An Approach for Integrated Solid Waste Management Systems in Virudhunagar Municipality of Tamilnadu

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***Abstract*: In the 21st century, due to industrial revolution and technology developments, consumptions patterns of the people all over the globe have changed. The use of natural and artificial resources and goods have increased manifold. Due to this, huge quantities of different types of solid wastes are produced everyday creating alarming problems of their disposal. Population growth, rapid urbanization and industrialization lead to indiscriminate disposal of municipal solid wastes which provide an attractive habitat for disease vectors. It requires long time for decomposition in usual course that may cause air pollution as well as water pollution. Solid waste management is one of the important obligatory functions of urban local bodies in India. However the essential service is not efficiently performed by municipal bodies resulting in problems of health, sanitation and environmental degradation. It is observed that lack of financial resources, institutional weakness, improper selection of machinery, vehicles and disposal options, citizen's apathy towards cleanliness have made this service far from satisfactory. It is observed that the current solid waste management system practiced in Virudhunagar Municipality is unsustainable. Only mixed wastes are being dumped and the solid wastes are not properly disposed as per Municipal Solid Wastes (Management and Handling) Rules 2000.**

Keywords: MSW, ISWM, ULB, Source segregation, Disposal options.

I. INTRODUCTION

Integrated solid waste management system is concerned with synthesizing a range of different option to deliver an environmentally and economically sustainable system for a particular area (White et al, 1995). Hence, it describes an approach in which decisions on waste management take account of different waste streams, collection, treatment and disposal methods, environmental benefits, economic optimization and social acceptability. To integrate a solid waste programme within a community, the programme should address the needs of the community as a whole. In otherwords waste generated from individual houses, apartments, public places, business, and industries located within a community should be taken into consideration for efficient management. Enough flexibility should be built into a programme so that it can protect the environment. Willing participation of the community as a whole in reducing waste is essential. Thus, apart from management practices, due consideration should be given to educating the source reduction concept coupled with proper storage, effective collection, transfer, treatment and disposal of waste.

II. STUDY AREA

Virudhunagar is located 45 km southwest of Madurai and is the headquarters of Virudhunagar District. Virudhunagar is a centre for trade, commerce and industrial activities and a nodal centre in its regional setting. The nearest airport is at Madurai. Virudhunagar is a major railway station on the Southern Railway network and is well connected to major cities in South India. Virudhunagar is located at 9° 35' North Latitude and 77° 57' East Longitude. at 101.3 m above mean sea level Virudhunagar municipality spreads over an area of 6.39 sq.km.. It has 36 wards with a population of 72144 (as on 2011). The daily generation of garbage is 35.50 T and the per capita generation of combined solid waste is 0.464 kg/day.

The solid wastes in Virudhunagar municipality consist garbage, paper and board, stone and debris, plastic, textiles, glass, rubber, aluminum, ferrous, and others. The major fraction of the solid waste is biodegradable only. The

unsegregated wastes are being collected from households, shops, markets, commercial establishments etc.

In Virudhunagar municipal area, about 35.50 tons with average amount of 0.266 kg/person/day of wastes was generated daily, and to store the wastes only 44 numbers of community bins are used.

The urban local body has used RCC bins and metallic containers to store the wastes and 128 numbers of workers are engaged to handle the waste management task. The sweeping crew collects the wastes from road sides and deposit in the nearby community bins by using tricycles. Door to door waste collection system has not yet been fully covered in the municipal area. To transfer the wastes two numbers of tractor trailers, a mini truck and a dumper placer are used. Every day, the tractor trailers performed 3 trips each while the mini truck and the dumper placer only 2 trip each. The collected wastes were carried in open trailers and trucks for about 2 Kilometres to the final disposal site. The collection drive starts at 7 A.M and continued till 2 P.M in the afternoon under the supervision of six officials of the Engineering divisions of the Urban Local Authority maintaining a pre-designed schedule.

Fig. 1: Map of Tamilnadu

Fig. 2: Map of Virudhunagar

Collected wastes are finally disposed by simply dumping. The dumping site is located within 2 Kilometre away from the town. The final waste dumping site is about an extent of 125 acres [5 lakhs sq.m]. Open air burning and unscientific dumping of wastes not only causes air pollution but also contamination of ground and surface water in the nearby locality.

III. WASTE COMPOSITION ANALYSIS IN VIRUDHUNAGAR

The components of MSW collected were analyzed in the study area. The percentage of organic components in the waste stream was 71 %. Hot and humid climatic conditions are considered as important causes behind the high percentage share of organic wastes in the waste stream. It was observed that, a large volume of organic wastes was generated from the residential areas in the form of kitchen waste, garden waste and fruit waste. Wastes sources like lawns, parks, playgrounds and institutional campuses have also contributed sizeable volume of organic wastes in the waste stream. Moreover, fruits and vegetable residues from the both wholesale and retail market areas, leftover foods from the hotels, restaurants, hostels, community halls etc. have increased the percentage of organic waste to such an extent. The quantity of silt, clay and fine earth was found high about 5 % in the total waste volume. Such types of wastes were mainly derived from covered and open drains. During the rainy season from the un-surfaced roads, a large quantum of silt and sands accumulates in the drains and contributes a sizable share to the total volume such wastes. The percentages of demolition debris were estimated at 13.75 % of the total volume of MSW and such types of wastes were originated from the construction and demolition sites. The pace of urban growth has increased the percentage of such kind of waste in the waste stream.

TABLE – 1: PHYSICAL COMPOSITION OF MSW OF VIRUDHUNAGAR

S. No.	Waste types	Percentage of waste types
1	Organic	70.73
2	Fine Earth	4.58
3	Demolition Debris	13.75
4	Plastic Materials, Polythene Bags, Thermocol etc.	5.17
5	Metals	0.78
6	Glass	0.53
7	Soiled papers, Card Boards	0.30
8	Textiles	3.63
9	Miscellaneous	0.53
TOTAL		**100**

TABLE – 2: CHEMICAL CHARACTERISTICS OF MSW OF VIRUDHANAGAR

S. No.	Parameters	Average
1	Bulk density (Kg/m3)	387
2	Moisture (%)	32.20
3	Volatile solids (% by dry weight)	51.07
4	pH	7.16
5	Total organic carbon (% by dry weight)	14.07
6	Nitrogen (% by dry weight)	0.46
7	Potassium (%by dry weight)	0.48
8	Phosphorous (% by dry weight)	0.56
9	C/N ratio	30.65
10	Cadmium (mg/kg)	2.21
11	Chromium (mg/kg)	3.98
12	Copper (mg/kg)	8.78
13	Lead (mg/kg)	7.18
14	Manganese (mg/kg)	28.86
15	Nickel (mg/kg)	4.80
16	Zinc (mg/kg)	9.57

Dense plastics, polythene bags, plastic packets were found in large quantities in the waste stream. Use of polythene bags not only increases their volume but is also responsible for serious environmental problems in the town. The percentage of soiled paper, card boards, thermocols, used tyres and synthetic materials were also found high in the waste stream and their percentage shares were estimated at 6%. But the quantity of metals, cans, news papers were found substantially low as such wastes have either picked up from the community bins and open dumping sites or collected directly from the households by the rag–pickers for recycling purposes. Fig.3 shows the percentage share of various components, found in the waste stream in Virudhunagar municipal area.

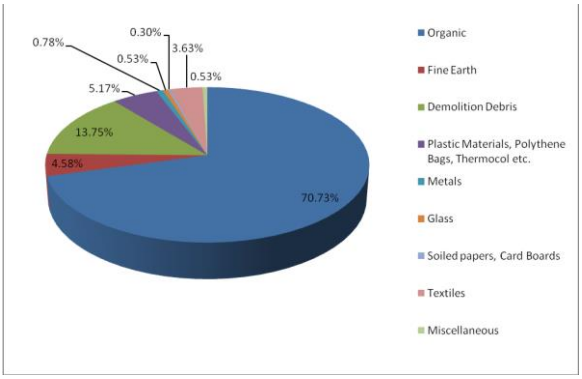

Fig 3. Percentage of Waste Types

IV. ISSUES OF SOLID WASTE MANAGEMENT IN VIRUDHUNAGAR MUNICIPALITY

Based on analysis of the information collected, field visits and discussions with Virudhunagar municipal officials, key issues like storage of waste, primary collection, transportation, waste processing and disposal of the existing system of MSW in Virudhunagar were discussed. The existing scenario of Virudhunagar MSW disposal is outlined below.

- The area available for solid waste processing/disposal is presently being used only as a massive dumping ground.
- Burning of waste is noticed at the dump site.
- Solid Waste is dumped in heaps without proper spreading and compaction along the access roads - Absence of an area-specific dumping plan.
- Waste is not covered with earth to prevent ingress of vector, pigs, dogs etc.
- A large number of stray animals are found during site visits to the disposal site.
- Waste from slaughter houses are observed to be disposed along public areas resulting in public health and pollution problems.

V. PLANNING INTEGRATED SWM

Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program. An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment. ISWM involves evaluating local needs and conditions, and then selecting and combining the most appropriate waste management activities for those conditions. The major ISWM activities are waste prevention, recycling and composting, and combustion and disposal in properly designed, constructed, and managed landfills. Each of these activities requires careful planning, financing, collection, and good transport systems.

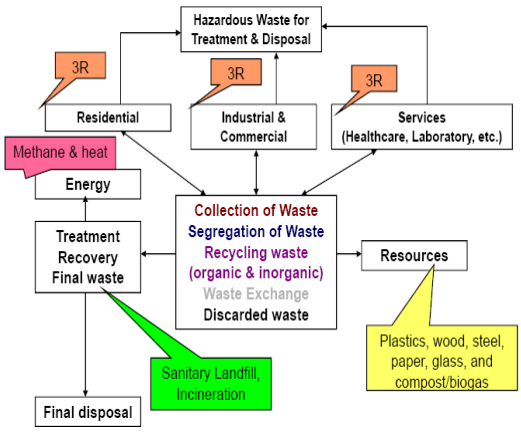

Fig. 4: Integrated Solid Waste Management Generation Source Perspective

A. Waste Prevention:

Waste prevention—also called "source reduction"—seeks to prevent waste from being generated. Waste prevention strategies include using less packaging, designing products to last longer, and reusing products and materials. Waste prevention helps reduce handling, treatment, and disposal costs.

B. *Recycling and Composting:*

Recycling is a process that involves collecting, reprocessing, and/or recovering certain waste materials (e.g., glass, metal, plastics, paper) to make new materials or products. Some recycled organic materials are rich in nutrients and can be used to improve soils. The conversion of waste materials into soil additives is called composting. Recycling and composting generate many environmental and economic benefits. For example, they create jobs and income, supply valuable raw materials to industry, produce soil-enhancing compost, and reduce greenhouse gas emissions and the number of landfills and combustion facilities.

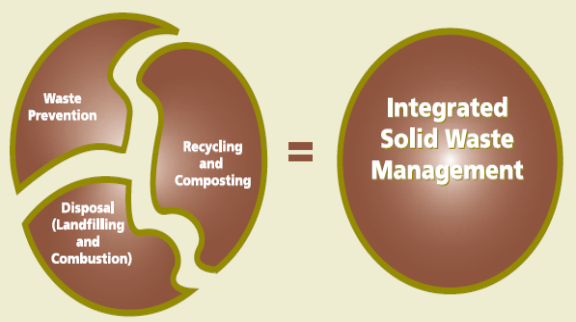

Fig. 5: Integrated Solid Waste Management

C. *Disposal (land filling and combustion):*

These activities are used to manage waste that cannot be prevented or recycled. One way to dispose of waste is to place it in properly designed, constructed, and managed landfills, where it is safely contained. Another way to handle this waste is through combustion. Combustion is the controlled burning of waste, which helps reduce its volume. If the technology is available, properly designed, constructed, and managed landfills can be used to generate energy by recovering methane. Similarly, combustion facilities produce steam and water as a byproduct that can be used to generate energy.

VI. CONCLUSIONS

A strategic planning study was carried out in Virudhanagar Municipal area of Virudhunagar District. To ensure better human health and safety, the planning of Integrated Solid Waste Management system has been explained below in a case study for Virudhanagar. A great advantage of the study is the ULB having 125 Acres of plain disposal land for its dumping process which is located with 2 km from Virudhunagar Town. An economically and environmentally sustainable solid waste management system is effective if it follows an integrated approach.

- Reduction of waste at source with the active participation of the community. Wastes can be reduced by changing the consumption pattern, use of recyclable materials, practice of waste segregation and refusing the use of polythene bags etc.
- Source separation and recycling of waste reduces the volume of the waste considerably. It is technically feasible to recycle a large amount of materials, such as plastics, wood, metals, glass, textiles, paper, cardboard, rubber, ceramics, and leather.
- The design for different disposal facilities like composting, sanitary landfill, and landfill bioreactor system and their costs were worked out in the study.
- Composting seems to be a very effective measure of waste disposal in the study area as organic waste constitutes about 72 % of the waste stream.
- A sanitary landfill is a facility designed specifically for the final disposal of wastes that minimize the risks to human health and the environment associated with solid wastes. Sanitary landfill system is also feasible because necessary bio solids [sludge] discharged from the existing ETP of sewerage system of Virudhunagar, which is available in the same premises.
- Incineration is the burning of wastes under controlled conditions, usually carried out in an enclosed structure. The rubber and other in non-degradable waste to be sent for co-processing unit of Ramco Cement Industries within 6 km from the disposal site which generates considerable income to ULB.
- The quantity of grits and demolition of wastes are used for filling of low-lying areas and new formations.

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