

# Integrated Solid Waste Management Score Board-A tool to measure performance in Municipal Solid Waste Management

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## Abstract

*Waste management is the collection of transport, processing, recycling or disposal, and monitoring of waste materials. All the waste materials, whether solids, liquid, gaseous or radioactive all within the remit of waste management. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. Waste management is also carried out to recover resources from it. Waste management practices can differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management of non-hazardous waste residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator subject to local, national or international authorities. Integrated waste management is a system of waste disposal that includes separating materials according to type, and finding the best used for discarded products, which may or may not include depositing in a landfill. The IWM score board is a tool for managing an integrated waste management system and the objective is to improve solid waste management practices. The Integrated waste management (IWM) score board has been prepared by United States Environment Program (UNEP). A case study of Municipal Solid Waste Management in Kochi Corporation has been considered here.*

**Keywords:** ISWM, Solid Waste Management, Municipal Waste, Solid Waste

## 1. INTRODUCTION

The rapid urbanization and change in life style has increased the waste load and thereby pollution loads on the urban environment to unmanageable and alarming proportions. The existing waste dumping sites are full beyond capacity and under unsanitary conditions leading to pollution of water sources, proliferation of vectors of communicable diseases, foul smell and odors, release of toxic metabolites, unaesthetic ambiance and eye sore etc. It is difficult to get new dumping yards and open dumping is prohibited by law. This is particularly true for Kerala, with severe constraints of land availability, dense population, environmental fragility and expectation for management of solid wastes relies on an overly centralized approach.

In earlier days, municipal wastes, comprised mainly of biodegradable matter, did not create much problem to the community as the quantity of wastes generated was either recycled/reused directly as manure or was within the assimilative capacity of the local environment. The biodegradable waste of the urban centre was accepted by the suburban rural areas for composting in the agricultural fields. With increasing content of plastics and non-biodegradable packaging materials, municipal wastes became increasingly unacceptable to cultivators. As a result, the excessive accumulation of solid wastes in the urban environment poses serious threat. Similar scenario is now emerging in rural areas as well due to the urban-rural continuum, typical to Kerala. Now, dealing with waste is a major challenge.

There are two aspects to the challenge, the social engineering and technology application. The social engineering deals with the ethics and efficiency for maintaining environment. In the case of waste management, it is, broadly, the practice of reduce, reuse and recover. The technology application deals with the improvement of assimilative capacity as well as supportive capacity of environment.

The Integrated waste management (IWM) score board has been prepared by United States Environment Program (UNEP). The IWM score board is a tool for managing an integrated waste management system and the objective is to improve solid waste management practices.

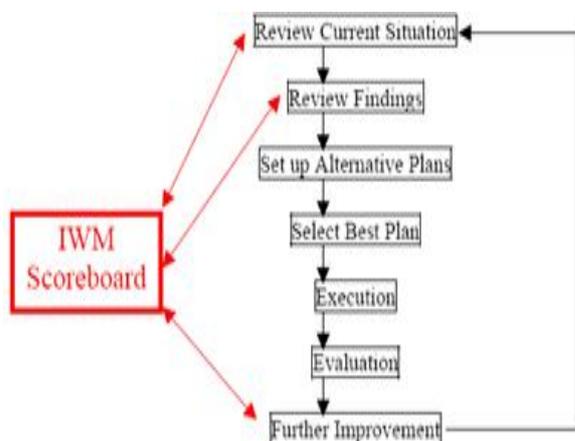
The IWM score board provides a methodology for evaluating municipal solid waste programs and systems at national, state, municipal, community and institutional levels. It operates on a point system and utilizes performance indicators which are based on the principles of integrated solid waste management. Review and scoring can be performed by individual or study team that may include representatives from national, state, municipal, regional, community and institutional levels.

Municipal government is generally responsible for implementation of municipal solid waste management program and facilitates with their jurisdiction. The role of the municipal government typically involves making a decision whether to be directly involved in providing solid waste management service or licensing companies to provide these services within jurisdiction.

**2. LITERATURE REVIEW**

The technology options available for processing the Municipal Solid Waste (MSW) are based on either bio conversion or thermal conversion. The bio- conversion process is applicable to the organic fraction of wastes, to form compost or to generate biogas such as methane (waste to energy) and residual sludge (manure). Various technologies are available for composting such as aerobic, anaerobic and vermi-composting. The thermal conversion technologies are incineration with or without heat recovery, pyrolysis and gasification, plasma pyrolysis and pelletization or production of Refuse Derived Fuel (RDF). The integrated solid waste management score board – the tool to measure performance of municipal solid waste management was founded by United Nations Environmental Program in 1972. Its activities cover a wide range of issues regarding the atmosphere, marine and terrestrial ecosystems. It has played a significant role in developing international environmental conventions, promoting, environmental science and information and illustrating the way those can work in conjunction with policy, working on the development and implementation of policy with national government and regional institution working in conjunction with non govt. organization. UNEP has also been active in finding and implementing environmentally related development projects.

**3. THE IWM SCORE BOARD**



**Fig.1** General flow for utilization of IWM score board

The reviewing and scoring process should be performed in accordance with the principles that are applicable to all types of environment audits (figure1).First identify the area to be studied. Determine how to obtain data and information .The source of funding for the review may have to be identified and budget and request are prepared in order to obtain approval.

Prepare for review. The review program should be formalized in a work plan. It includes institutional framework, waste reduction/avoidance, storage and collection, resource recovery, disposal and public

awareness. Logistical arrangement will need to be co-ordinate to ensure that resources are used effectively. The level of effort required preparing for and conduct review will be directly related to size of study area and population that is being served. The review work should be performed in accordance with the procedures that are set forth in the work plan and the results recorded on the forms provided. Supporting information should be compiled for easy retrieval at future date. The result of the review should be reviewed internally for accuracy and consistency.

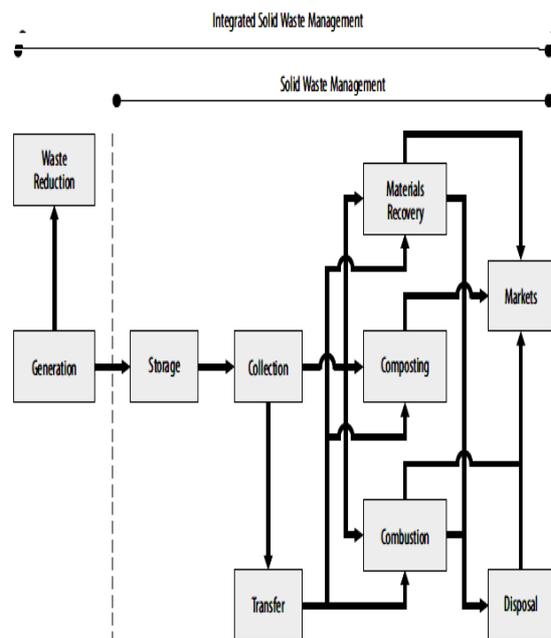
**3.1 STRATEGIES**

The following strategies are adopted in IWM

- a). Social and economic strategies include changing consumption pattern and protecting human health
- b). Environmental and resources strategies include protecting the atmosphere, water, river, ocean and dealing with municipal solid waste.
- c). Implementing strategies include transfer of technology, education and public awareness and capacity building.

**4. PROCESS OF SOLID WASTE MANAGEMENT**

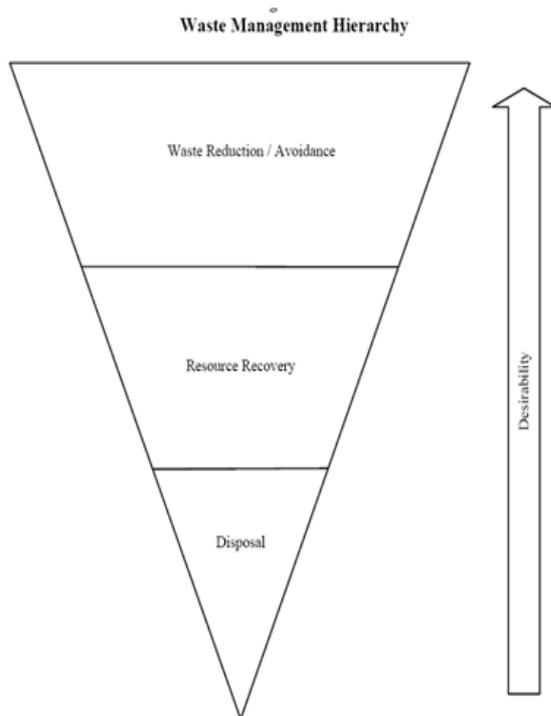
The Process of solid waste management model proposed by UNEP is shown in below figure 2.



**Fig.2** Solid waste management model proposed by UNEP (UNEP, 2005)

**5. WASTE MANAGEMENT HIERARCHY**

It is an internationally recognized strategy for management of municipal solid waste. It places greatest emphasis on strategies and programs for avoiding and reducing waste, with the treatment and disposal being the least favored option. Below figure 3 shows waste management hierarchy. More importance is given for waste reduction/avoidance and least importance for waste disposal.



## **6. MUNICIPAL SOLID WASTE MANAGEMENT**

The municipal govt. is generally responsible for the implementation of municipal solid waste management. The actual role of the govt. typically involves making a decision whether to be directly involved in providing solid waste management service or licensing companies to provide these services within their jurisdiction.

The govt. is ultimately responsible for ensuring that these activities take place within their jurisdiction and indicators are used to monitor these achievements. A maximum score of 10000 points is possible.

### **6.1 REGULATIONS AND POLICIES**

At municipal level, regulations and policies should be consistent with the standards or guidelines that have been established for management of municipal solid waste. The requirements may be tailored to meet the unique needs of the municipality. A maximum of 100 points has been allocated for this category.

### **6.2 ENVIRONMENTAL DEPARTMENT**

The municipal govt. should establish an environment department that includes a division that is responsible for solid waste management. The department should be responsible for implementing solid waste management program within the jurisdictional area. A maximum of 100 points has been allocated for this category.

### **6.3 RESEARCH AND DEVELOPMENT**

The municipal govt. through its environmental department or solid waste division should support research and development on solid waste management issues. At a minimum; this should include support and maintenance of a national data base on solid waste management within the municipality. A maximum of 100 points has been allocated for this category.

### **6.4 WASTE REDUCTION/ AVOIDANCE**

Waste generation rates are generally a function of economic prosperity and measuring waste reduction / avoidance is very difficult to accomplish in practice. As a result, score board point should be awarded for each activity. A maximum of 100 points is allocated for this category.

### **6.5 STORAGE AND COLLECTION**

They are generally managed at municipal level. Storage methods may be specified as being at the household level, community level or drop off facilities. The design for storage methods that are chosen must take into account local conditions (hi-rise building verses low density development, access and climatic condition)

Collection involves all the steps necessary for moving solid waste from storage point to the place of treatment or disposal. There are three methods of collection viz. manual, semi-automated and automated.

IWM score board point should be awarded based on the percentage of total population or households that receive frequent collection service. A maximum of 100 points is allocated in this category.

### **6.6 RESOURCE RECOVERY**

At the municipal level IWM score board point should be awarded for each of the various resource recovery activities including recycling, composting and combustion with heat recovery. Recycling and composting can be implemented with varying levels of technology as may be required to meet local conditions and requirements. Points should be allocated based on the percentage of total waste stream that is managed by these programs and facilities. A maximum of 200 points is awarded for this category.

### **6.7 DISPOSAL**

IWM score board points should be allocated based on the percentage of total waste stream that is managed at modern disposal facilities and the percentage of old disposed site that have been properly closed. A maximum of 100 points is allocated for this category.

### **6.8 PUBLIC AWARENESS/ EDUCATION**

At state/regional level, IWM score board points should be awarded for based on the establishment of program that raise public awareness regarding solid waste management issues and practices. A maximum of 100 points is allotted for this category.

Municipal solid waste rules are

- a). Emphasis participation of citizen in waste segregation, prohibiting littering of garbage, proper storage of waste and efficient transportation of waste for its processing and final disposal.
- b) Specification to be followed for land filling to protect environmental pollution and adoption of appropriate waste processing technologies has been emphasized.
- c). Rules are applicable to all towns irrespective of pollution

**7. RESPONSIBILITY OF POLLUTION CONTROL BOARD**

- a). Monitor standards regarding ground water, ambient air, quality of compost etc.
- b). Grant of authorization to municipal authority for setting up waste processing / disposal facilities (within 45 days of application)
- c). Furnishing annual report on status of implementation

**8. CASE STUDY**

**8.1 A. Municipal Solid Waste Management in Kochi Corporation**

According to Solid Waste Management Project under Jawaharlal Nehru National Urban Renewal Mission, Andhra Pradesh Technology development Corporation (APTDC) has started the work for Rs1963 cores for municipal solid waste disposal facility at Brahmapuram, Kochi.

**The key functions are:**

- Weighing mechanism with utility
- Sorting of non-biodegradable waste (manually or mechanically sorting plastic, glass, rubber, porcelain, metals etc.)
- Accelerated aerobic composting. The biodegradable waste is heaped on treatment platform and turned periodically to convert all into compost. Aerobic composting takes place with the help of suitable inoculums added to it.
- Secure land filling facility at Brahmapuram main solid waste processing site. About 4 to 5 cubic meter of hazardous waste will have to be buried every year. Approximately 10 cents of land will be required.
- Effluent treatment plant, monitoring cell with laboratory etc. are set at Brahmapuram main solid waste processing site.
- The plant capacity is 250 tons per day, including 200 tones by mechanical composting and 50 tones by vermin composting.

**8.2. Present status in Kochi Corporation**

- (I). Waste generation - 420 T/day
- (ii). Segregation at source - 3158 households
- (iii). Primary Collection - 28% door step, (40-45) % in community bins & rest in open places, canals drains
- (iv). Street sweeping - 50% of major roads & 10% of Minor roads, 30% occasional sweeping & 60% non-sweeping
- (v). Secondary storage-bins, collection points, open places
- (vi). Transportation - manual, open truck
- (vii). Frequency of removal - irregular in outskirts & regular in cities except on public holidays
- (viii). Disposal - less environmental protection measures, dumping
- (ix). Vehicles used - tractors, open tempos
- (x). Man power - 647 workers & 210 substitute workers
- (xi). O&M cost - 62% salary & 38% vehicle cost Rs 1887/ton

- (xii). Cost recovery - Kudumbasree collects @Rs (30-50) per month from houses
- (xiii). Community partnership - door step collection, home composting
- (xiv). Recycling activity - No recycling
- (xv). NGO Partnership - Kudumbasree doing door step collection & Sahridaya welfare society promoting home composting, biogas
- (xvi). Management - operations- health department, Engineering, Department & accounts department
- (xvii). Planning & Management - land fill, compost plant (200T/day), Vermin- compost (50T/day)

**TABLE 1: PRESENT DATA- Type of waste and Quantity in MT/day**

Type of waste	Quantity in MT per day	% of total
House hold domestic	330	55
Hotels/eateries	36	6
Markets/slaughter houses	30	5
Shops & commercial establishments	90	15
Building construction waste	30	5
Garden trimmings/plantain/ tree cuttings	24	4
Industrial waste	30	5
Industrial waste (non-hazardous)	18	3
Hospitals / clinics	12	2
<b>Total waste generated per day</b>	<b>600</b>	<b>100%</b>
Waste collected per day	240	
Collection efficiency	40%	

**Table 2: PRESENT DATA-Waste collection interval**

Category	Once a day	Once in two days	Once in 3 days	once in 7 days	uncertain
Bio-degradabl e	40%	25%	15%	10%	10%
Non Bio-degradabl	40%	15%	15%	10%	20%

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**TABLE 3: IWM SCORE BOARD FOR MUNICIPAL WASTE**

ITEM	MUNICIPAL LEVEL	POINTS	SCORE
1.Role	Implementation	N.A	N.A
2.Institutional frame work			
a. Policies	Environmental Protection	10	05
	Solid waste management	10	05
	Waste reduction/avoidance	15	08
	Resource recovery	20	12
	Land fill	15	10
	Financial sustainability & others	30	20
b. Environment agency	Solid waste department	100	60
c. R&D	Maintain data	10	10
	Funding Program	15	10
	Training & Capacity building	10	10
	Other initiatives	15	15
Waste reduction/avoidance	Adopting / initiatives	100	30
Storage& Collection	Frequent service	100	40
Resource recovery	Program/facilities	120	100
Disposal	Land fills	100	70

	Others	100	40
Public awareness	Education/ initiatives	100	40

**8.3 Interpretation**

Total score (Collection Efficiency) is 400 out of 1000 i.e. 40%. According to the score board the points is only 40%.

**8.4 Measures to improve present condition**

Inorder to improve the present condition of Kochi Corporation the following methods can be employed viz. reduce waste, reuse, exchange/ donate, recycle, preventing waste, efficient disposal.

**Table 4: Waste Material/ Waste Management Practice Combinations**

Material	Recycling	Composting	Anaerobic Digestion	Land Application	EFW	Land Filling
Paper	✓	✓	✓		✓	✓
Glass	✓				✓	✓
Ferrous Metal	✓				✓	✓
Aluminum	✓				✓	✓
Plastics	✓				✓	✓
Food Waste		✓	✓		✓	✓
Yard Waste		✓	✓	✓	✓	✓
Other Waste*					✓	✓

**\*Other waste includes textiles, rubber, tires, home renovation waste, house- hold hazardous waste etc**

Recycling, composting, anaerobic digestion and energy recovery result in the production of useful commodities namely, recycled materials, usable compost and energy. These commodities can be used in place of virgin materials, conventional soil amendments, and energy produced from the combustion of fossil fuels, respectively

Waste can be reduced by promoting the use of paper, using less material for product design, elimination of excess material in packing, use of reusable containers, purchase in bulk reuse, containers, furniture's, envelopes, papers, glass, clothes etc. Encourage employees to reuse office materials rather than purchase new ones. Exchange / donate old books, old clothes, old equipments etc. Recycle things that can be recycled.

Residents are organized to carry out the following to improve the waste management system, i.e. construct backyard compost pit, construction of storage bins where recyclable & reusable materials are stored, construction of storage centers, maintenance of clean yard and streets greening areas, encouraging others

## 9. CONCLUSION

Integrated Solid Waste Management (ISWM) takes an overall approach to creating sustainable systems that are economically affordable, socially acceptable and environmentally effective. An integrated solid waste management system involves the use of a range of different treatment methods, and key to the functioning of such a system is the collection and sorting of the waste. It is important to note that no one single treatment method can manage all the waste materials in an environmentally effective way.

All of the available treatment and disposal options must be evaluated equally and the best combination of the available options suited to the particular community chosen. Effective management schemes therefore need to operate in ways which best

Meet current social, economic, and environmental conditions of the municipality. The main issue identified is that there is poor system of collection, processing, and management of solid waste. The problem is acute in corporation and municipalities. The proposal is to create an efficient solid waste task force, create awareness, live demonstration, encouraging segregation, public participation and processing system. Moreover it is recommended to have waste treatment plants and biogas plants in high rise buildings.

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