (USAID) India. Early partners – Godrej's Industries, CII and USAID, with help from the Government of Andhra Pradesh – worked in tandem to envision and then build one of the greenest buildings in the world in India, an unparalleled feat in the developing world at that time. The building, now known as the Green Business Centre, received the U.S. Green Business Council's platinum rating in November 2003 for Leadership in Energy and Environmental Design and was the platinum rated building outside the U.S. The centre has matured from a demonstration in green building to an active hub for green business development. The various services offered at the GBC include Green Building Rating, world class energy efficiency, green audits, green business incubation, seminars and conferences on a host of green related topics, exhibit of green equipment and materials at the technology centre, access to knowledge on green at the Information Centre.

Creating awareness and Promoting Segregation through "ChakaChak Mission"

Realizing the significance of segregation, the PMC has launched an awareness raising campaign called as the "*ChakaChak Mission*". This mission, with the active participation of schools, launches awareness drives in order to educate the denizens about the importance and steps of segregation. Groups comprising of 4-10 students are formed and are advised to involve their families in cleaning and beautifying the surroundings. These groups nock-named "*ChakaChak Tolis*" meet once a week and plan their work with inputs from the Ward Medical Officers of the PMC. In order to further propagate this mission, a short documentary film has been made by noted film director *Sai Paranjpe*. This film along with the drives has created significant awareness. Zero waste days are observed on 1st January, 26th January, 15th August and *Gudi Padwa* (Maharashtrian New Year day). Strengthening and large-scale promotion of the *Chakachak Mission* should be one of the key activities of the EAC.

13. **Barriers:** The barriers to such a centre are the lack of co-operation from all the stakeholders. This can only be overcome by creating awareness among them.

[1] Source: http://www.usaid.gov/in/our_work/ppp/ppp_venture.htm and http://www.worldgbc.org/docs/newsletter-IGBC.pdf

14. Benefits:

- EAC's will carry full responsibility to develop environmental awareness among the people. The institutionalization of this extremely important requirement (public awareness) will greatly help in developing behavioral change in the attitude of the people on the positive side.
- They will also keep the people informed about the state of various municipal services in their areas and thus will help in assessing the performance of the municipalities.
- They will be out of the class examples of the centers of constructive recreational activities, for the people of almost every kind of social background and of all ages.
- They will help in the development of the sense of responsibility towards the nation among the citizens.

15. Links to other ISWM Pune Schemes:

- Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
- Design and Launch of a Comprehensive Awareness Campaign on ISWM
- Imparting Awareness and Training for BMW management
- Introducing Award Schemes
- Initiating Schools Involvement in Waste Management
- Improving Waste Management during Festivals
- Improving Health and Safety of PMC workers, rag-pickers and citizens in the proximity of landfills

2. PRIVATE PARTNERSHIPS IN THE CURRENT WASTE COLLECTION SYSTEM

1. **Introduction:** In view of inadequacy both in terms of infrastructure as well as finances, several Urban Local Body's have introduced privatization in the solid waste management arena. Out of 35 metropolitan cities in which practices have been reviewed, almost all have adopted to partial privatization barring the exceptions of Pune and Cochin. The SWM activities predominantly privatized include door-to-door collection, street sweeping and transportation of waste. Keeping in view the resistance to setting up of common treatment and disposal plants as well as growing interests in alternative sources of energy, there is significant enthusiasm of the private sector in areas of composting, pelletization and biomethanation plants. The availability of grants from bilateral and multi-lateral institutions has further led to heightened interests. This has led to a remarkable paradigm shift and a new perspective to waste management has been added. Waste is now being looked at as a resource instead of the liability.

2. **Purpose[1]:** The collection of Solid Waste in Pune is through PMC. The PMC deployed staff are responsible for the collection of solid wastes from houses, community bins, hotels, hospitals etc. The prevalent Municipal Solid Waste collection efficiency is 88%. There is no mechanism for collection of C&D waste. No estimates or studies have been undertaken for the collection of Bio-Medical Waste. The financial constraints coupled with inadequacies in terms of human and infrastructural resources have led to the reduction in waste collection efficiencies.

3. **Target**: To introduce the Private sector participation in solid waste management involving the following activities:
   - To privatize the collection mechanism by provision of vehicles or heavy equipment for the collection of waste and thereby increase the collection efficiency of waste collection.
   - Optimization in the transportation costs

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation.

6. **Support Agency:** Any Private company or Public Organization can take up this role

7. **Location (Suggested):** The implementation of PPP in solid waste management can be started at any location through out the city.

8. **Budget (Estimated):** The budgetary requirements of this plan will vary from case-to-case basis. The financial logistics for each case will have to be detailed out for various PPP modules as worked out by the consultant. The typical PPP modules include Build Own Operate Transfer (BOOT), Build Operate Own (BOO) and Build Operate Transfer (BOT). The consultancy charges for PMC will be approximately of the order of Rs 2.5 Million.

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Study and Assessment of Prevalent Waste Collection System (Human Resources: Level of Competence and Infrastructural Resources)															
Gap Analysis															
Identification of Potential Sites and Analysis of Alternatives															
Preparation of Bid Documents and Monitoring of Pilot tests															
Evaluation of Pilot Test															

1 FICCI Survey on Scope of Privatization of Solid Waste Management in India, 2007

10. **Description:** In order to introduce private partnership interventions in the Solid Waste Management, and especially Solid Waste Collection mechanisms PMC should hire the services of a consultant. The consultant should be commissioned

    a. To study and assess the prevalent collection systems and operation. The deployment of human resources, their training levels and competencies, collection capacity of vehicle fleet, frequency and timings of collection, the condition of the vehicles as well as the adopted routes should be assessed.
    b. On the basis of this detailed assessment, the consultant should identify the gaps and suggest points for private party interventions.
    c. The consultant should also assist PMC in selecting the most beneficiary PPP model and identify stake-holders/partners for the same.
    d. The consultant should assist PMC in identifying potential locations for setting up the pilot plants should be identified, followed by a detailed analysis of alternatives.
    e. For the selected location, bid documents should be prepared for introducing private partnerships. The concerns of the human resources and the gaps identified during the initial assessment should be reflected in the bid documents.
    f. The pilot plant should be evaluated on the basis of guidelines set in consultation with PMC.

    The success of the pilot plant can later be up-scaled at the city level to improvise overall efficiency. While applying the Private Partnerships in solid waste management areas the following points should be considered.

Box: Important Considerations while Implementing Private Partnerships

Labour Redundancy: Redundancy of labour can be avoided through freezing the hiring of new staff. Private sector participation can then be phased in to cover the shortfall in service, filling the gaps caused by the reduction of the government workforce.

Duration of agreement: To encourage the best use of the private sector's potential for raising investment capital, steps should be taken to minimize the private sector's investment risk and enable safe and appropriate periods of financing. Typically 5 years are needed to pay off loans for refuse collection equipment, and 15 years for major transfer or disposal facilities.

Worker Health and Safety: Data from high-income countries show that labourers in solid waste management face a relatively high risk of disease and injury. Special care must be taken to ensure that worker health and safety are not being sacrificed in an attempt to reduce costs..

Willingness to Pay: Although solid waste management service is a public good, collection of user charges enables the service to be financially sustainable. House-to-house surveys can indicate which methods of waste collection are preferred and the sensitivity of generators to the level of the charge that they will be asked to pay.

Defining equitable collection zones: It is not possible for the zones to be identical; each zone will have some unique differences. The optimized zoning for waste collection should be done with the help of optimization and route analysis studies.

Economies of scale and span of management: Each method of collection (such as animal cart, tractor with trailer, or compactor truck) has a particular quantity of waste which it can collect during its daily work period. By pilot testing alternative loading techniques and crew sizes, coupled with time-and-motion analysis, a realistic estimate of this quantity can be determined.

General Guidelines: The general guidelines to be followed include:

- Standards and requirements for performance should be carefully specified in private sector participation agreements, with adequate provision made for monitoring and penalizing
- Company (the magnitude of the penalties being commensurate with the seriousness of any failure

Box: Important Considerations while Implementing Private Partnerships

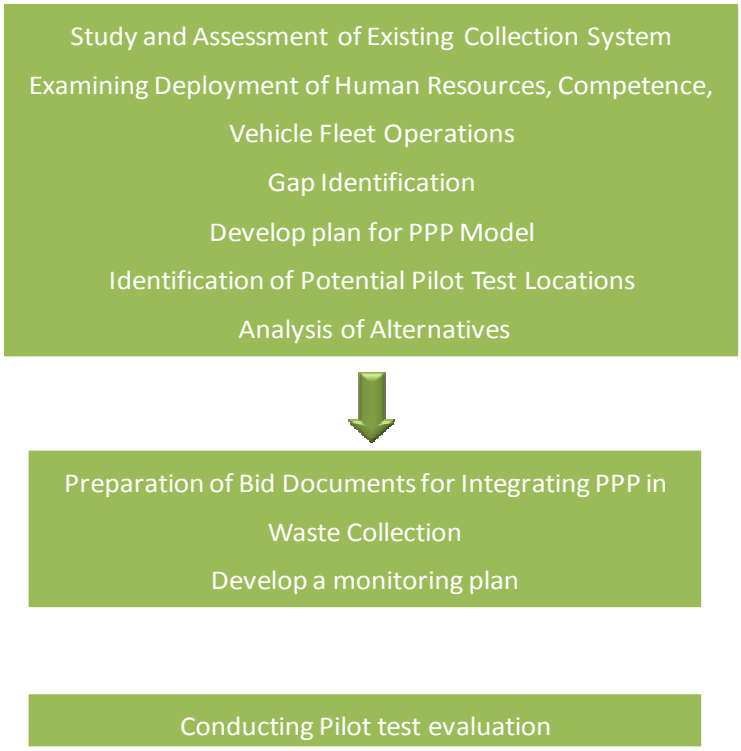
in performance).

- Allowance should be made for the particular conditions of different zones.
- Environmental requirements, such as the use of enclosed truck bodies or the covering of each load with a tarpaulin, and limits for exhaust fumes, need to be included.

Monitoring of performance: For comparative performance monitoring of public sector versus private sector service, it is advisable to create an independent arrangement. A separate third party monitoring office within local government may be created for this purpose.

Guarantee against political risk: The best way to minimize political risk is to limit the potential for political intervention by improving the transparency and accountability of the procurement process, and making procurements truly competitive.

11. Implementation:



12. Other similar experiences:

Chennai Waste Collection Experience with Onyx[2]: Chennai city authority has undertaken privatization of waste collection. The city management authorities have appointed Onyx since 2000 in order to collect the solid waste generated in the city. Onyx, through an extensive training session has undertaken the waste collection process. Training is provided to the workers in order to operate latest machineries and equipment. The waste collection is carried out through a fleet of 7-8 ton capacity compactors. The entire city has new, movable bins to collect waste. These bins are cleaned at least once a day. The collection occurs at greater frequencies during festivities in order to match the increased waste generation rates.

This privatization system has resulted in overall increased efficiency of waste collection. Public awareness through the application of communication tools such as pamphlets, hoardings and banners has led to rise in public awareness related to solid waste.

[2] Source: http://www.chennaibest.com/discoverchennai/citylifestyle/feature10.asp

UK and USA Studies: Private sector service costs have been at least 25% lower due to rationalized operations and greater management flexibility. *Managed competition*, with competition between government and private sector operations, is the most cost-effective option.

Canadian Studies: Private sector service costs have been at least 25% lower in most provinces, and at least 60% lower in Atlantic Province. Comparatively high costs for the private sector in Quebec Province were due to older and larger equipment, larger crew sizes and lower productivity.

Latin American Studies: Private sector service costs have been about 50% lower due to higher labor and vehicle productivity.

Malaysian Study: Private sector service costs have been at least 20% lower due to greater efficiency.

13. Benefits:

- The private sector has shown that it can provide a more efficient or cost-effective service.
- The private sector often has better access to capital financing and so it is able to use more efficient equipment.
- The private sector may have easier access to specialist skills. For example companies can form joint ventures with international specialist firms.
- Private sector operators are motivated by accountability and competition, and by the need to fulfil certain specific requirements as set out in contractual agreements.
- Private sector managers generally have more control over who is in their workforce and how they should work.
- Private sector companies are less restricted by bureaucratic procedures and more able to concentrate resources where they are needed
- Decentralized Treatment facilities can be improved though active participation from the private sector.

14. Links to other ISWM Pune Schemes:

- Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
- Establishment of Waste Exchange Centre
- Establish a CFL Recycling Programme and a Central Facility
- Pilot Projects for Recycle and Reuse of C&D Waste
- C&D Waste Management

3. PRIVATE PARTNERSHIPS IN DECENTRALIZED TREATMENT SYSTEM

1. **Introduction:** The ISWM plan has been envisioned in order to reduce the overall waste reaching the disposal or landfill sites. In order to achieve this ultimate objective, reduction in overall generation of waste as well as increased efficiency of treatment of waste becomes imperative. Pune generates approximately 1093 MTPD of Municipal Solid Waste. Out of this approximately 65% of waste is wet waste and can be effectively treated through decentralized biological processes. Several decentralized projects have been implemented throughout the city. However, out of the total waste treating capacity of 45 MTPD, only 15 MTPD of waste actually gets treated. This disparity in the treatment capacity and actual treated quantum occurs due to several factors such as ignorance of technological know-how, operational deficiencies as well as financial constraints.

2. **Purpose[1]:** Some of the major hurdles in large-scale implementation of decentralized treatment procedures include the lack of technological know-how and financial constraints. Several organizations such as large co-operative societies, hotels, commercial areas generate significant quantum of waste which can be potentially treated through decentralized processes. There is hence a need for developing a frame-work for integrating the interested stake-holders in order to develop a structure which is capable of handling the waste effectively. Public Private Partnerships provide the opportunity for interactions between various components in order to develop a beneficiary system for various stake-holders.

3. **Target**: To introduce the Private sector participation in solid waste management involving the following activities:
   - Provision of vehicles or heavy equipment for the collection of waste and thereby increase the collection efficiency of waste collection. (The current efficiency of Municipal Solid Waste in Pune is 88%, however no efficient collection systems have been developed for BMW and C&D wastes)
   - Collection and transfer of the municipal solid waste(commercial wastes from hotels, offices, markets or stores, household waste, street sweepings)to the centralized treatment facilities and the disposal sites.
   - Operation and management of the transfer stations and the collection centres.
   - Provision and maintenance of the waste bins with appropriate colour coding and labeling.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation.

6. **Support Agency:** Any Private company or Public Organization can take up this role.

7. **Location (Suggested):** The implementation of PPP in solid waste management can be started at any location.

8. **Budget (Estimated):** The budgetary requirements of this plan will vary from case-to-case basis. The financial logistics for each case will have to be detailed out for various PPP modules. The typical PPP modules include Build Own Operate Transfer (BOOT), Build Operate Own (BOO) and Build Operate Transfer (BOT). The entire frame-work of this project can be done through commissioning a consultant. Approximate fees for the consultant will be about Rs. 1 Million.

9. **Time Frame (Estimated):**

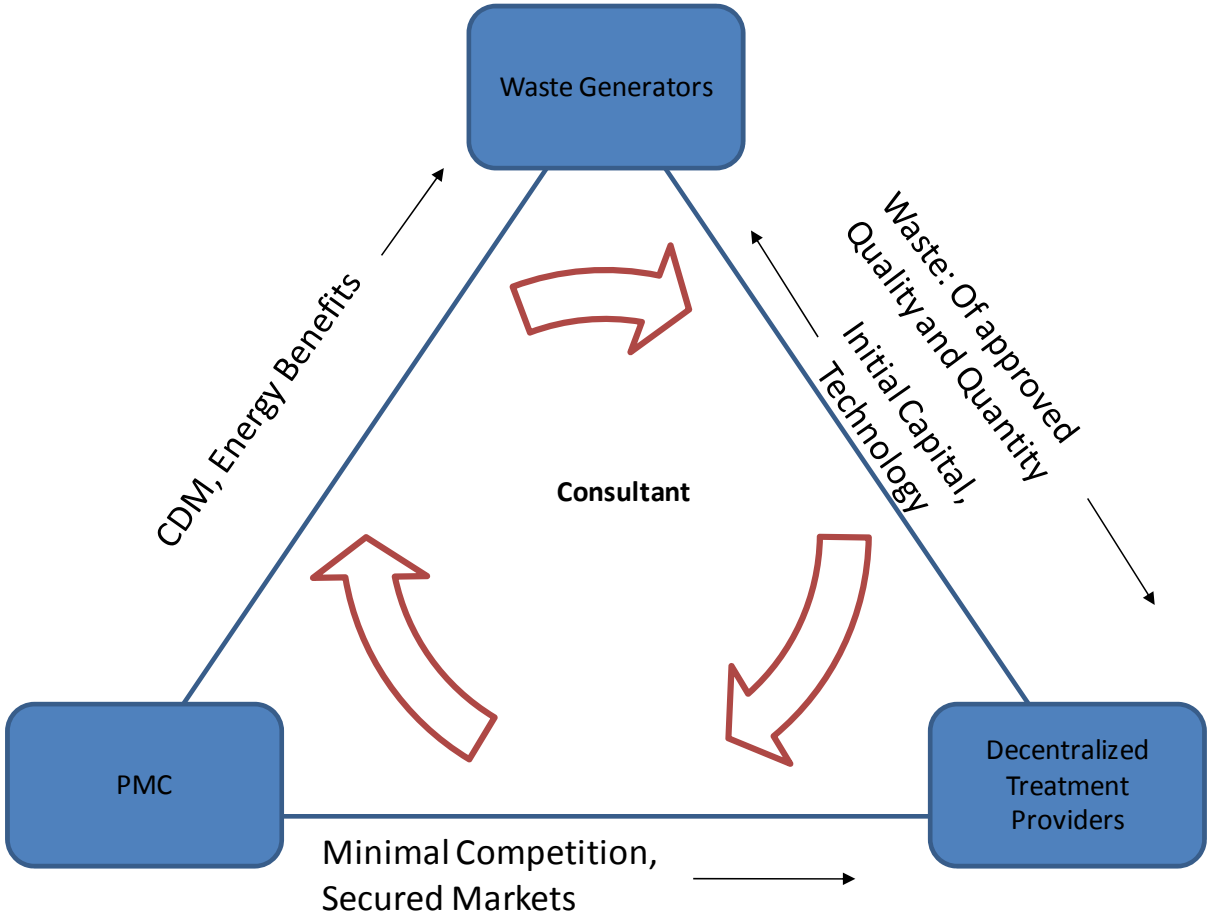
Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Identifying key stakeholders and site selection															
Preparation of Bid Documents and evaluation of bids															
Actual Implementation of the Pilot Project															
Monitoring, Evaluation and Reporting of the Pilot Project															

1 FICCI Survey on Scope of Privatization of Solid Waste Management in India, 2007

10. **Description:** The efficiency of decentralized treatment processes for solid waste management depends upon the quantity and quality of waste generated. Looking at the economies of scale, the decentralized treatment plants will be efficient in case the quantum of waste to be treated is approximately 5 MTPD. Large-scale societies or hotels can be looked at as typical waste sources for this decentralized treatment. For effective implementation of privatization, a tripartite committee should be set up. This tripartite shall include representatives from local communities such as members of National Society for Clean Cities or conglomerate of hotels in vicinity. These committees shall provide the private party with the quantum of waste for treatment. PMC shall act as a facilitator in this process. The PMC shall be responsible for ensuring the quality and quantity of waste provided to the treatment facilitator. Through zoning process, PMC shall initially ensure that no other organization undertakes the decentralized treatment process. The private party on the other hand shall bring in the initial financial as well as technical expertise for setting up the plant. PMC may include a conditionality of CDM benefits through bundling of various biomethanation treatment plants.

11. **Implementation:** The services of a consultant shall be hired for:

- Identify key stake-holders and interested parties for application of decentralized processes
- Assist PMC to identify beneficial PPP model
- Identify Sites for Setting up Pilot Projects
- Preparing Bid Document for the selected project site
- Evaluation of Bids
- Actual Implementation
- Monitoring , Evaluation and Reporting
-



12. **Benefits:**

- The private sector has shown that it can provide a more efficient or cost-effective service.

- The private sector often has better access to capital financing and so it is able to use more efficient equipment.
- The private sector may have easier access to specialist skills. For example companies can form joint ventures with international specialist firms.
- Private sector operators are motivated by accountability and competition, and by the need to fulfill certain specific requirements as set out in contractual agreements.
- Private sector managers generally have more control over who is in their workforce and how they should work.
- Private sector companies are less restricted by bureaucratic procedures and more able to concentrate resources where they are needed
- Decentralized Treatment facilities can be improved though active participation from the private sector.

13. <u>Links to other ISWM Pune Schemes:</u>

- Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
- Establishment of Waste Exchange Centre
- Establish a CFL Recycling Programme and a Central Facility
- Pilot Projects for Recycle and Reuse of C&D Waste
- C&D Waste Management

4. ESTABLISHMENT OF COMPOST COLLECTION AND MANAGING CENTRE (CCMC)

1. **Introduction:** There are various facilities set up for processing of wet waste at community level. These processing methods predominantly include both vermi-composting and biogas generation facilities. It is estimated that about 15 tonnes of wet waste gets treated by these options throughout the city. The reported number of vermi-composting plants varies from 8 to 250 in various wards. However the operational capacities and efficiencies of these plants are not known. Compost is the product of various treatment technologies of organic or mixed waste like Vermi composting, Aerobic composting. Vermi composting is a predominant way that many societies have followed to take care of the wet waste generated in their premises. It is also implemented at various religious locations where large amount of bio degradable waste gets collected daily and also at some schools.

2. **Purpose:** Although the number of vermi-composting plants is high, the operational number of these plants is very low. There is no information on the capacities and efficiencies of these plants. The products resulting from decentralized treatment plants such as manure do not have a market potential. Owing to the lack of demand, lesser number of people are interested in this field. The sustainability of a commercial compost plant will depend on the quality of compost produced and the successful and continuous sales of the compost.

3. **Target**:
   - To promote the use of compost in and around Pune city
   - To undertake compost enrichment studies
   - To develop guidelines for compost quality with the help of Organic Farming Certification process

4. **Type:** Project

5. **Lead Agency:** PMC can formulate a Non-profit to take charge of the CCMC centre. A private party or a public private partnership can be proposed (Even a Decentralized technology provider can take up this plan).

6. **Support Agency:** Recycling Division of the ISWM Cell can support this venture. Support from PMC can be in the form of awareness raising and providing technical support to the organization running the CCMC, technology providers, NGOs', waste generators and citizens.

7. **Location (suggested):** Looking at the economies of scale, a centralized compost collection centre is proposed.

8. **Budget (Estimated):** Rs 1 Million

9. **Time Frame (Estimated):**

Activity	Oct-Dec			Jan-Mar			Apr-Jun			Jul-Sep		
Estimating Supply Potential												
Estimating Demand Assessment												
Introducing studies for enrichment of Compost												
Setting Quality Standards for Compost												
Workshops and Training for Compost Business Community,												
Preparation of Guidelines for Composting												

10. **Description:** In order to achieve the final vision of reducing waste reaching the landfill sites, the decentralized treatment processes need to be promoted. Put of 1093 MTPD of MSW being generated, 710 MTPD is wet waste which can be treated effectively through biological treatment processes. Aerobic and vermi-composting are two predominant types of waste processing systems. The availability of markets for the sake of compost

generated through these processes in a major hindrance for wide scale application of this techniques. The ambiguity in the quality of compost in absence of well-defined guidelines further aggravates the problem.

Hence a dedicated and structured approach is necessary in order to assess the potential of this methodology. The entire consultancy project will require a detailed assessment of the various existing decentralized compost plants n order to assess the supply potential. Further studies will be needs to estimate the market trends for analyzing the demand.

No specific guidelines exist over the quality of compost generated through the process. Realizing the possible applications of manure usage in organic farming, clear guidelines need to be set in order to define the quality of compost. Enrichment studies should be promoted to enhance the quality and the certification needs and procedures required for Organic Farming need to be thoroughly reviewed. This will help in benchmarking the quality of compost and promoting the same in case of market potential.

11. **Implementation:** Functioning of the Compost Collection Centre is as follows:

Compost collection and management centre's (CCMC) can come up as a solution by taking up the responsibility of centralized collection & distribution of compost. The following methodology may be followed:

Step 1 - Management of the CCMC:

A representative committee be formulated to manage the operations of the compost collection centre. This committee formulated through the suggestions of a consultant will have representatives from the compost business, which includes PMC officials, decentralized treatment providers, farmers, and members of organic farming. This committee will suggest any policy reforms to be applied for the promotion of composting.

Partnership with municipalities can help as they can fulfill:-

- Space requirements
- Legal requirements: - To comply with any legal requirements for managing and carrying out any such operation.
- Can provide required database.

Step 2- Analysis of Existing Compost Plants:

- To identify the existing compost plants running throughout the city
- To assess the plants on the basis of their capacity, efficiency, operational and design parameters
- To map the locations of the plants using spatial tools such as GIS
- To estimate supply or production potential

Step 3 - Market analysis of compost:

- To conduct market analysis regarding sale of compost in the city
- To conduct surveys (perception) in order to estimate the constraints in usage of organic manure: quality, quantity, pricing, yield
- Reasons for usage of chemical fertilizers over organic manure

Step 4: Enrichment of compost collected according to the specific needs of the market (Like Compost can be provided to the farmer according to their soil type).

- Based on the market trend, promote studies to customize manure quality as per requirements of the local farmers
- Undertake enrichment studies through pilots demonstrating higher yields

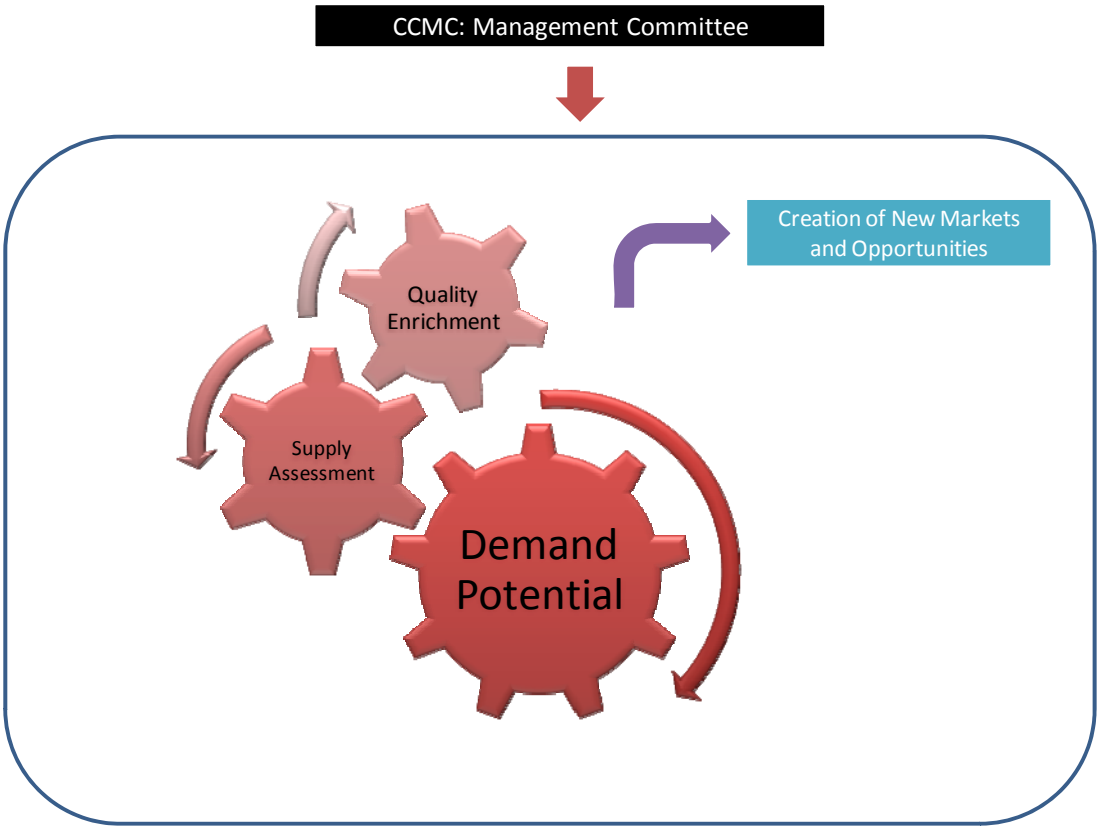
Step 5 – Establishment of Guidelines for Compost Quality

- Review certification requirements for Organic Farming
- Review quality performance indicators adopted in other countries
- Develop guidelines for evaluation of compost quality
- Prepare a compost quality evaluation manual in local language
- Conduct awareness and training programmes for disseminating the standardized quality requirements

- Apply for eco-labeling for standard quality compost
- Incentivize usage of compost through tax-redemptions to compost manufacturers as well as consumers in the initial stages

Step 6 – Explore New Markets

- Organic farming show long lasting positive results but on short term basis using them causes low production compared to inorganic fertilizers so PMC has to put their share of inputs in providing working capital.
- Exporting of compost produced can also be done as international demand for organic manure exist and will gradually increase. So even if CCMC initially not find good market in our country they can export compost by



12. Benefits:

- Markets for compost can be found
- Use of compost as an organic manure would help preventing the harm to the environment due to prevention of use of toxic chemical fertilizers
- Benefits from sale of compost
- Awareness about new markets such as Organic Farming

13. Links to other ISWM Pune Schemes:

- Establishment of Community Sorting Centres
- Establishment of Environmental Awareness Centre
- Private Partnerships in Decentralised Treatment System
- Demonstration projects for Hotel waste management
- Establishment of a cadre of operators for decentralized waste management
- Establishment of Standardized Guidelines for Operating Decentralised Treatment Plants.

5. DEMONSTRATION PROJECTS FOR HOTEL WASTE MANAGEMENT

1. **Description**: The Municipal Solid Waste (MSW) comprises of waste generated from various sources such as house-holds, hotels, hostels, wedding halls and market places including slaughter houses. Hotels generate approximately 25% of the entire MSW which is approximately 275 MTPD. Hotels demonstrate one of the highest source level segregation in the city. 80.55% of the waste is segregated. Approximately, 75% of the wastes are wet waste (biodegradable).

2. **Purpose:** To process the organic waste coming out from the bulk generators like Hotels, Restaurants and Wedding halls in a decentralized manner so as to decrease the waste going to the landfill.

3. **Target**: To promote decentralized treatments to process the hotel waste in the city.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC)

6. **Support Agency**: Hotel associations, Technology providers and NGOs

7. **Location (Suggested):** Pilot projects to set up decentralized treatment plants for hotels may be initiated in Tilak Road, Ghole Road and Dhole Patil Road wards in Pune as these have the maximum number of hotels in Pune.

8. **Budget (Estimated):** Rs. 1 Million

9. **Time Frame (Estimated):**

Activity	Oct-Dec			Jan-Mar			Apr-Jun			Jul-Sep		
Formulation of Hotel Conglomerates and identification of interested partners												
Development of a tripartite model												
Preparation of Detailed Project Report at selected location												
Preparation of Bid Documents												
Imparting training to the hotel staff												

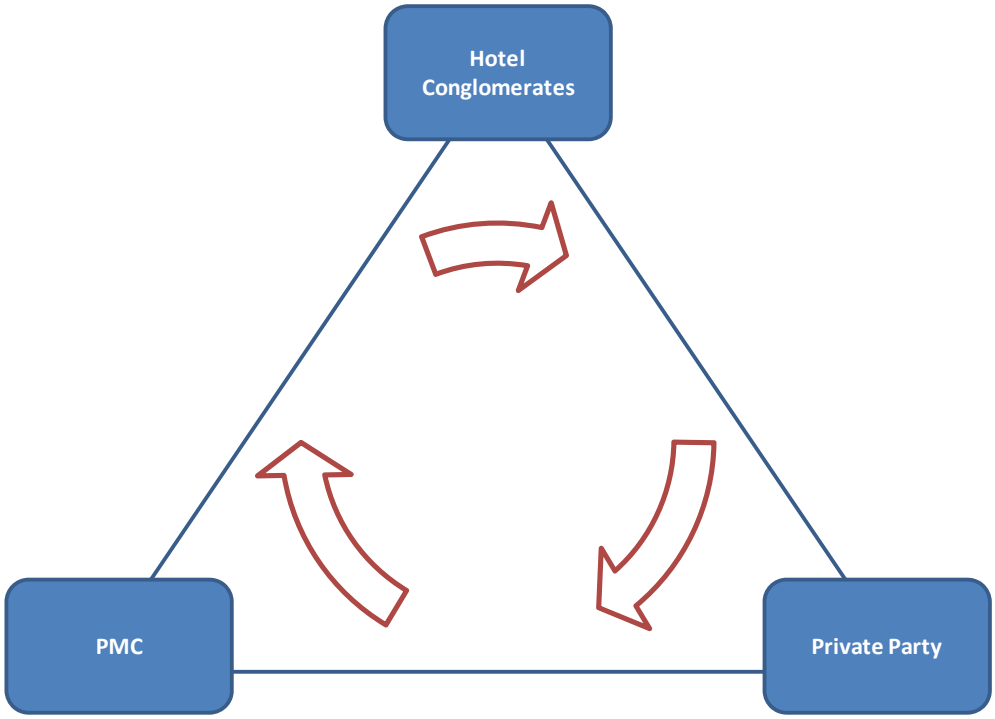
10. **Description:** Approximately 25% of total MSW is generated from the hotels. The waste is collected through a dedicated fleet of *Ghanta-Gadis* and then taken to the transfer stations. The extent of segregation of hotel waste is high, approximately 80% which makes it suitable for decentralized treatment options. PMC should promote and incentivize hotels to treat their waste through decentralized processes. The hotels should form conglomerates extending in adjacent wards in order to solve the waste problems jointly. Private partnerships could be formed with technology providers wherein, the private party brings in the technology. PMC should act as a facilitator and formulate power purchase or compost purchase agreements. Alternately, the compost or energy may be shared between the private party and the hotel bodies through joint ownership.

Role of Pune Municipal Corporation:

- Act as enforcing agency
- Guide the Hotel, restaurants' management for technology providers
- Monitoring of the working of the treatment facilities
- PMC should make segregation of waste mandatory for hotels, restaurants, clubs, canteens etc.
- PMC should provide a vehicle to collect this waste in segregated form
- Defaulters should be fined heavily, responsibility of the ISWM cell
- Introduce Trade Refuse Charge

- Strict enforcement for segregation of wastes. Each hotel should be forced to install separate bins for wet and dry waste. These bins should be standardised to suite the direct lifting by the compactors.
- The wet waste should be collected and sent to the common decentralised treatment spots in the particular ward or it should be handled by the individual hotel etc within their own premises.
- Incentive system should be designed.
- The dry recyclable waste should be sent to the community sorting centres.

11. <u>Implementation:</u> A consultant should be hired for PMC to prepare a proposal about the overall modules of inter-party participation for management of hotel waste. A representative structure for Hotel waste Management implementation is shown in the figure.



12. <u>Other similar experiences:</u> Some hotels from Pune have set up the treatment plants for treating their waste and also utilizing the product of the treatment facility. e.g. gas in case of biomethanation.

Hotel Waste Management in Mumbai[1] : There are a large number of restaurants and hotels in Mumbai. These hotels contribute substantially to the generation of waste in a ward. As per our study of a few wards, hotel and restaurant waste contributes to around 25-30 % of the total waste generated by the ward. At present Hotel waste generated by small restaurants is disposed off directly by the hotels at nearby collection spots. The substantial quantity of food waste dumped at these collection spots gets mixed with all the other kinds of dry and wet waste and gives an ugly look to the collection spots with lot of dirt and stink. In case of large four and 5 star hotels; the hotel waste is disposed off directly by the hotels through MCGM or through private contractors to the dumping ground. MCGM provides a service of directly lifting hotel waste from the small hotels in some wards such as A , B, H west, M West ward etc. MCGM charges Trade Refuse Charge (TRC) to the hotels for the waste generated by the hotels. The TRC is charged in multiples of license fees which are directly based on the area of the hotel and the grade**.** The grade one hotels are generally bars and permit rooms which do peak business during evening hours. The waste generated by the restaurants with bars and permit rooms is much less as compared to that generated by the food restaurants. However the TRC charged for the bars and restaurants is much higher than that charged for the ordinary restaurants which generate much more quantity of waste. Based on observations of the hotel waste generated by hotels in a few wards, around 70 to 75 % of the hotel waste is biodegradable and gets mixed with all the other type of waste when dumped at the collection spots. Also the waste which is collected directly by the MCGM/private contractors gets mixed with all the other type of non biodegradable waste at the dumping ground.

1 As referred to http://www.karmayog.com/cleanliness/hotelwaste.htm

Management of waste generated by all the 3, 4 and 5 star hotels and restaurants generating over one ton of waste is to be carried out by them. These hotels can look at options of in-situ composting, installation of small biomethanation plants in the premises etc. e.g.: At present, hotel Orchid, Rhodas and Lotus suites are managing their waste quite well and can set an example for other hotels.. MCGM should enforce in-situ management of waste generated by these hotels.

Bio Sanitizer by Excel Industries: Excel Industries Ltd. supplies machines of capacity 500kg, per day, 1 tonne per day and 3 tonnes per day machines along with biosanitizer. These machines can crush the food waste to 1/3rd of the original volume and odorless compost produced can be used as manure after curing. (Details can be available with Excel Industries).

Biomethanation: Biomethanation Plants of capacities 100 -500 kg per day can be installed in the premises of hotels if adequate space is available. Gas generated can be used for cooking.

Composting/ Vermi-composting – Options of composting/vermi-composting could be explored.

Cairns International Hotel Environmental Initiatives[2]:

CIH operates under the Cairns International Hotel Environmental Policy which sets out intentions and principles in relation to overall environmental performance of the organization.

The Environmental Policy formalizes a framework for action and for the setting of environmental objectives and targets. The following practices are followed by CIH:

- CIH has an active Environmental Committee. The committee provides a forum for environmental issues to be raised, assessed and acted upon.
- Voluntary Environmental Audits are conducted at CIH. The audits address a broad range of environmental issues throughout the hotel and have the primary aims of assessing compliance and identifying existing or potential environmental risk.
- Recycling is undertaken wherever possible throughout the hotel.
- Waste heat from the hotel air conditioning plant is used to heat hot water. Water is heated primarily by gas but an energy conservation system is built into the air conditioning plant to partially heat water before it is heated by the gas heaters.
- Procedures are in place for lighting and air conditioning in unused public areas to be turned off unless required.

13. Benefits:

- Decentralized treatment of the organic waste
- Lessen the cost of transportation
- Reduction in amount of waste going to the landfill site
- Returns to the hotels in terms of products recovery from the treatment processes.

14. Links to other ISWM Pune Schemes:

- Establishment of Cadre of Certified Operators for Decentralized treatment
- Design and Launch of a Comprehensive Awareness Campaign on ISWM
- Introducing Award Schemes
- Inventorization of Solid Wastes
- Private Partnership in Waste Treatment Systems

2 As referred to http://www.cairnsinternational.com.au/environment.html

6. CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT

1. **Introduction:** Construction and Demolition waste comprises of about 40.6 % of the total waste generated in the city. The MSW rules, 2000 prohibit the dumping of C&D waste in the sanitary landfills. However, the absence of any city or state level guidelines for C&D waste management results in huge quantum of debris ending up in the landfills or being dumped in low-lying areas including river banks & beds. These activities shorten the life of landfills on one hand and on the other changes the topography of land, thus affecting surface water drainage and ground water percolation Many of these materials can be reused or recycled, thus prolonging our supply of natural resources and potentially saving money in the process. The unauthorized dumping of C&D wastes as well as un attended silt left in public after de-silting operations, is a major cause of nuisance, environmental degradation and pollution. Currently no systematic management of C&D wastes is practiced in Pune.

2. **Purpose:** Approximately 450 MTPD of C&D waste are received at the dumping grounds where they get mixed with the organic and other types of MSW. This hampers the treatment efficiency of the waste treatment processes. PMC has to spend a lot in the collection and transportation of C&D wastes.

3. **Target**: To find better disposal techniques and system for C&D waste management.

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC) along with surrounding Municipal authorities such as Pimpri-Chinchwad Municipal Corporation and Pune Cantonment Board.

6. **Support Agency:** C&D Waste Management sub-division of the ISWM Cell including Promoters and Builders Association of Pune (PBAP), Builders and Contractors, Maratha Chamber of Commerce, Industries and Agriculture (MCCIA), National Building Construction Company and Housing Urban Development Corporation, NGO's, generators and housing societies.

7. **Location (Suggested):** The C&D waste disposal sites should be identified commonly after consultation with the surrounding Pimpri-Chinchwad Municipal Corporation (PCMC) as well as Pune Cantonment Board (PCB). The recycling facility for C&D waste should be planned as an integral part of the C&D waste disposal site.

8. **Budget (Estimated):** Rs. 1 Million

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Review of Inventorization Report, Site Identification, Analysis of Alternatives															
Environmental Assessment of selected site along with Public Consultation															
Detailed Project Reports and Preparation of Bid Documents for Disposal Site															

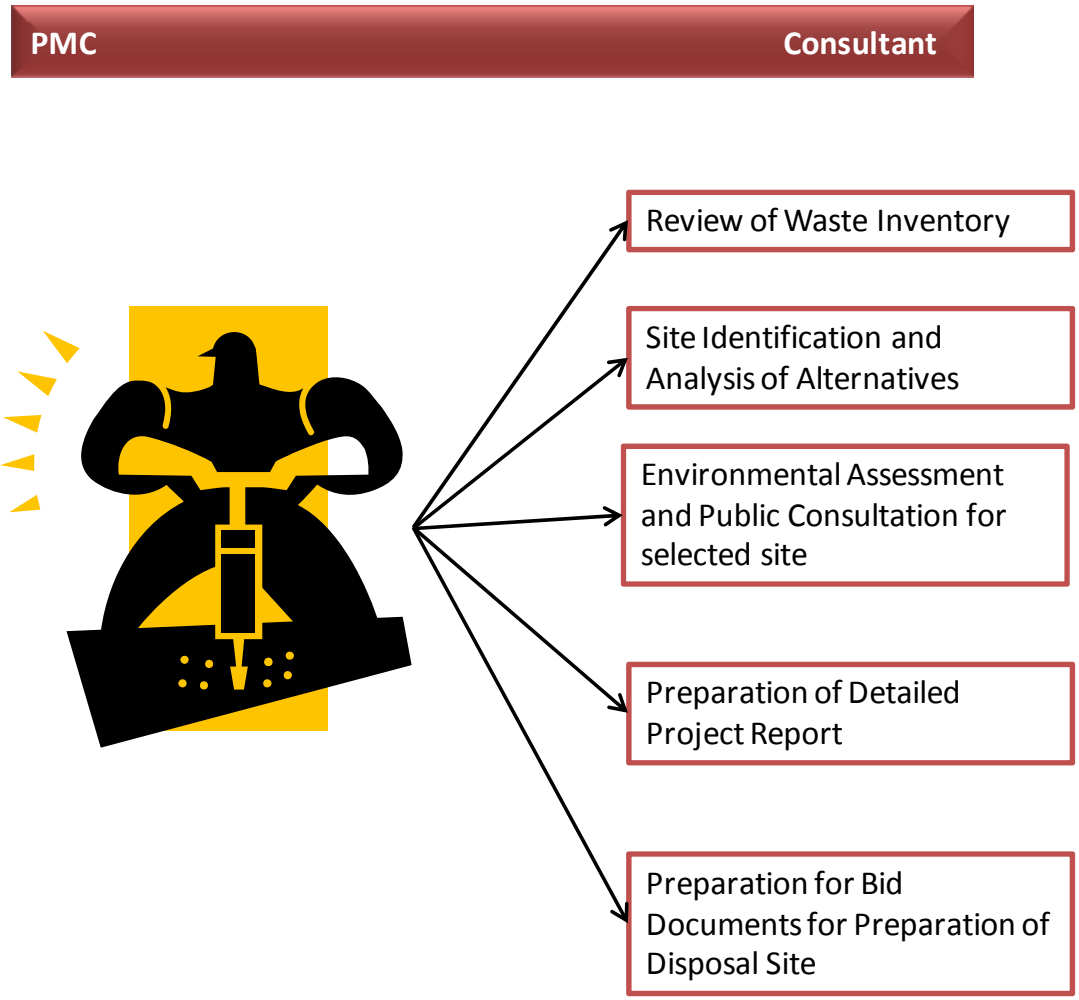
10. **Description:** Recycling operators could recycle the C& D waste at the disposal sites which will help to create more space for future wastes and disposal sites never get exhausted. For this a proper collection and disposal system would have to be designed by PMC along with the selection of disposal sites. There are no guidelines currently available for the C&D waste disposal. However, the selection procedure should broadly follow the "CPCB Guidelines for Sanitary Landfill". A review of the present waste generation as well as projected scenario should be carried out by the consultant on the basis of waste inventory. Potential waste disposal sites should be selected such as to minimize environmental and transportation implications. An Environmental Impact Assessment study should be undertaken to assess the environmental implications on the selected site due to

implementation of waste disposal site. The concerns of the neighbourhood should also be taken into account through the public consultation process. Detailed Project Reports should be prepared for the selected site.

Selection of Disposal Sites

- Sites for disposing C&D Wastes should not come under the no-development zone.
- Low lying areas should be considered other than areas around water bodies.
- Site selection should be followed as explained in the scheme for identification of new waste disposal sites
- An Environmental Impact Assessment followed by Public Consultation should be carried out for the selected site option

11. **Implementation:**



12. **Other similar experiences:** In Mumbai, a suggestion has been made to create a small hill in the Mulund disposal site where only C&D debris & silt to be put. This will enable 25 years of C&D waste disposal to be undertaken. Ultimately, this should be landscaped with grass, garden, trees, etc. and be converted into a picnic spot.

A suggestion has been that since Kanjur Marg is a low lying marshy area, it will need to be raised at least 2-3 meters above high-water mark to comply with landfill conditions. This can be an opportunity for disposal of clear debris to raise the level sufficiently for accepting municipal waste[1].

1 As referred to http://www.karmayog.com/cleanliness/desiltingwastecd.htm

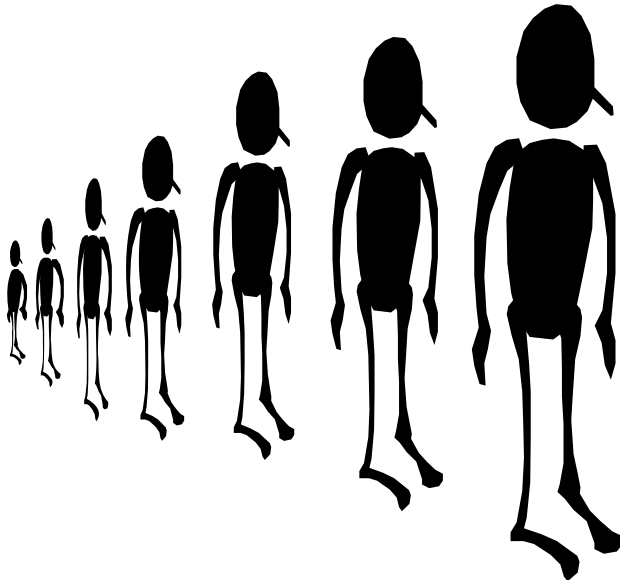
13. **Barriers:** Co-operation from all stakeholders for the change in the Policy of C&D Waste Management and the lack of awareness regarding C&D waste management.

14. **Benefits:**
    - Inventorization of C&D waste
    - Management of C&D Waste would become more convenient and easy to handle
    - Nuisance due to C&D Waste would be avoided
    - C&D Wastes would not get mixed with MSW and avoid the use of landfill space

15. **Links to other ISWM Pune Schemes:**
    - Develop and Introduce Policy Change for Construction and Demolition (C&D) Waste
    - Pilot Projects for Recycle and Reuse of Construction and Demolition Waste
    - Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
    - Establishment of Waste Exchange Centre
    - Inventorization of Solid Waste
    - Design and Launch of a Comprehensive Awareness Campaign on ISWM

Theme 4
Awareness and Promotion

1. Design and Launch of a Comprehensive Awareness Campaign on ISWM
2. Taming Consumption of Non-biodegradable Plastic
3. Imparting Awareness and Training for BMW Management
4. Initiating Schools involvement in Waste Management
5. Introducing Awards Schemes
6. Improving Waste Management during Festivals



1. DESIGN AND LAUNCH OF A COMPREHENSIVE AWARENESS CAMPAIGN ON ISWM

1. **Introduction:** The ISWM plan for Pune has been developed to tackle different waste streams such as MSW, BMW, C&D waste, E-waste and HW holistically. Out of the above mentioned waste streams, population can be taken as a surrogate generation factor for all wastes except HW. The Strategic Plan envisions Pune as a clean city without landfills. Reduction in generation is hence one of the key objectives of the entire plan. Since most waste streams are dependent on overall population, creating awareness amongst population (community) becomes an imperative step. Industries which are responsible for the generation of Hazardous waste also have to be familiarized with their role and responsibility towards achieving a clean city. Also since the ISWM plan has been developed through a participatory approach it aims at involving every stakeholder for mainstreaming the ISWM concept in overall urban management. Different methods and techniques using involvement of schools and educational institutions, business streams are hence essential towards achieving the set targets.

2. **Purpose:** To cope with all these waste related issues and manage the waste properly there is a need of technological, financial and environmental expertise. But even with highest level of technology the problem will not be solved if the citizens have not been informed in proper manner about all these systems. Only technological and financial solutions won't help to solve the problem unless there is mass awareness about the every stage of waste issue, right from the generation to disposal and also the environmental and social impacts of life cycle of waste. So awareness raising becomes an unavoidable rather the most important part. The awareness is not only important for the general public but also for specific sectors such as the medical fraternity and electronic and software companies etc. Currently segregation of waste is one of the major problems related to waste management in Pune. This calls for a specific awareness programme on MSW segregation. The present scheme discusses the awareness programmes for business and community especially with respect to awareness in MSW management.

3. **Target**: To introduce structured awareness programmes about waste and waste related issues for various stakeholders.

4. **Type:** Programme

5. **Lead Agency**: Pune Municipal Corporation with the help of NGO working especially for education and awareness.

6. **Support Agency:** Support agencies could be different for different kinds of waste streams. For example for the awareness in the field of electronic waste management Software Technology Parks of India (STPI)or Software Exporters' Association of Pune (SEAP).

7. **Location (Suggested):** The awareness for different wards shall be on the basis of the ward prioritization exercise. In wards with the minimum segregation such as Kasaba Peth and Bhavani Peth, the emphasis of awareness programmes needs to be on increasing extent of segregation.

8. **Budget (Estimated):** Rs 1.5 Million

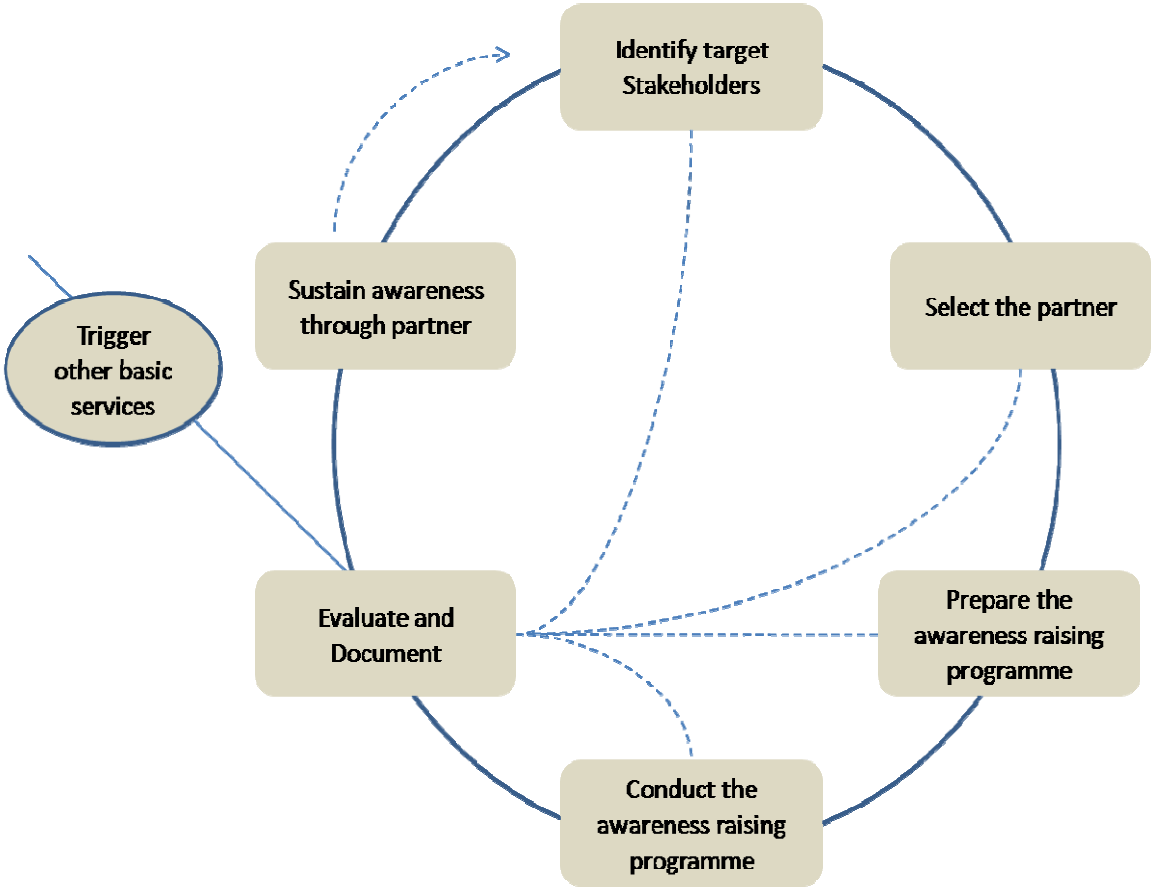
9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Review of existing awareness initiatives															
Identify target stakeholders and key focal areas															
Designing new campaign based on the needs and partners															
Conduct training programmes and workshops															

10. **Description:** Typically, awareness-raising programmes should focus on various target stakeholders in order to ensure that awareness of ISWM results in action. For every awareness-raising programme, there must be clarity in terms of the intended next step or the expected action, which then defines the objective of conducting

awareness raising. Planning awareness-raising programmes with intended action in mind assists in bringing to bear the required scope and focus for the chosen target groups.
It is very important that awareness is not just created for a specific action but is sustained so that actions can continue, multiply and lead to the adoption or mainstreaming of solid waste management. In this perspective, it is important that the awareness-raising programmes are launched not on an ad-hoc basis but as part of a strategic operation. This figure illustrates the recommended cycle over six milestones for creating and sustaining awareness.

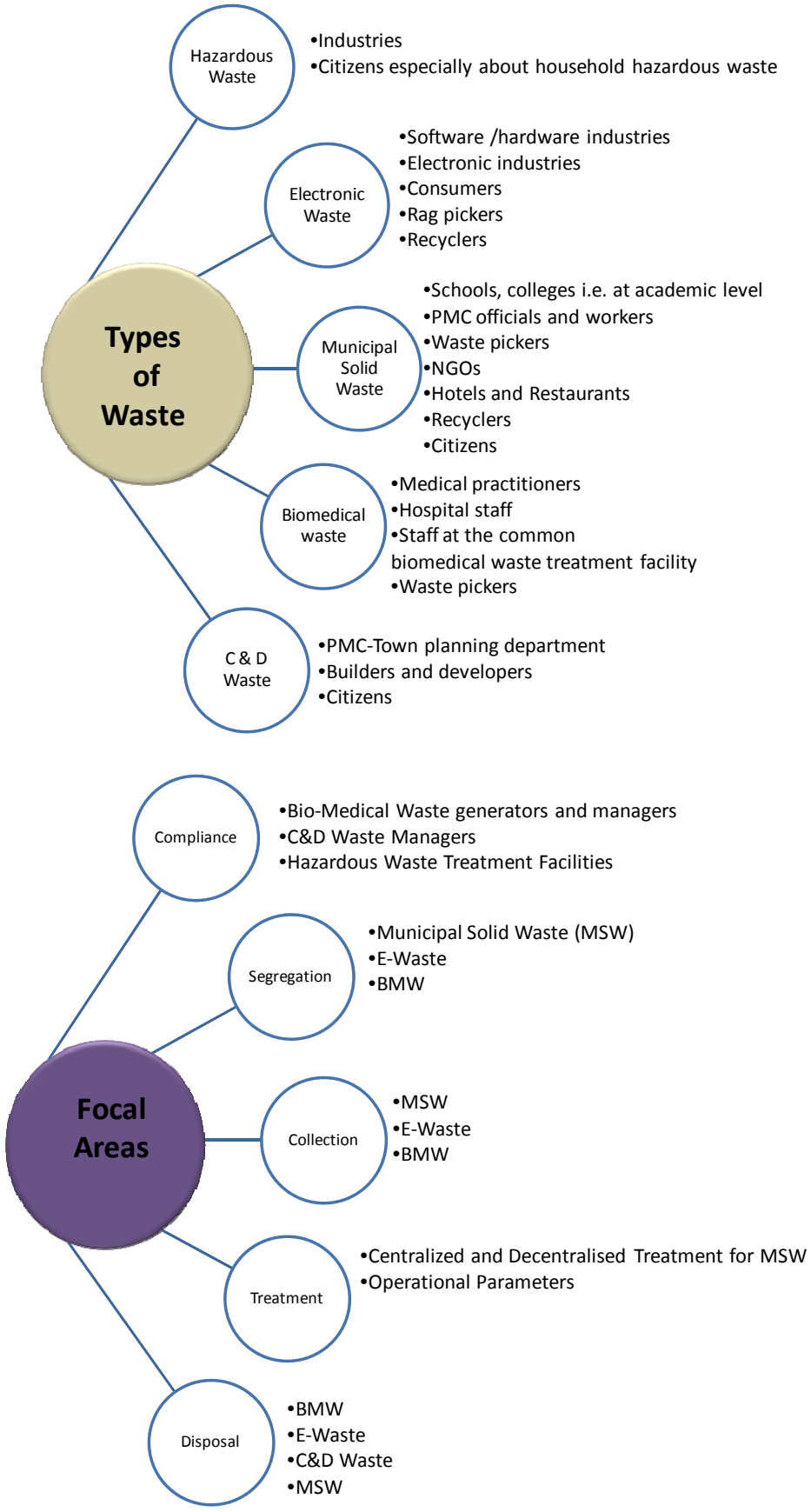
Identifying the target stakeholders is the first step of the program. This is followed by seeking a partnering organization that can assist in developing the content. It is useful to develop awareness programme in partnership so that the experience of the partner can factored in the programme. E.g. For an awareness programme on C&D waste the appropriate partner can be Promoter and Builder Association of Pune (PBAP). The next step is finalizing the content. Conducting the programme involves logistics of other procedures necessary for the same. The programme should then be evaluated and documented so that it can be further improved and updated. Sustaining the progress is the most important step in creating the awareness module. This can involve in creating a website that informs about the city updates and sending timely newsletters to the participants, forming discussion forums for the participants to interact after the award progress.



Creating and sustaining awareness

The Solid Waste is divided mainly into five different waste streams. Various stakeholders are associated with these different waste streams. The structure and the content of the awareness programme will change according to the waste stream and the stakeholders. The objective and expected outcome of the awareness programs will also be different according to waste streams and the group of stakeholder.

Types of waste and related stakeholder group who will benefit from the Awareness programmes



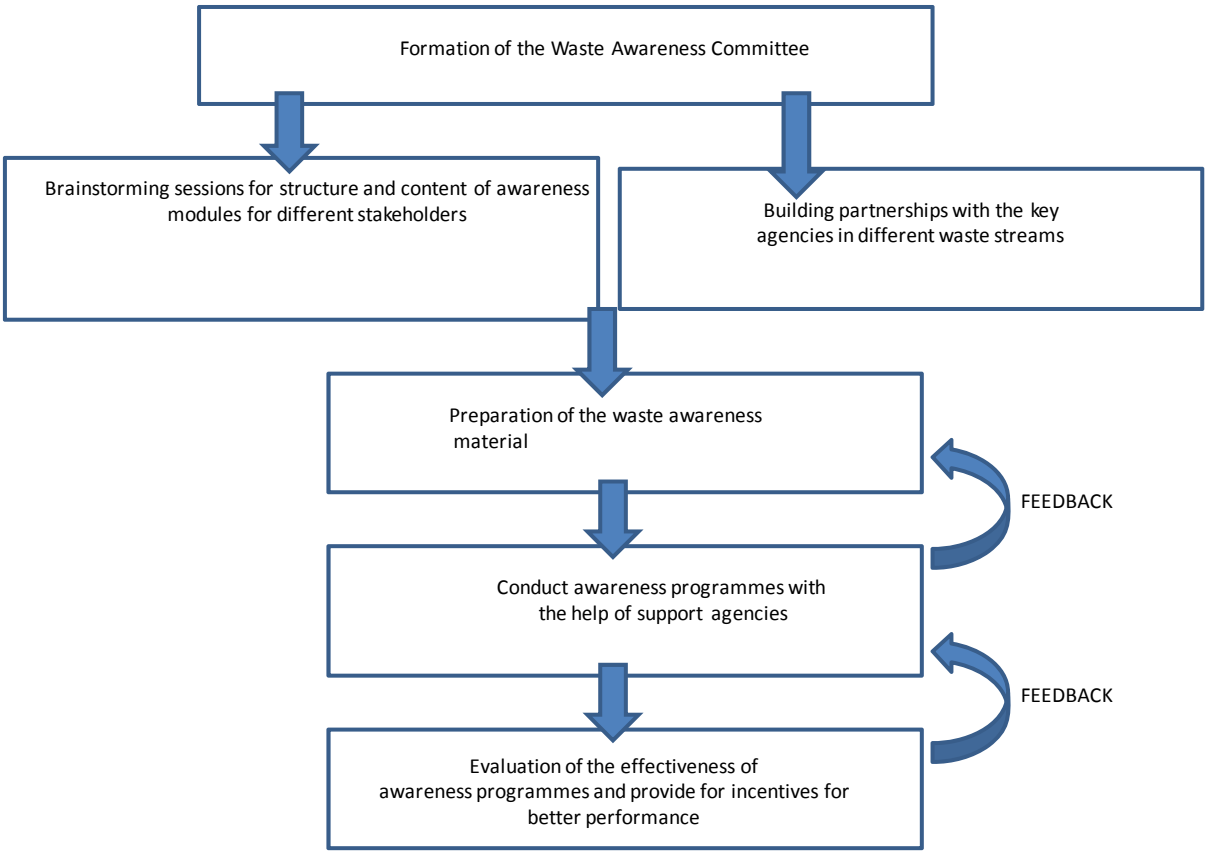
E.g.: For conducting an awareness programme for hotel it is necessary to compile information about the hotels and resorts, their ownership (e.g. whether a hotel is part of an international chain), their capacities (number of rooms) and occupancy rates, the resource-related pressures they are under; e.g. water and electricity, the

environmental issues they face; e.g. disposal of kitchen waste; whether there is any hotels association. Research and consultations on the best management practices towards hotel waste management would be useful in benchmarking the hotels.

Communities: An awareness programme for communities will mainly focus on stakeholders like local citizens, NGOs and other associations, government workers, institutions and school children and teachers. Awareness-raising mechanisms for communities are most effective when they take into account local conditions, language, culture, traditions, past experiences etc. Some of the mechanisms for conducting awareness programmes for communities include:

- One-to-one meetings;
- Seminars / conferences;
- Workshops;
- Organizing field visits;
- Holding or participating in exhibitions; and
- Conducting radio and television shows.
- Developing videos;
- Distributing brochures, banners, posters;
- Bringing out newsletters;
- Operating websites;
- Writing newspaper articles; and
- Publishing articles in scientific or business journals and periodicals.

11. **Implementation:** The pre-requisites for setting up the Waste Awareness Committee are some consultation and preparation stages as follows.



Role of Pune Municipal Corporation:

- Formation of the Awareness Committee consisting of academicians, professionals working in the field of waste management, NGOs, private sector participants and PMC officials

- Facilitate brainstorming sessions of this committee for the structure and modules of awareness programmes.
- Build partnerships with various support agencies for various waste streams.
- Conduct the awareness programmes.
- Facilitate preparation of awareness material
-

Formation of the Waste Awareness Committee:
Waste Awareness Committee should:

- Decide structure and content of the awareness programmes for various stakeholders and prepare modules for implementation
- Prepare the awareness material
- Conduct awareness programmes with the help of sectoral partner

12. <u>Benefits:</u> Increases awareness about waste related issues can lead to many possible benefits

- Responsible consumerism leading to reduction in the quantity of the waste
- Increased reuse and recycling of the waste
- Increased treatment of the waste
- Citizens' initiatives for better waste segregation
- Visually clean city
- Improved health and economical condition of the waste pickers
- Improved management of each waste stream

13. <u>Linkages to other schemes</u>:

- Establishment of the Environmental Awareness Centre
- Imparting Awareness and Training for BMW management
- Introducing Award Schemes
- Initiating Schools Involvement in Waste Management
- Improving Waste Management during Festivals

2. TAMING CONSUMPTION OF NON-BIODEGRADABLE PLASTICS

1. **Introduction:** The issue of plastic management has been a grave problem facing the modern times. Although plastics contribute to around 7% of the total waste in Pune, owing to their indiscriminate usage, non-degradability and lack of efficient end of life management, disposal of plastic wastes is becoming of increasing concern.

2. **Purpose:** Film packaging and polymer plastic bags are the major contributors to the plastic waste being dumped into municipal solid waste stream. Consumer behavior and pattern is one of the key players in the overall usage of plastic bags. Plastics owing to their non-degradability keep accumulating at the landfill sites, thus hampering the treatment of the other biodegradable waste as well. Further, the lack of defined regulations to prevent the usage of this non-biodegradable product makes matters worse. An attempt to introduce a state-wide ban (Maharashtra Non Biodegradable Garbage (Control Act), 2006) regarding the use of plastic bags failed due to lack of alternative options provided to the consumers. Hence in order to reduce the usage of plastics the option of biodegradable plastics needs to be assessed on techno-economical grounds.

3. **Target:**
   - To reduce the usage of plastics
   - Influencing the packaging waste generated through consumers as well as industries
   - To promote the use of biodegradable plastics

4. **Type:** Project

5. **Lead Agency:** Pune Municipal Corporation (PMC)

6. **Support Agency:** Plastic Waste Management sub-division of the ISWM Cell, PMC, Research Institutions such as National Chemical Laboratory, polymer manufacturers and users, NGOs', generators and housing societies.

7. **Location (Suggestions):** For awareness and promotion of the use of biodegradable plastics, the Environmental Awareness Centre may be used.

8. **Budget (Estimated):** Rs. 0.5 Million

9. **Time Frame (Estimated):**

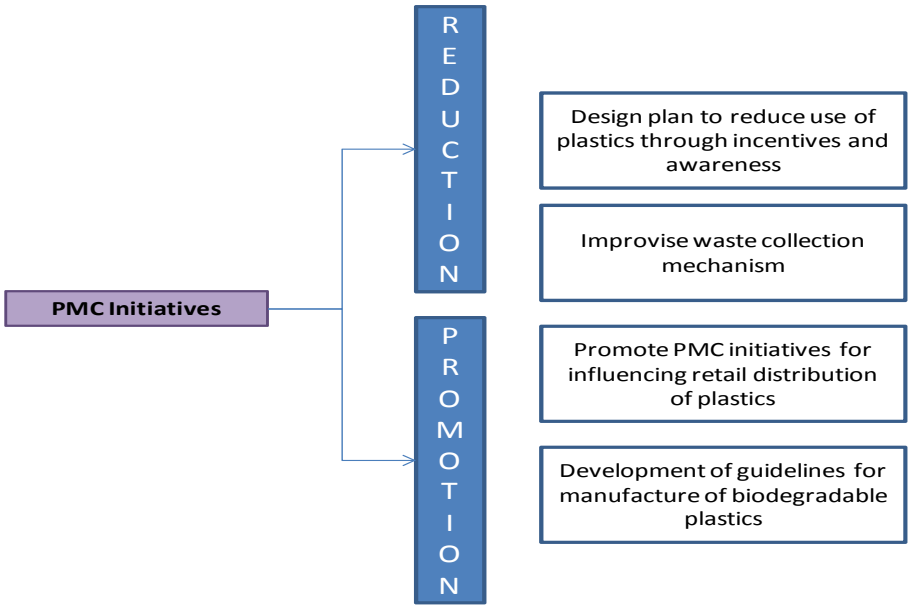
Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Provide incentives for reduction in usage of plastics															
Setting quality guidelines for biodegradable plastics: Setting packaging evaluation criteria															
Launching of award schemes															

10. **Description:** With a view to better manage the ever increasing problem of plastic wastes; PMC has introduced a ban on the usage of polymer bags below thickness of 50μm. Recycling of plastic wastes for exploring possibilities of refuse derived fuel such as plastic to petroleum/diesel needs to be examined. Proper collection and segregation of waste is a precursor to the successful application this waste to fuel project. Along with the application of waste to fuel or refuse derived fuels, research on the feasibility of introducing biodegradable plastics as an alternative for the conventional plastics needs to be investigated. Consumers play a significantly crucial role in the overall plastic waste management. The generation of plastics can be controlled and to a certain extent reduced through creating awareness amongst the consumers. Packaging related plastics are typically generated on a large-scale at the shopping malls. Mechanisms should be developed along with the mall co-operatives providing for incentive based mechanisms to encourage consumers to remove the packaging

waste at the malls. The collected plastic and packaging waste can then be directly supplied to the waste to energy processor.

Uses of biodegradable plastics: With the recent advancements within the industry, there are biodegradable plastics that replace virtually all traditional plastic products. Today there are biodegradable grocery bags, food packaging, disposable razors, toothbrushes, cups, suture threads, bone fixation, and many other things that are made from these environmentally friendly products. However, there is a need for setting standards for biodegradable plastics. In discussion with the manufacturers, PMC should look at developing specific quality guidelines for the manufacturing of biodegradable plastics.

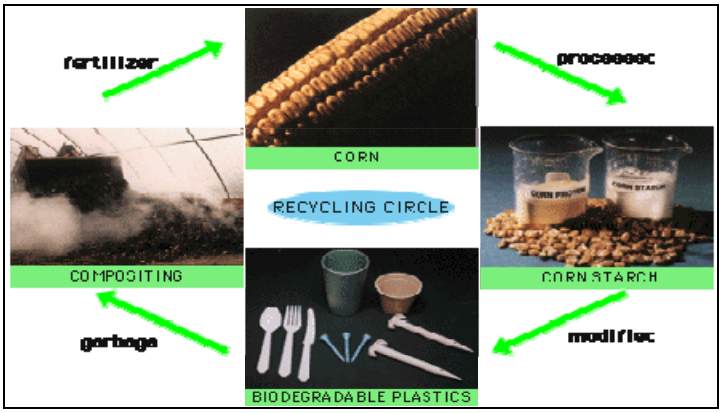
11. Implementation:



12. Other similar experiences:

Biodegradable Plastics

Biodegradable plastics are produced from renewable resources and which break down easily in the environment. When these biodegradable plastics are broken down by the microorganisms, they are decomposing into H_2O and CO_2. Traditional plastics cannot be broken down easily because of their longer chains of polymers that are tightly bonded. The renewable products which can be used for the manufacturing of Biodegradable Plastics include starch based materials, cellulose, chitin or chitosan, casein, Polylactic Acid (PLA) amongst others. The overall mechanism of development and use of biodegradable plastics have been explained in the following figure[1].



[1] Data on Chempedia

Oil generation from plastics waste using pyrolysis: case study

Developing countries are generating more and more plastic waste, particularly polyvinyl chloride (PVC), for which no treatment method is satisfactory other than disposal in landfills. More recently (UNEP-IETC, 1997) Toshiba's Environmental System Engineering and Construction Department has established a method of converting plastic waste to oil. The system allows for continuous treatment of plastic waste, without separation of PVC. No harmful by-products are generated.

The process involved crushing or powdering the thermo-plastic waste, which is then introduced into the de-chlorination apparatus and heated to 300°C with agitation. Hydrochloric acid generated is absorbed into water and collected. The mixed de-chlorinated thermo-plastic material is then pyrolysed at 400-450°C using thermal degradation to break down the long molecular chains of the polymers. The product variety depends on the material input. The oil obtained is distilled to kerosene, diesel oil, and heavy oil based on flash point, viscosity, distillation profile and specific gravity as for commercial fuel oil. The yield ranges between 50-80% when the PVC content is 10-50%. The heating value of the oil produced is 11kcal/g which is equivalent to that of commercial fuel oil.

In all pyrolysis units there is a net energy gain. The products of pyrolysis could be easily stored unlike the products of incineration. Air pollution from pyrolysis is less while proper destruction of waste is achieved[2].

13. Benefits:

- Management of Plastic Waste would become more convenient and easy to handle
- Nuisance due to Plastic Waste would be avoided
- Overall reduction in quantum of waste generated
- Plastic Wastes would not get mixed with MSW and avoid the use of landfill space
- Cost Benefits of recycling Plastic Waste
- Preventing the pollution possibility due to improper handling of plastic wastes
- Generation of refuse-derived fuel.

14. Links to other ISWM Pune Schemes:

- Establishment of Integrated Solid Waste Management Cell (ISWM Cell) and website
- Establishment of Waste Exchange Centre
- Establishment of Environmental Awareness Centre
- Design and launch of a Comprehensive Campaign on ISWM
- Private partnerships in waste collection and management system

2 Agamuthu, P. (2001), Solid Waste: Principles and Management: with Malaysian case studies, printed at University of Malaya Press, Kuala Lumpur

3. IMPARTING AWARENESS AND TRAINING FOR BMW MANAGEMENT

1. **Introduction: "Bio-medical waste" (BMW)** means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals. This definition is acknowledged by Ministry of Environment & Forest (MoEF), Government of India (GoI).

   Pune has over 565 Health Care Facilities (HCFs) roughly amounting to 6829 beds. Owing to the absence of any data on the total quantum of waste generation, a preliminary estimate using the accepted estimation method[1] of accounting 0.375 Kg of BMW per bed has been used. Thus the generation from these hospitals is estimated to be around 2560 kg/day.
   As per the details provided by the service provider, approximately only 1200 kg/day of BMW is currently being treated. Other than the common treatment facility, BMW generated by two prime hospitals amounting to 1250 beds (470kg/day) are treated at their own treatment plants.

2. **Purpose:** The current amount of waste being received by the central processing facility on Bio-Medical Waste reflects the awareness among the medical practitioners of Pune. The BMW has been classified into ten categories and these rules have come into effect since 20th July, 1998. Schedules for BMW treatment shows the implementation of prescribed treatment and processing of BMW should be implemented latest by 31st December, 2002.

   BMW generator could be any institution generating bio-medical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, research centre or blood bank in its premises as per MoEF, GoI.
   The rest of the BMW is being mixed with the Municipal Solid Waste (MSW) hence the amount reaching the central processing facility is less than the amount of BMW is being generated. Potential health hazards from BMW are listed below:

Type of waste	Health hazard
Sharps	Injury to hospital staff and waste handlers
Dressing material & bandages	Infection
Discarded medicines	Adverse effect on health of humans as well as animal
Disposable medical waste	Cross infections and death
Cytotoxins	Inhibition of cell growth and multiplication
Liquid waste and container	Injury and infection to visiting family members and waste & handlers

   The lack of awareness on BMW and the required training to carry out the proper handling and storage can lead to disaster any time if the infectious waste or BMW is improperly handled, stored, transported or processed. Thus awareness and training on BMW management becomes most crucial.

3. **Target**:
   - To create awareness among entire medical fraternity
   - To ensure BMW rules are complied.
   - To ensure continual efforts being made to protect public health.
   - To train medical staff, medical students on the health hazards of BMW and their proper segregation and management

4. **Type:** Programme

[1] "Manual on Municipal Solid Waste Management" Central Public Health & Environmental Engineering Organization

5. **Lead Agency:** MPCB and PMC

6. **Support Agency:** BMW Management Service Providers, NGOs and other Medical associations and institutions.

7. **Location (Suggested):** Awareness and training for segregation and proper disposal of BMW can be done at the Environmental Awareness Centre or at the individual hospitals/medical institutions.

8. **Budget (Estimated):** Rs 1 Million

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Identifying key stakeholders															
Development and conducting of Customized Training packages for each stakeholder															
Strengthening of medical curriculum for students															
Development of workshops and seminars (Training of Trainers)															

10. **Description:** In order to avoid or prevent such probabilities of health hazard on general public, awareness among the medical practioners is essential. Adequate training can reinforce the knowledge and it will make everyone from medicinal fraternity to move towards the self compliance to BMW rules laid by MoEF, GoI.

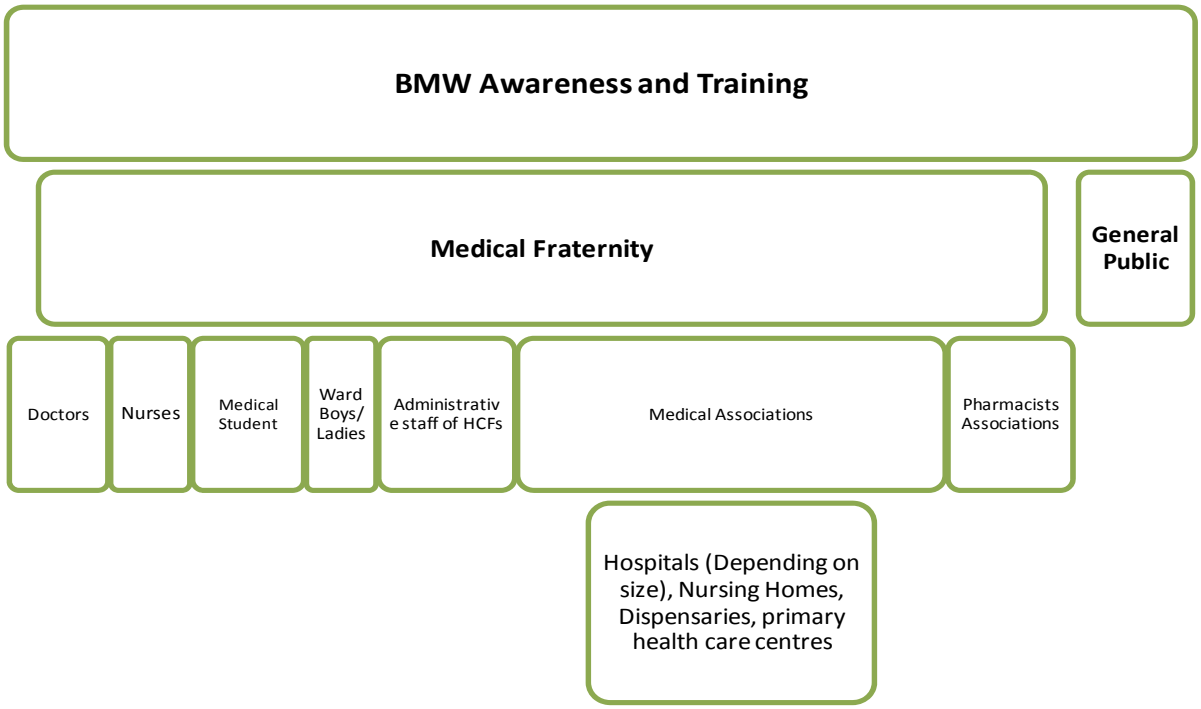
    A series of awareness and training programmes should be carried out to cover everyone and sensitise them on BMW management. Schedules are to be arranged as such that the awareness regarding the BMW rules, 1998 becomes more intense. Actions to be taken are mentioned below:

    1. Programmes on Awareness and Training to be carried out by local municipal body along with regulatory bodies like Maharashtra Pollution Control Board (MPCB), Central Pollution Control Board (CPCB), various stakeholders from all Health Care Facilities, related Associations and General Public. Every year such event can be organized. This will help in sensitizing medical associations with regulations requirements and facilities in local area for achieving the same.
    2. After that each big Hospital could be identified in each ward and similarly it can spread the awareness and train the medical staff with the help from Medical Associations and Pharmacists Association. Awareness and Training Programmes could be carried out in every quarter of respective financial year.
    3. While carrying out such programmes, whole staff would be benefited by undergoing such programmes. Rotation of the staff for programmes can cover entire population of medical practioners and people associated with them directly and indirectly. The awareness and training will make associated staff practice BMW rules more effectively.
    4. General public visits HCFs for various purposes i.e. for treatment, to visit their relatives, for office work, people like security guards, suppliers, mechanics etc. also visit HCFs on requirement. For them also such programmes can be integrated with pre-scheduled programmes. Their involvement would make them conscious and hence programmes would be highly effective.
    5. Posters, Pictures, Exhibitions can be arranged to have a multiplier effect on the front of spreading awareness on BMW.
    6. At every year end again the local municipal body would organise a programme and can review the progress and current status of that time. Accordingly new targets could be identified to make it continual activity.
    7. Awareness and training programmes as well as quarterly compliance checks at the common BMW management facility should be conducted to train staff at the facilities.
    8. Awareness campaigns should be conducted to educate students on household BMW and effective disposal of the same. This programme should target the PMC staff and students so that there is minimization of gaps.

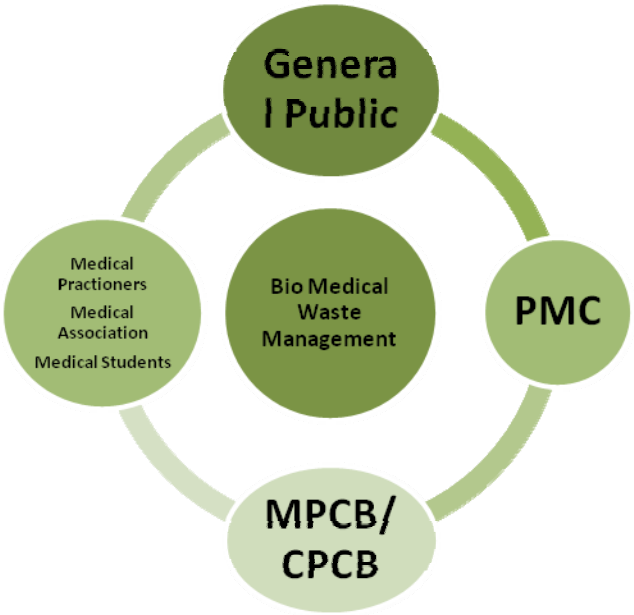
11. **Implementation:**

Target Group

To ensure that everyone from medical fraternity have participated in the awareness programme and trained so that health hazards and risks due to handling BMW are minimized.



As seen in the above figure, two main streams need to be addressed, primarily from medical fraternity and subsequently it should reach to the general public who are visiting the HCFs for various treatments and purposes. Awareness and Training Sessions should be arranged keeping these relationships in view:



(Pune Municipal Corporation has been taken for such yearly programmes, other HCFs/ Medical Association can arrange individually for their programmes)

Awareness and training sessions on BMW management would take into consideration the following points:

1. All steps to be taken to handle BMW safely
2. All stakeholders to segregate, treat and dispose BMW properly. Usually to be sent to the service provider for treatment and disposal
3. Waste should be segregated into specified containers and bags which should be labeled properly with the information of the type of waste
4. Waste should be transported in a vehicle that is authorized for the same purpose by competent authority the BMW service provider should provide for safe collection and transportation

5. Generators of BMW should set up requisite BMW treatment facilities to ensure the same at a common waste treatment facility.
6. Waste generators or service providers should not store untreated BMW beyond a period of 48 hours
7. The competent authority should provide for suitable common disposal/incineration site through a common service provider. Such a provider should be well-equipped to handle the waste.

12. Other similar experiences:

Developing Web-based Knowledge Site for Bio Medical Waste Management in Bangalore City[2]: Lack of awareness and technical guidance in the management of biomedical waste has led to the hospitals becoming a hub in spreading diseases, rather than working towards eradicating them. Hence there is a need for resource material on environment for hospital administrators, surgeons, doctors, nurses, paramedical staff and waste retrievers. As the hospitals in Bangalore already make use of internet facilities, a web based knowledge site on Bio-Medical waste management would be an ideal way to increase awareness among the hospital staff and also help in research to derive at best practices in Bio-Medical waste management. As the hospital staff are very busy and work without a fixed schedule (due to emergency cases), the web based learning would help them in a great way as they can access to the net as and when they require and within the hospital premises itself. The general objectives of the project are to promote efficient dissemination of information, improve existing bio-medical waste management techniques, and reduce pollution and health hazards. The proposed elements of the knowledge-base on bio-medical waste management would be Web based dynamic information resource; Access to experts for chat sessions, Discussion forums to share their experiences, case studies and success stories will also be hosted on the web which would be a valuable source of information. The anticipated Project outcome would be:

- Increase in awareness levels
- Development of best practices on bio-medical waste management
- Better environment and health
- Helps the decision makers
- Society as a whole would also benefit from the project as a clean and healthy environment is what every one expects.
- Replication of the project to other cities

Bio-Medical Waste Management in North-Zone in India[3]: In order to effectively implement the bio-medical waste management rules a comprehensive survey and monitoring was undertaken at various hospitals in Uttar Pradesh. In all thirty-three medical establishments were inspected and monitoring conducted for incinerators which are installed as per norms.

Observations

- The segregation of waste in almost all hospitals is not satisfactory.
- Colour coding for various categories of waste is not followed.
- The storage of bio-medical waste is not in isolated area and proper hygiene is not maintained.
- Personal protective equipment and accessories are not provided.
- Most of the hospitals do not have proper waste treatment and disposal facilities. In the cities where common treatment facilities have come up, many medical establishments are yet to join the common facility.
- Emission monitoring of five incinerators indicated that they do not meet the emission norms.
- Most of the incinerators are not properly operated and maintained, resulting in poor performance.
- Sometimes plastics are also incinerated leading to possible emission of harmful gases.
- Several hospitals have not applied to State Pollution Control Board for authorization under the rules.
- General awareness among the hospital staff regarding bio-medical waste is lacking.

Recommendations and Follow-up

- All health care facilities generating Bio-medical waste shall strictly ensure segregation, colour coding and

[2] Source: http://www.idrc.ca/panasia/ev-21256-201-1-DO_TOPIC.html
[3] Source: http://www.cpcb.nic.in/Highlights/Highlights02/ch-10.html

other provisions of Bio-medical waste (Management & Handling) rules, 1998 and amendments thereof.

- Hospitals should apply to state Pollution Control Board for authorization to handle and treat the waste.
- Incinerators, which do not conform the design & emission norms as per rules, must be modified and air pollution control system may be retrofitted to minimize the emission level.
- The operator should ensure proper O&M of incinerator through attainment of required temperature in both the chambers, regular operation of the incinerator, proper maintenance of the logbook and storage of the waste in isolated area, plastic incineration should not be undertaken.
- Proper training and personal safety equipment / accessories should be provided to waste handling staff.
- Records of waste generation, treatment and disposal should be maintained by the hospital.
- Steps should be taken to set up common bio waste treatment facility in each city/town with strict monitoring of these facilities by regulatory agency and individual facilities should be discouraged. This is on account of the fact that improper operation may lead to increase in air pollution problem. Better siting, management and monitoring is possible in common facilities only.
- The amounts changeable for the waste in most of the common facilities are for below the minimum O&M cost. This needs to be rationalized else it may lead to non-operation of facilities.
- Various regulatory agencies, Hospitals, Medical Association & Municipal Corporation should work together for proper management of Bio-medical waste in the cities/towns.

Action has been initiated against 3 medical colleges (KGMC, Lucknow, GSVM, Kanpur and JLN Medical College, Aligarh) having bed capacities more than 1000 that do not manage the bio-medical waste as per rules. Steps are also being taken against other hospitals, which do not follow the rules and operate the incinerators, to meet the emission norms. A project on 'Model Segregation Practices' was also completed in Vivekanand Polyclinic, Lucknow and in Govt. Medical College Jammu for practical demonstration of segregation of bio-medical waste in bio-medical waste management.

Bio-medical Waste Management in Himachal Pradesh[4]: The Himachal Pradesh State Environment Protection & Pollution Control Board has conducted study in major hospitals. It has been decided to set up the demonstration model named Dr. Rajinder Prasad Govt. Medical college & Hospital at Dharmshala with following objectives;

- Assessment of existing waste management practices.
- Classification, quantification & characterization of waste streams.
- The hospital is having 258 beds and equipped with all the medical facilities like Emergency, Maternity, Gynecology & Child wards, ENT Deptt., Surgical, Orthopaediatric, OPD, Blood Bank and other radiological facilities. The quantity of bio-medical waste generation is estimated to be 100 kg/day. Besides this 30 lit./day of liquid waste is being generated from washing of laboratories and kitchen. As per the data, per bed waste generation is estimated as 380 gm/day. Major contribution is from disposable, waste sharp and soiled waste. The following methods are adopted in the hospital;
- Provisions of needle destroyer in some wards. Discarded needles and syringes are rarely destroyed and disinfected.
- The transportation of waste by hand lifting in the bins or gunny bags.
- Final treatment of waste by incineration.

Lack of awareness amongst the hospital staff including doctors towards the segregation of infectious waste is one of the main reasons for mismanagement of Bio-medical waste in the hospital. Mass awareness programme for management of bio-medical waste should be carried out at regular interval.

13. Benefits:

- Better management of BMW
- Reduction in health hazards from BMW

14. Links to other ISWM Pune Schemes:

- Design and Launch of a Comprehensive Awareness Campaign on ISWM
- Introducing Award Schemes
- Improving Health and Safety of PMC workers, Rag-Pickers and Citizens in proximity of landfills
- Private Partnerships in waste collection and management system

[4] Source: http://www.cpcb.nic.in/Highlights/Highlights02/ch-10.html

4. INITIATING SCHOOLS' INVOLVEMENT IN WASTE MANAGEMENT

1. **Introduction**: Influencing school children, is actually building a more aware and a environmentally conscious generation for tomorrow. This programme envisages self assessment of environmental practices at the schools and promotes waste minimization and management through hands-on experience.

2. **Purpose:** This scheme aims to not only achieve awareness of waste management at an early stage but also involves them in real life awareness campaigns. By building awareness amongst children and school staff they can be actually involved in promoting awareness to the other citizens of the city. School children, teachers and parents are important stakeholders to be targeted, made aware and encouraged to take action for efficient waste management.

3. **Target**: To set up various initiatives to educate and involve school children in waste management activities

4. **Type:** Programme

5. **Lead Agency:** Pune Municipal Corporation (PMC), citizens

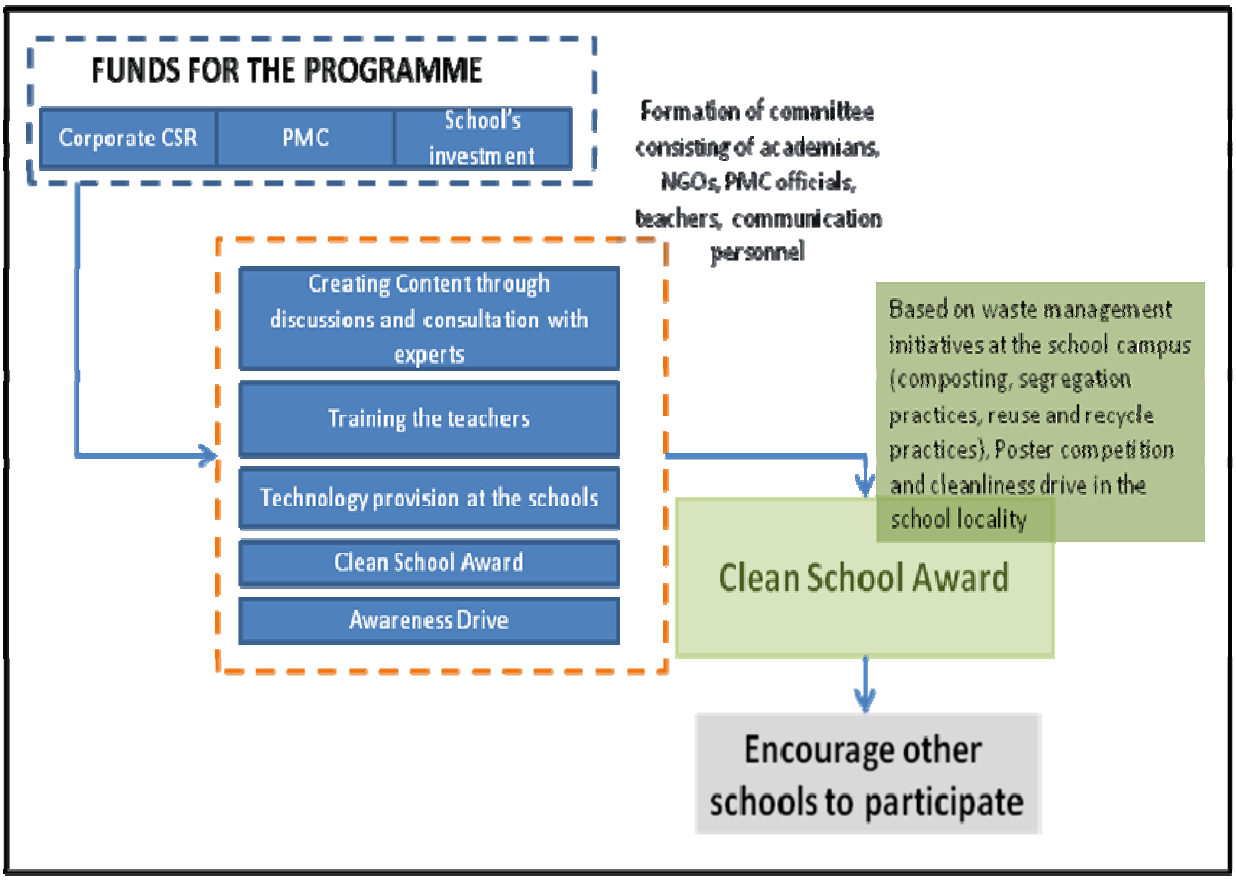
6. **Support Agency:** Academicians, educational institutions, NGO's

7. **Location:** Such as programme can be launched at schools in the wards such as Vishrambagwada, Kasaba Peth and Bibvewadi which have higher waste generation than other wards. This can set an example for the schools in all other wards in the city.

8. **Budget (Estimated):** Rs. 1 Million. PMC should provide funds for various schools. Roughly an amount of Rs. 50,000 should be provided to each school.

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Formation of a Committee consisting of PMC officials, academicians, NGOs working n the field of Environment and Education, and some communication personnel, Identification of schools															
Designing content for training workshops															
Trainers' training workshop															
Workshops and innovative competitions amongst schools															
Evaluation of Benefits and linkages to Chakachak Mission															



10. **Description:** A committee as a part of the Environmental Awareness Centre (EAC), should be formed consisting of academicians, NGOs working in the field of Environment and Education, Teachers, communication personnel and concerned PMC officials. The Committee should undergo brainstorming session for determining and developing the content and the various modules for creating awareness about various waste issues in school children. Once the modules and the content are finalized the preparation material can be prepared. One session should be done with the principals of all the private and municipal schools for them to understand the importance of introduction of specialized module on waste awareness and accepting and willing to take the initiative in their school. The consultant appointed for this project should assist PMC in identifying partners for generating the amount required for the development of such awareness programmes.

    The training of the trainers approach should be followed. A workshop should be arranged for the teachers of the schools who teach Environmental Sciences. The teachers should be exposed to various issues in waste handling and management. They should be updated with the innovative methods of treatment of wastes and new trends in 3Rs.Various communication strategies should be introduced. A lot of communication and awareness material and lot of references for further reading should be given to the participant teachers. The teachers should also be encouraged to train themselves in practical knowledge such as getting hands-on experience in vermi-composting pits etc. The teachers can then train the students on the waste management topics and give practical guidance. The schools should be motivated to involve in such activities by providing award facilities and chances to perform at common functions such as Ganesh Festivals. Inter-school competitions should be organized to evaluate the scale of simple waste management practices at the school level. The results and announcements regarding such competitions should be displayed on the EAC. The schools should organize day campaigns to educate the societies around the school on proper waste segregation and management procedures. Children and the school can benefit by selling a few products through waste to art campaigns.

PMC should facilitate the schools with various infrastructural amenities such as construction of vermi-composting pits as well as awards and recognition to various schools undertaking the waste management initiatives. PMC currently involves students or children (as per different wards) to form the "*Chakachak Tolis*". These *tolis* undertake various waste awareness programmes. This project however, currently does not include schools. Hence the *Chakachak Mission* should be modified to include schools and thereby result in *Chakachak Schools* practicing waste management practices.

11. Implementation:

Role of Pune Municipality:

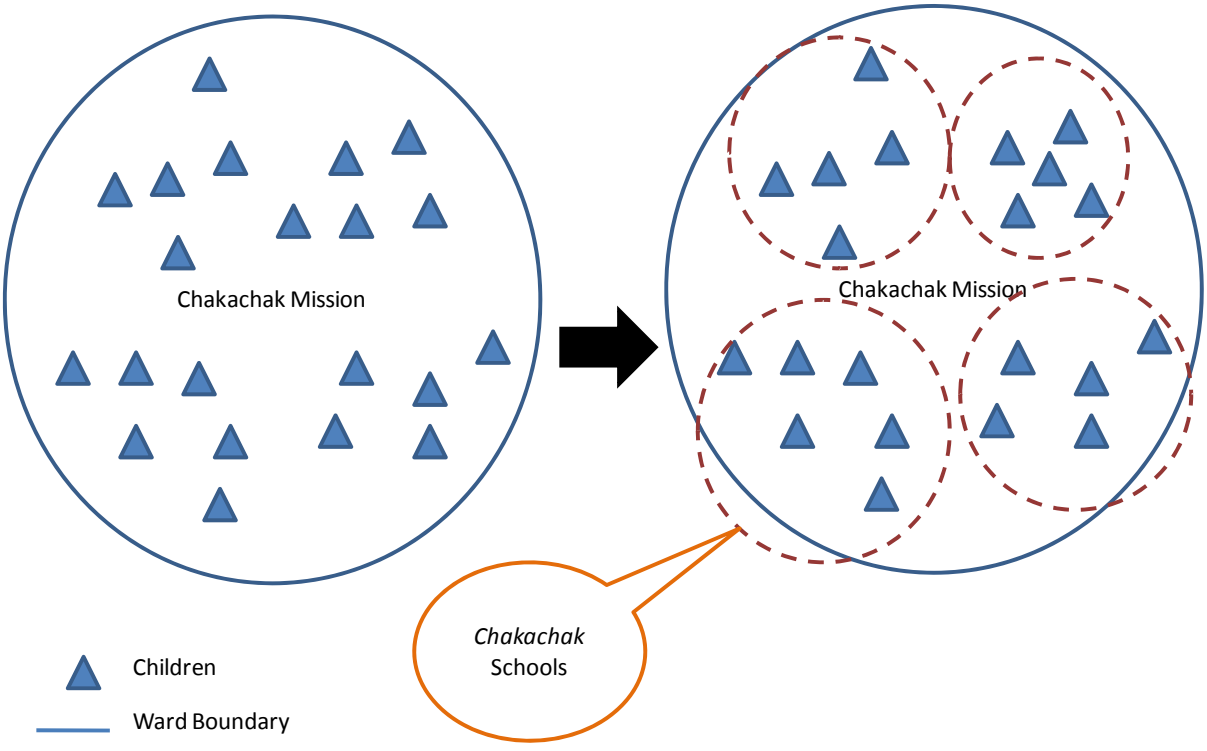
- Formation of the Committee with the experts
- Facilitate the brainstorming session for development of the content of waste awareness modules.
- Make proposals to the funding agencies for the support for the preparation of the awareness material.

Formation of the Committee:

The committee will consist of academic experts, representative principals and teachers, NGOs working in Environment and Education and concerned PMC officials.

The Committee should:

- Develop the content for the awareness modules and other awareness material
- Conduct teachers' Training workshop to train them to conduct he similar modules ta their respective schools



12. Other similar experiences:

Some of initiatives at school level that have taken place so far in India are mentioned below.

Going to School (GTS): GTS was started by Lisa Heydlauff, an Ashoka Fellow, four years ago, with the hope that creative media could act as an agent of social change, to make going to school relevant to children's lives in India. Since then, Going to School has demonstrated its ability to create media that inspires children, their families and communities; addressing the core social needs of education, employment, gender equity and equal opportunities for all. GTS' journey began with the celebration of school-going experiences of children all over India in a book called Going to School in India; hundreds of thousands of mini books were distributed to Government schools free of cost followed by the creation of 10 small movies that worked to inspire change and are currently on air on TV channels in India reaching over 50 million children. Both the books and movies have won international awards. And most recently, GTS was supported by UNICEF in the creation of Girl Stars, a series of 15 movies, which create icons out of everyday women and girls who have changed their lives by going to school. In 2007, over one million Girl Stars storybooks will be distributed to Government Schools reaching over 25 million girls at risk from dropping out of school. GTS stories have also been incorporated in Government of India NCERT textbooks appearing in 10 million textbooks and reaching at least 10 million children.

Kids Clean up Act: Development Alternatives (DA), an NGO, organized a meet named Community Led Environment Action Network (CLEAN) in New Delhi in February 2004. DA started the CLEAN-India program in 1996 with the belief that children can be powerful agents of change. Whether they are fighting against use of crackers and polythene bags or promoting eco-friendly festivals or paper recycling - when children talk, parents do listen. Today the CLEAN-India network has 25 schools across the country that work with NGOs, civic bodies and corporate organizations to improve the environment. The CLEAN-India meet is an annual feature and an opportunity for the members to interact and share their concerns about the environment.

At the 2004 meet, students (about 400 in the age group of 10-17) attended workshops on topics like concern for animals, the use of toxic chemicals in food, and waste paper recycling. The children also put up colorful displays in stalls, offering some solutions to environmental problems. Some students also suggested that during festivals like Durga Puja (worship of goddess Durga) and Ganesha Chaturthi (worship of god Ganesha) unbaked and unpainted idols should be immersed in rivers and lakes. In fact, students of Bharatiya Vidya Bhavan Kendra, Aurangabad (Maharashtra), described what they did during the last Ganesha festival. They collected all the flowers given as offerings from 400,000 people, and instead of throwing them into the river, decomposed them to use as fertilizer. The Aurangabad school students also showed how, with the help of wriggly worms (also on display), plastic bags and soil, organic kitchen waste can be converted into fertilizer and vegetables can be grown in these bags. The brinjal (eggplant) and ladies' finger (okra) growing in the plastic bags made a compelling argument.Two Delhi schools, Sanskriti and Gyan Mandir put up a prize-winning exhibition on paper recycling. They showed how old newspapers and paper waste are converted into recycled paper. Students of Amity International School (Delhi) have been ecologically active in the H-block of Saket. With the help of the community and the Municipal Corporation of Delhi (MCD), they have set up a solid waste management system. The garbage is segregated into wet, dry and hazardous waste. The wet and dry waste is thrown in red and blue bins while the hazardous waste goes into special bins supplied by MCD. Residents have responded very positively to this initiative. At the meet, Dikshit also launched CLEAN Pages (a Delhi Environment Directory) and handed over the first copy to Naini Jayaseelan, Secretary, Department of Environment. The directory is a guide for citizens who want to be involved in environment conservation.

***Chakachak* Mission**: *Chakachak Mission* is intended towards increase in segregation targeting the students. Realizing the significance of segregation, the PMC has launched an awareness raising campaign called as the "ChakaChak Mission". This mission, with the active participation of schools, launches awareness drives in order to educate the denizens about the importance and steps of segregation. Groups comprising of 4-10 students are formed and are advised to involve their families in cleaning and beautifying the surroundings.

These groups nock-named "ChakaChak Tolis" meet once a week and plan their work with inputs from the Ward Medical Officers of the PMC. In order to further propagate this mission, a short documentary film has been made by noted film director Sai Paranjpe. This film along with the drives has created significant awareness. Zero waste days are observed on 1st January, 26th January, 15th August and Gudi Padwa (Maharashtrian New Year day)

Not just Walk in the park: Awareness Drive for Children: As the name suggests it's not just another walk, it in fact a fun way to **learn, realize and feel Nature**. It is an attempt to give a new perspective to look at Urban Parks. This programme received a fair amount of positive response from children and has a potential of being a citywide movement through partnerships. This programme comprised of three parts, the nature trail, Demonstration of Vermi composting that can be carried out at Household level and Eco-mapping.

13. Benefits:

- Awareness about waste could be reached to the youngest people in the society who are citizens to be.
- The awareness indirectly reaches every house in the city
- Schools can enhance their image by demonstrating their responsibility to the environment and society.

14. Links to other ISWM Pune Schemes:

- Introducing award schemes
- Establishment of Environmental Awareness Centre
- Introducing Industry-University Partnerships
- Improving Waste Management during Festivals
- Design and Launch of a Comprehensive Awareness Campaign on ISWM

5. INTORDUCING AWARD SCHEMES

1. **Introduction:** The ISWM plan has been developed using the participatory approach. Various stakeholders have been identified and involved during the evolution of the plan. The successful implementation of the same hinges on the support of different parties in the overall ISWM process. Hence motivating the stakeholders becomes an important step in the process. Introduction of annual and biannual award scheme is another method of encouraging workforce and citizens. For some stakeholders like the rag pickers, a financial incentive leads to fair amount of motivation.

2. **Purpose:** The purpose of the award scheme is to create a competitive spirit amongst the group of different stakeholders. It will lead to better waste management, may help in finding innovative ways for reuse and recycle of waste. Ultimately this will lead to the mission of visually clean city. The competitive spirit will hence help channelizing the efforts of various communities towards effective Solid Waste Management e.g. during Ganesh Festivals such competitions can help propagating the concept of environmental friendly festivities.

3. **Target**: To introduce annual/biannual awards for the administrative wards in the city of Pune to encourage better solid waste management.

4. **Type:** Programme

5. **Lead Agency:** Pune Municipal Corporation (PMC)

6. **Support Agency:** Maharashtra Pollution Control Board (MPCB), Maratha Chamber of Commerce, Industries and Agriculture (MCCIA), NGOs, generators and housing societies.

7. **Location (suggested):** PMC office or the Environmental Awareness Centre.

8. **Budget (Estimated):**Rs 0.5 Million

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Formulation of an administrative committee															
Development of Forms and Procedures along with evaluation criteria for the awards															
Assisting PMC in partnering with the industry in order to raise corpus for awards															
Launching of awards															

10. **Description:** Awards schemes can be designed to assess environmental performance of EACs, CSCs, Schools (participating in the Schools Initiative), NGOs, and Wards etc. For implementation of this scheme the lead agency has to have the performance indicators for the awards. These performance indicators need to be communicated properly to the participating organizations. The information of the same can be given through ISWM cell and website.

    The awards could be given by PMC with the facilitation from some industrial institutions like Maharatta Chamber of Commerce and Agriculture (MCCIA) or an NGO. The PMC has an important role to play for the success of the scheme. The schemes should be crafted in terms of win-win situation for industries and PMC. The sponsorship for the awards should be given from technology providers and interested stakeholders e.g. Decentralized technology

providers should present awards for wards with maximum decentralized treatment. PMC should in such cases help in providing facilities to the technology provider for setting up plants in that area Thus a symbiotic co-operation between the PMC, industry and public should be nurtured through award schemes.

Role of Pune Municipal Corporation:

- There should be properly set performance indicators for the participant wards to follow. Co-ordinate the meetings with the waste management experts to fix the performance indicators.
- Appoint a Committee consisting of specialists in the various aspects of the field of waste management, sanitation and health, municipal officers in charge of solid waste management.
- Facilitate frequent visits for observation.

Formation of the Committee:

- The Committee will consist of specialists in the various aspects of the field of waste management, sanitation and health, municipal officers in charge of solid waste management.

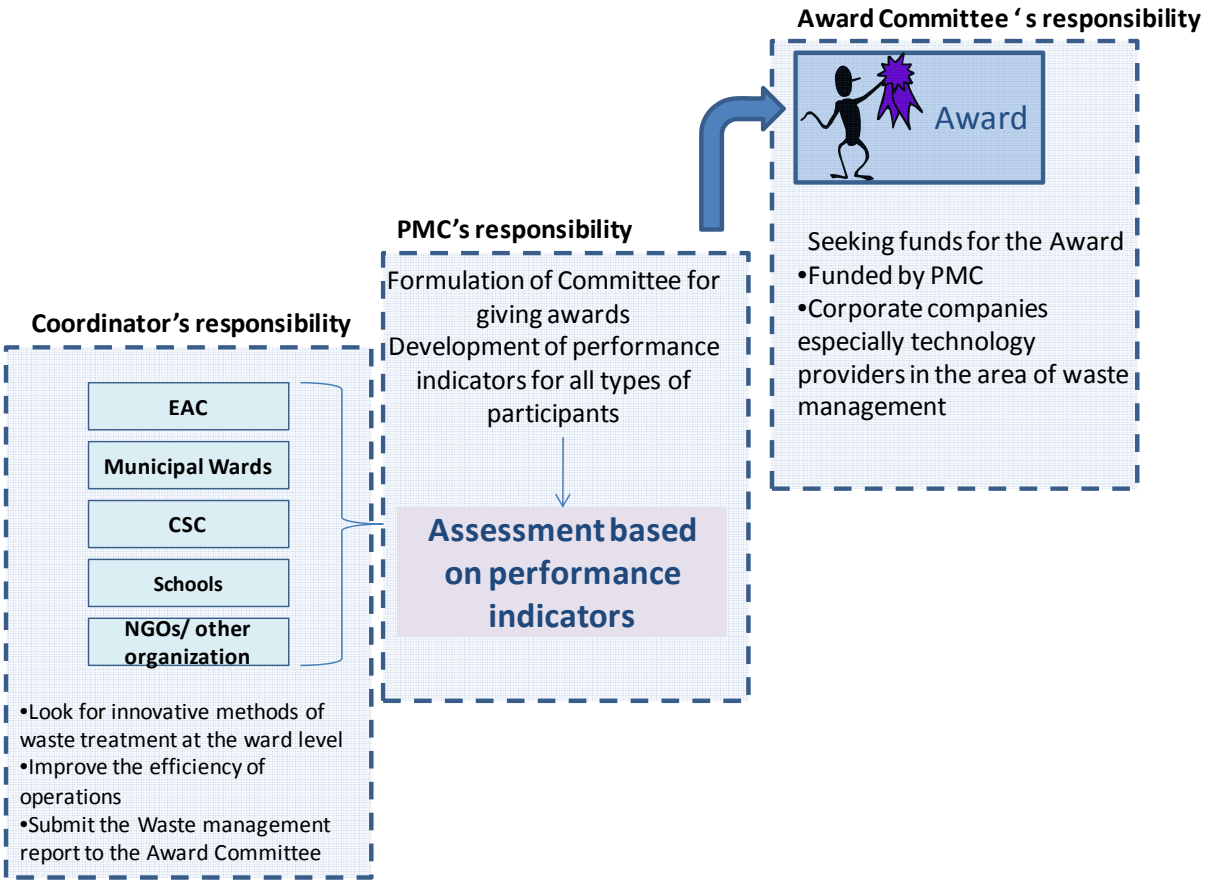
The award Committee should:

- Develop performance indicators for the award for various participating organizations. The set of the performance indicators for the competition between NGOs, EAC, Wards, or CSCs should be different, each based on the operations carried out.
- Conduct the meetings of authorities taking care of solid waste management and explain the criteria and the performance indicators for the awards.

Responsibilities of the Ward Medical Officers, EAC coordinators, CSC co-coordinators and NGO heads:

- Look for innovative methods of waste treatment at the ward level
- Improve the efficiency of operations
- Submit the Waste management report to the Award Committee

11. <u>Implementation:</u>



12. <u>Other similar experiences:</u>

WRAP award for business entities

The Waste Reduction Awards Program (WRAP) is administered by the California Integrated Waste Management Board. WRAP provides an opportunity for California businesses to gain public recognition for their outstanding waste reduction efforts and lets community know your business takes waste reduction seriously.

All businesses and private nonprofit organizations with California facilities are encouraged to apply for an annual WRAP award. Each business will be evaluated individually, based upon its own accomplishments. Award winners receive authorization to use the WRAP winner logo with their products, advertising, and business websites to publicize waste reduction efforts.

The Sant Gadge Baba Swachata Abhiyan or the Clean Village Campaign as it is named has infused a tremendous sense of community spirit among villages, their Panchayats and village organisations in rural Maharashtra. The Abhiyan or Campaign sponsored by the Government of Maharashtra aimed at promoting a competitive spirit among villages to create a clean environment through community self-initiatives.

These efforts were sponsored by the **Rural Water Supply and Sanitation department** without any subsidy of Grants. In turn, the Government rewards winning villages at the district, division and state levels.11 parameters

related to sanitation have been defined for this purpose. These parameters have been further sub-divided into 145 parameters for objective and impartial assessment of cleanliness status.
The state has set out elaborate guidelines that are to be adhered. The Abhiyan which began in September 2000 as a onetime programme is now an annual event. To begin with there is a 14 day drill that every participating village must go through.

Dr. Nanasaheb Parulekar Trust, an NGO in Pune works for the awareness of the citizens about various waste related issues. The trust used to give awards at a *Kothi* level for the efficiently managing the waste collection in the particular area. The parameters observed also included the punctuality of the workers and efficiency of collection, visual cleanliness of the area etc.

13. Benefits:

- The competitive spirit amongst the wards will keep them on alert about waste management.
- It will encourage them to look at the new, innovative ways of waste management as well as reuse, recycling options.
- The NGOs working for collection in the particular area can come up with an innovative method which will be helpful in efficient collection of waste.

14. Links to other ISWM Pune Schemes:

- Design and Launch of a Comprehensive Awareness Campaign on ISWM
- Private Partnerships in waste collection and management systems
- Establishment of Environmental Awareness Centre (EAC)
- Establishment of Community Sorting Centre
- Improving Waste Management during Festivals

6. IMPROVISING WASTE MANAGEMENT DURING FESTIVALS

1. **Introduction:** Special events such as festivals, fairs, sporting events, exhibitions, etc. can pose a unique waste management challenges and opportunities. In Maharashtra, Ganesh festival is celebrated traditionally all in a big way as a social and community activity. When started by Lokmanya Tilak, the objective of the festival was mainly to bring people together and promote freedom movement. Now with the passage of time, the celebration of Ganesh festival has changed in terms of its scale as well as involvement of the people. These activities also cause concerns in terms of water pollution, air pollution, noise pollution and solid waste management etc. In the context of solid waste management, the offerings made to the deity, the decorations material used (thermocol, plastic etc.); the use of plaster of paris (POP) for idol making lead to severe problems. It is therefore important that we celebrate the festival keeping in view the need for environment protection and thus promote an environmental friendly Ganesha festival.

2. **Purpose:** Celebrations such as the Ganesha festival represent a potentially significant untapped source of recyclable and compostable materials for recovery. Recycling helps minimize the environmental impact of the special event on its host community. Special events should be a place where the principles of recycling are reinforced. In fact, additional public awareness and education can be achieved through effective special events recycling programs.

3. **Target**: To introduce a sustainable recycling programme for managing festival/ special events wastes especially during the Ganesh festival.

4. **Type:** Programme

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Town Planning Department

6. **Support Agency:** ISWM Cell, Vendors, Event/Activity Organizers, Schools and other institutions, NGO's, generators and housing societies. Certain Industries can take up the management of festival wastes as part of their CSR.

7. **Location (suggested):** Ganesh festival large scale celebrations take place more at Karve Road, Kasaa Peth, Vishrambagwada, Bhawani Peth, Tilak road etc and such a programme can be initially launched at these wards.

8. **Budget (Estimated):** Rs. 1.5 Million

9. **Time Frame (Estimated):**

Activity	Year 1			Year 2			Year 3			Year 4			Year 5		
Compilation of a Good-Practice Manual in Vernacular medium															
Preparation of material for training and workshops															
Conducting Awareness and Training Workshops for stakeholders															
Monitoring impact of awareness															

10. **Description:**

Dealing with food waste: Up to half of the waste generated (or even more) in the celebration is the food waste and to tackle it is often a big challenge. However, the following approach may be followed:

Ways to reduce the amount of food waste generated at special events:

- The most efficient approach is to reduce the amount of food waste generated in the first place by working with vendors before the event. If possible, the vendors may be provided with estimates of the number of

people expected to attend the event-return vendors are usually better informed about how much they will need.

- Another option for dealing with food waste is to identify organizations in the community whose function is to recover and distribute surplus edible food. It is best to communicate with these food distribution organizations prior to the event to see what their needs and requirements are for handling the surplus food. One approach is to invite the organization to have a booth at the event, allowing them to publicize their services and to be on hand for material recovery after the event.
- In some areas, surplus food or food waste is a desirable source of animal food (usually for swine).
- Even with efforts to reduce the amount of food waste and to recover some surplus food, there may still be a significant quantity of mixed food waste to deal with. If the community has access to a composting facility that accepts food waste, then the challenge is to collect the food waste separate from non-compostable materials and get the materials to the facility.
- Providing incentives: The Ganesh festivities are generally implemented at different localities through "Ganesh Mandals". PMC can develop initiatives such as "Green Ganesh" to promote environmentally safe Ganesh festival. MC can promote eco-friendly practices through an incentive scheme. This can involve management of environmental aspects such as solid waste management (idol material, proposed immersion, food stalls, no plastic zones, management of garbage, decoration material, etc.). The competition for best decoration amongst the mandals can be extended to ecofriendly practices during the festivals.
- The Ganesh festivities are usually accompanied with various cultural and entertainment programmes. "Chakachak Tolis" should be encouraged to perform at such events to implement mass awareness.

One option is composting the food waste from the event at the site of the event itself. This option is obviously limited to unique situations where the resources exist to manage such an endeavor. The following is a summary of the initial steps to determine if composting the food waste from the event on location is a viable option:

- Obtain the required help regarding the composting from the Environmental Awareness Centre
- Identify possible composting sites based on composting rules.
- Estimate volume and type of materials to be composted.
- Develop a tentative plan for recovering food waste and transporting it to the site.
- Draft a site plan and operations plan for the composting operation.
- Determine availability of labor and other resource requirements to build and maintain the compost pile.
- Identify beneficial uses of the finished product.
- If the findings are favorable for on-site composting based on the above steps, contact the environment awareness centre or the ISWM cell to discuss the viability of the plan.

Management of the volunteers: Volunteers are the backbone of a successful recycling program at special events, and finding enough volunteers is always a challenge. If possible, volunteers with some knowledge or expertise in recycling should be recruited early in the planning process. The help of Environment awareness centers (EAC) may be taken in this regard and also the NGO's already active in the promotion of waste recycling may be contacted. Once the recruitment has been done managing them effectively is extremely important. Volunteers with recycling knowledge and leadership skills are instrumental in organizing and overseeing other volunteers. Some other volunteers include scout organizations, school clubs, religious undertakings, civic organizations and local environmental groups.

With an organized process, the general public can also be recruited. Offering incentives to volunteers, such as free admission or T-shirts, can help in the recruitment process. It is essential to have a good estimate of the number of volunteers needed, as well as the specific tasks for which they are needed. The following is a general list of volunteer tasks, taken from Recycling Advocates' Recycling at Your Event:

- making signs;
- working with vendors before the event;
- monitoring recycling stations;
- sorting bins for contamination;
- distributing recycling information at the entrance of the event;
- transferring recyclables from bins to collection points;
- obtaining sponsors and donations;
- Maintaining personal contact with vendors and exhibitors at the event.

To be most effective, it is important to have volunteer tasks well defined and quantified to the extent possible prior to beginning the volunteer recruitment process. Some Volunteers are better leaders than others, so it is beneficial to match the individual with the task at hand wherever possible. By identifying the tasks and available time slots beforehand, the potential volunteers will have some prior knowledge of their responsibility and some choice as to the type of activities that they will perform.

Managing food vending:

- Effective management of the food vendors may be of great help in the overall recycling program. Following should be taken care of in this regard:
- Wherever possible, provide service items (condiments, straws, utensils, napkins) in bulk dispensers rather than individually wrapped packages.
- In selection of food vendors, seek or encourage foods requiring minimal or no packaging, e.g., "finger foods", ice cream cones etc.
- Require food vendors to remove all of their own waste, thus providing incentive to keep it to a minimum through advance planning.

Aspects related to the idol immersion:

- Prior to immersion, worship material like, flowers, vastras (clothes), decorating material (made of paper and plastics), etc. should be removed. Such material may be separately collected either for recycling or composting if bio-degradable
- Small sized idols should be encouraged.
- The material used for making the idols should not be toxic and preferably natural clay.
- Also the colours and paints used should be environmental friendly which are made from natural and organic raw materials.

11. Implementation:

Identifying and involving stakeholders: There are many different stakeholders associated with recycling at special events, each with his/her/its own issues and perspectives. Examples of stakeholders include the following: event sponsors, the organization or group holding the event, the event planner (if separate from the organization holding the event), vendors at the event, the community at large in which the event is held, the facility at which the event is held and the people who attend the event.
The most effective approach is to bring these stakeholders to the table early on, encouraging their input in the planning process. This type of "ownership" is a constructive way to build a sustainable recycling program using a team-oriented approach.

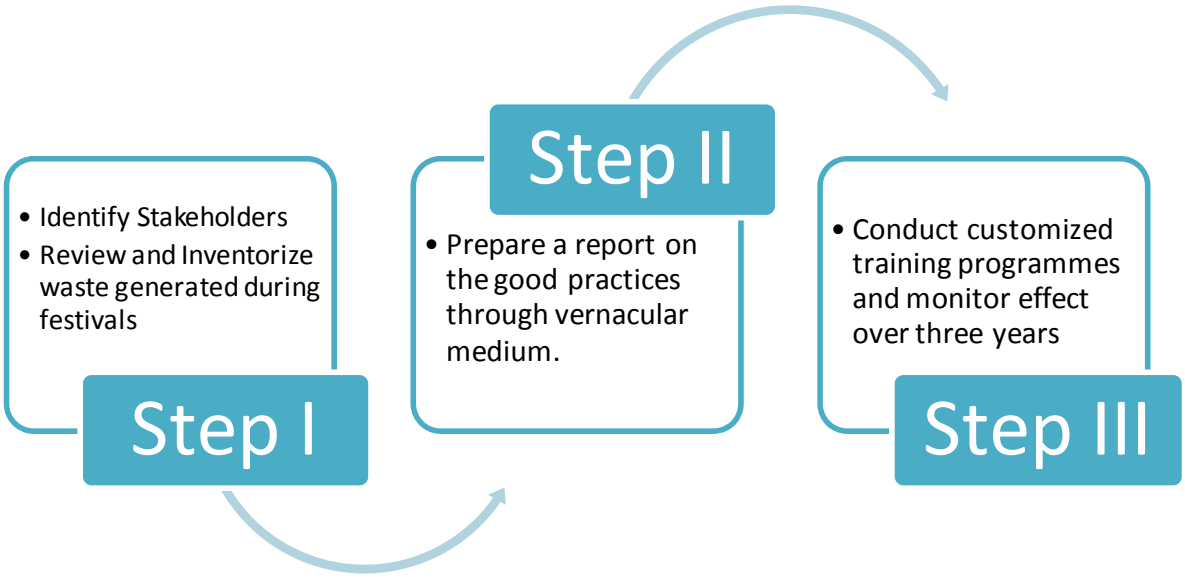
Identifying the typical wastes generated at the event: Working with vendors and activity managers prior to the event regarding the materials they plan to use will assist in predicting the waste stream and in planning for recycling opportunities.
The recycling and waste management program must be prepared to accommodate materials inevitably brought in from the outside by the public. Some examples of these are fast-food Scraps, wrappers and other items that are not distributed by on-site vendors. Instructions for the recycling program should address these extraneous materials, most of which may not be recyclable or easily incorporated into a composting program. The waste will basically comprise of:

- Food waste.
- Recyclable waste.
- Inert waste.

Tapping into community resources: The level of recycling activity and awareness within a community will have some impact on the organization and acceptance of recycling at special events. Early in the planning phase of special event recycling, every effort should be made to include people from the community who are familiar with local recycling programs, services, and related activities. Even if the community does not have **a** comprehensive recycling program in place, there are groups or organizations supportive of recycling that can be instrumental in carrying that message forward through the special event recycling program. The Environmental Awareness Centre and the ISWM Cell can play an important role in this matter.
Community involvement can be provided by public or private sector individuals, or by organizations involved in recycling or similar environmental pursuits. Enlisting the support and involvement of the community early

in the planning process for recycling at the event can save time and resources. Potential benefits that can be provided by community involvement include the following: source of volunteers, advertising or promotion for the recycling program, source of funds, materials, or in-kind services to support the recycling program and expertise in organizational and operational aspects of the recycling program.

Training and Capacity Building: The services of the consultant should be hired in order to develop a general good-practices guidebook. This guidance manual should be prepared in the vernacular language and should highlight the good-practices and waste management efforts undertaken during festivities all throughout the world. A dedicated training programme should be organized for various stakeholders, to promote the principles of ISWM. The identified stakeholders should also be encouraged through incentives and award schemes to follow waste management practices. The effectiveness of the promotional programmes should be captured through continual monitoring over a period of three years.



12. **Other similar experiences:** Development Alternatives (DA), an NGO started the CLEAN-India program in 1996 with the belief that children can be powerful agents of change. Whether they are fighting against use of crackers and polythene bags or promoting eco-friendly festivals or paper recycling - when children talk, parents do listen. At the 2004 meet, some students also suggested that during festivals like Durga Puja (worship of goddess Durga) and Ganesha Chaturthi (worship of god Ganesha) unbaked and unpainted idols should be immersed in rivers and lakes. In fact, students of Bharatiya Vidya Bhavan Kendra, Aurangabad (Maharashtra), described what they did during the last Ganesha festival. They collected all the flowers given as offerings from 400,000 people, and instead of throwing them into the river, decomposed them to use as fertilizer[1].

13. **Barriers:** In spite of all the good reasons to recycle at special events, there are some obvious challenges involved in setting up an effective recycling program for such an event.
    - The most significant barrier to overcome in establishing a special event recycling program is the already overloaded list of responsibilities for the event organizers. Event organizers are concerned with many issues, running the gamut from publicity to sanitation. Dealing with recycling adds yet another layer of complexity to the planning details.
    - It may be difficult to recruit the large number of volunteers typically required for a successful recycling program.
    - Initial planning and organizing of special events recycling program is time consuming.
    - Few models of successful special events recycling programs exist.

1 As referred to http://www.boloji.com/wfs2/wfs230.htm

- Monitoring of recycling container sites is usually required in order to keep the materials separate.
- There is seldom a financial incentive to recycle at special events.
- Space and suitable sites for placing recycling containers are often limited.
- Initial startup costs (e.g., to purchase containers and signs) are often prohibitive.
- Local outlets for the recovered material, especially food waste and certain types of plastic may not be available.
- Co-operation from local citizens may not be satisfactory at all times.

14. **Benefits:** Other indirect benefits of recycling include the following:

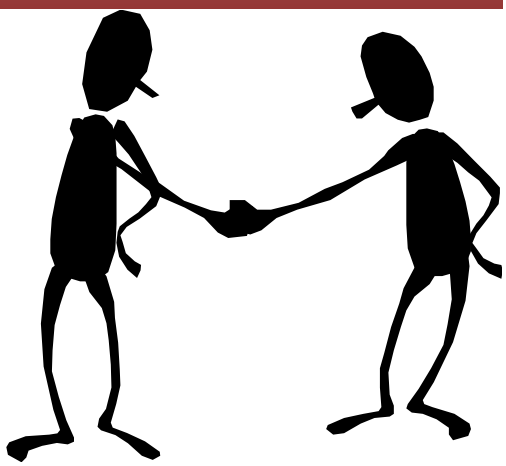
- Special events provide an opportunity to try innovative approaches to recycling and educating.
- Recycling at special events can pull community groups together through volunteer activity.
- Recycling provides a unique avenue to advertise an event.

15. **Links to other ISWM Pune Schemes:**

- Formation of Integrated Solid Waste Management Cell (ISWM Cell) and website
- Formation of Environmental Awareness Centre
- Conducting Awareness Programmes for Businesses & Community
- Initiating Schools involvement in Waste Management
- Introducing Awards Schemes
- Recycling of Plastic Waste
- Promotion of Biodegradable Plastic
- Influencing Consumption Patterns of Citizens

Theme 5
Capacity Building and Partnerships

1. Establishment of Standardized Guidelines for Operating Decentralised Treatment Plants
2. Establishment of a Cadre of Certified Operators for Decentralized Treatment
3. Introducing Industry - University Partnerships
4. Establishment of a Waste Exchange Centre
5. Establishment of an ISWM Cell
6. Develop and Introduce Policy for C&D Waste Management
7. Improving Health and Safety of PMC Workers, Rag pickers and citizens in proximity of the landfill
8. Strengthening of PMC Rag picker Co-operatives



1. ESTABLISHMENT OF STANDARDIZED GUILDELINES FOR OPERATING DECENTRALISED TREATMENT PLANTS

1. **Introduction:** Decentralised treatment which can also be termed as at source treatments help in reducing the quantum of waste to be treated at the centralized facilities and finally disposed at the central landfill (centralized disposal site). Pune generates approximately 1093 MTPD of waste of which 710 MTPD ifs wet waste. As per the data available and collected from various sources, around 45-60 MTPD of wet waste treatment capacity exists in the city. However, the actual quantity of treated waste is reported to be 12 tonne. Thus there is a huge gap in terms of feasibility and existing conditions for net waste treatment processes.

2. **Purpose:** Several wet waste treatment methodologies exists in the market. However, there are no guidelines on the quality, design and operation as well as maintenance of such plants. This is one of the key problems in implementation of decentralised waste treatment.

3. **Target**: To evaluate the decentralised treatment technology procedures and establish standardized procedures for Decentralised Treatment Plants.

4. **Type:** Project

5. **Lead Agency:** A Non-profit organization, University and educational institutions and Pune Municipal Corporation

6. **Support Agency:** PMC can make use of the services of a consultant along with a Non-profit organisation can take up this charge. It can be supported by industries around Pune, NGOs and Recycling units and operators along with the Universities and educational institutions in Pune.

7. **Location (Suggested):** A consultant such as Science and Technology Park of University of Pune can carry out such an evaluation.

8. **Budget (Estimated):** Rs. 1 Million

9. **Time Frame (Estimated):**

Activity	Year 1				Year 2			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Inventorization of decentralised treatment plants	3 months							
Preparation of performance indicators for the technology procedures		6 months						
Evaluate at certain decentralised treatment plants				3 months				
Preparation of procedure guidelines					3 months			

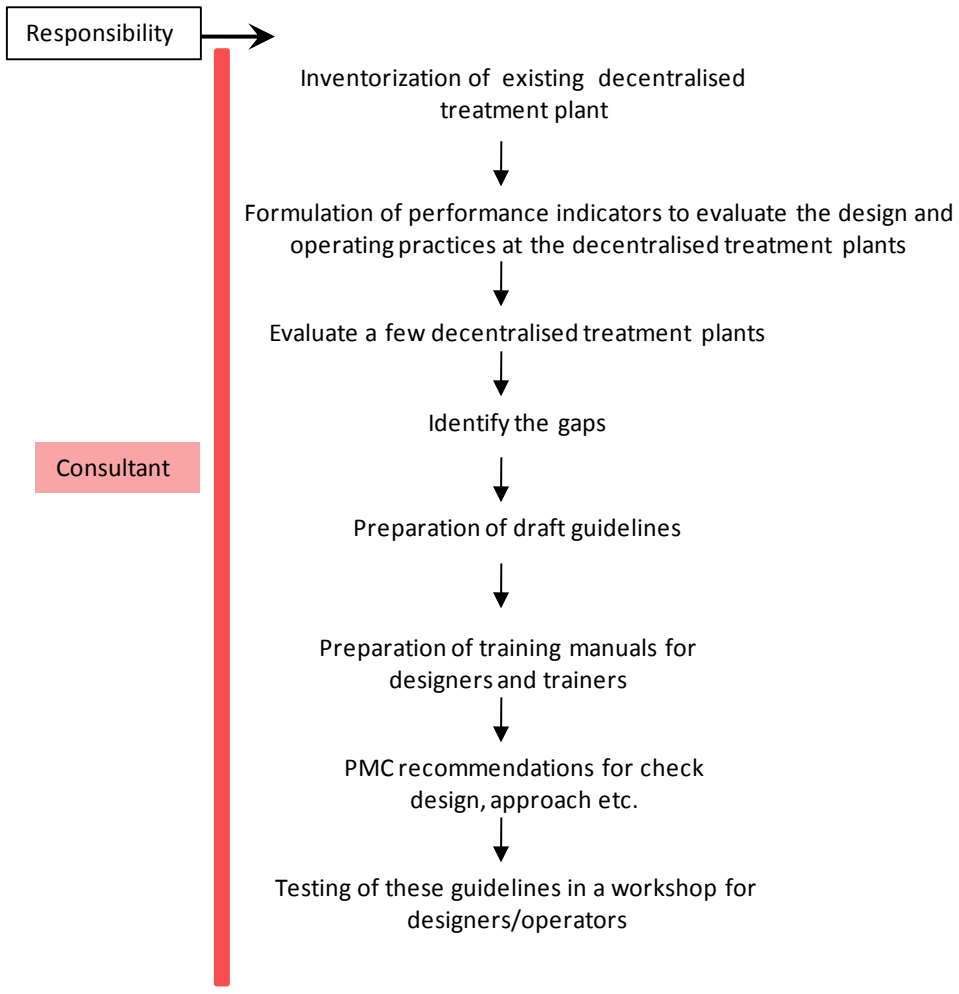
Training for designers and trainers						3 months		
Test guidelines in a workshop for designers/operators							3 months	

10. **Description:** Decentralisation of waste technologies can help reducing the infrastructural as well as economic pressure on the over-stressed city management authorities. With the increase in extent of segregation through implementation of various awareness campaigns and community sorting centres, the major hurdle facing efficient implementation of decentralised treatment shall be overcome.

    The decentralized waste treatment comprises of biological, physical and thermal treatment process of which biological is applicable to wet waste and thermal for dry waste.

    In case of decentralised wet waste, there needs to be a common information and knowledge pool developed for formulating the guidelines for assessing the quality and quantity of waste. These guidelines then need to trickle down to actual operators of treatment plants. The efficiency of treatment plants is based on the skill and competency of the operator. The increase in functional efficiency can be increased with a cadre of operators.

11. **Implementation:** PMC can use the service of a consultant to establish such guidelines for operating decentralised treatment plants. These can be done in the following pattern:



12. Other similar experiences:

Decentralised Treatment Methods in Pune: Significant work related to decentralized treatment is being done in Pune. Vermi-composting and biogas plants are the major options being looked at with regards to decentralized options for treating waste. Organizations such as Ennora, Mailhem and Excel industries are involved with the waste treatment business along with volunteers such as Latatai Shrikhande and Jyoti Shah.
Ennora involves the use of earthworm technology to convert waste into wormi-compost. The experts suggest that the vermin-composting plants are viable only if the generation capacities are greater than 20t/month. One of the major reasons for failure of vermin-composting plants was pointed out to be the casual approach of handling such plants. A sound technical training is therefore a pre-requisite for effective working of the plants. The land requirements for treatment plant are around 2100 sq.m. Mailhem specializes in state- of the art bio-methanation techniques to generate biogas from various types of bio-degradable organic solid waste. Excel industries have developed an organic waste convertor which produces Celrich, a rich source of organic matter generated primarily from animal, canteen and agro waste. This soil enricher is capable of enhancing the yields, optimizing fertilizer usage and ensuring sustainability in agriculture. The use of Bio-sanitizer and EM solutions for waste treatment are also being used.

13. Barriers: Willingness of decentralised treatment providers to follow such guidelines. This can be overcome by a policy change on behalf of PMC to enforce the practice of such guidelines.

14. Benefits:

- Such guidelines will benefit the decentralised treatment plants to work more efficiently and to have proper information with regard to any issues faced by them.
- This training will also benefit the decentralized service providers as they will have better trained operators and they can improve on their output
- Better output and market for the products from decentralised treatment plants.

15. Links to other ISWM Pune Schemes:

- Establishment of Community Sorting Centre
- Improving Health and Safety of PMC workers, Rag pickers and citizens in proximity of the landfill.
- Strengthening of PMC Rag picker Co-operatives
- Private Partnerships in waste collection and management system – Promotion of Decentralised Treatment plants
- Establishment of Environmental Awareness Centre
- Establishment of a Compost Collection and Managing Centre

2. ESTABLISHMENT OF A CADRE OF CERTIFIED OPERATORS FOR DECENTRALISED TREATMENT

1. **Introduction:** Decentralised treatment which can also be termed as at source treatments help in reducing the quantum of waste to be treated at the centralized facilities and finally disposed at the central landfill (centralized disposal site). Pune generates approximately 1093 MTPD of waste of which 710 MTPD ifs wet waste. As per the data available and collected from various sources, around 45-60 MTPD of wet waste treatment capacity exists in the city. However, the actual quantity of treated waste is reported to be 12 tonne. Thus there is a huge gap in terms of feasibility and existing conditions for net waste treatment processes.

2. **Purpose:** In decentralized treatment technologies like composting, vermicomposting is that the operator of this technology has to work in unhygienic conditions and their social acceptance is also low. So lack of operators is the major problem which bars the sustainable use of decentralized treatment. Hence a cadre of operators who are equipped and trained regarding various operational aspects of decentralised treatments should be formed.

3. **Target**: To form a proper cadre of operators who can take up this job of running decentralized plants sustainably.

4. **Type:** Project

5. **Lead Agency:** A Non-profit organization, University and educational institutions and Pune Municipal Corporation

6. **Support Agency:** PMC can make use of the services of a consultant along with a Non-profit organisation can take up this charge. It can be supported by industries around Pune, NGOs and Recycling units and operators along with the Universities and educational institutions in Pune.

7. **Location (Suggested):** Training may be provided at the Environmental Awareness Centre, the community sorting centres or at the individual decentralized treatment plants. Since the numbers of decentralized treatments are the highest in Sangamwadi Ward, such training programmes can be started in this ward.

8. **Budget (Estimated):** Rs. 0.5 Million

9. **Time Frame (Estimated):** 12 months

10. **Description:** Decentralisation of waste technologies can help reducing the infrastructural as well as economic pressure on the over-stressed city management authorities. With the increase in extent of segregation through implementation of various awareness campaigns and community sorting centres, the major hurdle facing efficient implementation of decentralised treatment shall be overcome.

    The decentralized waste treatment comprises of biological, physical and thermal treatment process of which biological is applicable to wet waste and thermal for dry waste.

    In case of decentralised wet waste, there needs to be a common information and knowledge pool developed for formulating the guidelines for assessing the quality and quantity of waste. These guidelines then need to trickle down to actual operators of treatment plants. The efficiency of treatment plants is based on the skill and competency of the operator. The increase in functional efficiency can be increased with this cadre of operators.

    In order to form a cadre of operators for decentralized treatment plants, training needs to be imparted to all those stakeholders involved in decentralized treatments. The venue for the training can be set as the Environmental Awareness Centre as well as at the site of the individual decentralized plants. PMC can

collaborate with Universities and educational institutions in Pune to provide for certifications of such courses. Such training programme should be offered at different times in a year. After successful implementation of such training programmes, PMC can introduce a policy for decentralised treatment plants to hire certified operators only.

The stakeholders who can be involved to form the cadre of operators are:

- Informal Sector such as rag pickers etc.
- Operators from the decentralized treatment service providers
- Workers working at restaurants, societies etc.

Informal sector: The best possible operators for doing vermicomposting or composting are from the informal sectors which work in the waste collection process. The advantages of using them are

- Psychologically they are comfortable with handling waste
- Cheap labour.
- Will provide them extra source of income
- Availability- Mostly rag pickers or waste collectors who are currently working in various communities can be employed for this job too. Even hotel/restaurant owners can employ them easily as they are in large quantity looking for better jobs.

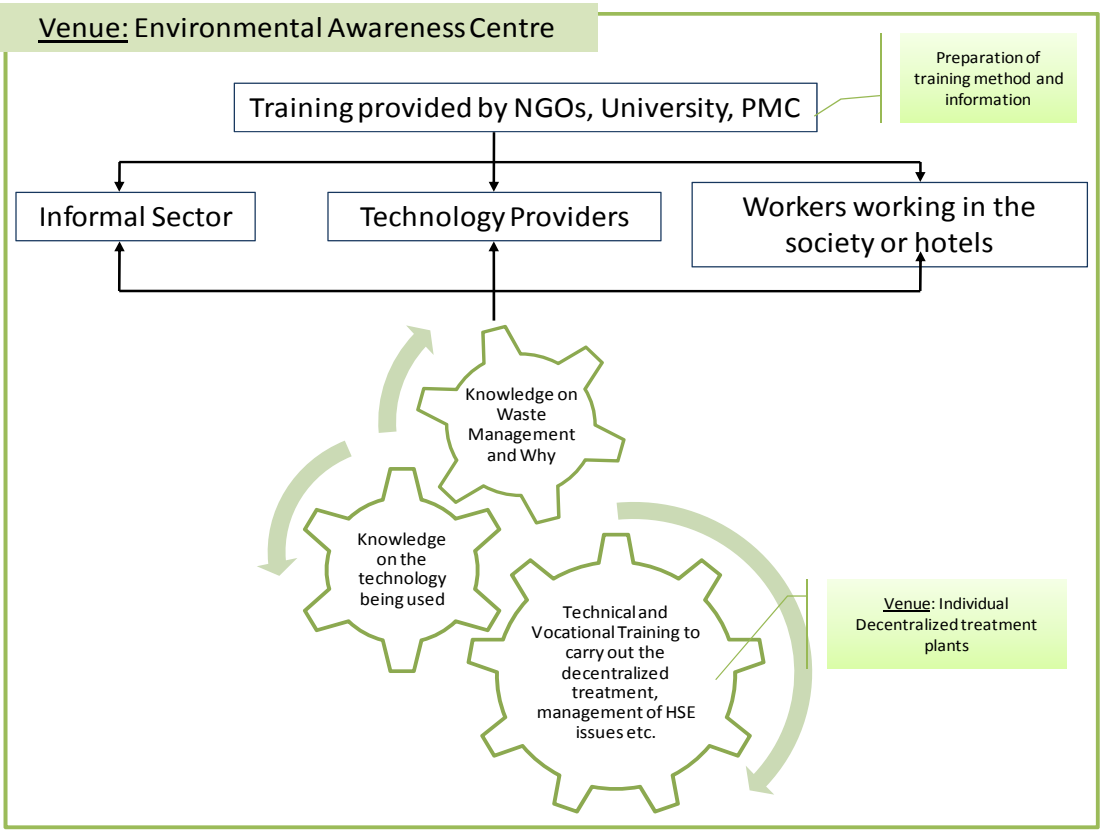
The only problem in training the informal sector is that most of them are uneducated, so giving them training of this job can be bit difficult as compared to other options. However, this problem can easily be solved as NGO's who work with them or technology providers can provide them the required training. Overall, they are the most suitable choice available.

Operator provided by technology provider. Many technology providers who install the decentralized plants are ready to provide regular operators. The advantages of using them are

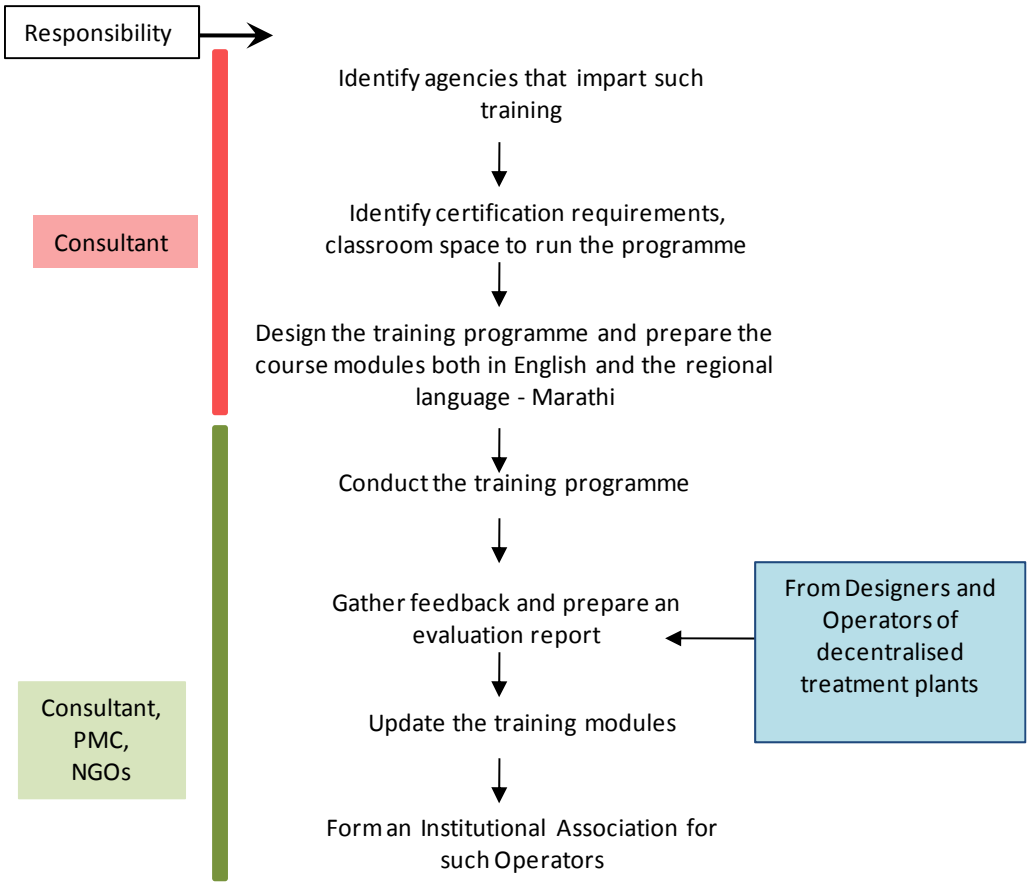
- They are fully trained professionals who can run the plant easily.
- They have technical knowledge hence can take care of details of waste management.
- They are suitable for a plant of size more than 1 T.P.D.

However, the cost of hiring technology provider for a regular operator job is quite high. Therefore, this option is unsuitable for small units below 1 T.P.D.

Workers already working in society or hotels: Workers in a society like the watchman, gardener, etc and in case of hotels/restaurants, the waiters or cleaners can be employed as an operator. The advantage is that they are already working and it will be easier for them to work on the decentralized unit.



11. **Implementation:** PMC can use the service of a consultant to establish a cadre of operators for preparing and conducting a training programme.



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In Mumbai, the Stree Mukti Sanghatana, with co-operation from the Municipal Corporation of Greater Mumbai, started an environment-friendly project called the Parisar Vikas. This project was a programme for women rag pickers. The activities of this project include the organizing and training of the rag pickers. Through this project, a cadre of operators was formed and they were given training in alternative skills such as vermiculture, biomethanation and gardening.

13. Barriers: Willingness of NGOs and education institutions to impart such training and also the co-operation from the informal sector due to their lack of education and other social constraints.

14. Benefits:

- Such a cadre of operator will benefit the informal sector to get skilled training and employment
- This training will also benefit the decentralized service providers as they will have better trained operators and they can improve on their output

15. Links to other ISWM Pune Schemes:

- Establishment of Community Sorting Centre
- Improving Health and Safety of PMC workers, Rag pickers and citizens in proximity of the landfill.
- Strengthening of PMC Rag picker Co-operatives
- Private Partnerships in waste collection and management system
- Establishment of Environmental Awareness Centre
- Establishment of a Compost Collection and Managing Centre
- Demonstration Projects for Hotel Waste Management

3. INTRODUCING INDUSTRY-UNIVERSITY PARTNERSHIPS IN PUNE

1. **Introduction:** Waste reuse and recycle as well as disposal technologies play a pivotal role in the context of solid waste management. The technology applications formulated in developed countries are not suitable and applicable to the Indian context. The large-scale application of any new proposed technology needs a phased approach involving thorough research, leading to development of lab-scale or pilot applications which later can be scaled-up to meet the actual requirements. The overall progress in a particular field is thus possible only with the propagation of industry aided research. New feasible interventions can be formulated and applied only if the research is guided and funded by the industry needs. In the context of Solid Waste Management, several technological interventions are needed at every level/step of waste management. E.g.: Geographic Information Systems aided with Network Analysis for route optimization, application of RDFs for Indian waste scenario, parameters affecting the efficiency of Biomethanation plants, strength and feasibility of using recycled C&D waste as a substitute. Thus symbiotic Industry-University partnerships form a basis towards realizing the vision of efficient waste management.

   The Science and Technology Park[1] is one of the Science and Technology Entrepreneurs Park (STEPs) set up in the year 1988 by University of Pune (UoP) and promoted by National Science and Technology Entrepreneurship Development Board (NSTEDB) of Department of Science and Technology, Government of India. The Park acts as an interface to bring complete cohesion between the researchers & industry to work for mutual benefits and for benefit of the society at large. It works as the nodal agency to provide training and consultancy services to the various government, public and private sectors. It is also involved in giving need-based training to researchers, entrepreneurs and industries by using resources in terms of manpower and infrastructure of the university and various national and state institutions. The promotion of high-tech entrepreneurship based on indigenous knowledge is one of its prime objectives. It functions as a bridge between industries and academia. The Park is playing significant role in Knowledge & Resource Management and mainly focuses on commercializing resources, managing innovations, managing Intellectual property, commercialization of technologies, promotion of industry sponsored research and contract research and to build synergy between industries and academia.

2. **Purpose:** Due to rapid industrialization and urbanization, population growth and not having an integrated method and modern infrastructure, solid waste management is a crucial problem in any city. The city of Pune generates 1093 MT of MSW per day[2]. This waste is currently disposed of at a dumping ground. Part of that waste is treated through decentralized treatment processes such as vermi-composting, Biomethanation etc. The other waste streams such as Construction and Demolition (C&D) waste, Electronic Waste etc which are increasing rapidly due to growth in construction activities and increase in the use of electronic items. Electronic wastes contain highly toxic materials which cause several environmental impacts. C&D wastes are currently mixed with MSW and disposed off at the landfill. C&D wastes are very bulky occupying more space on the landfill.

   The Integrated Solid Waste Management (ISWM) plan developed for the city of Pune lays out several schemes for proper management of the wastes. The proposed ISWM cell would be responsible for implementation of the ISWM action plan as well as the schemes which are a part of the ISWM action plan. During and after implementation of these schemes, several issues and opportunities may arise. These issues and opportunities may be researched further by the Science and Technology Park of UoP.

3. **Target**: To introduce certain areas where Industry – University (I/U) partnerships can be taken up in the field of solid waste management for Pune.

4. **Type:** Programme

1 As referred to http://stp.unipune.ernet.in/

2 Report on Centrally sponsored Scheme for Solid Waste Management and Drainage for IAF Airfield Town of Pune.

5. **Lead Agency:** ISWM cell of PMC, Science and Technology Park of UoP and the Maratha Chamber of Commerce, Indsutries and Agriculture (MCCIA)

6. **Support Agency:** Confederation of Indian Industry (CII), National Association of Software and Services Companies (NASSCOM), Software Exporters Association of Pune (SEAP), Software Technology Parks of India (STPI), Promoters and Builders Association of Pune (PBAP), Housing Urban Development Corporation, Recycling units and operators and Private Universities and Education institutions of Pune.

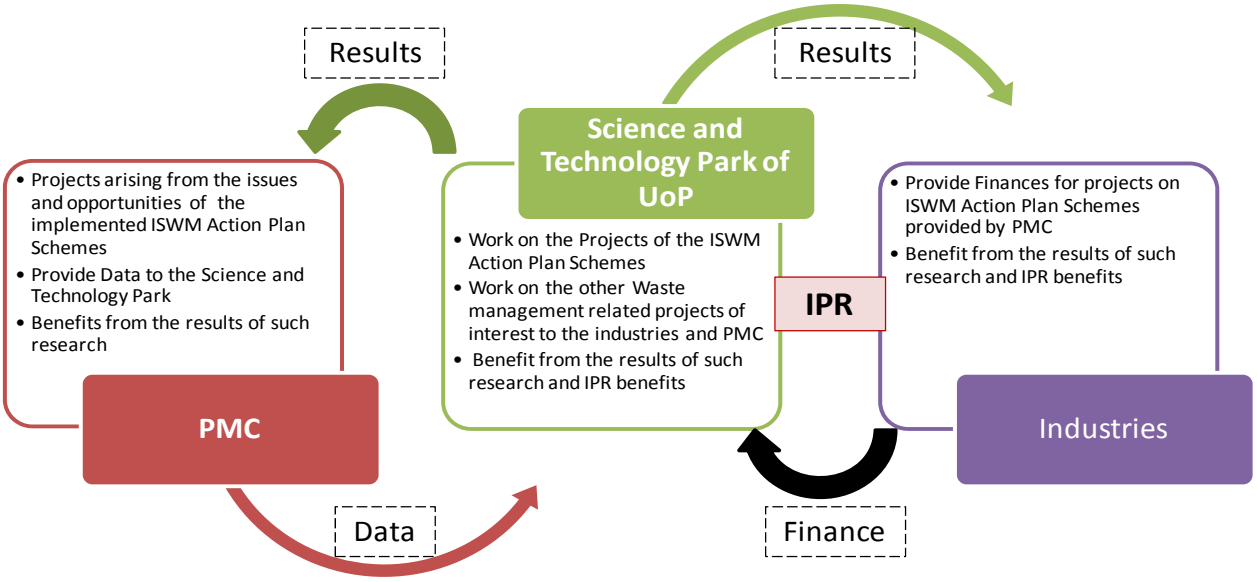
7. **Location (Suggested):** ISWM Cell of Pune and Science and Technology Park of UoP

8. **Budget (Estimated):** As per the selected projects. Financial support will be provided by the involved industries.

9. **Time Frame (Estimated):**

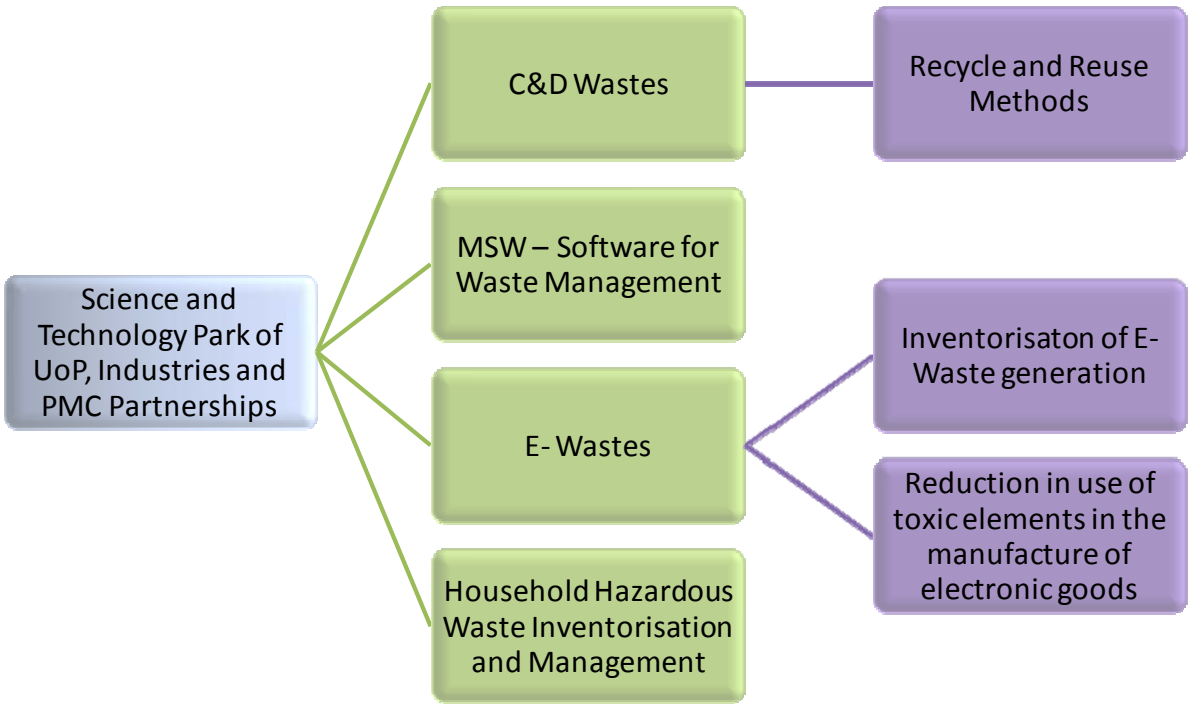
Activity	Year 1	Year 2	Year 3	Year 4	Year 5
Review of ISWM Action Plan Schemes	8 months				
Feedback to ISWM Cell and Proposals to Industries	6 months				
Meeting and discussion of proposed projects	12 months				
Preparation of model agreements		6 – 12 months			
Work on the agreements					
Results Delivery					

10. **Description:** During and after implementation of the schemes part of the ISWM action plan for Pune, several issues and opportunities will arise. It will be the responsibility of the proposed ISWM cell to address these issues or problems and opportunities. Several new ideas will come up as the ISWM action plan is implemented. These issues and opportunities can form several projects which the ISWM cell can propose to the Science and Technology Park of UoP for implementation. Partnerships can then be formed between the Science and Technology Park and several industries to carry out work on such projects. The Intellectual Property Rights (IPR) will be between the Science and Technology Park and the industry based on the individual partnerships and therefore the IPR related benefits will be with both the Science and Technology Park and the individual industries. The Work on such projects can be done by the Science and Technology Park of UoP who can hire or utilize the research resources of UoP, other institutions, etc. Students from UoP or Institutions can work on such projects. The industries can provide some workforce for these projects as well.

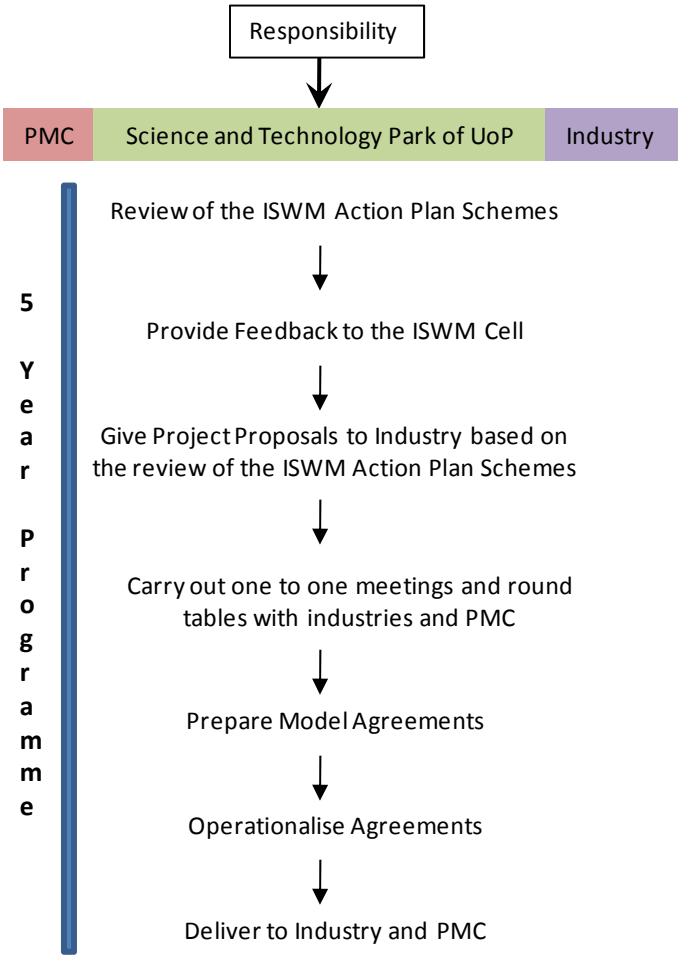


Individual companies or industries listed out on the Waste Exchange Centre can initiate projects such as waste management within their companies, find new resource recovery methods, changes in their technology and processes. These industries can collaborate together with the Science and Technology Park of UoP and PMC to carry out inventorization studies in Pune to make a proper inventory for solid wastes from generation to disposal.

The neglected portions of waste management can be given attention through such a partnership. The industries manufacturing household electrical and electronic appliances and batteries can help to carry out an inventorization of household hazardous wastes. Several methods can be devised through such partnerships to manage solid wastes more effectively. Apart from technology innovations, softwares can be designed to model the waste management flow in Pune.



11. **Implementation:**



12. **Other similar experiences:** Air Products and Chemicals, Inc., recently donated five patents to Lehigh University. The patents were related to technologies for strengthening asphalt and concrete and increasing the fire retardance of plastic and asphalt-based construction materials. According to Air Products CEO Harold Wagner, the patents were donated to Lehigh University because of the excellent, mutually beneficial relationship between the two organizations spanning more than five decades. More important, the patents were in technological areas outside those now being concentrated on by Air Products. By giving away patents in non-core technological areas, Air Products could now focus its attention and resources on areas more closely related to its core business. Moreover, with Lehigh's strong research acumen in these areas offering the best promise for technology commercialization, the firm could have a more cost-effective avenue to these technologies down the road. As a result, both organizations gain[3].

13. **Barriers:**

- Sometimes, universities signal the industrial community that academe is overly self-centered, rigid and unresponsive to industry's needs. This can be overcome by increasing the awareness among industries about the benefits of collaborative partnerships.

[3] Betts, Stephen C. (2002) Making industry--university partnerships work; a study of relationships between industrial firms and university research centers shows how to form partnerships that benefit both parties, Published in Research-Technology Management

- Also, firms often feel that full disclosure of research can give other firms an opportunity to incorporate this knowledge into their own products and processes. This will be overcome as the IPR for such projects will be with both the university as well as the industries.

14. Benefits:

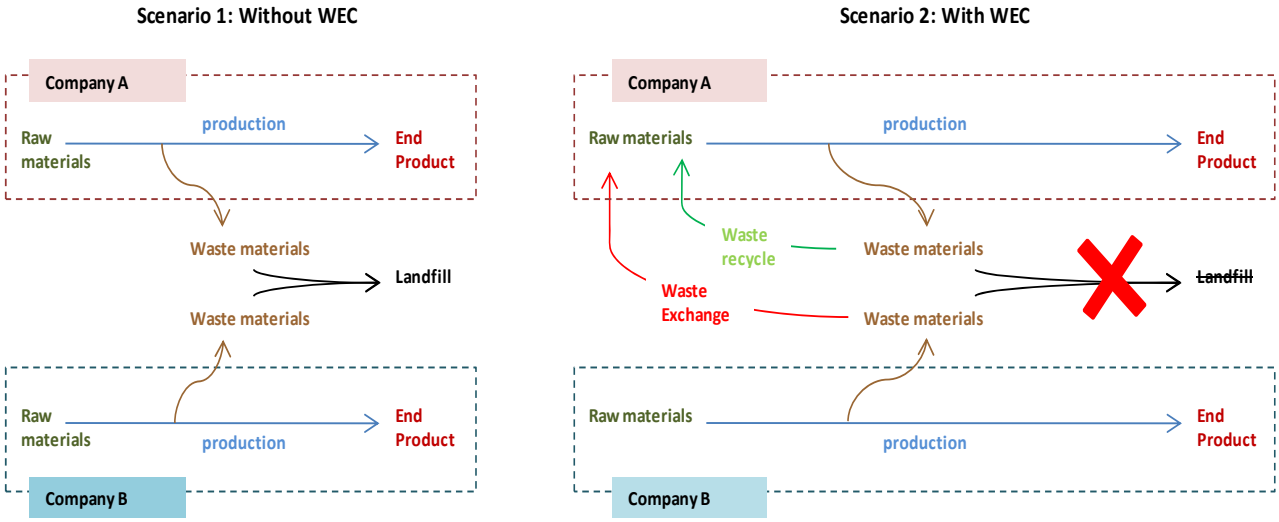
- I/U Partnerships often do not include the conflicts of interest that occasionally go along with inter-firm partnerships.
- Corporations also hire former students who have worked on joint industry-university initiatives. These graduates are valuable employees when their research, training and prior university experiences are leveraged to facilitate current and future industry-university relationships.
- Such partnerships help in generating knowledge and new technologies, i.e. concrete outcomes that include patents, licenses, and non-patented and non-licensed new products and processes.

15. Links to other ISWM Pune Schemes:

- Establishment of the ISWM Cell
- Establishment of Environmental Awareness Centre
- Establishment of the Waste Exchange Centre
- Pilot Projects for Recycle and Reuse of Waste Exchange Centre

4. ESTABLISHMENT OF A WASTE EXCHANGE CENTRE (WEC)

1. **Introduction:** The Integrated Solid Waste Management aims to holistically address various waste streams. The waste management process follows a life-cycle approach encompassing all issued from waste generation to disposal. The term integrated signified the need to capture and build on the inter-linkages between waste streams which currently are being missed out on. The whole project is driving towards making Pune a zero-waste city. The achievement of this ultimate goal will hence need a clear understanding amongst various stake-holders (waste generators, managers as well as processors) about the nature and quantum of waste being generated. This awareness will enhance the chances of developing new linkages and reutilization of waste products.



Looking at the dynamics involved in the entire process, a website (an online platform for waste exchange) has been proposed.

2. **Purpose:** The main purpose of setting up such a WEC would be to encourage reuse of waste materials by providing an open and known to all type of market for it. It will benefit by reducing the amount of waste landfilled and will lower the cost of waste disposal; both for PMC and the other stakeholders. This would also help the industries in Pune to gain more international market advantage. Furthermore a central formalized WEC would lead to a prescribed and safe procedure for waste sorting thereby considerably reducing the occupational risks and health hazards that are currently associated with the improper waste handling by informal sector.

3. **Target**: To form a WEC which will serve as an online network to allow for the exchange of materials between different industries, companies, other stakeholders such as the recycling businesses, markets and the citizens of Pune; based on their requirement.

4. **Type:** Project

5. **Lead Agency:** PMC and MPCB

6. **Support Agency:** The municipalities around Pune such as PCMC and PCB can collaborate with the ISWM Cell of PMC. The other stakeholder that should be involved in proper functioning of the Waste exchange are State industries department, industries around Pune, Maratha Chamber of Commerce, Industries and Agriculture (MCCIA), National Association of Software and Services Companies (NASSCOM), Software Exporters Association of Pune (SEAP), Software Technology Parks of India (STPI), Confederation of Indian Industry (CII), Promoters and Builders Association of Pune (PBAP), Housing Urban Development Corporation, NGOs and Recycling units and operators and the citizens of Pune.

7. **Location (Suggested):** ISWM Cell

8. **Budget (Estimated):**
   - For Consultant – Rs. 0.5 Million

9. **Time Frame (Estimated):**

Activity	Year 1		Year 2	Year 3	Year 4	Year 5
	Oct - Mar	**Apr - Sept**				
WEC Website Design and launch						
Review legislative barriers and provide suggestions						
Marketing the WEC Website						
Report performance to increase waste exchange						
Maintain and update website						

10. **Description:** The WEC will be developed as an online platform for waste exchange. This platform will allow qualified and selected members to access information regarding the generation of waste, its quantity, location, quality and the organization. Through an interactive user-interface, the members will then be led to the information on treatment processes, costs, recycling options and the organizations involved in the transactions.

People who will be served by the WEC:

- Companies that are seeking cost effective recycling solutions for the unwanted materials generated by their operations;
- Municipalities that are interested in finding new or alternative markets for the materials recovered through their recycling programs;
- Manufacturers that need to secure reliable, high quality sources of recyclable commodities;
- Companies that recycle waste for producing secondary materials;
- Waste brokers and traders

Types of material that will be exchanged at WEC:

- Production by-products, obsolete or unused raw materials, recyclable and recycled products, used machineries and equipments, electronic waste, construction and demolition waste etc.
- WEC will help in a major way to sort out the problem of Electronic waste and Construction & Demolition waste at the industrial level itself.
- WEC will work in close co-ordination with the Community Sorting Centers (CSC) and will provide them the market support.

Process at WEC: WEC will be an on-line Waste Exchange Network available for all companies from different sectors set up to increase business profitability by promoting waste trading. This system will streamline co-operation between waste producers, re-users and business advisers making transactions quicker and easier to achieve. WEC will be focused on providing an exchange system that will allow Customers to locate compatible buyers and sellers and engage in direct negotiations as quickly as possible.

Step 1: **Suppose Company A** generates a waste that they wish to dispose of (or find an alternative to their current disposal route). They will be asked to fill in the form on the WEC website to advertise their waste. There will be a database where all the information regarding all the material available from different sources will be stored. Waste will not be added to the database immediately. First it will be reviewed and all the information related to the waste as well as the company will be gathered. Once it is reviewed, the information will be added to the database and will be made available on the web site. The details of the company A will not be advertised and will be kept confidential.

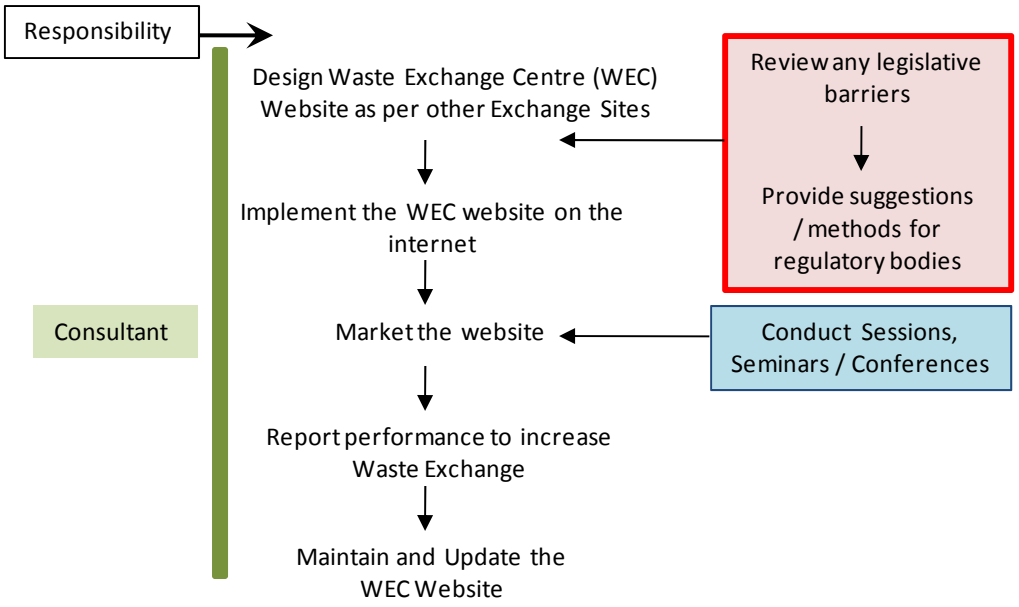
Step 2: **Company B**, will find the details of the waste by searching through the database and contact WEC to express an interest, either through the website, or by email or telephonically. WEC will then contact **Company A** to notify them of the interest and give them details of **Company B** so that they can contact them directly.

User fee: A user fee may be asked from the companies participating in the scheme which will serve as the major source of revenue. The collection of user – fee will be facilitated through a member-gateway. The entire process will be through secured online services.

Other Steps to be Taken by PMC and MPCB

- Policy change in order to make all industries in and around Pune register on the WEC website and to actively participate. Each industry which needs to dispose of their waste should first try this WEC. Landfill disposal by industries should site reasons for not being able to find a solution through the WEC.
- WEC's may be linked with similar international centres to encourage waste recycling on a global scale.

11. **Implementation:** PMC can make use of the services of a consultant. Such a consultant would have skilled workforce to design and set up the WEC website and implement it on the web. However, waste exchange may have some barriers as per the current legislative rules and regulations. The consultant would have to review such barriers and come up with methods or suggestions for the regulatory bodies. In order to increase the number of industries, associations and organizations on to the WEC website, the consultant would have to conduct several seminars/ conferences and market the website. The consultant should maintain and update the website regularly. The performance of the website should be reported as a section in the website itself as well as to PMC and MPCB to increase waste exchange.



12. **Other similar experiences:**

- The on-line waste exchange is one of the emerging businesses in Europe that is increasingly assuming a pivotal role in the achievement of recycling and resource recovery EU objectives[1]. Waste Exchange actively promotes the reuse and recycling of industry by-products and wastes. It offers a remarkable opportunity to save time and resource in waste.

  Waste – exchange.org is one such initiative started off in the UK by **ARENA Network,** which is an independent organization working on a not-for-profit basis. It provides guidance, information and practical assistance on environmental and waste management issues to businesses throughout Wales. They are being supported in this initiative by **The Environment Agency Wales,** which is responsible for protecting the environment through enforcement of legislation and promotion of good practice. The

1 As referred to http://www.wastexchange.co.uk/help.phpsc?i=h

Agency is working with Government, industry and Local Authorities on a range of initiatives to reduce waste.

- The On-line Halon Trader[2] is a "business to business" web portal developed by the UNEP DTIE OzonAction Programme under the Multilateral Fund, whose ultimate purpose to is contribute to the protection of the stratospheric ozone layer by promoting halon banking and responsible halon management. This web site site is designed for companies/organisations that use halons in "critical" applications, including owners, managers and/or operators of fire protection systems, fire control services and other organizations related to fire protection. The OHT provides a virtual marketplace where persons can match demand with supply. Through this free service, companies that need halon for critical applications ("halon seekers") are able to post listings of specific demand in a virtual "marketplace". Companies or halon banks that can meet this demand with recovered, reclaimed or recycled halon ("halon providers") can respond or post their own listings about halons available for exchange. UNEP provides the platform for this exchange and does not in any manner become party to the transaction between those who seek halons and those who provide halons.

13. **Barriers:** The barriers to such a centre are the lack of co-operation from all the stakeholders. This can only be overcome by creating awareness among them. The legislative barriers arising out of such waste exchange may be overcome firstly providing suggestions and explaining the benefits of waste exchange as well as by the results shown due to such a waste exchange.

14. **Benefits:**

- WEC will also encourage the concept of segregation at source by providing a market for the recyclables and by working in co-ordination with Community Sorting Centre's.
- The environmental benefits will include energy saving, reduction in GHG emissions, reduction in load on the landfills, reduction in emissions of land and water pollutants, conservation of natural resources etc.
- Reduced disposal costs.
- Lower purchase costs.
- Greater exposure to the global recycling marketplace.
- Lower chances in man-handling and misuse of waste during transfers. An institutionalized process will be set for conducting waste-transfer, thereby banishing the ad-hoc mechanisms.
- Access to more buyers & sellers around the world.
- Instant notification of material available for sale or purchase.
- Global price visibility.
- Saving times and a positive image by creating benefit to society as a whole through redistributing resources and materials to where they are most beneficial.
- WEC's will provide industry with an environmentally preferable source of raw materials.
- Reduction in cost of collection of waste
- Reduction in utilization of landfill space thereby increasing the life of the landfill

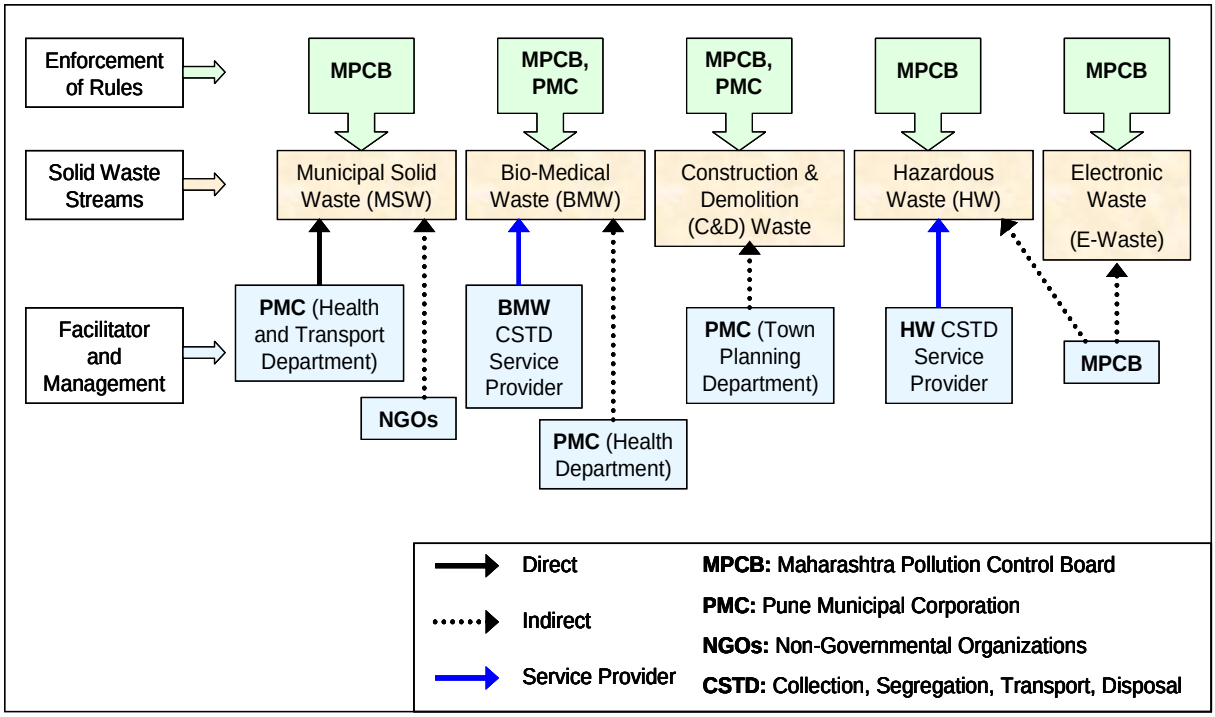
15. **Links to other ISWM Pune Schemes:**

- Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
- Establishment of Community Sorting Centre
- Introducing Industry – University Partnerships in Pune
- Establishment of Environmental Awareness Centre
- Private Partnerships in waste collection and management system
- Pilot Projects for Recycle and Reuse of C&D Waste Management
- Establish a CFL Recycling Programme and Common Facility

2 As referred to http://www.halontrader.org/text/help/index.htm#oht

5. ESTABLISHMENT OF THE INTEGRATED SOLID WASTE MANAGEMENT (ISWM) CELL

1. **Introduction:** Infrastructural, financial and institutional capabilities determine the success of overall implementation of any new proposal. For the ISWM plan of Pune to be actually implemented, institutional set-up laying down clear roles and responsibilities is very essential. The Institutional framework for each waste stream would include the organizations which are responsible for the formation of policy, for planning and for enforcement; the business organizations who are also the generators as well as the catalytic institutions. The existing institutional arrangements are presented in the figure given below:



2. **Purpose:** Separate institutions / organizations / generators have roles based on the type of the solid waste being generated in the city. While the MSW is managed primarily by the PMC, all other forms of regulated solid waste have their management vested on the generators. In case of BMW a service provider for the common waste is available in the city that caters to the maximum of the BMW generators. For the management of hazardous solid waste the responsibility has been vested on the generator of the waste along with the operator of the treatment and disposal facilities where such wastes are taken. For the C&D and E-waste no clear institutional framework exists at present. In order to institutionalize and standardize the overall waste management procedures a common nodal authority formulated through representatives of various involved stake-holders in the form of an ISWM cell has been proposed.

3. **Target**: To formulate an Integrated Solid Waste Management Cell for Pune to assist PMC as an institutional body for managing the wastes and also to make an ISWM website. This website will work as an information portal for Pune's waste management aspects.

4. **Type:** Programme

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Solid Waste Management department

6. **Support Agency:** All other stakeholders related to solid wastes in Pune city. PMC can use the service of an in-house team of consultants to implement all the proposed schemes which are part of this ISWM action plan.

7. **Location (Suggested):** Pune Municipal Corporation (PMC) office

8. **Budget (Estimated):**
   - For consultants team – Rs. 5 Million

9. **Time Frame (Estimated):** The team of consultants will provide support to the ISWM Cell in a tapered manner over 4 years.

10. **Description:** The institutional capacities and human resource gaps in some of the key institutions for solid waste management of Pune are presented below.

    Maharashtra Pollution Control Board: The MPCB is the authority for the implementation and monitoring of compliance of all the rules pertaining to the management of all the solid waste management in the city. While MPCB has efficiently implemented the Hazardous Waste rules, the MSW and BMW rule implementation has gaps. The MSW rule has the implementation responsibility on the municipal authority which themselves are constrained in terms of manpower, financial resources, expertise, etc. (discussed elsewhere in this chapter) and therefore the MPCB has not been able to initiate action against the board. In case of BMW, most generators do not take MPCB's permission and therefore MPCB also is unable to monitor such facilities. Besides due to the number of such facilities within the PMC area the manpower requirement of MPCB is presently not adequate keeping in view the responsibilities regarding the implementation of all other environmental rules and regulations also is vested on MPCB.

    Pune Municipal Corporation: The PMC is accountable for the implementation of the provision of these MSW rules. This means PMC is responsible to provide and facilitate for collection, segregation, storage, transport, processing and disposal of the MSW generated in the city. Within PMC the division of functions is defined as follows:

    The health department of PMC oversees the MSW management of the city. However the transport facilities being used for the movement of the waste are not with the health department.

    Presently, there is no apparent linkage between the health department and the town planning department of the PMC in the SWM context, whereas the town planning practices do affect the management of solid waste.

    The implementation of the SWM functions of Pune is undertaken by the available manpower with the health department. As discussed the MSW management of Pune is predominantly managed by the health department officials. The senior officers are qualified medical doctors and most of them have specialization in public health. The sanitary inspectors along with their team work at the ward levels for managing the SWM activities. There is relatively low engineering department support.

    At the landfill also the operations are handled by the staff from the health department. As is obvious from the discussion above, the PMC does not have the multidisciplinary team to handle the varied issues of MSW management.

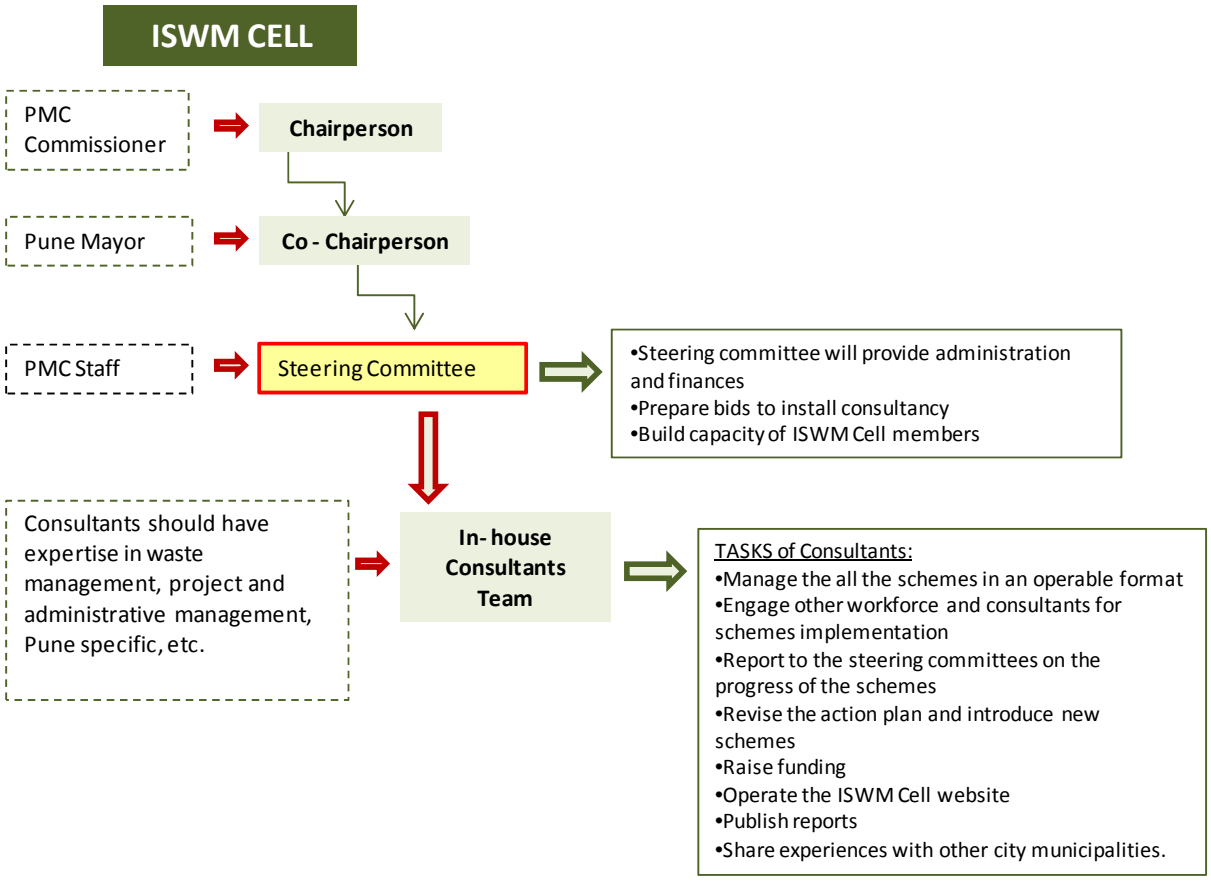
    In its endeavor to improve the waste management situation of the city, PMC has developed linkages with various NGOs and organizations. However the lack of a formal structure and description of jobs expected makes the process repetitive.

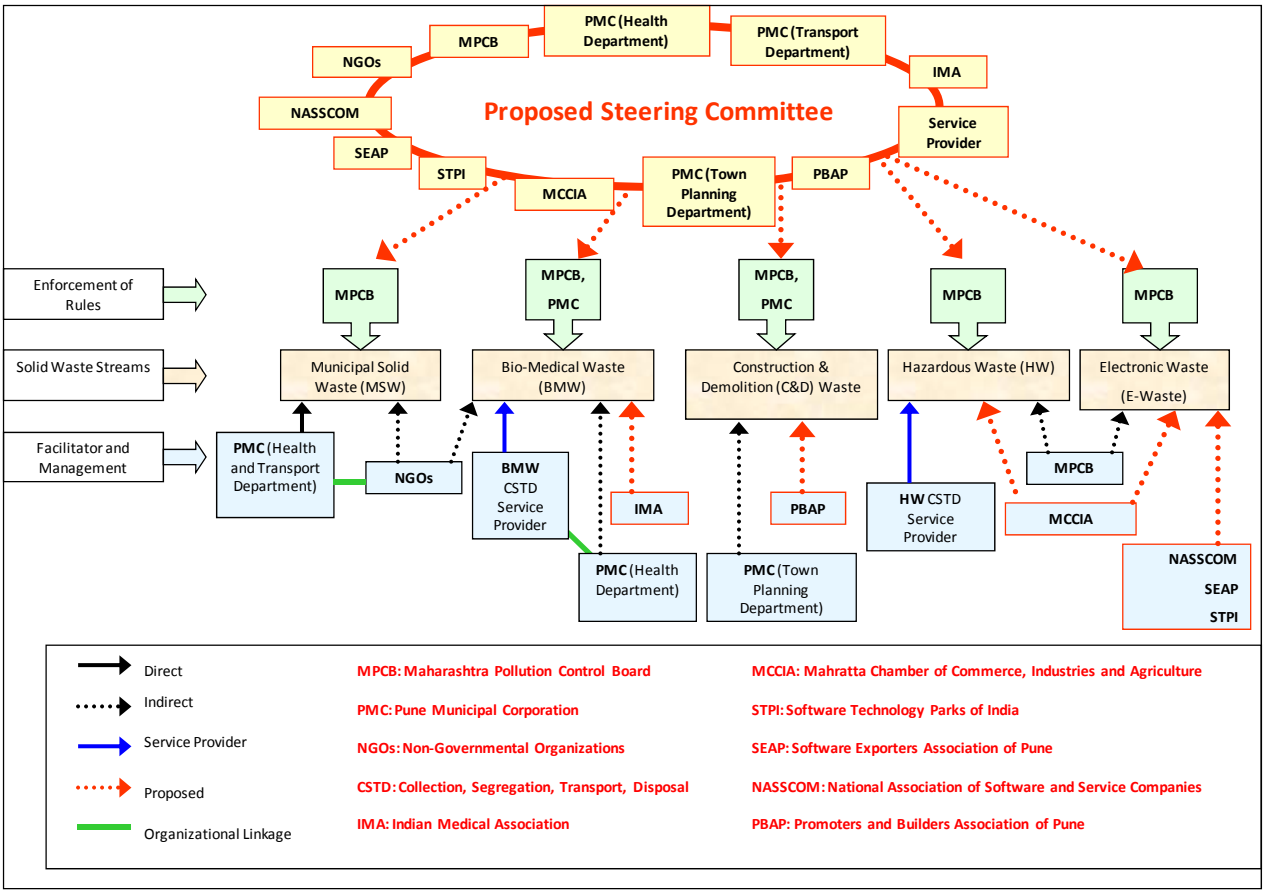
    A quick review of the existing institutional framework brings out various other organizations / institutions capable of providing the support to the waste management scenario and thus augmenting the waste management process. If these organizations are looked at from the perspective of Integrated Solid Waste Management, then the potential linkages as depicted in the figure below could be explored.

11. **Implementation:** The proposed ISWM Cell will be housed in the Solid Waste Management Department of PMC with some of the PMC staff operating the ISWM Action Plan. There will be a steering committee appointed which will provide administration and financial support. The PMC Commissioner will be the chairperson of the Steering Committee and the Co-chairperson will be the Mayor of Pune.

Stakeholders involved in the Steering Committee: The stakeholders involved in the Steering Committee will include officials from various regulatory/governance related bodies such as the MPCB as well as the PMC, the business community as well as the representatives of the communities such as NGOs and citizens.

A team of in-house consultants of 4 members will be hired for a period of 4 years who will provide support in a tapered manner. All four consultants will work for 2 years, the third year only 2 consultants will work and in the final year, one consultant will be employed. Meanwhile, the steering committee will build the capacity of the ISWM members.





ISWM Website: In order to propagate and communicate the initiatives taken up at the city level, a dynamic website needs to be developed solely for ISWM. This website should feature the data related to ISWM of Pune. It will be used for disclosure of data where the stakeholders will exercise their right to information, and tenders for new projects will be put up on this website. This website will require constant update and maintenance in terms of the data representation. Advanced GIS techniques can be utilized in order to use this website for route-optimization as well as provide a grievance-addressal mechanism.

12. **Barriers:** The interactions, co-operation between numerous stakeholders coupled with the initial large-scale investment are the major hurdles in implementing this cell.

13. **Benefits:**
    - Centralized agency for managing all forms of waste
    - Development of a dynamic, interactive and user-friendly platform for waste management
    - Development and evolution of a self-sustaining waste management model
    - Proves Right to Information for all Stakeholders

14. **Links to other ISWM Pune Schemes:** This scheme is the central scheme. All the other schemes are related to this scheme in some way or the other.

6. DEVELOP AND INTRODUCE POLICY FOR CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT

1. **Introduction:** With the growth of automobile and IT sector in Pune, the city has been expanding at an alarming rate. With the increase in economic activities, the construction and demolition activities in and around the city have increased manifold. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) has also sanctioned several large scale infrastructure projects in Pune. This would give rise to the amount of construction waste generated.

   It is estimated that approximately 40.6% of the total garbage generated in the city. In absence of proper C&D waste disposal rules, the debris finally ends up in the landfills or is dumped in low-lying areas including river banks & beds. These activities shorten the life of landfills on one hand and on the other changes the topography of land, thus affecting surface water drainage and ground water percolation. The unauthorized dumping of C&D wastes as well as unattended silt left in public after de-silting operations, is a major cause of nuisance, environmental degradation and pollution. Currently no systematic management of C&D wastes is practiced in Pune.

2. **Purpose:** Several tons of C&D wastes are generated which get mixed with the organic and other types of MSW. PMC has to spend a lot in the collection and transportation of C&D wastes. However, this effort is negated by large amounts of unauthorized and un-attended waste which is washed into storm water drains resulting in blockage etc. Due to the above reasons the management and disposal of C&D waste has become a critical issue in the city. There are presently no specific rules formulated either by the Government of India or State Government that specifically govern such C&D wastes. However, there have been guidelines introduced for C&D waste management in the city of Mumbai by the Municipal Corporation of Greater Mumbai. Therefore it has become necessary to formulate a detailed framework to specifically regulate the storage, collection, handling, transportation, management and disposal of the types of solid waste that is generated from various construction and demolition activities.

3. **Target**: To introduce specific guidelines for management and disposal of C&D waste generated within the city of Pune.

4. **Type:** Policy

5. **Lead Agency:** Pune Municipal Corporation (PMC) – Town Planning Department

6. **Support Agency:** C&D Waste Management sub-division of the ISWM Cell including Promoters and Builders Association of Pune (PBAP), Builders and Contractors, Maratha Chamber of Commerce, Industries and Agriculture (MCCIA), National Building Construction Company and Housing Urban Development Corporation, NGO's, generators and housing societies.

7. **Location (Suggested):** Office of PMC – Town Planning Department

8. **Budget (Estimated):**
   - For Consultant – Rs. 0.7 Million

9. **Time Frame (Estimated):**
   - For preparation of final guidelines – 8 months

10. **Description:** PMC can use the services of a consultant to formulate these guidelines. PMC should appoint a Municipal officer responsible for formulating and implementation of these guidelines. Certain disposal sites can be designated as disposal sites for C&D Wastes. The procedure for designating disposal sites for C&D

Wastes has been explained in the Scheme for C&D Waste Management. The Officer in charge should approve other sites other than the designated disposal site, carryout inspection of premises where any C&D waste generation activity is being undertaken for review of compliance with the approved relevant waste management plan and prepare weekly reports of the various C&D waste generation activities at ward level should be submitted by building supervisors in each ward.

Several inputs can be taken from the C&D Waste (Management and Disposal guidelines from Municipal Corporation of Greater Mumbai (MCGM) and these inputs may be incorporated in the C&D Waste Management Guidelines for Pune city[1].

Formation of the Authorized Agency: Authorized Agency can be any organization licensed by PMC to collect, transport and dispose the C&D Waste within a specific area, in accordance with these Guidelines.

Authorized Agency should:

- Collect, transport and dispose C&D waste
- Ensure disposal of unaccounted C&D waste (for example waste lying on roads etc) at its own cost
- This agency shall put in place appropriate mechanisms to reduce the quantum of such unaccounted C&D Waste
- Every authorized agency shall deploy transport vehicles complying with applicable laws and meeting relevant BHARAT standards for fuel and emission as per National Auto Fuel policy in India.
- Every authorized agency should be expected to gradually upgrade the data and document management system to a computerized online system over a period of two years.
- Every authorized agency shall submit weekly report on C&D waste management within its relevant area.
- Authorized agency shall attend to all complaints (whether written or otherwise) within a period of 24 hours and shall inform the PMC regarding the same.
- Licensing of authorized agencies should be done through competitive tendering. Strict pre-qualification criteria should be designed.
- Authorized agency should bear tipping fees for C&D waste disposal at the Designated Disposal Sites. Therefore, a Clause which would allow the authorized agency to collect service charges from bulk generators and construction projects needs to be incorporated in the C&D Waste Guidelines
- Transit stations shall be constructed for temporary storage of C&D waste in containers for aggregated the C&D waste provided by small quantity generators.
- Authorized agency shall be given / provided with containers by municipality for storage and transportation of C&D Waste

Tipping Fees to be paid by Authorized Agency for Disposal of Waste at Designated Disposal Sites:

C&D Waste Volume	**Illustrative Rates (Rs/Container)**
Container (<3 m^3)	90
Container (6 m^3)	180
Container (9 m^3)	270
Container (>12 m^3)	360

Description of Construction & Demolition (C&D) Waste: Construction & Demolition and De-silting waste (C&D Waste) means solid waste resulting from construction and remodeling. Repair, renovation or demolition of Structures or from land clearing activities or trenching or de-silting activities include but not

1 As Referred to http://www.mcgm.gov.in/contents/C-D-W_G.pdf

limited to bricks, concrete, rubble, other masonry materials, soil, any type of vegetation, rock, painted, treated, coated wood and wood products, land clearing waste, wall coverings, plaster, drywall, plumbing fixtures, non-hazardous insulation, roofing, waterproofing material, other roof coverings, asphalt pavements, glass, plastics, paper, gypsum boards, electrical wiring, components, containing no hazardous materials, pipes, steel, aluminum. C&D waste shall not include even if they result from construction activities if they are defined under the Hazardous Waste (Management and Handling) Rules, 1989.

To whom are these guidelines applicable: These guidelines would be applicable to all C&D generators within the city, all C&D waste generation activities and all C&D waste generated within the city of Pune.

C&D Waste Generators may be:

- Any builders and developers whether from the private sector or government owned or controlled sector. These would include major civil works under-taken by
- Utilities or their contractors or a Government Agency undertaking any C&D waste generation activity that requires a no-objection certificate
- De-silting and excavation contractors appointed by the municipality to clear storm water drains
- Small quantity generators undertaking or in charge of implementing a small quantity C&D Generation Activity.

Responsibility of C&D Waste Generator:

- It complies with the relevant provisions of these guidelines
- All large category generators should submit a waste management plan.
- Collection, Transportation and Disposal of C&D Waste by the Authorized Agencies

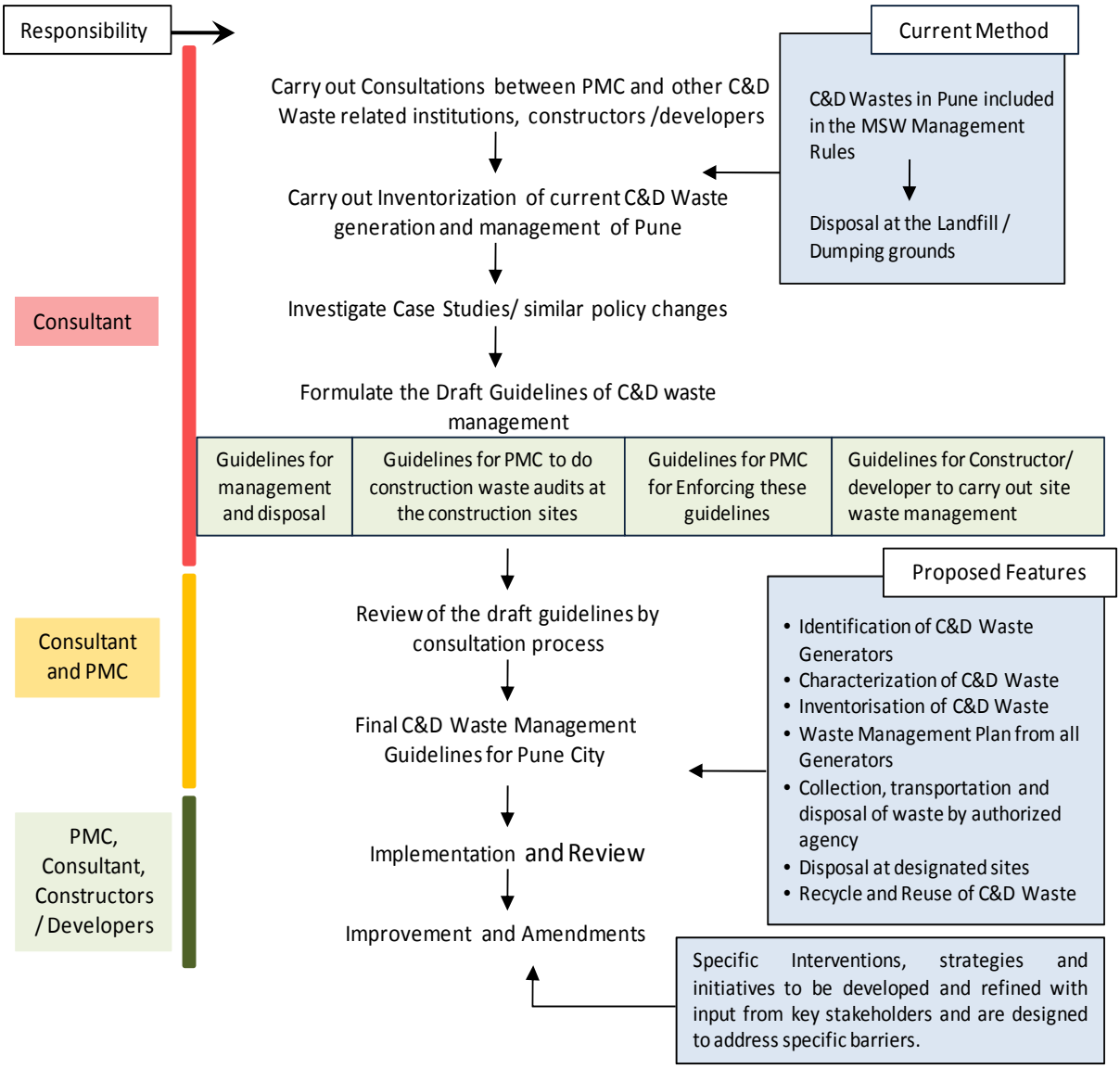
Waste Management Plan to be submitted by the Waste Generator to PMC - Town Planning Department:

The Waste Management Plan should include several details such as

- Name of the C&D Waste Generator
- Category of Generator
- Construction Site Details
- Type and description of work
- Type of waste likely to be generated
- Estimated quantum of generation
- Disposal at designated disposal site
- If disposal at site other than Municipality designated disposal site then
    - Location
    - Reason for disposal at the said site
    - Owner name of contact
- If salvage planned then
    - Intended use
    - Quantum proposed to be salvaged
- Total quantum to be disposed by Authorized Agency

11. **Implementation:** The consultant hired by PMC can carry out inventorization of the C&D Wastes generated in Pune through a consultative process between PMC and other related stakeholders. The consultant should formulate draft guidelines which should include:

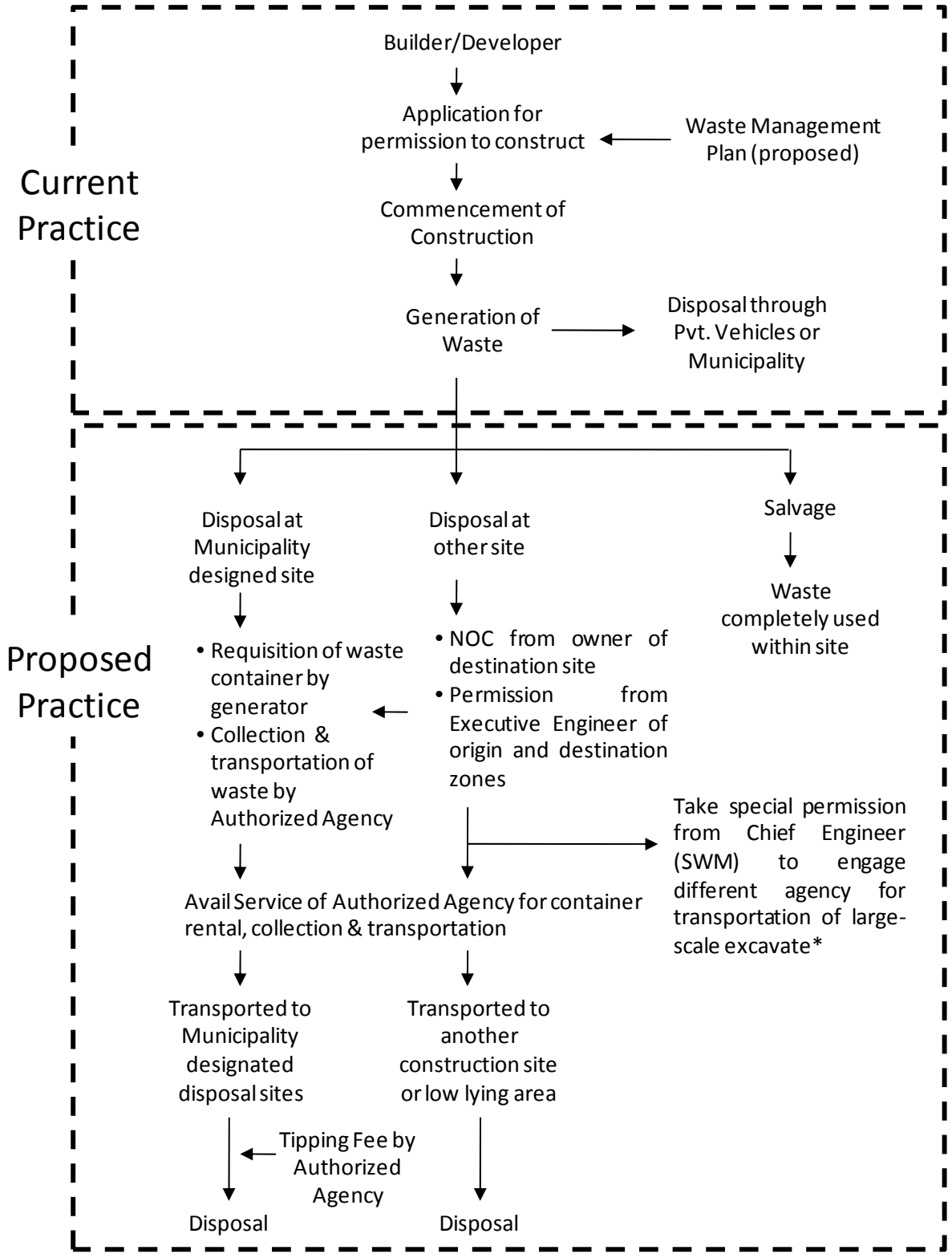
- Guidelines for management and disposal of C&D wastes
- Guidelines for PMC to carry out construction waste audit at the site and also enforce these guidelines
- Guidelines for Constructors / Builders/ Developers to carry out site waste management.



12. **<u>Other similar experiences:</u>** In Mumbai, an estimated amount of 2200 tons of C&D Waste generated and received everyday at the municipal dumping grounds of Mumbai, most of which are collected and transported by Municipal Corporation of Greater Mumbai (MCGM) appointed contractors. To address the issues of C&D waste management, the MCGM under the Mumbai Municipal Corporation Act, 1888 formulated the ***"Municipal Corporation of Greater Mumbai C&D and De-silting Waste (Management and Disposal) Guidelines, 2005".*** These guidelines also stipulate the processes and procedures to be followed by various categories of generators for C&D Waste management in the city of Mumbai. The following categories of waste generators were identified and their current practice of C&D waste management was discussed and proposals for future management were provided[2].

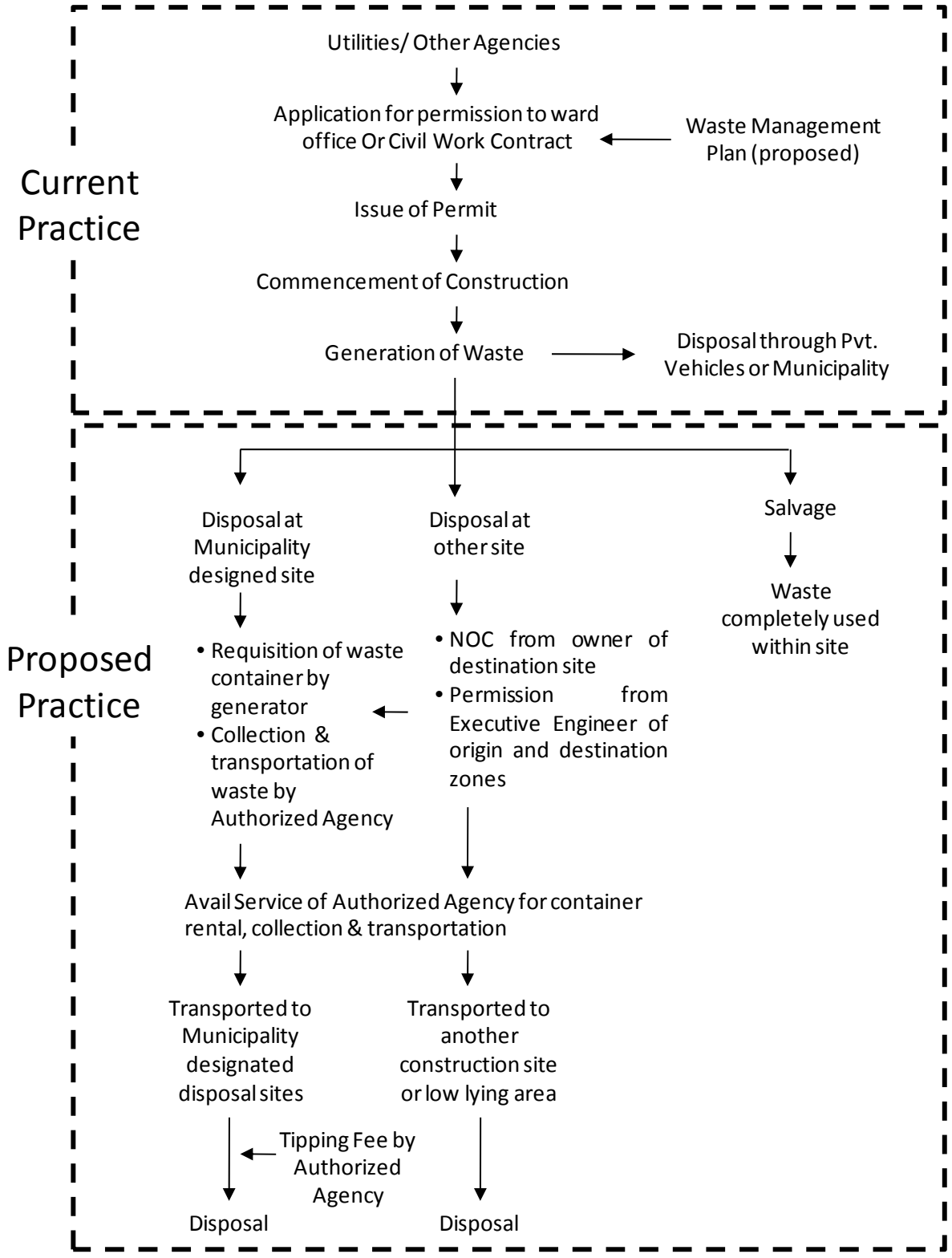
2 As Referred to http://www.mcgm.gov.in/contents/C-D-W_G.pdf

CATEGORY 1: BUILDER/ DEVELOPER

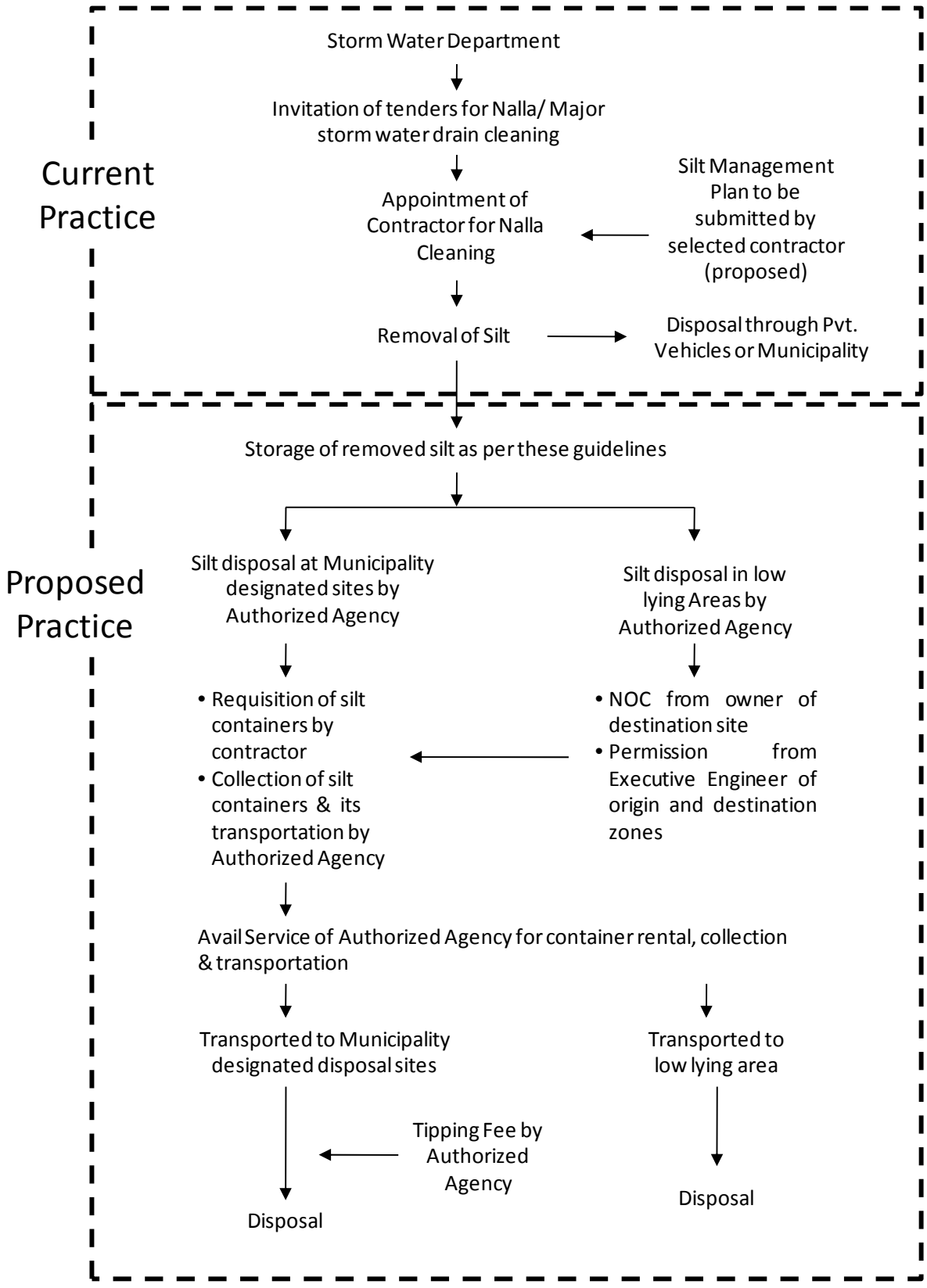


* Such permission shall only be granted in case of large scale excavation undertaken for "basement" provision, and when the excavate is likely to exceed 100 tons/day continuously for more than a week

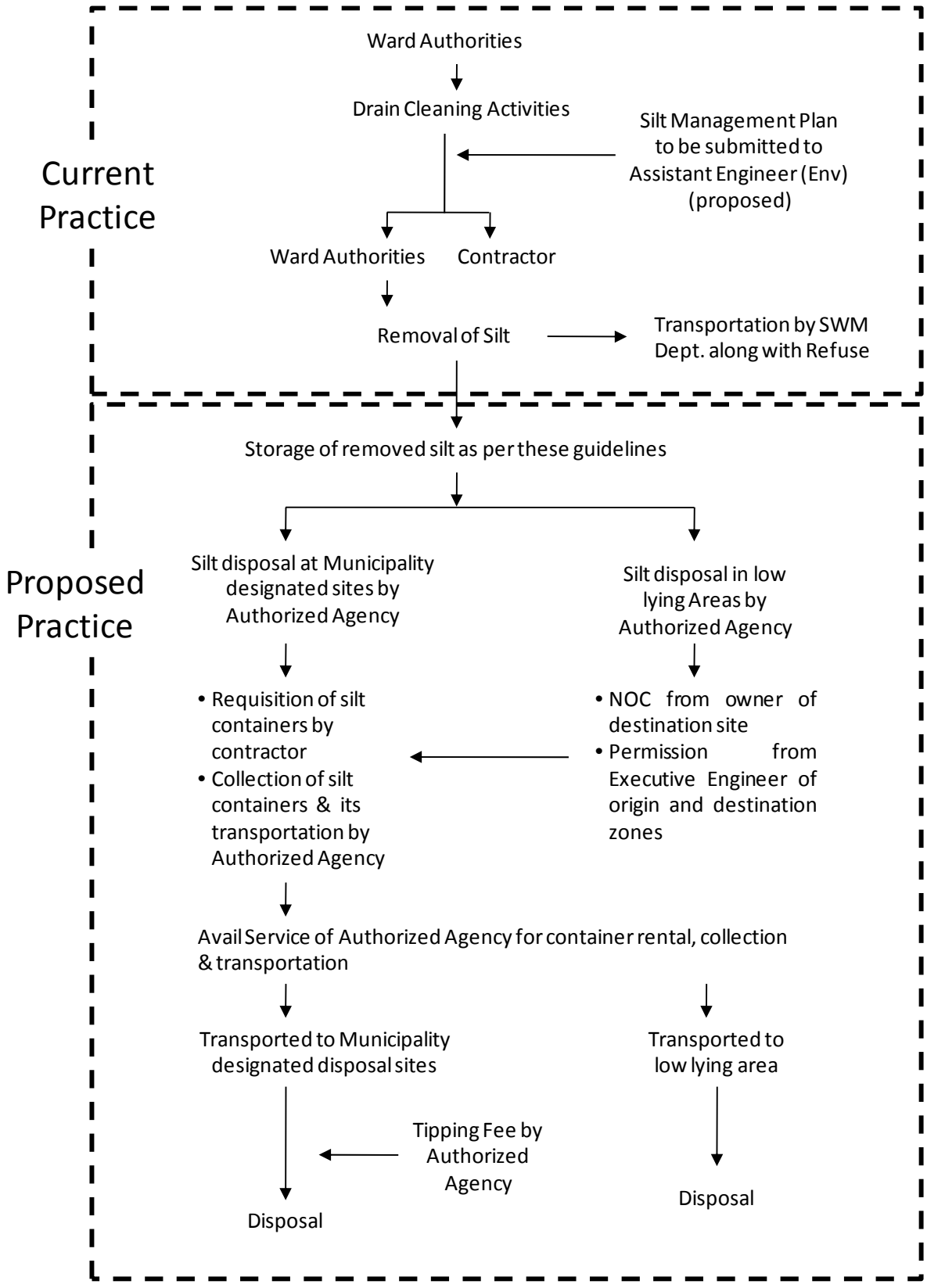
CATEGORY 2: UTILITIES /OTHER AGENCIES



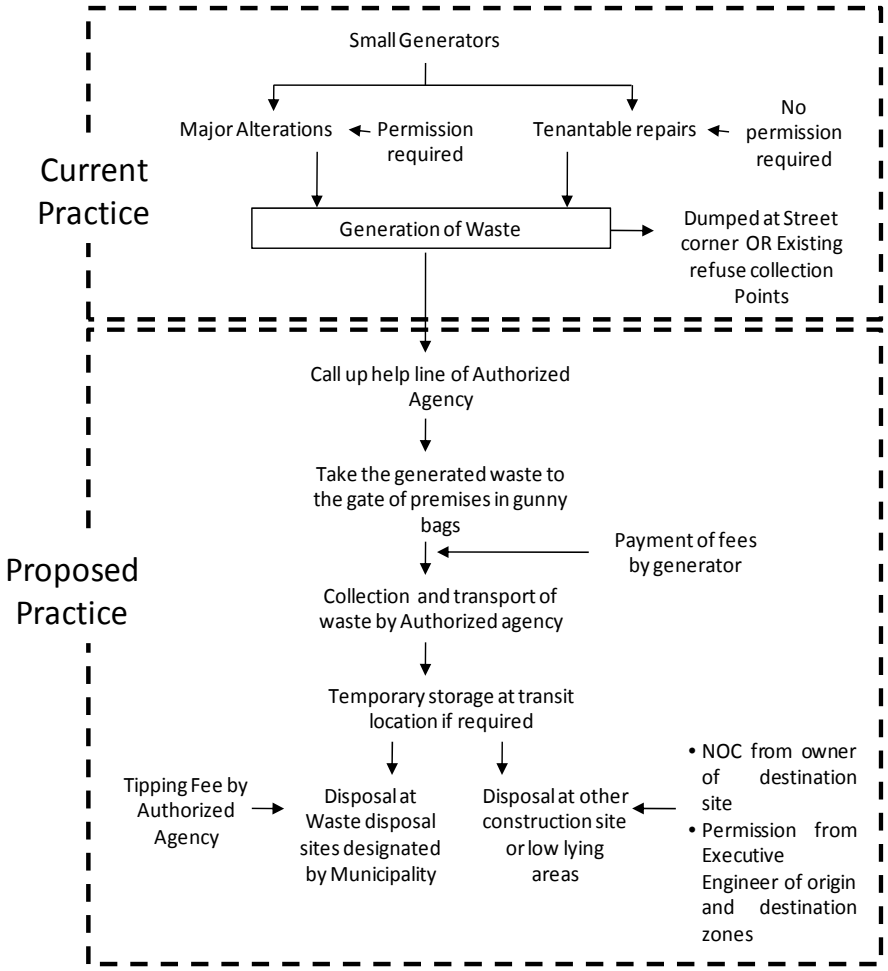
CATEGORY 3A: DE-SILTING WORK (STORM WATER DEPARTMENT FOR NALLA /MAJOR DRAIN CLEANING)



CATEGORY 3B: DE-SILTING WORK (WARD AUTHORITIES FOR SMALL STORM WATER DRAIN CLEANING)



CATEGORY 4: SMALL QUANTITY GENERATORS



13. **Barriers:** Co-operation from all stakeholders for the change in the Policy of C&D Waste Management and the lack of awareness regarding C&D waste management. This can be overcome by increasing the awareness through the proposed awareness programmes to be conducted for businesses and community.

14. **Benefits:**
    - Management of C&D Waste would become more convenient and easy to handle
    - Nuisance due to C&D Waste would be avoided
    - C&D Wastes would not get mixed with MSW and avoid the use of landfill space
    - These would help to avoid the blockages of Storm water drains
    - Air Pollution in the form of dust is also avoided
    - These guidelines help to improve the awareness regarding C&D waste management and recycling to all stakeholders
    - This policy change would help in the integrated waste management of Pune City.

15. **Links to other ISWM Pune Schemes:**
    - Pilot Projects Recycle and Reuse of Construction and Demolition Waste
    - Construction and Demolition Waste Management
    - Establishment of Integrated Solid Waste Management Cell (ISWM Cell)
    - Establishment of a Waste Exchange Centre
    - Establishment of an Environmental Awareness Centre

7. IMPROVING HEALTH AND SAFETY OF PMC WORKERS, RAG PICKERS AND CITIZENS IN PROXIMITY WITH THE LANDFILL

1. **Introduction:** The PMC Workers and Rag pickers have to deal with various kinds of waste streams. Even the Municipal Solid Wastes are often mixed with household hazardous wastes, broken pieces of glasses etc. These wastes are dealt by the waste management workers manually without any safe handling procedures or safety equipment. This leads to several injuries and illnesses among such workers.

   Since the landfill at Pune is currently an open dumping ground, there are several health and safety issues that arise from there. Rag pickers and PMC workers work at these landfills for segregation and sorting processes and are also exposed to the safety concerns there. In Pune city, due to the shortage of space and expensive housing, illegal housing is also done around and near the landfill. This gives rise to health issues of the citizens living close to the dumping ground.

2. **Purpose:** Schemes such as Formation of the community sorting centres, Strengthening of PMC rag pickers co-operatives, formation of a cadre of operators for decentralised treatment etc. do touch upon the health and safety issues of rag pickers. However, a detailed assessment needs to be carried out; awareness and training needs to be provided along with the safe procedures of waste handling and equipments need to be supplied. The same needs to be done to the PMC workers as well.

   A study needs to be conducted around the existing landfill which is described in the scheme for assessment of existing waste disposal sites and evaluating management options. This study will be able to identify the safety issues in and around the landfill area. This will help to make arrangements for the addressing the safety and health issues in this area.

3. **Target**: To introduce programme for improving the health and safety of PMC workers, rag pickers and citizens in proximity with the landfill**.**

4. **Type:** Programme

5. **Lead Agency:** PMC, NGOs working with the rag pickers.

6. **Support Agency:** PMC can use the services of a consultant, Sustainability Sector from Corporate company, NGOs

7. **Location (Suggested):**
   - All those locations where the PMC Workers come in contact with waste management including while collection, at the transfer station and at the landfill.
   - All those locations where the rag pickers come in contact with waste management including while collection, at the transfer station and at the landfill. Special attention should be given at the Community Sorting Centres especially those which may be placed at the following wards in Pune – Hadapsar, Karve Road, Kasaba Peth, Vishrambagwada, Tilak Road.
   - Locations for Health and Safety of citizens in proximity with the landfill are areas which are near the Urali Devachi landfill area and the new suggested landfill locations such Yevalewadi, Pimpri Saandas and Punawale.

8. **Budget (Estimated):**
   - For Consultant – 1 Million

9. Time Frame (Estimated):

Activity	Year 1			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
Planning for carrying out the health and safety assessment	3 months			
Evaluation of health and safety for rag pickers, PMC workers, citizens in proximity with the landfill		6 months		
Recommendations for improvement in operations				3 months

10. Description:

An assessment should be carried out to

- Identify and understand the health and safety issues faced by the PMC workers and rag pickers.
- Assist with the injuries and illness prevention efforts
- Help investigate the underlying causes of injuries
- Help find and implement solutions to health and safety problems
- Provision of health and safety equipment for PMC workers and rag pickers
- Impart training for safe procedure for handling of wastes.

Assessment for the health and safety issues near the landfill should address the following:

- Pest Control
- Litter Control
- Fire Control
- Dust Control
- Odour Control
- Site Safety
- Leachate Management
- Landfill Gas Control

Responsibility of PMC:

- PMC should impart training to the rag pickers and PMC workers regarding safety measures
- Protective equipment should be supplied to the workers
- Regular health checkups should be done at the municipal hospitals
- Medical insurance should be provided

Implementation of Health and Safety around the landfill:

Pest Control

- Files, however, will still be a problem especially at poorly managed sites.
- The problem may be made worse where the waste is taken to the site via a transfer station several days may elapse between collection and deposition.
- In many situations, the life cycle of the common house fly may be completed in less than 10 days thereby creating a serious risk
- Local authority environmental health officers responsible to arrange a system of site inspection for pest control or by a pest control contractor

Litter Control

- Litter control at landfill sites is most important, in particular at sites situated close to housing, recreation areas or highways
- The direction of working face should be selected in relation to wind direction; consequently, meteorological records should be consulted when planning the filling sequence
- A large proportion and plastic, litter may be a particular problem. This may be minimized, where possible, by bagging or baling such material at source.

Fire Control

- Fires on landfill sites are now uncommon although the following are cause which must be guarded against if possible:
    - burning or hot incoming waste
    - discarded cigarettes from site workers
    - licensed or unlicensed from scavengers
    - spontaneous ignition of the waste
    - Vandalism
    - ignition of landfill gas, and
    - Over pumping of gas which could increase the oxygen level.

Dust Control

- Dust may be both a health and safety problem, especially during dry weather
- It should be controlled, where possible, by good operation practices and if necessary, by spraying water onto the dust using tankers fitted with sprinklers.

Odour Control

- Odour are inevitable at landfill sites and will be especially noticeable during hot weather
- The problem may reduce by minimizing the time during which put risible material remains uncovered

Site Safety

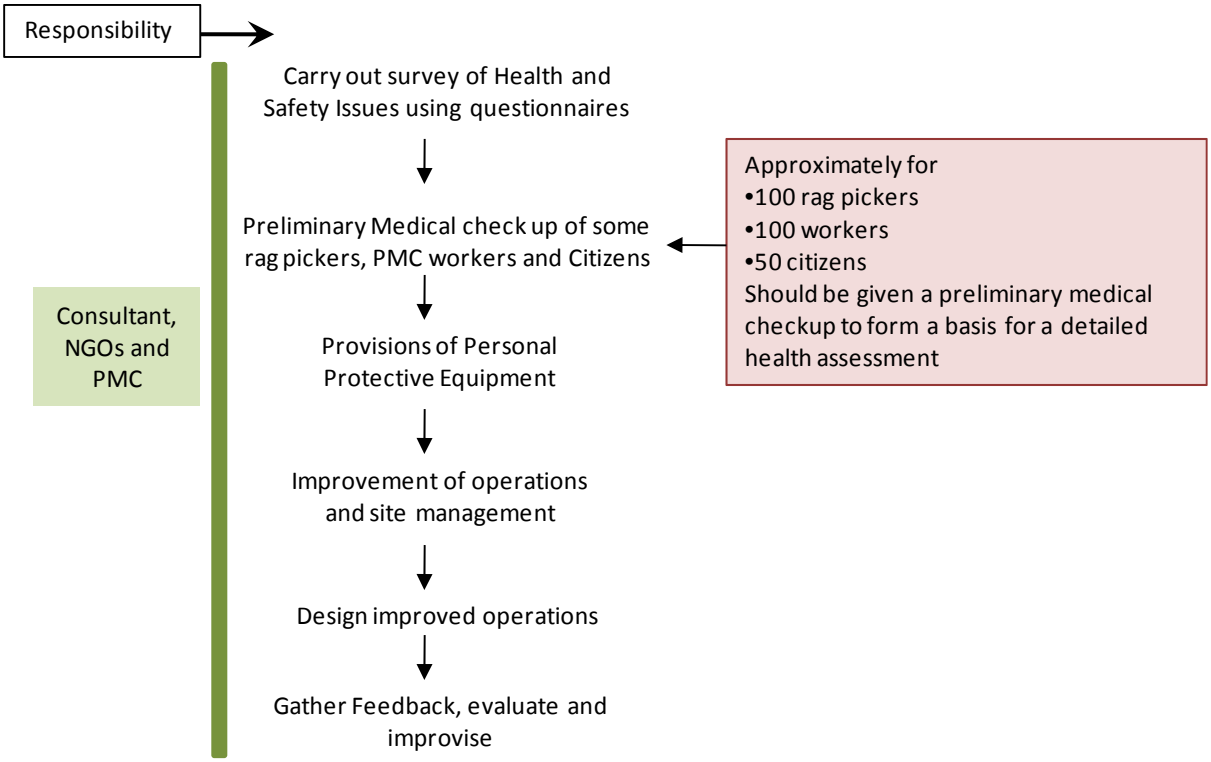
- ***The regulation should not only relate to the actual landfill operations, site investigation, preparation and restoration but should be extended to include:***

    - provision and maintenance of safe plant
    - handling, storage, and transport of substances and articles
    - provision of information, instruction, training and supervision
    - maintenance of workplace and access in safe
    - Conditions
    - Provision and maintenance of safe working environment with adequate facilities for welfare.

The other site safety measures must consider:

- Ovoid steep gradient and sharp curves on site access
- Provided warning signs and crash barriers
- Display speed limits
- Measures the level of waste does not rise above a level agreed with the electricity undertaking
- " no smoking" notices should be prominently display at appropriate locations
- All site personnel and visitors should be provided with protective clothing, including hard hats strengthened toe-cap boots and, if necessary, safety glasses.

11. Implementation:



12. Barriers: Since many of the rag pickers and workers are illiterate, imparting training would be a difficulty. However, this can be overcome by training them with real life situations explanation.

13. Benefits:

- Safe working conditions for rag pickers and PMC Workers
- Provision of protective equipment
- Indirectly Avoiding spread of diseases etc.
- Practice of safe disposal methods

14. Links to other ISWM Pune Schemes:

- Assessment of Existing Waste Disposal Sites and Evaluating Management Options
- Identification of New Waste Disposal Sites
- Establishment of Community Sorting Centres
- Optimizing and Strengthening of MSW Collection systems
- Establishment of Environmental Awareness Centre
- Strengthening of PMC Rag picker co-operatives
- Establishment of a cadre of certified operators for decentralised treatment

8. STRENGTHENING PMC RAG PICKER CO-OPERATIVES

1. **Introduction:** In areas where mixed waste is generated at the generators level, the segregation and separation is predominantly done by rag pickers. The rag pickers segregate waste at various levels/ stages like at door step collection, at *Ghanta* Trucks, community bins and also at disposal site.

2. **Purpose:** The rag-pickers have been integrated into the waste collection and segregation system with the aim of increasing the level of segregation as well as improving the life of the rag pickers by providing them a constant source of livelihood. From the total waste generated 1093 tons per day in Pune, 30tons is collected by rag pickers, 95 tones is unattended waste and 968 tons is lifted by vehicles[1]. Thus the waste collection efficiency calculated is 88%. However, in spite of institutionalizing the rag-pickers many of them are still working individually under unsafe conditions without the knowledge of PMC initiatives. Women constitute a major portion of the rag-pickers. A need is felt to involve the women in self-sustenance activities. The rag-pickers will help PMC in achieving the objectives, improving segregation of MSW and benefiting the rag-pickers as well.

3. **Target**:
   - To carry out an inventory of the rag pickers working in Pune and to increase their numbers in the PMC co-operatives
   - To impart vocational training to be given to the Rag picker Cooperatives
   - To provide incentives and benefits to such cooperatives
   - To provide for Medical insurance system
   - To impart awareness amongst rag-pickers to encourage the independently working rag pickers to join co-operatives and work at the Community sorting centres.
   - To promote rag pickers to work at CSC, spread awareness at EAC, promote sale of crafts sold at EAC and communities, gardening etc for various community gardens/ PMC gardens etc.

4. **Type:** Programme

5. **Lead Agency:** PMC

6. **Support Agency:** Existing NGOs working closely with the rag pickers

7. **Location (Suggested):** Training can be imparted at EAC and the respective CSC's. In order to increase the number rag-pickers, surveys can be carried out. Karve Road and Kasaba Peth wards can be considered as the initial wards for introducing survey for increasing the number of rag-pickers.

8. **Budget (Estimated):**
   - For Consultant – 0.5 Million

9. **Time Frame (Estimated):**

Activity	Year 1		Year 2	Year 3	Year 4	Year 5
	Oct - Mar	Apr - Sept				
Inventory of Rag pickers working in Pune						
Increase members in PMC rag picker co-operatives						

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Training and Skill development of rag pickers		

10. **Description:** The numbers of rag pickers registered with PMC working on various aspects of waste management are shown in following table. This table shows the ward-wise status of rag-pickers.

Ward-wise Status of Rag Pickers in Pune

Ward Office	Waste pickers at the level of		
	Containers	Residence(Societies)	Commercial
Aundh	-	66	40
Ghole Road	-	70	25
Warje Karvenagar	33	45	-
Karve Road	18	52	-
Dhole Patil Road	10	47	30
Hadapsar	76	31	6
Sangamwadi	-	200	20
Yerwada	-	160	40
Kasaba Peth	15	62	4
Vishrambagwada	41	74	19
Bhavani Peth	33	153	2
Tilak Road	92	34	15
Sahakarnagar	37	80	8
Bibvewadi	33	153	2
Total	**388**	**1227**	**211**

Since most of the rag pickers are women, activities that would help women in earning a living should be encouraged. Some of the activities where women can be involved are listed below:

- Making handicrafts out of waste paper etc
- Waste recycling and waste exchange centers
- Composting Programme and gardening
- Environmental Awareness Centers
- Cleaning of public places

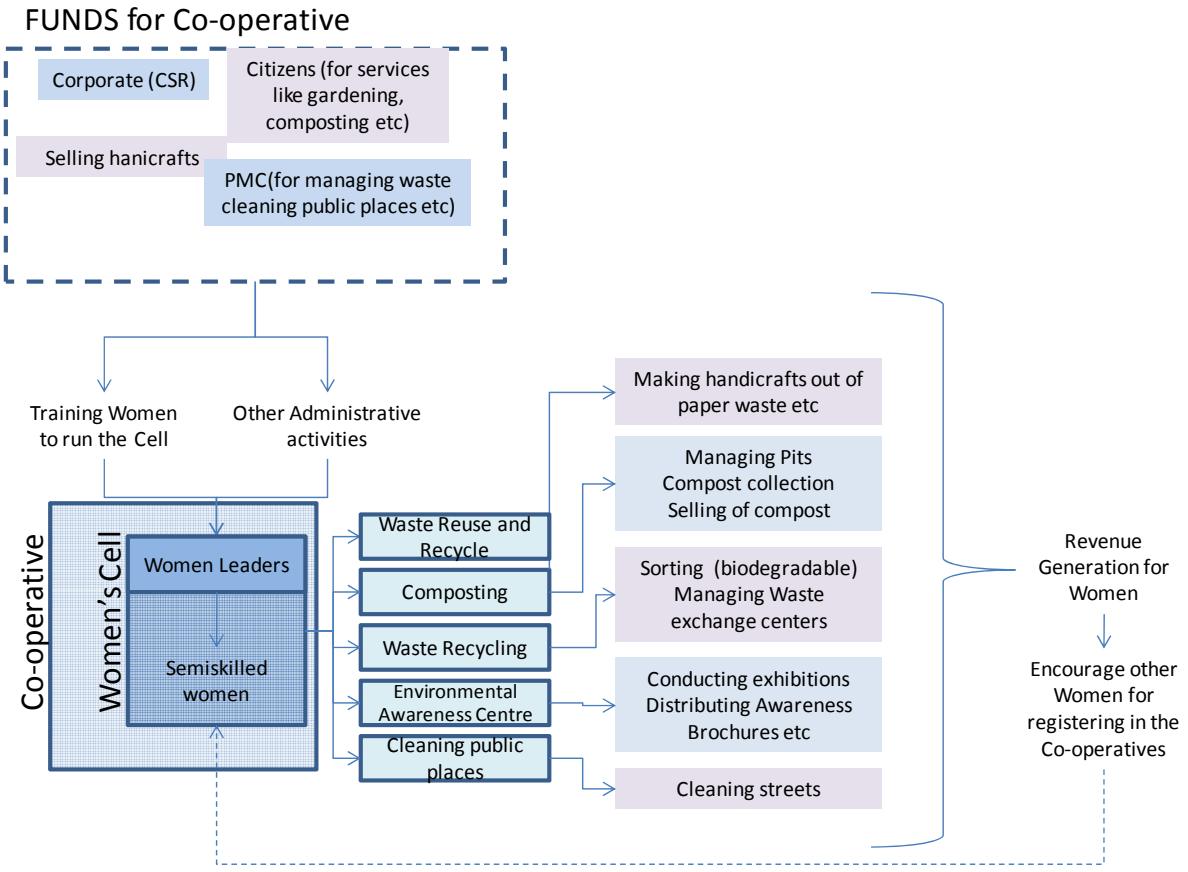
To make the women group able and competent, vocational training needs to be imparted to the women for carrying out the above activities. PMC can use the services of a consultant. The consultant can work towards achieving the listed targets. The consultant along with the NGOs can take the initiative of conducting training programmes. PMC should provide the financial and technical assistance to such NGOs. This training is carried out for those rag pickers that are part of the Co-operative.

Awareness raising programme should be carried out to explain the benefits and facilities provided by Co operatives. A scheme for earning extra income, free medical insurance can be some of the incentives for encouraging rag pickers to join the co operatives

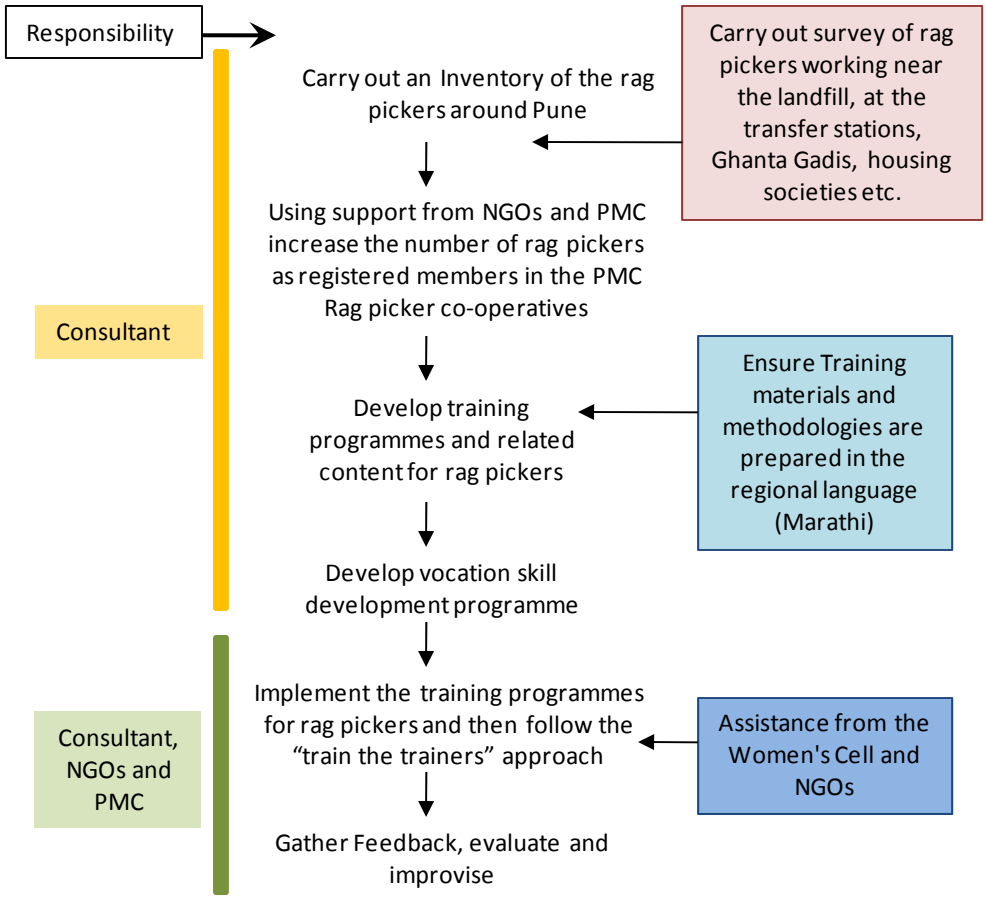
To manage all the activities like training, awareness raising, formulating schemes etc , a women's Cell can be formed that takes charge of assigning the right work to the women groups, based on their qualifications and constraints to work. The women who will run the Cell can be trained to manage the activities e Cell. The Activities of the cell are shown in Figure below. This basically follows the "Train the trainers" approach. The women who undergo the training to run the Cell will further train other women on specific activities like Composting or cleaning public places.

Women's cell is funded by a certain percentage of income earned by the women, the PMC and the corporate sector, through its CSR activities. The handicraft items that are made from waste can be displayed at the EAC

The Composting programme can involve women, where they can be assigned the work of collecting, sorting waste and managing the pits etc. This can be further extended to gardening in the residential areas as well at public places.



11. Implementation:



12. **Other similar experiences:** The Parisar Vikas programme was launched in the year 1998 by the Stree Mukti Sanghatana with the cooperation of the Municipal Corporation of Greater Mumbai (MCGM). The programme aims to address the problems of waste management and of self-employed women engaged in the 'menial' tasks of collecting waste. Initially with the help of BARC and NACIO, these women were given training in segregation of waste, composting and gardening. They were thought the procedure and materials going into the dry and wet segregation process, composting methods and the BARC gardeners helped to teach them some gardening. There are currently 2500 rag picker women who have been given training out of which 400 have received gardening training, 450 in leadership/vocational training and 300 are working for several other projects.

For this training, travel allowance, notebook, pencils were provided and this allowance given upon the deal that these women will be able to sign their names at the least.

A savings account for each savings group was opened and their profits had to be put in the account. This money was used by these women in clearing out any debts or start any new business etc. Later based on the Swarnajayanti Sharari Rozgar Yojna (SJSRY) of the Central Government, they were given some equal amount of money for each rag picker to be put in their savings account. These schemes were launched by the Central Government for people living below Poverty line

13. **Barriers:** Women are usually tied up by other activities like doing household work and taking care of the families. However facilities such as crèche at the working place could be helpful in encouraging women to participate in the co-operative.

    Financial assistance is required in the beginning to start the Cell. The PMC officials and the corporate companies should be positive about such an initiative.

14. **Benefits:**
    - This can provide a source of income to the women and improve the overall productivity of the rag pickers.
    - This can benefit PMC by increasing the work-force towards segregation and improve the actual working of CSCs and decentralized treatment facilities.
    - The rag pickers will be benefitted by getting assured employment, medical and other benefits.
    - Efforts can be made to increase the social acceptance about the work of these rag pickers.

15. **Links to other ISWM Pune Schemes:**
    - Establishment of EAC
    - Establishment of CSC
    - Establishment of a cadre of certified operators for Decentralised Treatment
    - Improvising Health and Safety of PMC workers, rag-pickers and citizens in proximity of the landfill
    - Design and Launch of a Comprehensive awareness Campaign on ISWM