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A REVIEW ON MUNICIPAL SOLID WASTE MANAGEMENT

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Abstract — Disposal of solid waste is one of the most challenging issues in urban cities, which are facing a serious pollution problem due to the generation of huge quantities of solid waste. In India existing systems for the collection, transportation and disposal of solid waste are mired in chaos. This problem is even more acute in urban areas where the rapidly growing population continues to increase the amount of solid waste that the city authorities (ULB) cannot effectively manage. Improper disposal of solid waste poses environmental and public health risks. Uncontrolled dumping of waste on the outskirts of the city has created overcrowded landfills that cannot be recovered, as well as due to random dumping. However, they also have serious environmental impacts in terms of contributing to groundwater pollution and global warming. Waste incinerator causes air pollution in the form of increased TSP and PM10 emissions. Leachate from sanitary landfills contaminates ground water and sub soil that leads to health hazard. Open burning of solid waste and land fill gases generated from sanitary landfills causes global warming. Poor collection and disposal of municipal solid waste can trigger off epidemics. Conservancy staff and rag pickers are the most vulnerable to health hazards associated with poor solid waste management. The composition of waste depends on a variety of factors such as living standards, climatic conditions and socio-economic factors. The main aim of the paper is explain about solid waste management situation in India, solid waste management process and integrated solid waste management.

Keywords- Urban local bodies, TSP, PM10, Leachate, Sanitary landfills and Global warming.

I. INTRODUCTION

Solid waste is a broad term that includes all types of waste, including municipal waste, industrial waste, hazardous waste, biomedical waste, and electronic waste, depending on their origin and composition. Solid wastes are those organic and inorganic waste materials produced by various activities of the society (Maarten Wolsink, 2010). Solid waste management is a major health and environmental issue in urban areas in many developing countries. Municipal solid waste comprises of domestic wastes and commercial wastes collected within an area. Municipal waste includes biodegradable waste, inert waste made from recyclable materials, and hazardous and non-hazardous waste. Depending on the state of agglutination of the waste, the waste can be divided into solid, liquid and gas. SWM involves activities associated with generation, storage and collection, transfer and transport, treatment and disposal of solid wastes [1]. The quantity of MSW has also increased tremendously with improved life style and social status of the populations in urban centers [19]. The annual waste generation has been observed to increase in proportion to the rise in population and urbanization, and issues related to disposal have become challenging as more land is needed for the ultimate disposal of these solid wastes [4]. Quantity of MSW is increasing due to increase in population and rapid urbanization [2].

It is estimated that approximately 80% - 90% of the municipal waste is disposed in landfills without proper management practices and open burning, leading to environmental pollution [11, 31]. Citizens are barely aware of waste management issues, and careless handling of waste poses challenges for local governments. The potential threat about MSW at landfill sites which emits harmful greenhouse gases eventually leading towards environmental pollution subsequently contaminates the groundwater with the formation of leachates [21, 38, 12]. The sound & micro-dust is another issue during transportation causes nuisance for the elderly and newborns [22].

MSWM is the generation of hazardous chemical wastes by cities such as hospitals and industries leads to breathing problems and premature deaths [31]. In recent years, India has become the emerging recycling market; however, recycling has not done as per the prescribed marks [29]. Improper management of municipal waste in landfills often attracts animals, rodents, mosquitoes, vultures and scavengers, which can lead to health problems and death for frontline workers and waste collectors [32].

II. CURRENT STATUS OF SOLID WASTE MANAGEMENT IN INDIA

2.1 Municipal solid waste quantity and generation rate

In 2016, the world's towns together generated 2.01 billion tonnes of MSW, with a consistent with capita volume of 0.74 kilograms per day. "With fast populace boom and urbanization, annual waste technology is anticipated to growth via way of means of 70 percentages from 2016 ranges to 3.4 billion tonnes in 2050" [27]. This variation in the solid waste generation is based on population growth, improved incomes, and changing consumption patterns. In particular, an increase in the urban population directly leads to an increase in the amount of waste generation [14].

The amount of waste generation in India has increased rapidly in recent years. As of January 2020, 84,475 stations generate 147,613 tonnes (MT) of solid waste per day, according to the Swachhata Sandesh newsletter of the Department of Housing and Urban Development (MoHUA). The 2014 report of the Task Force on Waste to Energy under Planning Committee estimates that urban areas of India will generate 2,76,342 tonnes of waste (TPD) per day by 2021; 4,50,132 TPD by 2031; 11,95,000 TPD by 2050. The amount of waste generated per person is 450 grams per day, an increase of 1.3% each year [14]. As of January 2020, the amount of waste at 84,456 stations varies from 32 tonnes to 22,080 tonnes per day.

Maharashtra produces the highest at 22,080 tonnes per day (out of 7,322 stations) and Sikkim produces the lowest at 89 tonnes per day. Within the Union Territory (UT), Delhi produces the most waste at 10,500 tonnes per day. Overall, Daman & Diu is the lowest waste generator in India [26]. Increasing the amount of plastic waste has become a serious issue and has greatly contributed to the deterioration of the environment. India produces 26,000 tonnes of plastic waste per day, or 9.4 million tonnes per year.

2.2 Composition of municipal solid waste in India

Waste composition has a significant impact on waste management practices. High-income groups use more packaged products and therefore have higher amounts of paper, glass, metal, plastic and fiber than low-income groups [37]. MSW may also contain harmful wastes such as paints, used medicine, pesticides, E-wastes and batteries. The economy of the informal sector solely relies on the composition of generated waste. Previous studies have shown that about 40-50% of the composition of solid waste is organic, 30% (inert and construction / demolition waste) and the rest of the recyclable waste.

2.3 Handling of MSW and current scenario of India

Proper handling of solid waste is an important part of a successful waste management system. Most communities do not have the tools and machinery needed to dispose of such large amounts of unorganized waste. Door-to-door collection is the primary responsibility of the local government, and waste collection and disposal is primarily manual. Municipalities may also outsource collection, separation / sorting, transportation, waste disposal, and final storage tasks to private organizations. However, the recyclables collected by the vendor will be sold to local scrap dealers and transferred to recycling units outside the city.

III. CHALLENGES RELATED TO MUNICIPAL SOLID WASTE MANAGEMENT IN INDIA

3.1 Environment and health issues

Human health is very much associated with environmental degradation. Without proper gloves, uniforms and safety equipment, formal and informal workers are exposed to direct health risks. A high percentage of gastrointestinal parasites worm infects those who live near to the disposal sites. Incineration is often reported to be associated with an increased risk of developing non Hodgkin's lymphomas and sarcomas. Incineration is often reported to be associated with an increased risk of developing non Hodgkin's lymphomas and sarcomas [16]. Open dumps release methane from the decomposition of biodegradable waste under anaerobic conditions even found causing fires and explosions, a vast contributor to global warming [10]. There are problems related to odor and exudate acceptance water and soil transfer [25]. Tires dumped in landfills collect water, which increases the risk of mosquitoes and diseases such as malaria, dengue and West Nile fever. Uncontrolled burning of waste at dumpsites releases fine particles & smog, which are a significant cause of respiratory diseases [37, 15]. The newborn babies & adults are profoundly affected by harmful gases like CO, CO₂, PM_{2.5}, Mercury, & polycyclic aromatic hydrocarbon (PAHs), plastic pyrolysis, even arsenic in water leads to cancer & death [35,5].

3.2 Infrastructure and finance management

Significant capital and maintenance costs in Class 1A cities were estimated at 900 and 269 rupees per person per year [36], according to estimates by an expert committee of the Ministry of Urban Development of India. Local governments and ULBs are struggling without a comprehensive strategy due to the lack of financial and management systems in the waste sector. As a result, unsorted waste does not make a profit, so it is not practiced and set aside. The Department of Expenditure today has an amount of Rs 2427 in 11 states for rural enterprises in urban areas. The amount released in is the first installment payment for the 2021-22 Tied grant. Of the total grants recommended by the Non Million plus Cities Commission, 40% are basic (unbound) grants and the remaining 60% are Tied grants.

Tied grants for the Non-Million Plus cities are released for supporting and strengthening the delivery of basic services out of which 50% is earmarked for 'Sanitation Solid Waste Management and attainment of star ratings as developed by the Ministry of Housing & Urban Affairs (MOH&UA) and the remaining 50% is tied to 'Drinking water, rainwater harvesting and water recycling'.

3.3 Improper implementation of government policies

The management of solid waste generated in a country must be one of the priorities while forming policies at the national level [20]. The main reasons, especially in urban areas, are economic growth, urban migration, unplanned land use and, most importantly, the lack of proper solid waste management practices. The institutional framework for waste management is still in the process of development. Swachh Bharat Mission (SBM), a Ministry of Urban Development (MoUD) under the Government of India. As a national campaign, local municipal bodies, (ULBs) have to make cities open defecation and focuses on the SWM system with social priorities [36].

IV. MSWM PROCESSES & THEIR OPERATIONAL CHALLENGES

4.1 Segregation & collection

An important aspect of efficient waste management is "waste separation". Currently, waste producers put their waste in color-coded trash bins (blue for dry waste, green for wet waste) to ensure proper collection, reuse and recycling. It is obligatory to dispose of it. This greatly reduces the load on the ULB from the SWM. Tamil Nadu achieved 100% segregation in 20 of the 50 small communities and the remaining 80-90%. However, in most states, the mixing of segregated and unsegregated waste remains a serious problem. To motivate people to separate waste, MoHUA launched the "Source Segregation Campaign" as part of the Swachh Bharat Mission on World Environment Day 2017. As part of this campaign, all municipalities should adopt "source segregation" as a mass movement. According to MoHUA's Swachhata Sandesh Newsletter 2020, 63,204 stations (74.82 percent) achieved 100 percent waste separation at the household level in January 2020 [26]. Separation is rare, so unsorted waste is usually collected daily by the municipality with the help of inadequate staff. Waste collection is done on a door-to-door basis from a very crowded narrow street on a manual basis [6].

The MoEFCC estimates that only 75–80 percent of the total municipal waste gets collected and only 22–28 percent of this is processed and treated. A large portion of the waste collected is often dumped indiscriminately, clogging drainage channels and sewer systems. They are also breeding grounds for rodents and insects that are carriers of deadly diseases. According to a survey published by ICRIER in January 2020, Delhi's garbage collection is the lowest (39%) and Ahmadabad's garbage collection is the highest (95%).

In countries like India where cheap labour is available, collection methods are labour-intensive and cheaper than machine collection. Due to the lack of sufficient storage capacity of the generated waste and the lack of discipline among producers, the waste is always dumped on the road [30].

4.2 Storage & transportation

The solid waste generated is usually stored in community bins and individual bins. Residents often use a single container for mixed waste, which is not disposed of and is not filled with seepage water, especially in the rainy season. The solid waste collection vehicles visit on weekly bases. If the vehicle does not appear to be detected, if there is insufficient capacity, and if most cities also use traditional manual collection methods. The scarcity of land for waste dumping is even a more challenging issue [15].

Transporting solid waste is another challenge, as many cities do not have suitable transport options. Vehicles commonly used for primary collection are push trucks or tricycles with containers or bins, tricycles with hydraulic tipping containers, light commercial vehicles (mini trucks) with hydraulic tipping containers, and international standard waste collection bins. It is a four-wheeled mini truck equipped with. Vehicle choices usually depend on a variety of factors such as waste volume, distance, road width, condition, and process technology. To save travel time, minimize human error and improve surveillance systems, many ULBs have Global Positioning System, Geographic Information System and implemented. Global system for in-track mobile communication to collect waste from secondary sources for waste disposal

Thousands of urban inhabitants in India live on many small industrial wastes that use plastics, tin cans, bottles, bones, hair, leather, glass, metal, etc. from municipal waste. All metals, uncontaminated paper, plastic, glass, cardboard, etc. are easily put on the market and are recycled by the household or by rags. When the trash arrives in the trash can, it contains all the recyclable materials and mainly consists of vegetable / fruit bowls, dirty paper and plastic scraps, used toiletries, etc [28].

4.3 Treatment and final disposal

Processing technologies currently used in India include composting, biomethaneization, recycling, refuse-derived fuel, incinerators, pyrolysis, waste and energy. Which technology to use depends on the type and amount of waste available and its calorific value, availability of funds and resources, capital investment, cost recovery, ULB internal capacity, space availability, environment for location. It depends on various factors such as consideration for.

The high proportion of organic matter in municipal waste indicates that biological waste treatment is desirable. Composting was a widespread organic processing practice in India, but in the past composting was discontinued due to inadequate urban land and inadequate waste separation. Recently, efforts have been made to promote waste separation

and composting. The characteristics of Indian municipal waste show the fact that most of India's municipal waste cannot achieve a self-sustaining combustion reaction and requires auxiliary fuel to support the incinerator of waste [1]. Landfill and open burning are still the main waste disposal methods in India. Most cities and towns dispose of waste by dumping it in the lowlands outside the city. According to a 2014 Planning Committee report, more than 80% of the waste collected in India is indiscriminate and unsanitary landfill, which is harmful to health and the environment. Landfill technology is widely used in India to dispose of waste. However, landfills often lack sustainability as landfills due to lack of foundations, linings, leveling, cover floors, leachate management, or treatment systems.

In most metropolitan areas, waste is landfilled in low lying for disposal. Landfills are selected because they are close to the collection area, and new landfills are usually identified only when the existing landfill is completely full. In most cases, waste is simply dumped there and bulldozers are rarely used to compress landfills, except in four big cities. Even in these cities, they are used only for leveling of the deposited waste [13].

The incoming SW vehicle is not weighed and there is no specific plan for filling the landfill. There are no restrictions on leachate and gas management. Ground cover is rarely provided except when the site is closed. Most landfills are unfenced, garbage collection is a trend, and there are problems with landfill operations. Most of the disposal sites are unfenced and the waste picking is commonly in vogue, posing problems in the operation of the sites. Open firing of MSW at disposal sites is most common, for reducing the volume of wastes and also for easy rag-picking [17].

V. SOCIO-ECONOMIC ISSUES ON WASTE MANAGEMENT

5.1 Literacy: Policies & its awareness

The general awareness of solid waste management is quite low due to a lack of self-motivation and attitude [3]. Citizens usually dispose of their garbage from their homes without separating it. This makes it even more difficult for waste collectors to distinguish between waste types. It is not only their education, but also the social taboos on waste that is pervasive in society, which does not allow them to act responsibly for waste management. Municipalities have to take responsibility to educate people about national policies and decentralized methods of the treatment locally [34,18]. Educational institutions can also assist local governments through various seminars, group meetings, posters, contests, awards, advertisements, print media, awards and fines, and chaotic waste management.

5.2 Inadequate resources & land: Availability/prices

Municipalities are mostly struggling to handle the vast waste with the untrained and unorganized waste sector. The adequate machinery and tools are found missing and lack of funds and fiscal amenities [11]. Lack of communication with manual handling, collection, sorting and transport leads to the fact that waste is deposited in landfills located on the outskirts of the city. An additional 1400 square meters is required to generate solid waste in urban areas by 2047. Uncontrolled and regular rises in land prices make land availability difficult to manage.

VI. INTEGRATED SOLID WASTE MANAGEMENT

The primary purposes of solid waste management strategies are to address the health, environmental, aesthetic, land-use, resource, and economic concerns associated with the improper disposal of waste [33, 23, 7]. Systems analysis (engineering models, analysis platforms, and evaluation tools focused primarily on well-defined engineering systems) has been used since the 1960s to support SWM institutions in developed countries [24].

Integrated Solid Waste Management (ISWM) is an evolving concept. Initially ISWM was developed for to increase the efficiency of municipal solid waste management chain, viz.: source separation, collection and transportation, transfer stations, treatment and final disposal [8, 9]. The ISWM then comprehensively regulates all types of waste from all waste sources (residential, commercial, industrial, health care, construction and demolition, agriculture) within geographical or administrative boundaries such as cities. It became a management system. In addition, ISWM is in the process of achieving the 3Rs (Reduction, Reuse, Recycling) aimed at minimizing the amount of waste that can be disposed of and maximizing waste material and energy recovery. Thus, ISWM is a system based on 3R approach at a city/town level covering all the waste generating sectors and all the stages of waste management chain, including segregation at source for reuse and recycling, collection and transportation, sorting for material recovery, treatment and resource recovery and final disposal.

VII. CONCLUSION

India is currently facing the urban waste dilemma in which all elements of society are responsible. There is no system to separate organic, inorganic and recyclable waste at the household level. The country has an appropriate legal framework to combat MSWM. What is missing is the implementation. Despite strict legislation, open landfill is the most popular form of waste disposal. Possible reasons for inadequate implementation can be a combination of social, technical, institutional and financial issues. Public awareness, political will, and public participation are essential prerequisites for successful enforcement of legislation and for an integrated approach to the sustainable management of country municipal waste. Despite this possibility, Indian municipalities still consider waste a problem. This becomes more difficult with

high population densities if the waste is not isolated at the source. There is a lack of proper assessment of the quantity and quality of solid waste and infrastructure.

The concept of effective waste management is a long-term goal of the municipality. The composition of India's waste is different from that of other developed countries-so, the adoption of strategies may not be the same. Recycling and disposal of the required waste needs to be integrated more efficiently. Therefore, resource-rich solid waste is separated from each of the following sources: Wet waste for compost / biogas production and dry waste for energy systems, RDF, recycling and reuse. This ensures that the final landfill or technical landfill is as low as possible in waste. Other advanced treatment processes such as gasification and pyrolysis need to be evaluated economically and ecologically before implementation. Adopting centralized and decentralized strategies for managing solid waste from a variety of sources can help achieve concrete sustainability in MSWM systems. With less involvement of the organized informal waste sector and private and government agencies, this is an important aspect in addressing the challenges of MSWM to seize potential opportunities for future cities in India.

VIII. REFERENCES

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