Swachh Bharat Mission: A Step to Sustainable Solid Waste Management

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Abstract- **The vision of shift of national status from developing country to developed by virtue of industrialization, innovations, cleaner –greener India, on 2nd October 2014, PM of India announced a mission. Swachh Bharat Mission (SBM) is named as "Swachh Bharat Abhiyan" in Hindi as it's a National Language and comprises of Rural and Urban management separately. Main focus of the mission is to bring about an enhancement in the general quality of life style in the rural areas, by promoting cleanliness, hygiene and eliminating open defecation and to speed up sanitation coverage in rural areas to achieve the vision of Swachh Bharat by 2nd October 2019 on 150th Birth Anniversary of Mahatma Gandhi. SBM also covers secondary objective of efficient and sustainable solid waste management. The paper covers the history of solid waste management, technologies, with current scenario with current situations after implementation of SWM.**

Index Terms- **Cleaner –Greener India, Swachh Bharat Mission, Sanitation, sustainable solid waste management**

1. INTRODUCTION

A first step towards development of country starts with one good initiative. One such step is Swachh Bharat Abhiyan (SBA) or Swachh Bharat Mission (SBM); nation-wide campaign in India designed and implemented for the period 2014 to 2019. This aims to clean up the streets, roads and infrastructure of specified India's cities, towns, and rural areas. The campaign's official name is in Hindi and translates to "Clean India Mission" in English. The prime most objectives of Swachh Bharat include eliminating open defecation through the construction of household-owned and community-owned toilets and establishing a proper mechanism of monitoring use of toilet and sustainable municipal solid waste management.

1.1 SBM and Sanitation of India

Run by the Government of India, the mission aims to accomplish an "open-defecation free" (ODF) India by 2nd October 2019, the 150th birth anniversary of Mahatma Gandhi, by constructing 90 million toilets in rural India at a projected cost of Rs 1.96 lakh crore (US$30 billion). The mission will also contribute to India reaching Sustainable Development Goal 6 (SDG 6), established by the UN in 2015. This emphasizes to contribute by sustainable waste management of solid and liquid wastes.

Being India's largest cleanliness drive to date with three million government employees and students from all parts of India participating in 4,041 cities, towns, and rural areas, the campaign was officially launched on 2nd October 2014 at Rajghat, New Delhi by PM Narendra Modi and named as "Satyagrah se Swachhagrah".

The mission has mainly divided into two cores: Swachh Bharat Abhiyan ("gramin" or 'rural'), which is being operated under the Ministry of Drinking Water and Sanitation; and Swachh Bharat Abhiyan ('urban'), being operated by the Ministry of Housing and Urban Affairs. (CEEW, 2014)

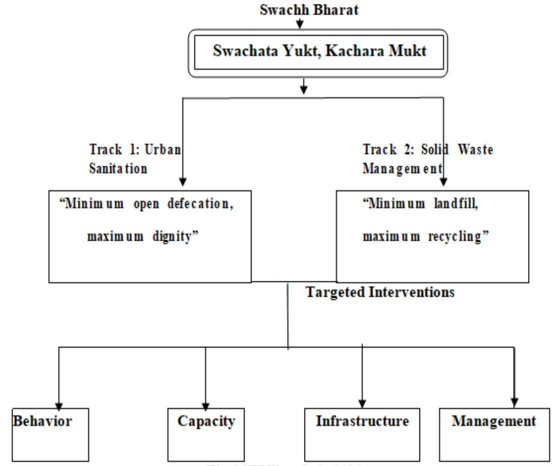

Fig. 1CEEW analysis, 2014

1.2 Objectives of the SBM

Swachh Bharat Mission was started by putting following objectives to be fulfilled for the development of sustainable cleaner and greener India.

a) Bring about an improvement in the general quality of life in the rural areas, by promoting cleanliness, hygiene and eliminating open defecation.
b) Accelerate sanitation coverage in rural areas to achieve the vision of Swachh Bharat by 2nd October 2019.
c) Motivate Communities and Panchayati Raj Institutions to adopt sustainable sanitation practices and facilities through awareness creation and health education.
d) Encourage cost effective and appropriate technologies for ecologically safe and sustainable Sanitation.
e) Develop where required, Community managed sanitation systems focusing on scientific Solid & Liquid Waste Management systems for overall cleanliness in the rural areas.

As part of the campaign, volunteers have promoted indoor plumbing and community approaches towards sanitation (CAS) in rural areas. NGO's are actively participating by running activities like national real-time monitoring such as The Ugly Indian, Waste Warriors, and SWaCH Pune (Solid Waste Collection and Handling) that are working towards ideas of Swachh Bharat.

The statistics of SBM portrays efforts of government in constructing 86 million toilets. Since 2014, a reduction is observed in the number of persons openly defecating from 550 million to fewer than 150 million in 2018.

2. MUNICIPAL SOLID WASTE MANAGEMENT SCENARIO OF INDIA

On the other side urban India is facing an increasing challenge of providing infrastructural needs of a growing urban population. According to the census 2011, the population of India was 1.21 billion, of this 31% live in cities. It is projected that by 2050, half of India's population will live in cities. With this increasing population, municipal solid waste management (MSWM) in the country has emerged as a challenge not only because of the environmental and aesthetic concerns, but also because of the huge quantities of municipal solid waste (MSW) generated every day. According to Central Pollution Control Board (CPCB), 1, 43, 449 tonnes per day (TPD) of MSW was generated in India during 2014–2015,1 with an average waste of 0.11 kilogram (kg)/capita/day. Of the total MSW, approximately 1, 17, 644 TPD (80%) was collected, while only 32,871 TPD (22%) was processed or treated.

Currently the solid waste collected from household is being stored for prolonged time, sometimes it reaches to landfill where rag pickers try to pick useful materials from huge heaps hence maximum resource recovery is not possible. Segregation at source, collection, transportation, treatment, and scientific disposal of waste was largely insufficient leading to degradation of the environment and poor quality of life. (CPHEEO, 2016)

2.1 Functional Elements of proper Solid Waste Management

For any kind of management it needs to have well-defined functional elements as shown in fig. below such as generation, storage, collection, transfer and transport, processing, and disposal so as to carry out scientific, smooth functioning.

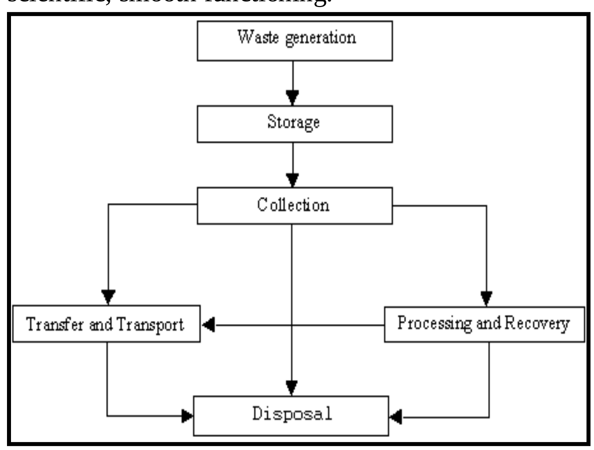

Fig. 2 Functional Elements of MSWM

2.2 Waste Minimization Hierarchy

Waste Minimization is a waste management approach that focuses on reducing the amount of waste and contamination in waste generated. In addition to solid wastes generated; The Resource Conservation and Recovery (RCRA) encourages minimization of hazardous wastes regulated under EPA. Waste minimization techniques focus on preventing waste from ever being created, otherwise known as source reduction, and recycling. These techniques can be implemented and practiced at every stage in most waste generating processes. It also requires careful planning, changes in attitude, creative problem solving, sometimes capital investment, and genuine commitment towards understanding the need of waste minimization. Following flowchart will give a brief idea of waste minimization practices to be followed.

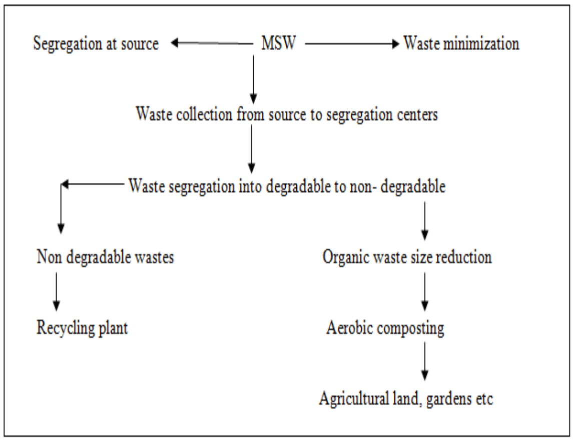

Fig. 3 Waste Minimization Hierarchy

2.3 Solid Waste Treatment Technologies: As a part of solid waste management, processing/ treatment is of importance, hence commonly available treatment methods for solid waste are as follows:

2.3.1 Incineration

Incineration is the treatment of solid waste material by combustion of organic substances present in the waste materials. It converts the waste material into heat, flue gas and ash which are released into the atmosphere without any further treatment for usage.(Nindoni, 2017)

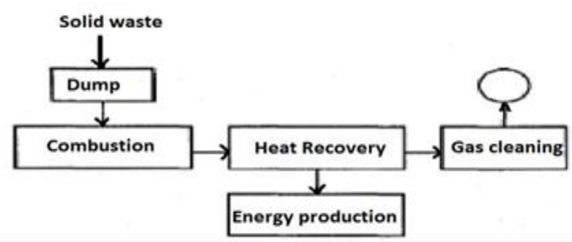

Fig. 3 Incineration Process

2.3.2 Composting

Composting is defined as the biological decomposition of organic matter under controlled aerobic conditions to form stable, humus- like end product. The process is facilitated by a diverse population of thermophilic microbes involves the development of temperatures as a result of biologically produced heat. (Vanlalmawii, 2016) It is one of the best-known processes for the biological stabilization of solid organic wastes by transforming them into a safer and more stabilized manure that can be used as a source of nutrients and soil conditioner in agricultural applications. Composting can be achieved by three major methods:

Manual composting was systematized by Howard & his associates. It was further developed by Acharya & Subrahmanyam and the methods are conventionally referred as Indore and Bangalore methods of composting.(ENVIS)

a. Indore Method: This method of composting in pits involves filling of alternate layers of similar thickness as in Bangalore method. However, to ensure aerobic condition the material is turned at specific intervals for which a 60 cm strip on the longitudinal side of the pit is kept vacant. For starting the turning operation, the first turn is manually given using long handled rakes 4 to 7 days after filling. The second turn is given after 5 to 10 more days. Further turning is normally not required and the compost is ready in 2 to 4 weeks. In the urban areas, due to extensive provision of water carriage system of sanitation, night soil is not available. Composting of MSW alone is hence often carried out. Aerobic composting of MSW is commonly carried out in windrows.

b. Bangalore Method: This is an anaerobic method conventionally carried out in pits. Formerly the waste was anaerobically stabilized in pits where alternate layers of MSW and night soil were laid. The pit is completely filled and a final soil layer is laid to prevent fly breeding, entry of rain water into the pit and for conservation of the released energy. The material is allowed to decompose for 4 to 6 months after which the stabilized material is taken out and used as compost.

c. Windrow Composting: The organic material present in Municipal Waste can be converted into a stable mass by aerobic decomposition. Aerobic micro organisms oxidize organic compounds to Carbon dioxide and oxides of Nitrogen and Carbon from organic compounds is used as a source of energy, while Nitrogen is recycled. Due to exothermic reactions, temperature of mass rises. In areas where higher ambient temperatures are available, composting in open windrows is beneficial. In this method, MSW is dumped on a leveled land and well drained open space in about 20 windrows with each windrow sizes as 3m long x 2m wide x 1.5m high, with a total volume not exceeding 90 cu. m.

d. Each windrow is turned on 6th & 11th days towards centre to destroy larvae and for aeration. On 16th day, windrow is broken and passed through manually operated rotary screens of about 25mm square mesh to remove the oversized material. The screened compost is stored for 30 days in heaps 2m wide x 1.5m high and up to 20m long to ensure stabilization before sale.

e. Vermi-composting: Vermi compost is a natural compost of organic wastes generated by Earthworms, who digest organic wastes and convert such wastes in the form of granules, rich in nitrogen content. Such vermin compost has good plant nutrients and hence compost. This is a traditional natural composting method used in India and other countries for centuries. However, in recent years systematic methods have been developed to enhance composting practices.

2.3.3 Landfilling

The term landfill generally refers to an engineered deposit of wastes either in pits/trenches or on the surface. And, a sanitary landfill is essentially a landfill, where proper mechanisms are available to control the environmental risks associated with the disposal of wastes and to make available the land, subsequent to disposal, for other purposes.(NPTEL)

However, it must be noted that a landfill need not be necessarily an engineered site as in rural areas, when the waste is largely inert at final disposal where wastes contain a large proportion of soil and dirt. This practice is generally designated as non-engineered disposal method. When compared to uncontrolled dumping of MSW, engineered landfills are more likely to have pre-planned installations, environmental monitoring, and organized and skilled workforce. Sanitary landfill implementation, therefore, requires careful site selection, preparation and management.

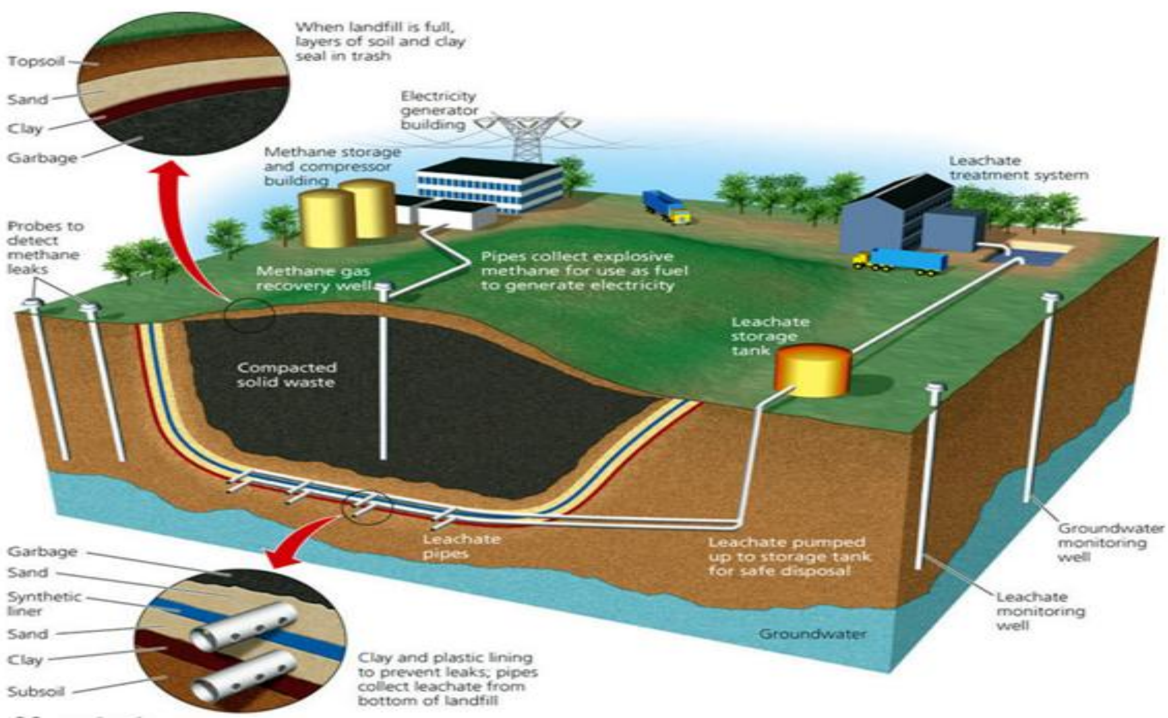

Fig. 4 Typical c/s of Landfill

2.3.4 Refuse Derived Fuel

The refuse derived fuel (RDF) is one of the products of recycling combustible waste fractions from MSW to be used as fuel for stream or electricity production. RDF refers to the high calorific, non-recyclable fraction of processed municipal solid waste which is used as a fuel for either steam/ electricity generation or as alternate fuel in industrial furnaces/boilers (coprocessing/co-incineration of waste in cement and steel industry and for power generation). The composition of RDF is a mixture that has higher concentrations of combustible materials than those present in the parent mixed MSW.

Fig. No. 4 RDF (Source: Clean India Journal)

The RDF process typically includes thorough pre-separation of recyclables, shredding, drying, and densification to make a product that is easily handled. Glass and plastics are removed through manual picking and by commercially available separation devices. This is followed by shredding to reduce the size of the remaining feedstock to about eight inches or less, for further processing and handling. Magnetic separators are used to remove ferrous metals. Eddy-current separators are used for aluminium and other non-ferrous metals. The resulting material contains mostly food wastes, non-separated paper, some plastics (recyclable and non-recyclable), green wastes, wood, and other materials. Drying to less than 12% moisture is typically accomplished through the use of forced-draft air. Additional sieving and classification equipment may be utilized to increase the removal of contaminants. After drying, the material often undergoes densification processing such as pelletizing to produce a pellet that can be handled with typical conveying equipment and fed through bunkers and feeders.

2.4 SWM Activities in SBM

In the 5 year plan from 2014 to 2019, till date various activities were planned for improvement in current status of SWM in India. As per SBM August 2018 data, 43% of the total wards in the country are segregating their waste at source. In 2017, door-to-door collection coverage increased from 53% to 80%. Cities supporting segregation are Panchgani, Ambikapur, Vengurla, Panaji, Indore, Mysuru, Muzaffarpur. In these cities, the segregated waste is taken to the processing units where compost is made from the wet waste and inerts goes to the landfill. Sadly most of the country is not segregating waste. Of the 1.45 lakh tonne of waste generated per day (TPD) in India, 49,401 TPD (34.07%) is being processed. Just within the past 10 months, the processing capacity has increased from 24% to 34%. This includes the non-operational and under construction plants and majority of the processing centres in the country take mixed waste and are based on cost intensive centralised systems. The total waste is processed takes into account the incoming waste to plant per day; however not all of this is processed. This further compromises on the quality of compost, RDF and recyclables.

3.DISCUSSION

During SBM, few of the activities implemented were arrangement of Swachhta Run, Pledge of Cleanliness, Plan for Developing Entrepreneurs, Budgetary allocations in Funding for cleaner and Greener India. Annually, India generates around 62 million tons of MSW leading to huge problems in the environment. Small number of initiatives towards implementation of traditional waste treatments such as Biogas plants, Composting, Vermi-composting Recycling along with some advanced treatments like Incineration, Pyrolysis, Bio-refining and Sanitary Landfilling will lead to successful completion of SBM.

4. CONCLUSION

Sanitation and sustainable solid waste management are the two vital pillars of SBM. The success of the mission will be dependent upon the systematic implementation of the strategies planned, laid procedures, regular monitoring and the actions taken based on the monitored results. For achieving the goal of sanitation and sustainable solid waste management, comprehensive upgrading policy and paradigm shift is essential.

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