OPEN BURNING OF MUNICIPAL SOLID WASTE AND ITS CONTRIBUTION TO URBAN AIR POLLUTION IN INDIA: A LEGAL ANALYSIS

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ABSTRACT

Solid waste management is one of the most important services for preserving urban areas' quality of life and guaranteeing higher levels of cleanliness and health. Due to the antiquated and ineffective systems used, this service in India is not up to par. Insufficient coverage, poor technology selection, institutional weakness, a lack of financial and human resources, and a lack of both short- and long-term planning are the causes of the insufficiency of service. Particularly in developing nations like India, open burning of municipal solid waste (MSW) is a possible non-point source of emissions that raises more concerns.Lack of knowledge on the effects of open burning on the ecosystem One of the main obstacles to an effective municipal solid waste management system in India is the belief that "open burning a source of emission of carcinogenic substances."

The open burning of MSW in India is highlighted in the paper, along with the current and anticipated emissions of ten major pollutants (dioxin, furans, particulate matter, carbon monoxide, sulphur oxides, nitrogen oxides, benzene, toluene, ethyl benzene, and 1-hexene). The waste to energy potential of MSW was also estimated using efficient biological and thermal techniques. The data was analysed using statistical methods, and the present and anticipated emissions of several contaminants were calculated. Seven Union Territories and 29 States had their population, MSW generation, and collection efficiency data gathered. The study offers suggestions and analysis on the viability, difficulties, and possibilities of implementing waste-to-energy (WtE) systems in the Indian setting. The results of this study help local authorities find practical solutions to integrate WtE technology by providing a basis for additional optimization studies of MSW from a WtE viewpoint. In order to help municipalities make the shift to cleaner, energy-secure smart cities more seamless, this assessment provides a baseline.

Keywords: Municipal solid waste, Urban air pollution, solid waste management, public health

Introduction:

Open burning of municipal solid waste (MSW) in India has emerged as a major and often unregulated source of urban air pollution. A significant portion of waste generated in cities, estimated to be between 2% and 24%, is openly burned, contributing to the increasing levels of harmful air pollutants such as PM2.5 and PM10. The burning of waste releases several toxic substances into the atmosphere, including dioxins, furans, and black carbon, which pose serious risks to both environmental quality and public health. Although the practice is legally prohibited under the Environment (Protection) Act, 1986, the continued occurrence of open burning is largely attributed to weak enforcement of environmental laws and the lack of adequate waste management infrastructure in many urban areas. Improper disposal of municipal solid waste leads to various forms of environmental pollution, including air, soil, and water contamination. Uncontrolled dumping of waste can pollute both surface water and groundwater sources. In urban areas, accumulated waste often blocks drainage systems, leading to stagnant water that creates favorable conditions for the breeding of insects and also contributes to flooding during the rainy season. Open burning of municipal solid waste is another major contributor to urban air pollution[1]

Concept of Municipal Solid Waste and Its Collection:

Municipal solid waste (MSW) refers to the everyday waste generated from households, commercial establishments, small industries, institutions, markets, and public places in urban areas. It includes materials such as food waste, paper, plastic, glass, metals, textiles, and garden waste. With rapid urbanization, industrialization, and population growth, the generation of municipal solid waste has increased significantly in India. According to the Central Pollution Control Board, India generates more than 1.6 lakh tonnes of municipal solid waste per day, and only a portion of it is scientifically processed while the rest is either dumped in landfills or improperly disposed of. Improper waste management has serious environmental consequences, including air pollution, groundwater contamination, and the spread of diseases. One of the most common issues associated with poor waste management is the open burning of waste, which contributes to the release of harmful pollutants into the atmosphere.

To control littering and ensure proper waste management, state governments and municipal

[1] Gaurav Sharma et al., Will Open Waste Burning Become India's Largest Air Pollution Source?, Env't Pollution (2022), https://www.sciencedirect.com/science/article/abs/pii/S0269749121018923

authorities have established regulations for the systematic collection and handling of municipal solid waste. Under the Solid Waste Management Rules, 2016, littering of waste in public places such as streets, markets, and open areas is strictly prohibited. Municipal authorities are responsible for organizing an efficient system for waste collection and transportation. One of the key methods adopted is door-to-door collection, where waste is collected directly from households, commercial establishments, and institutions at regular and pre-scheduled times. Waste collection vehicles often use musical bells or announcements to inform residents about the collection schedule. In many urban areas, waste is also collected through community bins or central collection points, where residents can dispose of their waste in designated containers.

Special arrangements are also made for areas that generate large amounts of waste, such as slums, hotels, restaurants, markets, and commercial establishments. In such places, municipal authorities place additional collection equipment such as large bins and containers to ensure proper waste disposal. After collection from households and commercial locations, the waste is usually transported to community bins or transfer stations through hand-driven carts, tricycles, or small motorized vehicles before being taken to processing or disposal sites.

To maintain hygiene and public health, municipal authorities also take measures to prevent stray animals from accessing waste storage facilities, as animals often scatter waste and create unsanitary conditions. Another important requirement in municipal solid waste management is the segregation of waste at the source. Hazardous waste such as biomedical waste from hospitals and industrial waste must not be mixed with municipal solid waste. These types of waste are required to be handled separately according to specific regulations to avoid environmental contamination and health risks.

For example, cities like Indore and Mysuru have implemented effective door-to-door waste collection and segregation systems, which have significantly improved urban cleanliness and waste management. Such initiatives demonstrate that proper planning, public participation, and strict implementation of waste management rules can reduce environmental pollution and improve the quality of urban living.[2]

[2] M. Sharma, M. Khare & R. K. Mishra, Air Quality Changes in Delhi Due to Open Waste Burning: An Accidental Fire in Bhalswa Landfill, Int'l J. Env't Sci. & Tech. (2023),

Causes And Impact of Public Health Threats in Open Burning:

Open burning of municipal solid waste poses serious threats to public health and the environment. Recent research shows that the health risks associated with open burning are far more severe than previously understood. When waste is burned in open spaces, it usually occurs at low temperatures and under smouldering conditions. Such incomplete combustion leads to the formation of many toxic and hazardous chemicals. These include highly dangerous substances such as dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), and other toxic compounds that are recognized under the Stockholm Convention on Persistent Organic Pollutants. These pollutants can be produced regardless of the type of waste being burned, meaning that even common household waste can generate harmful emissions when burned in the open.

One of the major concerns with open burning is that the pollutants released into the air do not remain confined to the area where the burning occurs. Many of these chemicals can travel long distances through the atmosphere and eventually settle on soil, vegetation, and water bodies. This leads to widespread environmental contamination. In addition, the ash that remains after the burning process often contains toxic residues and heavy metals. These pollutants can gradually seep into the soil and contaminate groundwater sources, thereby affecting agricultural land and drinking water supplies. The contamination caused by open burning can also enter the food chain. Animals and fish may ingest polluted water, soil, or contaminated plants, allowing harmful substances to accumulate in their tissues. Plants may also absorb certain pollutants through their leaves or roots. When humans consume such contaminated food products, these toxic chemicals enter the human body and may accumulate over time. This process, known as bioaccumulation, increases the risk of long-term health problems.

In addition to environmental contamination, smoke and fine particulate matter released during open burning have immediate health impacts on nearby populations. The smoke contains high concentrations of particulate matter such as PM2.5 and PM10, which can easily penetrate deep into the lungs when inhaled. Exposure to these pollutants can trigger various respiratory problems, particularly among vulnerable groups such as children, the elderly, and individuals suffering from asthma or other respiratory illnesses. Continuous exposure may lead to chronic respiratory diseases, reduced lung function, persistent coughing, and throat irritation. Overall, open burning of municipal solid waste not only degrades environmental quality but also creates

significant public health risks. Effective waste management systems, strict enforcement of environmental regulations, and public awareness are essential to reduce this harmful practice and protect community health.[3]

Role of Pollution Control Boards:

The Central Pollution Control Board (CPCB) is the apex statutory body in India responsible for regulating and controlling environmental pollution. It was established by the Government of India in September 1974 under the provisions of the Water (Prevention and Control of Pollution) Act, 1974. The Board was later entrusted with additional powers and responsibilities through the Air (Prevention and Control of Pollution) Act, 1981. CPCB functions as the central authority for planning, coordinating and implementing nationwide programmes aimed at preventing, controlling and reducing air and water pollution. It advises the Central Government on environmental protection policies and plays a crucial role in setting national standards for air quality and water quality. The Board also collects, compiles and publishes scientific data relating to pollution levels and environmental conditions across the country. In addition, CPCB develops technical guidelines, manuals and codes of practice for industries and local authorities regarding the treatment and disposal of sewage, trade effluents and industrial emissions. It also conducts research and provides technical assistance to various government agencies and pollution control authorities. Training programmes, environmental awareness campaigns and collaboration with international and national institutions are also part of CPCB's mandate to strengthen environmental governance and promote sustainable development in India.

At the state level, pollution control responsibilities are carried out by the State Pollution Control Boards (SPCBs), which are statutory bodies established by respective state governments. These boards function under the overall guidance and coordination of the CPCB and are primarily responsible for implementing environmental laws and regulations within their respective states. The main objective of SPCBs is to prevent, control and abate pollution affecting air and water resources. They monitor environmental quality by conducting inspections, collecting samples and assessing emissions from industries, municipal bodies and other potential pollution sources. SPCBs also play an important role in setting and enforcing environmental standards for industrial emissions, sewage discharge and trade effluents. They advise state governments

[3] Kanchan Kumari et al., Emission from Open Burning of Municipal Solid Waste in India, Env't Tech. (2017), https://pubmed.ncbi.nlm.nih.gov/28678614

on the environmental suitability of industrial locations to ensure that new industries do not adversely affect sensitive ecosystems or densely populated areas. Furthermore, these boards support research activities, provide technical guidance to industries and local authorities and promote public awareness about environmental protection. Through their regulatory and advisory functions, SPCBs contribute significantly to maintaining ecological balance and protecting public health.

Monitoring air pollution resulting from waste burning has become an important environmental challenge in India. Effective monitoring requires the integration of advanced technologies, scientific analysis and community participation. Modern monitoring systems combine ground-based air quality sensors, satellite observations and mobile monitoring techniques to track pollutants released from open waste burning. Hyperlocal sensor networks equipped with low-cost Internet of Things (IoT) devices are increasingly used to measure particulate matter such as $PM_{2.5}$ and PM_{10}, which are major pollutants generated from burning waste. Satellite-based systems, including data from sensors like MODIS, help detect largescale smoke plumes and landfill fires over wide geographical areas. In addition, chemical analysis of particulate matter can identify toxic substances such as dioxins, furans and heavy metals released during the burning of plastics and mixed waste. Advanced atmospheric dispersion models are also used to trace the movement of pollutants and identify their source locations. Despite technological advancements, challenges such as inadequate monitoring infrastructure, limited data availability and sensor reliability remain significant obstacles. Strengthening monitoring systems, increasing public awareness and enforcing stricter regulations against open waste burning are therefore essential for improving air quality and protecting environmental and human health.[4]

International approaches to waste management:

In the European Union, waste management, The Waste Framework Directive 2008/98/EC, which sets the waste hierarchy principle prevention, reuse, recycling, recovery, and disposal as the final option is the main legislation governing waste management in the European Union. According to the directive, member states must ensure environmentally sound waste treatment and reduce waste output. Because it releases harmful pollutants including dioxins and

[4] Sarika Sinha et al., Municipal Solid Waste Management; Air Pollution and Its' Impact, Int'l Rsch. J. Eng'g & Tech. (IRJET) (2023), https://www.irjet.net/archives/V10/i3/IRJET-V10I3125.pdf

particulate matter, open burning of rubbish is absolutely forbidden in all EU countries. Only highly regulated facilities that adhere to stringent emission criteria under the Industrial Emissions Directive 2010/75/EU are allowed to incinerate waste. To reduce hazardous emissions, these facilities must employ cutting-edge filtration technologies. Additionally, EU policy encourages member states to enhance recycling rates and decrease landfill usage by promoting recycling and circular economy initiatives. Consequently, many European Countries have attained high recycling rates and drastically decreased waste disposal-related environmental.

Japan's waste management system is well known for being extremely disciplined and well-organized. The garbage Management and Public Cleansing Act, which sets stringent guidelines for garbage collection, treatment, and segregation, governs waste management in Japan. Waste must be divided into several categories by Japanese families, including recyclable, non-combustible, combustible, and bulky waste. Japan is mostly dependent on waste-to-energy incinerators due to a lack of land for landfills. To avoid air pollution, these incinerators, in contrast to open burning, run under sophisticated technological systems with stringent emission control regulations. Additionally, the government encourages recycling by enacting legislation like the Container and Packaging Recycling Law, which mandates that producers and consumers.[5]

Suggestion and recommendations:

Several crucial steps need to be taken in order to lessen the negative impacts of burning rubbish outside. Strict enforcement of environmental rules is necessary, as is the imposition of sanctions on persons or organizations who burn garbage. To lessen the quantity of mixed garbage, proper waste segregation at the source as mandated by the Solid garbage Management Rules, 2016 should be reinforced. To ensure that waste is disposed of scientifically, municipal authorities should also invest in cutting-edge waste management technology like composting, recycling, and waste-to-energy plants. Campaigns to raise public awareness of the negative effects of rubbish burning on the environment and human health are crucial. Additionally, the government should use cutting-edge technologies like pollution sensors and satellite

[5] Dilip Kumar Mahato et al., Burning of Municipal Solid Waste: An Invitation for Aerosol Black Carbon and PM2.5 over Mid-Sized City in India, Academia.edu (2023), https://www.academia.edu/104492266/Burning_of_Municipal_solid_waste_An_invitation_for_aerosol_black_carbon_and_PM2_5_over_mid_sized_city_in_India

monitoring to enhance air quality monitoring systems.

Conclusion:

In India, one of the main causes of urban air pollution is the open burning of municipal solid waste (MSW). The amount of waste produced in cities has increased due to rapid urbanization and population development, and poor waste management systems have resulted in inappropriate disposal methods like open burning. Particulate matter, dioxins, and furans are among the dangerous pollutants released by this process that affect the environment and seriously endanger human health, especially respiratory disorders and long-term health issues. Even though the Environment (Protection) Act of 1986, the Air (Prevention and Control of Pollution) Act of 1981, and the Solid Waste Management Rules of 2016 contain robust legislative requirements, the issue persists because of lax enforcement, ignorance, and inadequate facilities for treating garbage. Monitoring and regulating pollution is a major responsibility of regulatory organizations like the Central Pollution Control Board and State Pollution Control Boards. Strict legislative enforcement, technology advancements, and public involvement can greatly minimize garbage burning and enhance environmental protection, as demonstrated by international practices, especially in the European Union and Japan.

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