Burden of Solid Waste, and Control Measures for Health Hazards Emanating from Its Mismanagement in a Populous Country Like India; with Special Reference to Odisha Slums and Rural Areas

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Abstract:

The article summarizes the growing burden of solid wastes across the world and closer in relation to the Bhubaneswar city. Rapid urbanization and human habitation is not matched with efficient solid waste handling and disposal. This is posing a serious threat to environment and even becoming the root cause of spread of infectious diseases as well as reemerging diseases. The review opens up the pandora box of the types of waste, how they need to be segregated and legislations and policies that have evolved to manage this issue. Of late newer forms of solid waste like e-waste and construction waste are also being added. A wide public as well as political awareness and urgent action is needed to prevent environmental damage and calamities.

Keywords: Solid waste management(SWM), e-wastes, slums and Rule of SWM

Jimmy carter once quoted "solid waste is the discarded leftovers of our advanced consumer society. This growing mountain of garbage and trash represent not only an attitude of indifference towards valuable natural resources, but also impending serious economic and public health problem ''

Interaction between man and the environment results in some type of waste generation, which is inevitable. To protect our environment and health, it is vital that we manage solid waste effectively and efficiently in a timely manner. By definition *"any object that has reached the end of its useful life and has been dumped is waste''* [1]. They can be either solid or liquid in nature. It is the solid wastes that offer an insightful appearance and foul odor.

Broadly solid waste can be categorized depending on whether or not the waste is biodegradable. Solid wastes that can be degraded (broken down) into their component parts by bacteria and other microorganisms are referred to as biodegradable wastes. The main biodegradable wastes include human excretory waste, food waste, manures, and agriculture outputs which are dependent on population & it's

inhabitation. These wastes result in methane production which is a potent foul greenhouse gas that is inflammable if enough of it builds up and there is an ignition source nearby[2]. Normally, this waste was considered the core of waste management in well-planned villages/towns. However, the presence of a growing population and rampant unorganized settlements is contributing to the increasing build-up of biodegradable wastes. Thus they are now the main reason for air and soil pollution [1,2]. If these wastes are littered, the damage to the environment is conceivable.

Solid waste that is non-biodegradable, also known as inorganic waste and they do not break down due to microbial activity. Plastic bags, food and drink cans, scrap metal, and plastic containers are some of such wastes [1,2]. With aggressive urbanization and changes in living standards, these wastes are growing. Contrary to the belief that dumping would be good for these kinds of wastes, they are becoming the alternate means of spreading diseases like dengue or even cancer to name a few. Soil pollution is inevitable when these wastes are left unattended [3].

According to a published study by Annepu et.al 2012; it was reported that rubbish comprises of both combustible (paper, plastic etc.) and incombustible (glass, metal etc.). There are special wastes such as construction debris, leaves and street litter, abandoned automobiles, and old appliances that are collected and managed separately. Rubbish consists of organic matter (51%), recyclables (17.5%) and others *i.e.,* inert. Notably, the actual composition may differ due to the informal separation of recycling wastes at the source.

The Municipal Solid Waste (MSW) characterization in India has been depicted Fig1[4].

Global waste production has significantly increased recently, and there are no indications that it will slow down. Global production of municipal solid garbage is anticipated to have grown by nearly 70% to 3.4 billion metric tons by 2050[5]. Multiple variables, including population growth, urbanization, economic expansion, and consumer purchasing patterns are the reasons contributing to this. Every year, less than 20% of waste is recycled, there by leaving vast amounts to be dumped in landfills. East Asia and the Pacific region produce the greatest amount of MSW. The United States produces about 12% of the world's MSW and is the largest per capita producer of MSW despite having less than 5% of the world's population[6]. Canada produces the most waste in the world when "special waste" categories are included (including industrial, e-waste, hazardous, and agricultural waste).

The added waste stream that is expanding the fastest globally is e-waste. The production of electronic waste on a global scale reached more than 50 million metric tons in 2019 and is predicted to rise by an estimated 20 million metric tons over the next ten years. The most prevalent type of trash, which makes up over 50% of all MSW globally, is food [3-6].

Figure 3 depicts India's urban population producing 107.01 million tonnes of garbage per year by 2031. Figure 3 also reveals that it will be 160.96 million tonnes per year by 2041, representing a five-fold increase in four decades. Figure 4 depicts a decadal prediction of population, trash generated, and required land for landfill disposal . According to this estimate, 1400 square kilometres of land will be needed to dispose of the waste in 2051[6]. This massive amount of urban trash must be properly managed in an

environmentally safe manner so that it does not negatively effect inhabitant health, the surrounding environment, or daily life in Indian cities.

Figure 1. Predicted urban population and its impact on waste generation
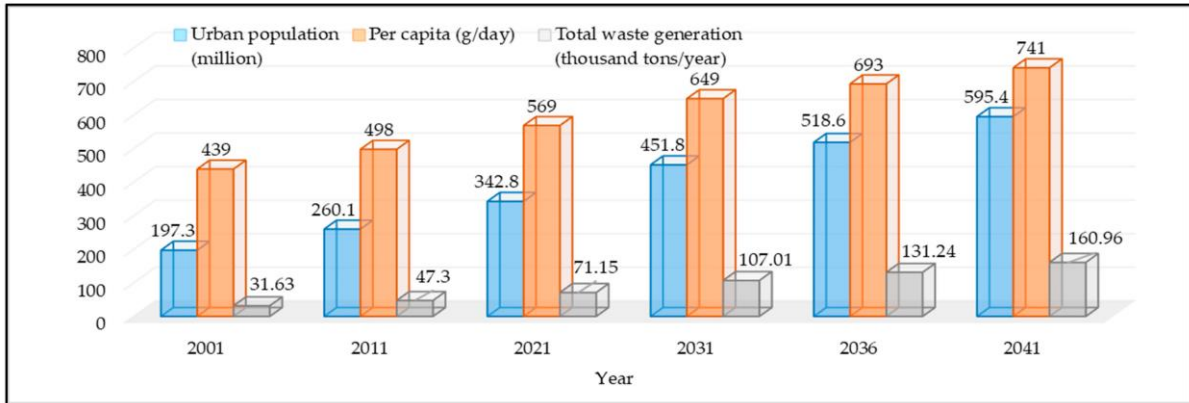
**Figure 2.** Predicted population, waste generation, and land requirement for disposal
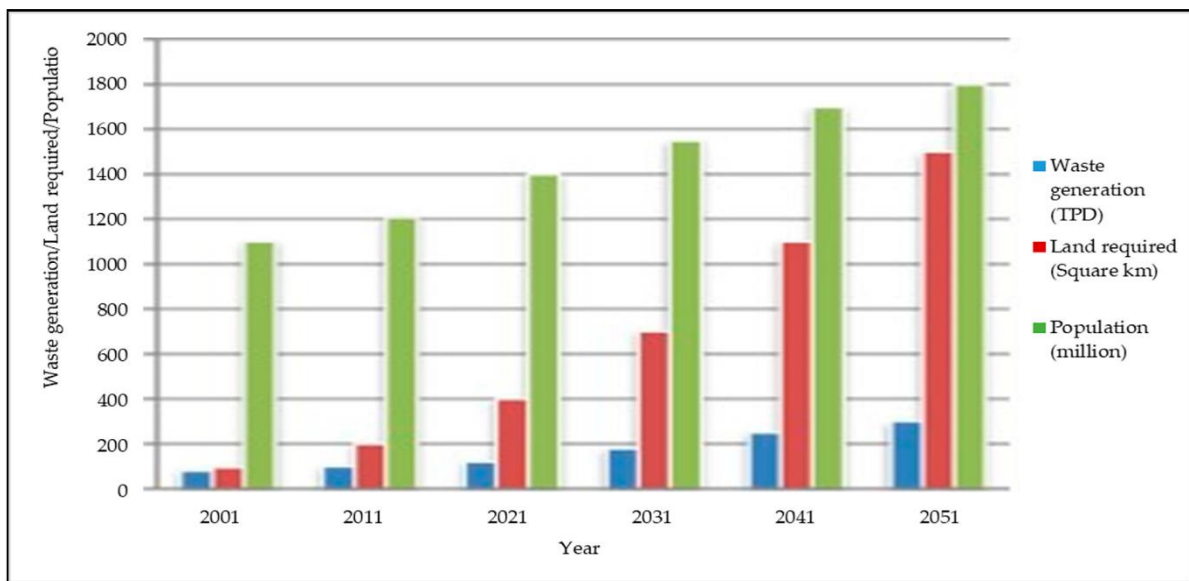
Source for Fig 1 and 2: Shahab S, Anjum M. Solid Waste Management Scenario in India and Illegal Dump Detection Using Deep Learning: An AI Approach towards the Sustainable Waste Management. Sustainability [Internet] 2022;14(23):15896. Available from: http://dx.doi.org/10.3390/su142315896

The problem is that waste generation is natural and seemingly non-cumbersome to start with, which becomes cumbersome both for the environment and its perpetrators when it is unattended and grows in bulk. Its management is tough, expensive, and often even needs legislative enforcement. Thus, it is a growing menace for low-income countries. Restricting it at the point of production if possible or managing it at the smallest community level would be a cost effective solution.

India is experiencing a severe rise in the production of waste. The development of collection efficiency is limited. Crude dumping is a widespread and convenient practice. India is rapidly urbanizing, yet many still discard domestic waste by ignoring the right waste management channel. India produces a lot of solid

waste every day, but collection and treatment are insufficient. According to Kumar and Goel (2009) [7], SW generation per capita in India ranges from 0.17 kilogram per person per day in small areas to 0.62 kg per person per day in cities. Population density, economic standing, commercial activity, culture, and area all have an impact on waste generation. Asian and Pacific Region are consuming significant quantities of toxic chemicals and producing a large amount of hazardous waste. According to Central Pollution Control Board (CPCB) the total quantity of Solid waste generated in the country is 160038.9 Tons per day(TPD) of which 152749.5 TPD of waste is collected at a collection efficiency of 95.4%. Around 79956.3 TPD (50 %) of waste is treated and 29427.2 (18.4%) TPD is land filled [5-7]. Around 31.7 % of the total waste generated remains un-accounted. Eight times as much MSW is produced today in Indian cities as compared to the amount in 1947, and the current category of waste is given in Figure 3.

Figure 3: Categories of municipal solid waste in typical Indian cities
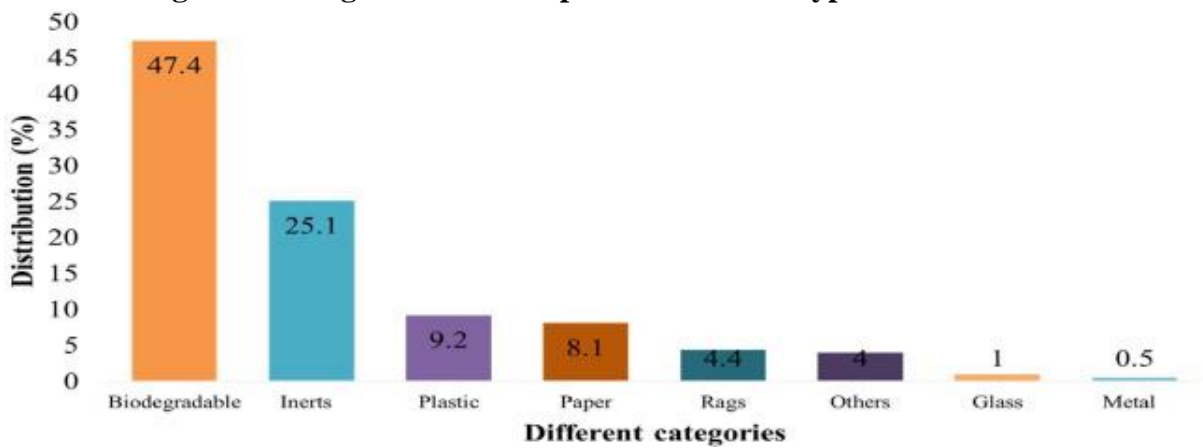
Source: Meena MD, Dotaniya ML, Meena BL, Rai PK, Antil RS, Meena HS, Meena LK, Dotaniya CK, Meena VS, Ghosh A, Meena KN. Municipal solid waste: Opportunities, challenges and management policies in India: A review. Waste Management Bulletin. 2023 Jun 1;1(1):4-18.

Rural Indian households' domestic waste generation is a growing source of considerable concern. Although the majority of the solid waste produced in rural areas is organic and biodegradable, the fact that this waste is not being segregated in-situ and amounts to between 0.3 and 0.4 million metric tons per day is posing a serious problem as per the Ministry of Drinking Water and Sanitation (MDWS), Government of India(GOI) [8]. Callous littering is damaging the environmental sanitation, which is outcome of poor standards of living; hence domestic wastes should be managed carefully at the point of generation. There should be a working waste management system in place in order to handle garbage in a desirable manner. To hold individual families accountable for handling waste in an inappropriate manner, a working garbage collection and disposal system at the Panchayat level should be available and functional. Gram Panchayats are expected to develop a practical system for managing solid waste in rural region, under the guidance of Government Of India(GOI) and state government. WASH (water, sanitation, and hygiene) directly affect human health and, if neglected, have serious repercussions. One of the main pillars of Swachh Bharat Mission (SBM) (G), which was established with the aim of improving hygienic conditions and overall quality of life in rural regions, is Solid and Liquid Waste Management (SLWM)[6,7].

India's growing urban population also continues to grow whereby solid waste management continues to be one of the biggest environmental health concerns. Solid waste generation in cities is currently

estimated to be 1.3 billion tons per year, with emerging countries anticipated to see an increase of more than double that amount to 2.2 billion tones by the year 2025[8]. Congested slums with limited access to essential infrastructure and services are characterized by subpar solid waste management. Slums are defined as urban settlements lacking basic facilities [9] found in many states, with Odisha being one of them.

As the state's capital, Bhubaneswar contains a number of slum settlements. Slums are subject to indiscriminate garbage disposal practices, which might have the negative health effects mentioned above because of the poor housing standards, relatively low literacy rates, and lack of fundamental waste management knowledge. Municipal solid trash collection is currently one of the most important public services that is lacking in some of the slum areas of Bhubaneswar, which is a point of concern. Effective solid waste management is directly impacted by community involvement, as well as by their awareness, attitudes, and actions [8-10]. Deviations result in several threats to the environment and public health, including soil pollution, deterioration of ecosystems, contamination of surface and groundwater, and greenhouse gas emissions from anaerobic waste decomposition. Indiscriminate disposal of wastes causes flooding, air pollution and the development of infections like respiratory illnesses and diarrhea [11].

In Odisha, garbage generation climbed from 646 tones per day in the years 1999–2000 to 2239 tones per day in the years 2011–2012, and it continues to rise each year. Only 33 tons of the 1837 tons of rubbish collected each day from the total amount of waste created were processed [14]. Bhubaneswar, the state capital of Odisha, had an estimated population of 8, 37, 737 as of the 2011 Census of India. Bhubaneswar is the ninth-largest city in terms of geographical area and the eleventh-largest in terms of population in India. The municipality of Bhubaneswar generates about 360 grams of solid trash daily, or 360-gram per capita day. Out of the 8 major sources; the main producer of garbage in Bhubaneswar are home and institution, primarily produce organic waste. School and colleges in Bhubaneswar are the city's second source; food wastes, which are primarily organic in nature, produced by restaurant and vegetable markets are fourth source; and Healthcare institutions are the fifth source of trash generation. However, Biomedical Waste Management is not under the purview of this review. City's leather-producing enterprises are the sixth cause of garbage output inclusive of slaughterhouses which produce bones, intestine, etc. Waste produced by dairy farming and animal husbandry is final category[14-15]. All this makes it imperative to compile and relook at the control measures and policies that address these problems.

Policies and programmes to control and address the problem of waste:
On September 25 2000, the Municipal Solid Waste (Management and Handling) Rules was announced and enforced. These regulations, however, were modified in response to public feedback in the areas of plastic, e-waste, biomedical, hazardous, and construction and demolition waste management regulations. Later, in 2016, the government released the Solid Waste Management Rules, 2016[12]. These new set of regulations also apply to urban agglomerations, census towns, notified industrial townships, areas under the management of Indian Railways, airports, special economic zones, pilgrimage sites, sites of historical and religious significance, and organizations run by state and federal governments, in addition to municipal areas.

The Central and State Pollution Control Board, along with the Ministry of Environment and Forests (MOEF), handle the WM concerns. The High Court's appointed Technology Advisory Group periodically delivers its assessment on the extent of technological advancement and application. In order to address the issue, the government also passed the Plastic Waste (Management and Handling) Rules, 2011 and the E-Waste (Management and Handling) Rules, 2011. The Indian Constitution's Article 48-A encourages each state to recycle and utilize the waste it generates. To reduce toxicity and its ultimate volume and to limit any negative environmental effects, final SW is disposed of in landfills (Misra & Pandey, 2005). For easier disposal, state governments have taken the effort to outlaw electrical products and plastic carry bags. In contrast to European nations, India has not seen success with the Extended Producer Responsibility (EPR) concept. Guidelines for Environmentally Sound Management of "End-of-Life Vehicles" (ELV) are a publication by CPCB (2012) that address the negative effects of automobiles on the environment. On paper, there is a policy framework, but the situation in the real world is worrying. The government has taken steps, but there is still a long way to go until the intended results are attained.

The "Swachh Bharat Abhiyan," often known as the "Clean India Mission," is a courageous initiative to educate people about the value of waste management and ensure community involvement and ownership. Public-Private-Partnership (PPP). Models are being encouraged to assist in producing revenue and ultimately competency level for effective SWM [8-10]. Obstacles are nevertheless created by a lack of sustained funding, popular support, and fast tracking administrative requirements.

A "gap" between intended performance versus actual performance typically denotes a breakdown in institutional frameworks and the supportive environment. Solid waste management is frequently seen by central authorities as a municipal responsibility that falls outside of their jurisdiction. Line ministries frequently don't think it's their job or practical to give local governments the advice, resources, and requisite support that they need to implement policy. However, it is the role of central governments to establish the overarching institutional, policy, and legal framework for the municipal waste management industry. It may be argued that there is more than one "gap." A few examples include the disparity in waste management results between nations with varying wealth levels, the funding gap for services and infrastructure, and the technical and operational capacity gap at all levels of government[13].

Roads yet to be reached: Pollution of the air, land and water are results of improper MSW management and disposal. Surface and groundwater supplies are contaminated by garbage that is dumped carelessly. MSW causes drain blockage in metropolitan areas, which results in stagnant water, thereby becoming breeding ground for vectors and floods during rainy seasons. Uncontrolled burning of MSW and inappropriate incineration greatly increase the amount of air pollution in cities. Around 22 human diseases have been related to poor MSWM[14]. The co-disposal of hazardous and medical wastes with MSW poses a severe threat resulting health issue mostly in the waste pickers as they rarely shielded from direct exposure by the use of appropriate Personal Protective Equipment in underdeveloped nations[15].The incubation and proliferation of vectors of public health important like flies, mosquitoes, and rodents—affect the health of the population. The solid waste disposal sites found on the outskirts of urban areas are the main sources of contamination. The above-mentioned circumstance results in gastrointestinal, dermatological, pulmonary, genetic, and various other infectious diseases. Since the Industrial Revolution, garbage has been an issue for mankind. It has been noted that residents of urban slums tend to have various

medical ailments , including allergies, asthma, skin irritation and other gastro intestinal disorders[13-17]. Majority of people are unaware of the negative impacts of rubbish piles and act as breeding ground for vectors like flies, cockroaches, mosquitoes, rodents and others that spread diseases among those who live nearby. Flooding during rains & contaminated waste entering households of urban slums & rural areas pose a serious threat to the physical health of the inhabitants.

Hence, SMW should be prioritized and inbuilt into a health programs of the country to maximize health benefits. This will not only curb the expenses on the health system to treat preventable ailments but also would contribute to Sustainable Development Goals of 6, 7,11, 13, 14,14,15, making this Earth a very safe place to live.

References

1. Kacprzak M, Attard E, Lyng KA, Raclavska H, Singh B, Tesfamariam E, Vandenbulcke F. Biodegradable Waste Management in the Circular Economy. DOI. 2022;10:9781119679523.
2. Vogel W, Hwang CD, Hwang S. Gender and sanitation: women's experiences in rural regions and urban slums in India. Societies. 2022 Jan 30;12(1):18.
3. T. Cecilia, *Urbanization, Gender and Urban Poverty: PaidWork and Unpaid Carework in the City*, International Institute for Environment and Development: United Nations Population Fund, London, UK, 2012.
4. Meena MD, Dotaniya ML, Meena BL, Rai PK, Antil RS, Meena HS, Meena LK, Dotaniya CK, Meena VS, Ghosh A, Meena KN. Municipal solid waste: Opportunities, challenges and management policies in India: A review. Waste Management Bulletin. 2023 Jun 1;1(1):4-18.
5. D. Hoornweg and P. Bhada-Tata, *WHAT A WASTE, A Global Review of SolidWasteManagement*,UrbanDevelopment Series,TheWorld Bank, 2012.
6. Shahab S, Anjum M. Solid Waste Management Scenario in India and Illegal Dump Detection Using Deep Learning: An AI Approach towards the Sustainable Waste Management. Sustainability [Internet] 2022;14(23):15896. Available from: http://dx.doi.org/10.3390/su142315896 Shahab S, Anjum M. Solid Waste Management Scenario in India and Illegal Dump Detection Using Deep Learning: An AI Approach towards the Sustainable Waste Management. Sustainability [Internet] 2022;14(23):15896. Available from: http://dx.doi.org/10.3390/su142315896
7. N. Freudenberg, "Time for a national agenda to improve the health of urban populations," *American Journal of PublicHealth*,vol. 90, no. 6, pp. 837–840, 2000.
8. UNEP, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, United Nations Environment Programme, Nairobi, Kenya, 2011.
9. J. B. Nyakaana, H. Sengendo, and S. Lwasa, *Population, Urban Development and the Environment in Uganda:The Case of Kampala City and Its Environs*, Geography Department, Makerere University, 2009.
10. M. Sujauddin, S. M. S. Huda, and A. T. M. R. Hoque, "Household solidwaste characteristics and management inChittagong,Bangladesh," *Waste Management*, vol. 28, no. 9, pp. 1688–1695,2008.
11. MoWE, *Joint Sector Review Report*, Ministry of Water and Environment, Kampala, Uganda, 2010.
12. Yadav S, Patel S, Killedar DJ, Kumar S, Kumar R. Eco-innovations and sustainability in solid waste management: An indian upfront in technological, organizational, start-ups and financial framework. Journal of Environmental Management. 2022 Jan 15;302:113953.

13. F. K. Judd, H. J. Jackson, A. Komiti, G. Murray, G. Hodgins and C. Fraser, "High prevalence disorders in urban and rural communities," *Australian and New Zealand Journal of Psychiatry*,vol. 36, no. 1, pp. 104–113, 2002.

14. Pan Z. How Waste Is Managed in Urban and Rural Areas: Evidence from China. InIOP Conference Series: Earth and Environmental Science 2020 Sep 1 (Vol. 566, No. 1, p. 012009). IOP Publishing.

15. Prakash M, Singh U, Kumar AC, Kullappa M, Mullackal MK. Handbook on scaling up solid and liquid waste management in rural areas.

16. Mohanty S, Mishra S, Mohanty A. Municipality Solid Waste Management. A Case Study of Smart City Bhubaneswar, Odisha. Journal of Environmental Management & Tourism. 2022 Oct 1;13(5):1361-73.

17. Das D, Panda S, Kisku T. A Survey on Waste to Energy Potential in Odisha. Int. J. Innov. Res. Sci. Eng. Technol. 2017;6:16110-5.

18. World Bank. Bridging the Gap in Solid Waste Management: Governance Requirements for Results. World Bank; 2021 Jul 15.