



OPEN ACCESS INTERNATIONAL JOURNAL OF SCIENCE & ENGINEERING

MUNICIPAL SOLID WASTE MANAGEMENT: CURRENT APPROACHES, GAPS AND SOLUTIONS

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Abstract: Municipal Solid Waste Management (MSWM) is the global problem and it has been facing by both developed and developing countries. Increase in the population has more demand of resource consumption which further generating a large amount of waste. The unsustainable waste management causing severe hazardous health and environmental effects, which are more observe in developing countries i.e. India. In India, municipal solid waste ranges between 0.3-0.6 kg per capita per day and it has been increasing annually at the rate of 1.33 percent per capita per day. There are some gaps in managing the solid waste such as inefficient collection of waste is varying from city to city where the door to door collecting is not done and due to the poor management of the waste, inadequate collection and unsuitable disposal of waste; municipal solid waste systems are responsible for the inappropriate MSWM. The pollutant has been generated from the dump sites, the people living nearby the dumping sites are getting affected by poor water and air quality, to over some from this, approaches such as reduction, recycling, reuse and recovery. In developing countries, the effective solid management is costly, it needs an integrated system that is well organized, socially supported and sustainable. From the worldwide perception, present waste management is lack of approach, consumption, extraction and recycling. In some countries, an enormous amount of garbage majorly come from the houses where the household experiencing low service gap and because to lack of adequate manpower and technical expertise the capability issues have been developing at the management site. Furthermore, suitable methods of final waste disposal are sanitary landfills. For reducing the environmental hazardousness, landfill must be well operated, correctly design, sited carefully and before the disposal treatment, recovery and recycling must be establish. In this study, a critically review the approaches, gap and solution for municipal solid waste management is discussed. It has concluded from the study that with a proper planning and implementation of effective methods of waste collection, segregation of waste, its reuse and recycling could help in decreasing risk of the environmental effects of water, air and soil pollution.

Keywords: *Municipal solid waste, environmental effects, waste management*

I INTRODUCTION

Municipal solid waste management is the method of collecting, transporting, treating and recycling solid wastes and it will create problems if the management of waste is not well practiced at the landfill sites. Due to Urbanization, industrialization and population growth, the large amount of rising in total Solid waste generation occur in developing countries. In general, many developing countries are still left behind the developed countries with respect to solid waste management e.g. United States, Germany and Sweden [1] Solid Waste Management (SWM) is essential for sustainable development. Environmental and health effects are causing

due to the unsustainable management of waste, which was more shown in developing countries. Because of improper waste collection from home and inappropriate disposal of waste as a result pollutants have been generated. The pollutants further form leachates at the landfill site and these leachates are get contaminated and affecting surface or groundwater qualities because of this, the resident living near the perimeter are facing many problems of air pollution and water qualities. In developing countries, the current solid management is expensive; it wants a combined system that is well controlled and sustainable [2].

In India, the amount of waste generation had been increased since last three decades and that makes a huge

challenge to the municipal corporation for their appropriate management [3]. Choosing the suitable processing approach not only decrease the influence of MSW on the native surroundings, but correspondingly decrease greenhouse gases (GHG) production at the sites and help to save global warming and fossil fuel [4]. In countries such as India and China and others such as Brazil, Mexico and Turkey the urbanization and industrialization causes almost 90% of the solid waste and that waste painstaking as the main cause for creating methane is regularly intended to the landfills sites and dumps are easily liberating enormous amounts of methane and carbon dioxide to the atmosphere. Worldwide, landfills are considered as the 3rd largest man-made methane source, answerable for approximately fourteen percent of projected global methane releases to the environment [5].

A. Solid waste management: Global view

Solid waste management is the global issue. Increase in urbanization increases the solid waste generation e.g. 2.9 billion urban population generated the huge amount of waste which was about 0.64 kg of municipal solid waste (MSW) per head per day. Presently, the quantity has been increased to 3 billion peoples generating waste of amount 1.2 kg per head per day which will rise to 1.42 kg per head per day MSW generated by 4.3 billion people in the year 2025 which predicts that will be generation of 2.2 billion tons of solid waste annually in the upcoming years [6]. The unmanaged solid waste landfill where the waste has been directly dumped without any segregation, which further causes the severe problem like leachate generation and air pollution; the municipal solid waste at the landfill sites involved in greenhouse gas emission. Due to the huge amount waste which improperly managed at the landfill sites impact the global and local environment and causing health-related issues. The main of management of solid waste strategies are to report environmental, health, land-use, aesthetic and resources apprehensions related with unsuitable waste disposal [7]. These problems are current concerns for corporations, municipalities and every person [8]. Reduction in the disposal of municipal solid waste is a requisite to reduce health issues and dilapidation of land properties. The practice of unsafe directly dumping of solid waste observed in most of developing countries. The method of direct disposal of municipal solid waste was noted as 50 percent in China, 90 percent in India, Sri Lanka shows 85 percent and 65 percent in Thailand [8].

B. SWM: Indian context

The government of India has unnoticed the one the major which is Municipal solid waste management. The municipal solid waste is different for different countries, at the state level as well as the city. In India, the generation of MSW lies between 0.3-0.6 kg per capita per day and it has been increasing annually at the rate of 1.33 percent per capita

per day [9]. Most of the waste in India can be found at corners of the street and empty grounds. The waste which is dumped at the landfill site is not well segregated. The proper systematic approaches to waste collection, transportation and disposal have not been found in any landfill sites. Globally, without treatment two third of the waste is directly dumped at the landfill sites, this practice can also be observed in Indian landfill sites [10]. At landfill sites, unmanaged MSW causing an environmental problem like water pollution, air pollution and numerous health threats. It is uncommon to see heaps of waste at landfill sites in metro cities like Kolkata and Delhi [11].

C. Gaps and approaches in different countries

C.1) Reduction

The reduction is the process through which the size of the waste is decreased as much as possible. That process of reduction of the size of the waste is requisite for the better transport, dumping and recycling. Shredders are using for the reduction of the size of the waste. A well efficient can be achieved by segregating the waste which further reduces the waste at landfill sites. There are ways to reduce the waste generation either by no generation of waste or by converting waste into useful material. Generating zero waste is not possible because of urbanization and industrialization [12].

C.2) Recycling

Recycling of waste reduces the waste disposal at the dumping sites. There is different type of waste dumping in the wasteland fields the waste consists of food waste, paper, packaging fibres, plastics packaging, renovation waste, glass containers, sanitary products and diapers, pet waste, textiles etc. the effective approach is to use the material and again use for different manufacturing procedures this could help to reduce the waste coming to sanitary landfill for final disposal. The level of recycling method it relies on the cost-benefit study of the procedure [13].

C.3) Reuse

Reuse of some waste which is being generated and collected. The reuse of waste includes reusable bottles, paper, scrap, metals etc. After shredding tyres or plastic could be used for road constructions [14].

C.4) Recovery

The recovery of paper, metal, recycling plastic, textile and organic waste contribute recycling and reuse which then helps to manage the solid waste. For instance, the organic waste generation in developing countries is used for making compost for the plant. The paper and metal are recyclable material they recovery of this material is also possible [14].

II REVIEW OF LITERATURES

A. Municipal solid waste generation in India

India, about 25 percent of MSW is not collected and due to inadequate transport capacity in 70 percent of the

Indian cities. The unavailability of landfills to dispose of sanitary waste makes the situation worst. The current functional landfill sites are either well prepared or properly managed. Along with this, there is no liner at the landfill sites which let the impurities to contamination of groundwater and soil [16].

The table illustrates that municipal solid waste in cities with population and waste generated per capita per day. It insinuates that average MSW is 0.21 to 0.50 kg per capita per day in India [16].

Table 1 Municipal Solid Waste In Indian Cities

Cities population (million)	Waste Generated (kg/person/day)
Less than 0.1	0.17-0.54
Between 0.1–0.5	0.22-0.59
Between 1–2	0.19-0.53
Greater than 2	0.22-0.62

Figure 1 illustrates the projected MSW generation in the cities of India. The growth in urbanization has increases the waste generation. In the year 2011, the population was 260.1 million and the total waste generated was 47.3 million tons which will increase to 71.51 million tons in the year 2021 and after one decade in the year 2031, the projected population will be 451.8 million and waste generation will be 107.01 million tons. As per the Figure 1, after every decade there will be an increase in population which gives the increase in waste generation. In the year 2036, it is estimated that almost 50 percent of the increase in population as compared to the year 2011 and the 36 percent increase in waste generation in five decades which would be 131.24 million tons [17].

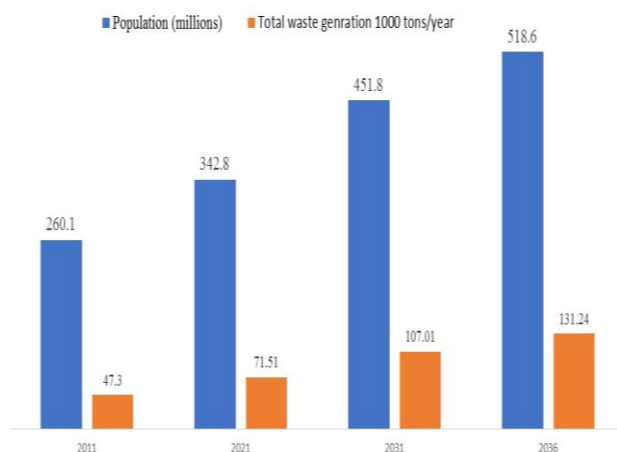


Figure 1 Projected MSW generation for urban population in India

B. Types of solid waste generation

With the growth in urbanization, the utilities of the human being also increase, the rise amount of solid waste

generation take place every year and the characteristics and composition of MSW also changing. MSW is the mixture of the waste from the house, construction sites, destruction debris, and waste from street and sanitation residue. The main source of garbage is residential and commercial complexes mention in Table 2 [17].

Table 2 Garbage: The Four Broad Categories

Organic waste	Vegetable, fruits, kitchen waste, leaves flowers.
Toxic waste	Paint, bulbs, fertilizer, shoe polish, pesticide containers, chemicals, batteries, spray cans and sold medicines.
Recyclable	Plastics, metal, glass, paper
Soiled	hospital waste

B.1) MSW

MSW per capita per day increases every year with the rate of 1.33 percent per capita per day. The MSW generation depends on the population. The huge amount of MWS perceived in metro cities. The municipal solid waste consists of sanitation waste, household waste, waste from streets and construction waste.

B.2) Hazardous waste

The waste from the industries which contains harmful chemical, heavy metals and toxic compounds which are harmful to human, animals and plants and the whole environment. The unmanaged disposal may lead to bad consequences such as poison gas emission, spill of oil in the sea, chemical in air and contamination of soil which get further lose its fertility and groundwater contamination which cause water pollution and resident live nearby areas get highly affected [17]

B.3) Biomedical waste

It is the waste generated from the Hospital which is being generated daily through clinics such as, health care centre’s and pharmaceutical companies. Biomedical waste spreads bacterial infections and viral diseases among all living beings. There are many ways by which biomedical waste generated such as body fluids, anatomical waste, disposable syringes, human excreta, bandages etc. If the proper treatment and management are not used then biomedical waste might be equally harmful as industrial waste with highly toxic effluent if it directly discharges to water sources [18].

C. Monitoring of Solid waste

There are much monitoring which can use for monitoring of solid waste i.e. GIS and GSM through which rationalize solid waste monitoring and supervision efficiencies will increase [18].

Table 3 Composition Of Solid Waste

Kind	Composition	Source
Junk	The waste from cooking and serving of foods; market waste, loading and sell of food	Restaurants, domestic, institutions, stores
Rubbish	Paper, , barrels wood furniture, flammable, non-combustible, carton, boxes, tree branches.	Markets, commercial activities
Fragments	Remaining from fire used for cooking and heating	Domestic, incinerators.
Waste	Street waste, sweeping, dirt	Street side
Industrial waste	Food making, waste, leftovers	Factories, power plants
Demolition	Plumbing parts, bricks, blocks	Demolition sites
Construction	Scraps	Construction locations
Other wastes	Hazardous liquid and solid, radioactive and explosives, materials, waste from Hospital	Household, Hospital, Institutions
Sewage treatment residue	Solid from Screen and grits, sludge	Septic tank and Treatment plants,

D. Methodology for solid waste

D.1) Incineration

Incineration is a controlled burning of organic substances where the waste burns at 1000⁰c or above which produce residue non-flammable material and it can reduce the volume of MSW by 80-90 percent. It converts waste into the flue gas, ash and heat. The heat can be used for energy generation process [19].

D.2) Pyrolysis

In the absence of air, the thermal decomposition of waste to make char, syngas and pyrolysis oil. Sometimes the external source is required because there are some which are thermally unstable. [19].

D.3) Gasification

In this process the carbonaceous material into CO₂, CO, and hydrogen. It is the process in which incomplete burning of MSW in the absence of oxygen the power resulting from

combustion and gasification of the resultant gas is selected as a source of renewable energy [19].

The Figure 2 shows the solid waste monitoring system.

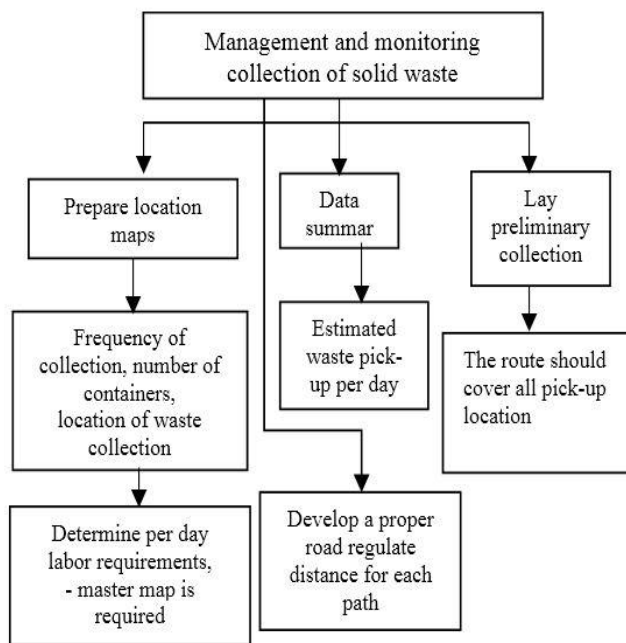


Figure 2 Applied structure for minimization of solid waste

D.4) Composting

The developing countries where the soil requires organic matter and the climate is arid in that country the method of composting is very useful [19]. The decomposition of organic matter and convert into fertilizer. It is the process in which shredding of waste is done, the material is further break up by worms and fungi. Heat, ammonium and CO₂ stars resale from it the end product is nutrient-rich compost.

E. SWM Effect on health

Air, water and soil pollution cause due to unscientifically design and unsuitable disposal of MSW. MSW burning of waste in incineration causes air pollution and which is also caused by harmful gases like methane release from the waste which affects the health. When waste is not segregated then the possibility of generation of leachate is more which then percolate in the ground strata and contaminate the groundwater when if it consumes by any human being it will cause them severe diseases. The health effect due to improper management of solid waste which is chemical poisoning, Low birth weight, congenital malformation, cancer, nausea and vomiting, mercury toxicity, water-borne diseases etc.

F.Public participation

India has achieved socio-economic status. The urbanization is increasing every year due this waste generation is also increases. A systematical approach to reduce the waste generation and increase the performance

requires the participation of each person, NGOs, institutions and communities [20].

III CONCLUDING REMARKS

From the study, it was found that the various gaps present in municipal solid waste management such as waste collection, transport and disposal generation can reduce. There are many approaches are available i.e. reduction, recycling, reuse and recovery from all these activities the waste can be manage easily. The improper management of solid waste can cause environmental and health effects. Incineration, pyrolysis, gasification and composting are the method by which the solid waste generation will reduce. Every individual participation also plays an important role in municipal solid waste management.

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