

PRIMER ON MUNICIPAL ORGANIC WASTE AND CLIMATE CHANGE



2026



Primer on Municipal Organic Waste and Climate Change

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About Chintan:

Chintan is a non-profit Circular Society Do-Tank that improves the lives, livelihoods and leadership of the people who contribute the least to environmental pollution and climate change while combating the excessive and inequitable consumption that causes it.

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01

INTRODUCTION

INTRODUCTION

Organic waste management is emerging as one of the most pressing sustainability challenges across the Asia-Pacific region. Rapid urbanisation, population growth, rising incomes, and changing consumption patterns have led to a steady increase in the generation of biodegradable waste, including food waste, fruit and vegetable residues, garden waste, and agricultural biomass. At the same time, many cities and towns continue to rely on open dumping or poorly managed landfills because of inadequate collection systems, limited processing infrastructure, weak enforcement, and insufficient public awareness. These challenges are particularly significant because organic waste constitutes the largest fraction of municipal solid waste across much of the region, presenting both a major environmental risk and a substantial opportunity for resource recovery through composting, bimethanation, and other circular economy approaches.

The Asia-Pacific region is home to more than half of the world's urban population and includes many of the fastest-growing cities globally. As urban centres expand, the quantity of municipal solid waste continues to rise, placing increasing pressure on local governments and waste management systems. In many low- and middle-income countries across South Asia, Southeast Asia, and the Pacific, biodegradable waste accounts for between 50 and 70 per cent of municipal solid waste, yet much of it remains unsegregated and is ultimately disposed of in open dumpsites or landfills. Under these conditions, organic waste decomposes anaerobically, releasing methane, a greenhouse gas significantly more potent than carbon dioxide over the short term. Poorly managed organic waste also contributes to landfill fires, air pollution, groundwater contamination, and the spread of disease vectors, making it a growing public health and climate concern across the region.

**170,000
tonnes/day**

Municipal solid waste
generated in India

**31+ million
tonnes/year**

Organic waste generated
in India

50%+

of India's municipal waste
is organic

Although these challenges are shared across the Asia-Pacific region, their scale and manifestation differ depending on national policies, institutional capacity, and levels of urban development. Countries such as India, Indonesia, the Philippines, Bangladesh, Nepal, and Sri Lanka are increasingly promoting source segregation, decentralised composting, bimethanation, and community-based waste management to reduce methane emissions and recover valuable resources from organic waste. However, significant gaps remain in imp-

lementation, financing, market development, and citizen participation.

India illustrates both the scale of the challenge and the urgency for action. According to the Union Ministry of Environment, Forest and Climate Change, India generates close to 170,000 tonnes of municipal solid waste each day, of which more than half is organic, amounting to over 31 million tonnes annually. Similar patterns are observed across many countries in South and Southeast Asia, where organic waste forms the largest component of municipal waste streams. This primer therefore uses India as its primary case study while drawing lessons and recommendations that are relevant across the wider Asia-Pacific region.

Organic waste, also referred to as biodegradable or wet waste, originates from living matter and includes leftover food, fruit and vegetable peels, dry leaves, crop residues, cattle dung, and eggshells. While biodegradable by nature, improper management of organic waste poses significant environmental and public health risks, including methane emissions, leachate contamination, foul odour, landfill fires, and the spread of vector-borne diseases.

Several factors make organic waste management a more daunting and underestimated challenge than is commonly acknowledged across the Asia-Pacific region:

- False perception of low risk due to the biodegradable nature of organic waste. Because organic waste naturally decomposes, it is often assumed to be harmless and capable of safely breaking down without intervention. However, when it is mixed with other waste and disposed of in open dumpsites or landfills, it decomposes in the absence of oxygen, releasing methane, a potent greenhouse gas, while also generating leachate, foul odours, and conditions that attract disease vectors. These impacts are less visible than those associated with plastic waste, leading to a widespread underestimation of the environmental, climate, and public health risks posed by poorly managed organic waste.
- Rapid urbanisation and changing consumption patterns, resulting in increasing volumes of organic waste that municipal systems struggle to manage effectively.
- High proportion of organic waste in municipal solid waste streams, typically accounting for 40–60% of total waste, amplifying the consequences of poor management.
- Limited applicability of recycling-centric approaches, which dominate policy and public discourse but are largely irrelevant for biodegradable waste.
- Absence of viable and scalable economic models that incentivise segregation, collection, and processing of organic waste, unlike non-biodegradable waste streams.
- Low awareness of climate and health linkages, despite well-established scientific evidence connecting organic waste to methane emissions, air pollution, and public health risks.

An additional and often overlooked dimension of organic waste management in the Asia-Pacific region is the role of the informal waste workforce. Millions of waste pickers and sanit-

INTRODUCTION

ation workers provide essential environmental services, yet continue to face unsafe working conditions, social marginalisation, and limited access to social protection. Addressing organic waste management therefore represents an opportunity not only to reduce emissions and improve public health, but also to advance environmental justice and inclusive urban development.

Awareness is a necessary precursor to action, particularly for enabling source segregation of waste, which is foundational to effective organic waste management. However, awareness alone is insufficient. Sustainable solutions require enabling policies, institutional systems, and adequate infrastructure. Across the Asia-Pacific region, strategies such as composting and bio-methanation are increasingly promoted as viable pathways to convert organic waste into useful outputs such as nutrient-rich manure and biogas. The next section examines these pathways in detail and assesses how effectively they address the environmental, health, climate, and social challenges outlined above.

02

**PATHWAYS
FOR ORGANIC
WASTE IN
INDIA**

Organic waste in India is managed through multiple processing pathways, ranging from established biological treatment methods to emerging circular economy models. These pathways vary in scale, formality, and effectiveness, and are implemented across urban and rural contexts with differing levels of success. While the technical options for processing organic waste are well understood, systemic challenges related to segregation, collection, economics, and governance continue to limit their overall impact.

Broadly, the primary pathways for organic waste management in India include composting, bio-methanation, diversion to animal feed and rendering, and a set of emerging circular economy, oriented interventions.

A. Waste to Compost

Composting is one of the most widely adopted pathways for organic waste management in India. It involves the controlled biological decomposition of organic materials by micro-organisms in the presence of oxygen, making it an aerobic process. The primary input is segregated organic waste, and the output is compost—a nutrient-rich soil amendment that improves soil structure, fertility, and moisture retention.

Composting is implemented at multiple scales, including household-level devices, community composting units, decentralised facilities in institutions and markets, and large centralised plants operated by urban local bodies or private operators. When properly managed, composting reduces the volume of waste sent to landfills, avoids methane generation, and returns nutrients to the soil. However, the effectiveness of composting systems is highly dependent on the quality of source segregation and the presence of markets for compost. Poorly segregated waste often results in contaminated compost, limiting its agricultural usability and economic value.

B. Bio-methanation (Anaerobic Digestion)

Bio-methanation is a biological process in which micro-organisms break down organic waste in the absence of oxygen, making it an anaerobic treatment pathway. This process produces two main outputs: biogas and digestate.

Biogas is primarily composed of methane (approximately 50–75%) and carbon dioxide (25–50%). It can be used directly as a cooking fuel, for heating, lighting, or electricity generation. With further purification and compression, biogas can be upgraded to Compressed Biogas (CBG), commonly known as Bio-CNG, which contains more than 90 per cent methane and has properties similar to compressed natural gas (CNG). Bio-CNG can be used as a renewable

transport fuel and can also be supplied through existing natural gas infrastructure, reducing dependence on fossil fuels. As a result, biomethanation contributes not only to sustainable organic waste management but also to renewable energy generation, clean transportation, and energy security.

The second output, digestate—also referred to as slurry—is a nutrient-rich by-product that can be cured and dried for use as organic manure. When appropriately managed, digestate supports soil health and reduces dependence on chemical fertilisers.

Despite its climate and energy benefits, bio-methanation remains underutilised relative to its potential. High capital costs, operational complexity, and inconsistent feedstock quality often limit plant performance, particularly when waste is poorly segregated.

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AN EXAMPLE OF BIOMETHANATION IN ACTION

New Delhi Municipal Council (NDMC) set up an organic waste treatment facility in Laxmi Bai Nagar, New Delhi. NDMC provides close to 500 kg of organic waste daily to the facility. The biogas produced at the facility is supplied to the nearby Indira Niketan Girls hostel for using as cooking fuel in the kitchen. The digested slurry is taken by NDMC and as manure by the horticulture department of NDMC.

AN EXAMPLE OF COMPRESSED BIOGAS (CBG) PLANT IN ACTION

A 100 tonnes per day municipal solid waste (TPD MSW) to compressed biogas (CBG) plant has been set up at Ghogha Dairy, Delhi. The plant is equipped to convert the input of 100 TPD MSW daily into:

- A. 4 tonnes of CBG per day
- B. 15 tonnes of solid manure
- C. 50 kiloliters of liquid manure

C. Animal Feed and Rendering

In several parts of the country, food waste from markets, hotels, and households is diverted for use as animal feed, particularly for pigs and cattle. Similarly, rendering plants process organic waste from slaughterhouses, meat shops, and fisheries into by-products such as tallow, meat meal, and bone meal, which are used in animal feed, soaps, and industrial applications.

These pathways contribute to waste reduction and nutrient recovery and are aligned with circular economy principles. However, they often operate informally or with limited regulatory oversight. Inadequate hygiene standards, improper handling, and environmental contamination pose risks to public health and ecosystems. Strengthening regulation, monitoring, and integration with formal waste management systems is essential to ensure that these pathways remain safe and sustainable.

D. Emerging Circular Economy Models

In recent years, a range of innovative interventions has emerged to address organic waste management through decentralised and circular economy-oriented approaches. These include:

- Black Soldier Fly (BSF) composting, which uses larvae to rapidly convert food waste into high-protein animal feed and organic fertiliser.
- Biochar production from agricultural residues and organic waste, offering benefits such as soil enhancement, improved water retention, and long-term carbon sequestration.
- Smart composters and IoT-enabled systems deployed in urban institutions, commercial establishments, and residential complexes for real-time monitoring of waste generation and processing.

While these models demonstrate strong potential, their adoption remains limited. Challenges include high upfront costs, lack of standardised regulations, limited access to finance, and weak integration with municipal waste management systems.

Persistent Gaps and Systemic Challenges

Despite the availability of multiple processing pathways and significant installed processing capacity across the country, a large proportion of organic waste continues to end up in landfills and dumpsites. In major urban centres, including the national capital, more than half of the waste disposed of daily at landfills is estimated to be organic in nature.

Several factors contribute to this disconnect between available processing options and actual

outcomes. Source segregation remains uneven, with biodegradable and non-biodegradable waste frequently mixed at the household and commercial levels. Collection systems are inconsistent, and organic waste often reaches processing facilities in a degraded or contaminated form. Economic incentives for organic waste processing are relatively weak compared to those for non-biodegradable materials such as plastics and metals. Finally, limited public awareness and behavioural change reduce accountability and demand for improved systems.

As a result, mismanaged organic waste continues to drive methane emissions, air pollution, and public health risks. Addressing these gaps requires not only technological solutions, but also strong policy frameworks, economic instruments, institutional coordination, and sustained citizen engagement—elements that are explored in subsequent sections.

03

ORGANICS WASTE AND CLIMATE CHANGE

As per the guidelines of Swachh Bharat Mission 2.0, only the inert and process rejects – in no case to exceed 20 percent of the total waste – which are not suitable for either biodegradable or non-biodegradable waste treatment, can be sent to landfill sites¹.

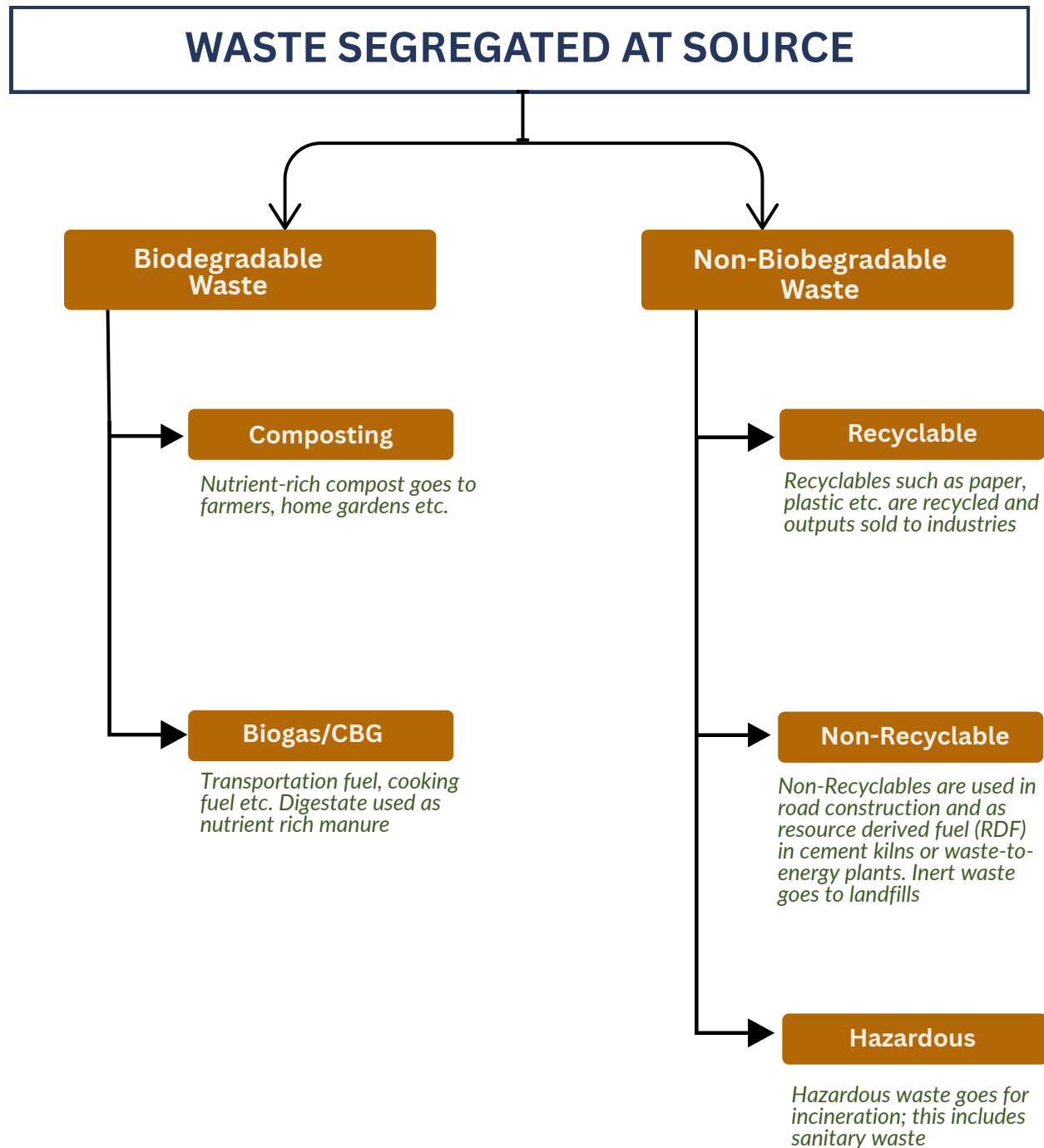


Figure 1: Management of Municipal Solid Waste (MSW)

1. Biswas, A., Parida, S., & others. (2021). *Waste-wise cities: Best practices in municipal solid waste management*. Centre for Science and Environment & NITI Aayog.

But as data and ground observations suggest, this is not what happens. Absence of source segregation of waste is the primary driver of non-compliance. Mixed waste, which includes organic waste as well as non-biodegradable waste, reaches the landfills. When waste is dumped repeatedly in landfills, compact layers of waste are formed. Oxygen is unable to penetrate deep into these layers where, in the absence of oxygen, microbes decompose the organic waste anaerobically.

The primary output of anaerobic decomposition is methane (CH₄) gas. Note that methane is also produced in biogas plants via anaerobic decomposition of organic waste, but in that scenario, it is a controlled process that captures methane and other gases to produce useful products. But in landfills, methane is released into the environment.

According to India's Fourth Biennial Update Report (BUR-4)², submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 30 December 2024, India's greenhouse gas inventory for 2020 shows that methane accounted for 13.32 per cent of the country's total greenhouse gas emissions (excluding Land Use, Land-Use Change and Forestry (LULUCF)). The waste sector contributed approximately 76 million tonnes of carbon dioxide equivalent (MtCO₂e), representing 2.56 per cent of India's total greenhouse gas emissions. Emissions from the waste sector include both solid waste disposal and wastewater treatment and discharge. While wastewater remains the larger source of methane emissions within the waste sector, methane released from decomposing organic waste in landfills and dumpsites represents a significant and growing urban climate challenge, highlighting the importance of diverting organic waste away from disposal sites through source segregation and scientific processing.

According to a 2026 satellite-based analysis by the STOP Methane Project at the University of California, Los Angeles (UCLA), using Carbon Mapper satellite data, India hosts two of the world's 25 largest methane-emitting landfill sites: Jawahar Nagar (Secunderabad, Telangana) and Kanjurmarg (Mumbai, Maharashtra). The study analysed 2,994 methane plumes from 707 waste sites worldwide and identified these landfills as major global methane hotspots, underscoring the significant climate impact of poorly managed organic waste disposal. The findings reinforce the urgent need for source segregation, diversion of organic waste from landfills, and scientific treatment of biodegradable waste to reduce methane emissions³.

2. Ministry of Environment, Forest and Climate Change. (2023, July 24). *Measures to reduce methane emissions*. Press Information Bureau, Government of India. <https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1942106>

3. Roy, P. (2026, April 22). *Satellite data shows Secunderabad and Mumbai among world's biggest methane-emitting landfill sites in 2025*. Down To Earth. <https://www.downtoearth.org.in/waste/satellite-data-shows-secunderabad-and-mumbai-among-worlds-biggest-methane-emitting-landfill-sites-in-2025>

Methane is normally present in the Earth's atmosphere only in trace amounts—approximately 0.0002 per cent by volume. However, at a typical unmanaged dumpsite or landfill in India, methane concentrations can range from 3 to 15 per cent by volume, representing an increase of several thousand times over normal atmospheric levels. This is particularly significant because methane becomes highly flammable at concentrations between 5 and 15 per cent in air, creating conditions that can trigger spontaneous landfill fires while simultaneously releasing a powerful greenhouse gas into the atmosphere. The stark contrast between atmospheric and landfill methane concentrations illustrates how poorly managed organic waste transforms a naturally occurring trace gas into a major environmental, climate, and public health hazard⁴.

METHANE

The conversation around methane released from organic waste is critical for many reasons.

- A highly flammable gas that causes fires easily
- A highly potent greenhouse gas that traps heat and contributes to global warming and thus climate change
- Is released due to anaerobic decomposition of organic waste, including at unscientific landfill that create ideal conditions for such release of methane
- Is both a key driver of landfill fires and is emitted in a greater quantity during landfill fires due to multiple reasons. A) Some methane escapes unburned during landfill fires, and B) Fire destabilizes waste layers that unleashes trapped methane in large quantities as opposed to slow release over time.

3.1 Methane emission from landfills

Methane is a highly flammable gas. When methane is formed in the compact layers of landfills, it slowly moves through the layers and accumulates. Upon coming into contact with oxygen, typically near the surface, it catches fire. The ignition for the fire comes from heat generated within the landfill, such as from microbial activity, external sources such as high temperatures, cigarettes etc., or both. While non-biodegradable waste does not emit methane, its presence in the mixed waste at landfills aids landfill fires by acting as hot load.

4. Carrington, D., & Clarke, S. (2024, February 12). *Revealed: the 1,200 big methane leaks from waste dumps trashing the planet*. The Guardian. https://www.theguardian.com/environment/2024/feb/12/revealed-the-1200-big-methane-leaks-from-waste-dumps-trashing-the-planet?utm_source=chatgpt.com

Wastes such as plastics, textiles, paper etc. easily catch fire and sustain fire for days and weeks.

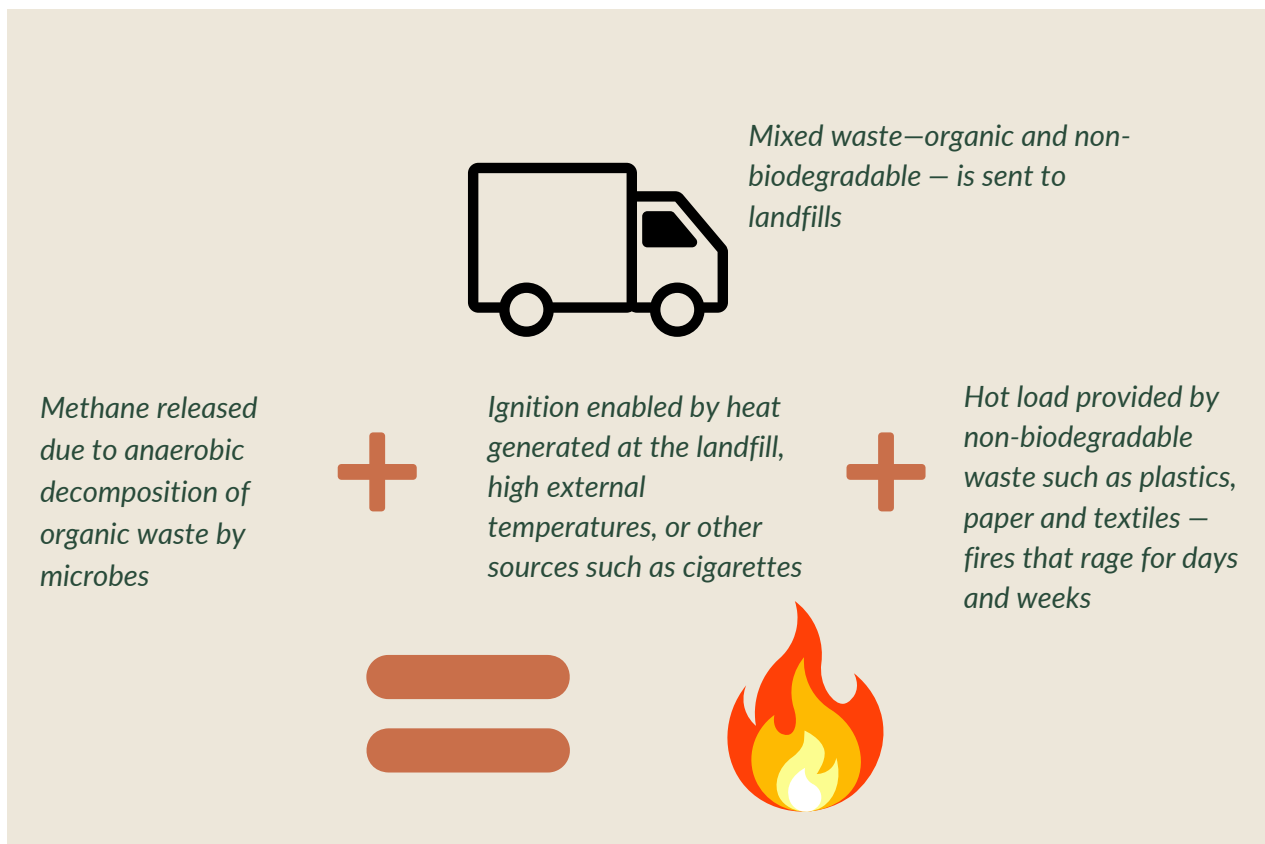


Figure 2: Methane and landfill fires

According to the data submitted by the Delhi Fire Services to a joint committee constituted by the National Green Tribunal (NGT) in 2022, there were 76 fire calls from Delhi's three landfill sites between 2018 and 2022⁵. In 2023, the fire at Brahmapuram waste management plant in the city of Kochi raged for 12 to 13 days before it was brought under control⁶. India's more than 3000 dumpsites provide a dangerous scale to this deadly hazard. All except a few of these are unscientific sites. The national capital received its first engineered/scientific landfill at Tehkhand in southeast Delhi only in 2024, supplementing the three existing traditional landfill sites. Scientific, engineered, or sanitary landfill refers to scientifically designed and operated sites where measures are in place to prevent seeping of leachate into groundwater or soil and to capture released methane, among other things.

5. Express News Service. (2022, August 2). 76 fire calls from Delhi's three landfills in four years, DFS recommends underground water tanks, pumps at sites. The Indian Express. <https://indianexpress.com/article/cities/delhi/76-fire-calls-from-delhis-three-landfills-in-four-years-dfs-recommends-underground-water-tanks-pumps-at-sites-8064974/>

6. Shaji, K. A. (2023, March 14). Kochi: Brahmapuram fire exposes outdated waste management practices in Kerala cities. Down To Earth. https://www.downtoearth.org.in/waste/kochi-brahmapuram-fire-exposes-outdated-waste-management-practices-in-kerala-cities-88214?utm_source=chatgpt.com

However, landfill fires linked to methane generation and the accumulation of mixed waste are not unique to India. Similar incidents continue to occur across the Asia-Pacific region, highlighting the widespread risks associated with poorly managed organic waste. In Indonesia, large landfill fires have repeatedly affected major waste disposal sites, including the Jatiwaringin landfill near Jakarta in 2026, where a fire burned for more than a week, forcing the evacuation of nearby communities and exposing thousands of residents to hazardous smoke. The incident renewed concerns over landfill methane emissions, inadequate waste segregation, and the continued reliance on open dumping. Likewise, the Bantar Gebang landfill, one of the world's largest waste disposal sites, has been identified as one of the world's largest methane emitters, prompting Indonesia to accelerate reforms aimed at ending open dumping and improving methane management. In the Philippines, major landfill fires, including the 2026 Navotas Sanitary Landfill fire in Metro Manila, have highlighted how methane accumulation, inadequate landfill gas management, and poor operational practices can trigger prolonged fires and severe air pollution. Together, these incidents demonstrate that landfill fires are a regional challenge requiring improved source segregation, scientific landfilling, methane capture systems, and diversion of organic waste through composting and biomethanation.

These incidents underline a broader systemic issue: the continued reliance on open dumpsites and poorly managed landfills across rapidly urbanising regions. Scientific, engineered, or sanitary landfills—designed to prevent leachate contamination and capture landfill gas—remain limited in number across many low- and middle-income countries. In their absence, uncontrolled methane emissions and landfill fires pose serious risks to climate mitigation efforts, urban air quality, and public health, reinforcing the urgency of diverting organic waste away from landfills through effective segregation and processing.

CASE STUDY • KOCHI, KERALA

From Waste Crisis to Circular Economy — the Brahmapuram Transformation

Background — In March 2023, a massive fire broke out at the Brahmapuram Solid Waste Management Facility in Kochi. The fire burned for nearly two weeks, severely affecting air quality and exposing long-standing deficiencies in the city's waste management system, linked to accumulated mixed legacy waste and inadequate source segregation.

Intervention — Following the fire, Brahmapuram became the focus of one of India's most significant waste management reform initiatives: biomining of legacy waste; a Compressed Biogas (Bio-CNG) plant commissioned by BPCL in February 2026 processing 150 tonnes of source-segregated biodegradable waste per day; a large-scale Black Soldier Fly facility processing food waste into compost and insect biomass, with compost exported internationally by 2025; and an integrated approach combining decentralised processing, composting, and leachate management.

Lessons — Waste management crises can become catalysts for long-term systemic reform. Biomining of legacy waste can significantly reduce methane emissions, reclaim land, and minimise the risk of recurring fires. Integrating technologies such as Bio-CNG, BSF processing, composting, and decentralised waste management creates a resilient, diversified system. Scientific infrastructure alone is insufficient — sustained source segregation, institutional coordination, and continuous investment are essential to prevent future waste crises.

3.2 Landfills and Air Pollution

Besides the obvious risk of fire related burns and injuries to those living and working in the backdrop of the landfills, air pollution caused by landfill fires increases the geographical scope of the impact of landfill fires. Air pollution is not limited by Ward or District boundaries – a landfill fire in one Ward generates air pollution that spreads to effect entire cities and towns. Moreover, India is a densely populated country with population centres in close proximity to these fire sources. The impact is thus compounded.

The burning releases several pollutants, one of the most dangerous being particulate matter (PM), especially PM_{2.5} – these are extremely fine particulate matter that are 2.5 micrometres or smaller in diameter. Their small size allows them to be inhaled deep into the lungs and enter the bloodstream. One research estimated that PM_{2.5} emissions from waste combustion results in 270,000 premature adult mortalities globally. Additionally, health impacts associated with increased exposure to PM_{2.5} are likely to become aggravated when landfill fires occur close to densely populated areas such as cities in India. These health impacts include lung cancer, asthma, and chronic obstructive pulmonary disease⁷.

7. Kodros, J. K., Wiedinmyer, C., Ford, B., Cucinotta, R., Gan, R., Magzamen, S., & Pierce, J. R. (2016, December 12). *Global burden of mortalities due to chronic exposure to ambient PM_{2.5} from open combustion of domestic waste*. *Environmental Research Letters*, 11(12), Article 124022. <https://doi.org/10.1088/1748-9326/11/12/124022>

Methane is one of the most important Short-Lived Climate Pollutants (SLCPs), a group of pollutants that includes methane, black carbon, and ground-level (tropospheric) ozone. Although SLCPs remain in the atmosphere for a much shorter period than carbon dioxide, from a few days to about a decade, they have disproportionately high warming potential and are responsible for substantial health impacts. Methane is particularly significant because, besides being a potent greenhouse gas, it reacts with other pollutants in the presence of sunlight to form ground-level ozone. According to the World Health Organization (WHO), exposure to ground-level ozone contributes to respiratory diseases, reduced lung function, aggravated asthma, chronic obstructive pulmonary disease (COPD), and premature mortality. WHO further notes that reducing emissions of SLCPs can simultaneously improve air quality, reduce disease burden, and slow the rate of near-term climate change, making methane mitigation one of the most effective strategies for achieving both climate and public health benefits.

These incidents underline a broader systemic issue: the continued reliance on open dumpsites and poorly managed landfills across rapidly urbanising regions. Scientific, engineered, or sanitary landfills—designed to prevent leachate contamination and capture landfill gas—remain limited in number across many low- and middle-income countries. In their absence, uncontrolled methane emissions and landfill fires pose serious risks to climate mitigation efforts, urban air quality, and public health, reinforcing the urgency of diverting organic waste away from landfills through effective segregation and processing.

Black carbon, a component of fine particulate matter (PM_{2.5}) which is released during the incomplete burning of organic waste (in addition to during incomplete burning of fossil fuels), is a significant contributor to the accelerated melting of glaciers in critical regions such as the Himalayas. When deposited on snow and ice surfaces, black carbon reduces their reflectivity, causing them to absorb more solar radiation and melt at an increased rate. A recent study from 2025 revealed that the average snow surface temperatures in the Himalayan snow peaks rose by more than 4°C over the last two decades. This increase in temperature has led to accelerated glacier melting, particularly in the Eastern and Central Himalayas⁸.

While the exact composition of air pollutants released depend upon factors such as contents, age, and design of the landfill, carbon monoxide (CO), carbon dioxide (CO₂), sulphur oxides (SOX), nitrogen oxides (NO_x), particulate matters (PM), volatile organic compounds (VOCs) and persistent organic pollutants (POPs) are some other harmful pollutants that have been known to be released during the landfill fires. NO_x and VOCs react in the presence of sunlight to form a secondary pollutant, surface-level ozone (O₃) that is known to impact the

8. Climate Trends. (2025, May 31). Impact of Black Carbon on Himalayan glaciers: A 23-year trends analysis. The New Indian Express. <https://www.newindianexpress.com/nation/2025/May/31/fossil-fuels-induced-black-carbon-melt-himalayan-snows-says-study>

respiratory tract. PM, O₃, SOX, and NOX have the potential to damage the human cardiovascular and respiratory systems. Analysis of the air quality impact of landfill fire at Brahmapuram Municipal Solid Waste Treatment Plant in Kochi, India revealed that it released significant quantities of particulate matter (PM₁₀ and PM_{2.5}), carbon monoxide (CO), sulphur oxides (SOX), nitrogen oxides (NOX), carbon dioxide (CO₂), methane (CH₄), and volatile organic compounds (VOCs)⁹.

These emissions severely degraded local air quality, with high concentrations of fine particulates and toxic gases posing serious respiratory and cardiovascular risks to nearby residents. In addition, methane and carbon dioxide are potent greenhouse gases that contribute to global warming, linking the incident not only to acute air pollution but also to long-term climate impacts. As per the State of Global Air 2024 report, published in June 2024 by the Health Effects Institute (HEI) in partnership with UNICEF, an estimated 2.1 million people in India died in 2021 due to air pollution, making it one of the leading risk factors for mortality in the country. The Brahmapuram incident, along with many similar events across the country, thus underscores the broader public health crisis linked to poor air quality, highlighting that the urgency of mitigating air pollution cannot be overstated.

It must be noted that landfill fires are not the only source of combustion of waste. Burning of waste in piles, whether for warming oneself in the winters of northern India or for simply disposing of waste is a widespread practice despite law prohibiting it. In Delhi alone burning of garbage releases 5300 tonnes of PM₁₀ and 7550 tonnes of PM_{2.5} annually¹⁰.

Moreover, direct impact on human health is just one of the many impacts of air pollution. Damage to biodiversity, such as due to acid rains caused by sulphur dioxide and nitrogen oxides in the atmosphere, corrosion and other damage to buildings and materials, and cultural and economic impact are far reaching.

Even when landfills and dumpsites are not on fire, they continue to release air pollutants into the atmosphere via decomposition of organic waste. Some major ones and their impacts are listed below:

9. Kannankai, M. P., & Devipriya, S. P. (2024). *Air quality impacts of landfill fires: A case study from the Brahmapuram Municipal Solid Waste Treatment Plant in Kochi, India*. *Science of the Total Environment*, 916, 170289. <https://doi.org/10.1016/j.scitotenv.2024.170289>

10. Gurjar, B. R. (2021, April 5). *Air pollution in India: Major issues and challenges*. TERI. <https://www.teriin.org/article/air-pollution-india-major-issues-and-challenges>

Air Pollutant	Impact
Methane	Not only a potent greenhouse gas but also a major source of air pollution. Reacts with other pollutants in sunlight to form ground-level (tropospheric) ozone, correlated with cardiovascular disease, asthma, respiratory illness, and premature death.
Carbon Dioxide	The most abundant greenhouse gas; contributes to ground-level ozone formation. Rising CO ₂ levels are estimated to reduce zinc, iron and protein content of wheat and rice by up to 10% by 2050.
Ammonia	Causes irritation in eyes, nose and throat, headache, and nausea. Higher concentrations can cause severe damage to the respiratory tract and lungs.
Hydrogen Sulphide	A foul-smelling gas resembling rotten eggs. Low concentrations cause eye, nose and throat irritation, headaches, nausea and dizziness; higher concentrations can cause pulmonary edema, loss of consciousness, and nerve damage.
Volatile Organic Compounds (VOCs)	Cause eye and throat irritation, headaches, nausea, dizziness, and respiratory challenges.

3.3 Landfills, Health and Safety

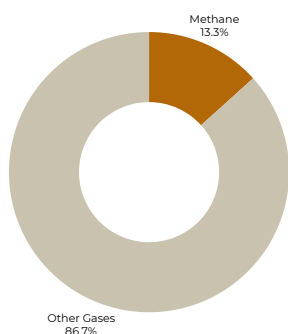
Global warming refers to the increase in the planet's overall average temperature. The primary driver for this rise in temperature is the release of certain gases known as greenhouse gases (GHGs) that trap heat and thereby increase the temperature. Carbon dioxide is the most abundantly found greenhouse gas in the atmosphere, but methane is approximately 27 times more potent at trapping heat than carbon dioxide when measured over a 100-year period. When measured over shorter periods, the potency of methane is even higher.

GLOBAL WARMING POTENTIAL (GWP)

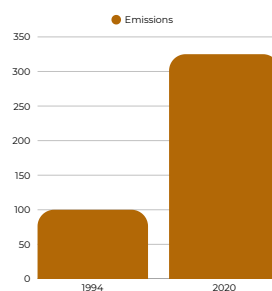
GWP is the measure that compares the warming potential of a gas with carbon dioxide's warming potential since it is the most abundant of greenhouse gases. The quantities of all greenhouse gases released is expressed in terms of carbon dioxide equivalent (CO₂e).

As per the Intergovernmental Panel on Climate Change's Sixth Assessment Report, the Global Warming Potential (GWP) of methane is close to 27 times that of carbon dioxide over a 100-year period. Methane is relatively short-lived—it lasts for close to 12 years in the atmosphere. While carbon dioxide lasts for hundreds of years.

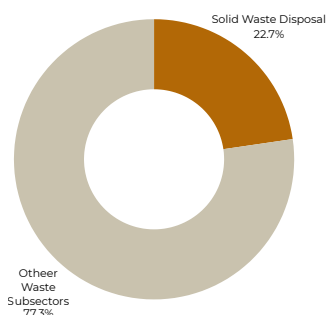
As per India's Fourth Annual Update Report to the UNFCCC, India's total GHG emissions, excluding Land Use Land-Use Change and Forestry (LULUCF), were 2,959 million tonnes of CO₂e. Methane constituted 13.32% of these emissions¹¹. The waste sector contributes approximately 76 million tonnes of carbon dioxide equivalent (MtCO₂e) emissions and has become one of the fastest-growing segments in India's GHG inventory. The sector grew by 226% from 1994 to 2020 due to population growth, rapid urbanisation, and increased industrial activities. In 2019, the sector contributed 2.34% to total greenhouse gas emissions, 22.69% of which came from solid waste disposal¹².



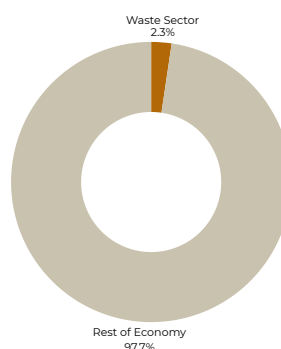
Methane's share of total GHG Emissions (2020)



Waste sector emissions, indexed – up 226%



Waste Sector Composition, 2019



Waste sector's share of total national GHG (2019)

11. Ministry of Environment, Forest and Climate Change, Government of India. (2024, December 30). *India: Fourth Biennial Update Report to the United Nations Framework Convention on Climate Change (BUR-4)* [PDF]. <https://unfccc.int/sites/default/files/resource/India%20BUR-4.pdf>

12. National Institute of Urban Affairs. India's Fourth Biennial Update Report (BUR-4): *Focus on GHG emissions & solid waste management*. NIUA. <https://niua.in/blogs/india-fourth-biennial-update-report-bur-4-focus-ghg-emissions-solid-waste-management>

The intricately interwoven ecosystems manifest climate change in the form of more frequent and extreme weather events such as heat waves, floods, droughts, wildfires, and storms, to name a few. Indiscriminate construction to satiate the demand of a growing population and associated damage to the ecological systems is exacerbating the impact of the extreme weather events.

3.4 Climate Change, Health and Safety

The connection between mismanaged organic waste and risk to human health and safety is apparent and grave.

Climate change driven extreme weather events led to 495,000 human deaths across the world in 1999-2018¹³. India is no exception. In fact, India is one of the most vulnerable. As per the Climate Risk Index (CRI), released at the 25th Conference of Parties (COP25), India ranked fifth in terms of climate vulnerability in 2018.

More than 75 per cent of Indian districts are extreme climate event hotspots. According to the National Disaster Management Authority (NDMA), the 2018 floods affected an area equal to the size of the state of Punjab. Rapid urbanization and change in land use has exacerbated the intensity and impact of these floods. Pre-2005, cyclones would on an annual average basis, affect eight districts in India. Post-2005, the number of districts has increased to twenty-eight¹⁴.

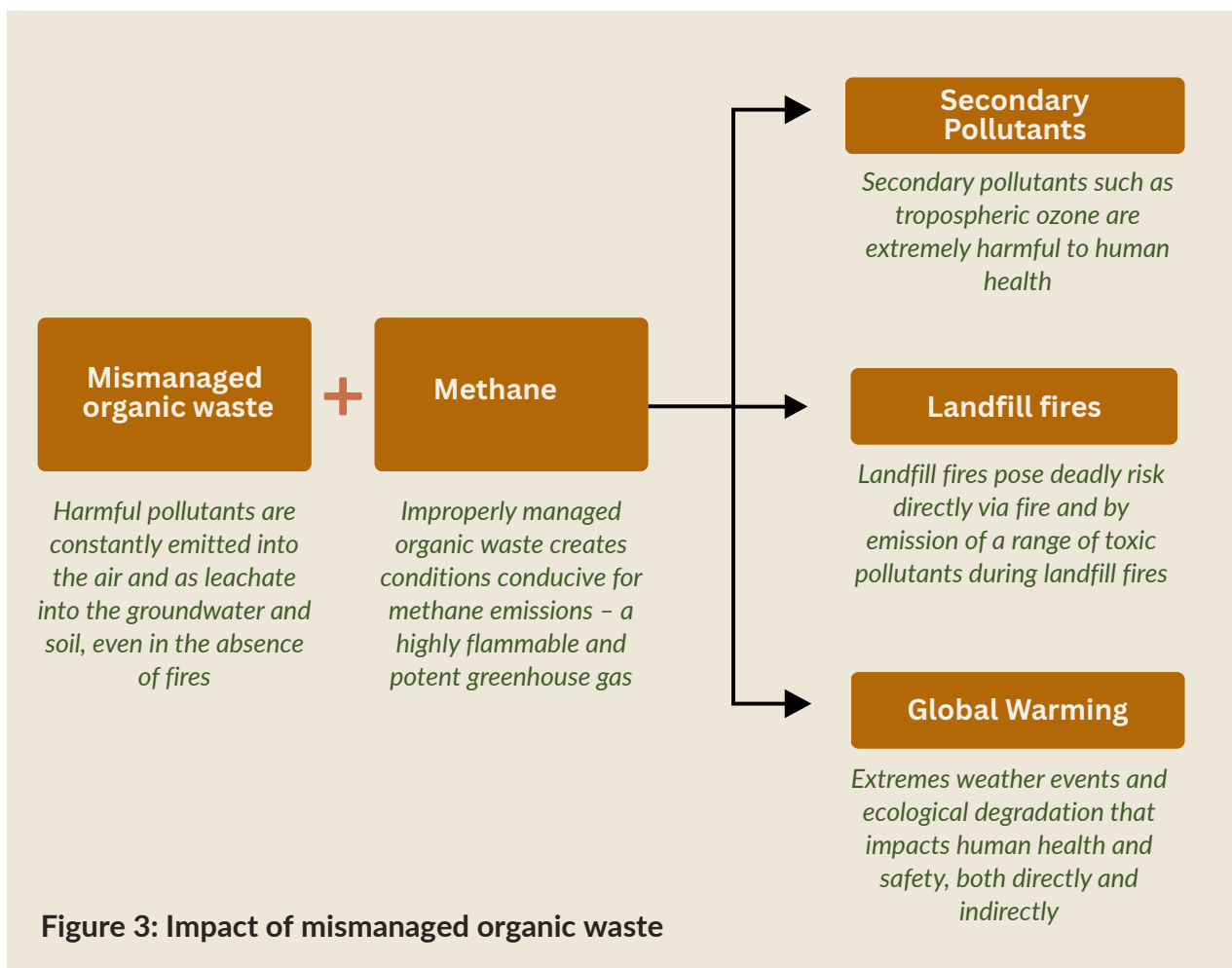
India experienced over 280 heatwave days across 16 Indian states from March 11 to May 18, 2022¹⁵. This particularly impacts the homeless, outdoor workers, and other vulnerable populations and results in deaths, productivity loss, and strains critical infrastructure such as healthcare and electricity grids. According to The Lancet Countdown on Health and Climate Change, there has been a 55 per cent increase in heat related deaths in India when comparing 2000–2004 data with that from 2017 – 2021.

In 2025, India faced an unprecedented combination of heatwaves and floods, highlighting the escalating impacts of climate change. According to a report by HeatWatch titled Struck by Heat: A News Analysis of Heatstroke Deaths in India, at least 84 heatstroke deaths were recorded across the country between February and July 2025. Simultaneously, extreme

13. Council on Energy, Environment and Water (CEEW). (2020, December 10). Preparing India for extreme climate events: Mapping hotspots and response mechanisms [PDF]. https://www.ceew.in/sites/default/files/CEEW-Preparing-India-for-extreme-climate-events_10Dec20.pdf.

14. *ibid*

15. Bhadwal, S., & Venkatramana, K. (2025, April 30). *Burning Point: Increasing heatwaves threaten lives across India*. TERI. <https://www.teriin.org/article/burning-point-increasing-heatwaves-threaten-lives-across-india>



rainfall events triggered devastating floods in various regions. According to India Meteorological Department (IMD), based on data from media reports, floods and heavy rains in the monsoon season in 2025 resulted in 935 deaths.

Population displacement, migration for employment, disease outbreaks – the impact of these catastrophic climate change driven events are far reaching. While it can be argued that most greenhouse gases' mitigation efforts are complex and difficult to actualize for individuals and common citizens, methane emissions from organic waste are very much controllable and within the influence zone of common citizens. Individual action, local collective steps, supported by government policies can turn the hazard of organic waste into a quick win opportunity.

04

**INFORMAL
SECTOR
INTEGRATION**

The informal waste management economy in India consists of various informal actors and entities that operate across the waste value chain – from waste collection, segregation, transportation to recycling. While there is no official national-level data available, it is estimated that about 15 lakhs (1.5 million) people in India make their living as waste pickers¹⁶. While recovering, sorting, and selling recyclables forms a major source of the informal sector's income, they also collect organic waste for dumping and on rare occasions, where such infrastructure exists, to compost. In addition, when engaged as service providers, such as door-to-door waste collection, they earn nominal service fee.

Their services go beyond waste management. The quantification of the public health and environmental service provided by the informal sector is slightly more complex, but the direct correlation is hard to miss.

In the city of Pune, emission of more than 167,000 tonnes of carbon dioxide equivalent per year is prevented by the waste pickers by collecting and preventing the open burning of waste in underserved communities¹⁷. The more indirect impacts of their waste management services include enablement of ecosystem services, additional tourism revenue the cities can enjoy as tourists no longer see it as a filthy city, and ecological and economic value added by keeping materials in circulation longer.

Despite their pivotal role, the waste picker community in India has historically been marginalised and continues to face social stigma and exclusion. Many waste pickers belong to historically disadvantaged communities and have limited access to education, healthcare, social security, formal employment, and financial services, perpetuating cycles of poverty and vulnerability. Their living and working conditions, often in close proximity to dumpsites and landfills, expose them to heightened occupational risks, disease burdens, and environmental hazards.

Despite these challenges, India has emerged as a global leader in developing inclusive models that integrate waste pickers into formal waste management systems. Organisations such as Kagad Kach Patra Kashtakari Panchayat (KKPKP) and SWaCH in Pune, Hasiru Dala in Bengaluru, Stree Mukti Sanghatana (SMS) in Mumbai, and Chintan Environmental Research and Action Group in Delhi have demonstrated that waste pickers can successfully deliver door-to-door collection, source segregation, recycling, decentralised composting, and awareness programmes while securing improved livelihoods, occupational safety, and social recognition. At the national level, the Alliance of Indian Wastepickers (AIW) has played a significant role in advocating for the inclusion of waste pickers in India's Solid Waste Man-

16.. Urban Management Centre & Centre for Environment Education. (2015). *Compendium of good practices in urban solid waste management: Involving waste-pickers to improve door-to-door collection* [PDF]. SWaCH. <http://www.swachcoop.com/pdf/wastepickerstoimprovedoor-to-doorcollection.pdf> (accessed 05 June 2024)

17. Women in Informal Employment: Globalizing and Organizing (WIEGO). (2021, November). *Reducing greenhouse gas emissions through inclusive recycling: Methodology & calculator tool* [PDF]. <https://www.wiego.org/wp-content/uploads/2021/12/GHG-methodology-WIEGO.pdf>. (accessed 03 June 2024)

agement Rules and other policy frameworks. Similar movements are emerging across the Asia-Pacific region, including Samyukta Safai Jagaran (SASAJA) in Nepal, the Bangladesh Waste Pickers Union and Labour in Informal Economy (LIE) in Bangladesh, Ikatan Pemulung Indonesia (IPI) in Indonesia, and the Philippine National Waste Workers Alliance (PNWWA) in the Philippines. These organisations demonstrate that integrating informal waste workers into formal waste management systems is not only socially just but also improves resource recovery, strengthens circular economy outcomes, and enhances climate resilience.

4.1 Provisions under the law

Across the Asia-Pacific region, informal waste workers—commonly referred to as waste pickers, recyclers, or sanitation workers—play a critical role in recovering recyclable materials, reducing landfill loads, and supporting circular economy outcomes. However, their contributions have historically remained undervalued, with limited legal recognition, unsafe working conditions, and inadequate access to social protection. In recent years, several countries, including India, the Philippines, Indonesia, and Bangladesh, have begun introducing policy and legal frameworks aimed at recognising and integrating the informal waste workforce into formal solid waste management systems.

India

The Solid Waste Management Rules, 2016, with subsequent amendments till 2026, define a waste picker as *“a person or group of persons informally engaged in the collection and recovery of reusable and recyclable solid waste from the source of waste generation, streets, bins, material recovery facilities, processing and waste disposal facilities for sale to recyclers directly or through intermediaries to earn their livelihood.”*

The Rules include several progressive provisions to promote the integration of waste pickers into formal solid waste management systems, including requirements for local authorities to:

- Establish systems to **recognise organisations of waste pickers and informal waste collectors** and facilitate their participation in door-to-door waste collection and other waste management activities.
- Set up **Material Recovery Facilities (MRFs) or secondary storage facilities** with adequate space to enable sorting of recyclables and provide easy access to waste pickers and recyclers.
- Facilitate the formation of **Self-Help Groups (SHGs)**, issue **identity cards**, and encourage the integration of waste pickers into municipal waste management systems.
- Implement **registration schemes for waste pickers and waste dealers** to formalise their engagement.

INFORMAL SECTOR INTEGRATION

While implementation remains uneven across cities, these provisions provide a strong legal basis for inclusive waste governance.

In addition, the Government of India has launched the **NAMASTE (National Action for Mechanized Sanitation Ecosystem) Scheme**, which represents a significant step toward formal recognition of sanitation workers, including waste pickers. The scheme focuses on occupational safety, mechanisation of hazardous tasks, access to social security, skill development, and livelihood diversification.



Figure 4: Key aspects of the NAMASTE Scheme

Note: The NAMASTE scheme covers a broader category of sanitation workers and is not limited exclusively to informal waste pickers.

The Philippines

In the Philippines, the **Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003)** provides the primary legal framework for solid waste management. While the Act does not explicitly define “waste pickers,” it recognises the role of the informal sector in recycling and resource recovery.

Key provisions relevant to informal waste workers include:

- Promotion of **segregation at source and the establishment of Barangay-level Material Recovery Facilities (MRFs)**, which often serve as key entry points for informal recyclers.
- Encouragement of **partnerships between local government units (LGUs), cooperatives, NGOs, and informal waste workers** in waste diversion and recycling activities.
- Recognition of junk shop networks and informal recyclers as essential actors in achieving national waste diversion targets.
- In practice, several cities—such as Quezon City and Cebu—have adopted local ordinances to register waste pickers, issue identification cards, and integrate them into MRF operations. However, the absence of a nationally standardised mechanism for social protection and occupational safety remains a challenge.

Indonesia

Indonesia's **Law No. 18 of 2008 on Waste Management** and subsequent regulations provide the overarching framework for solid waste governance. The law acknowledges community participation and informal recycling activities, particularly through the widespread “**waste bank**” (**bank sampah**) system.

Key features relevant to informal waste workers include:

- Formal recognition of **community-based waste management initiatives**, including waste banks that enable households and informal collectors to exchange segregated recyclables for monetary or non-monetary benefits.
- Local government authority to **partner with informal waste collectors** for collection, sorting, and recycling activities.
- Integration of informal actors into municipal systems through cooperatives and community groups, particularly in urban areas such as Jakarta, Surabaya, and Bandung.

While waste banks have improved material recovery and livelihoods for some informal workers, gaps remain in occupational health and safety, income stability, and access to social security benefits.

Bangladesh

In Bangladesh, solid waste management is governed primarily through municipal laws and city corporation ordinances, rather than a single national solid waste law. Informal waste pickers—locally referred to as tokai—play a dominant role in recycling, particularly in cities such as Dhaka and Chattogram.

Key trends and provisions include:

- Municipal-level recognition of **informal waste pickers as essential contributors to recycling and waste reduction**, though often without formal legal status.
- Growing involvement of NGOs and development agencies in **organising waste pickers into cooperatives**, providing identity cards, protective equipment, and access to health services.
- Pilot initiatives to integrate waste pickers into **door-to-door collection and secondary sorting facilities**, particularly under donor-supported urban resilience and climate projects

Despite these efforts, informal waste workers in Bangladesh continue to face high occupational risks, social stigma, and limited access to formal labour protections, underscoring the need for stronger national policy frameworks.

Regional Observations

Across India, the Philippines, Indonesia, and Bangladesh, several common patterns emerge:

- Informal waste workers are **central to recycling and resource recovery**, yet their inclusion remains partial and uneven.
- Legal recognition often exists in principle but is **inconsistently implemented at the local level**.
- Access to **occupational safety, social protection, and stable livelihoods** remains limited.
- Successful integration is most often observed where **local governments partner with cooperatives, NGOs, and community-based organisations**.

Strengthening legal recognition, institutional integration, and social protection for informal waste workers is essential not only for environmental outcomes but also for advancing social equity and just transitions in waste management systems across the Asia-Pacific region.

05

POLICIES AND FRAMEWORKS FOR ORGANIC WASTE MANAGEMENT

The **Solid Waste Management Rules, 2026** strengthen India's transition towards a circular economy by placing greater emphasis on source segregation, decentralised processing, resource recovery, and accountability of waste generators. The Rules mandate segregation of municipal solid waste into **wet (biodegradable), dry (non-biodegradable), sanitary, and special care waste**, with source segregation recognised as the foundation for effective organic waste management. The Rules also reinforce the principle that biodegradable waste should be processed as close to its source as possible through composting, biomethanation, or other scientifically approved technologies, thereby reducing dependence on landfills and limiting methane emissions.

A significant feature of the Rules is the expansion of responsibilities for **Bulk Waste Generators (BWGs)** through the introduction of **Extended Bulk Waste Generator Responsibility (EBWGR)**. The revised definition substantially broadens the categories of establishments required to register and manage their waste. Bulk waste generators are now required to process biodegradable waste on-site or through authorised facilities, maintain records of waste management, and register through a centralised digital portal. The Rules also promote **Extended Producer Responsibility (EPR)** for organic waste by encouraging institutional arrangements that support processing, utilisation, and market linkages for compost, biogas, and other recovered resources, thereby strengthening the economic viability of organic waste management.

The Rules further recognise that effective organic waste management requires decentralised systems and inclusive governance. Urban local bodies are required to promote decentralised composting and biomethanation facilities, prepare city-level solid waste action plans, remediate legacy waste dumpsites through biomining and bioremediation, and formally integrate informal waste workers into municipal waste management systems. By combining source-level management, decentralised processing, market support for recovered products, and inclusion of the informal sector, the Rules provide a stronger policy framework for reducing methane emissions, improving resource recovery, and advancing India's circular economy objectives.

The **SATAT (Sustainable Alternative Towards Affordable Transportation)** initiative, launched by the Ministry of Petroleum and Natural Gas (MoP&NG) in **2018**, aims to establish a nationwide ecosystem for the production, procurement, and utilisation of **Compressed Biogas (CBG)**, also known as Bio-CNG, from organic waste and other biomass feedstocks. The initiative seeks to promote circular economy principles by converting municipal organic waste, agricultural residues, cattle dung, sewage, and other biodegradable feedstocks into clean transport fuel while reducing methane emissions from unmanaged organic waste. SATAT originally envisaged the establishment of **5,000 CBG plants** across the country, with a

production target of **15 million metric tonnes (MMT) of CBG annually**, equivalent to a substantial share of India's transport fuel demand. Under the scheme, public sector Oil Marketing Companies (OMCs) issue **Long-Term Letters of Intent (LoIs)** to procure CBG from entrepreneurs at assured prices, thereby providing market certainty and encouraging private investment. The initiative is complemented by financial support under the Ministry of New and Renewable Energy's Waste-to-Energy Programme, which provides Central Financial Assistance for Bio-CNG plants, along with technical support, online approval mechanisms, and incentives for project developers. Beyond renewable energy generation, SATAT supports improved organic waste management, reduces dependence on imported fossil fuels, promotes rural entrepreneurship, and contributes to India's climate and circular economy objectives¹⁸.

GOBARdhan (Galvanizing Organic Bio-Agro Resources Dhan) initiative of Government of India encompasses a wide range of schemes, programs, and policies designed to facilitate the conversion of organic waste into biogas and CBG. The Department of Drinking Water and Sanitation (DDWS), Ministry of Jal Shakti, is the nodal department for GOBARdhan¹⁹.

Global Methane Pledge (GMP) is a voluntary commitment of more than 150 countries to contribute to a collective effort to reduce global methane emissions at least 30 per cent from 2020 levels by 2030. Under it, there are six different action areas or pathways, the waste pathway being one of the six. India is not a signatory to the pledge. Participation in Global Methane Pledge could unlock technical and financial assistance to tackle methane emissions from the six pathways, including the waste pathway. It could also signal the country's leadership in climate change mitigation efforts and at the same time develop leverage in climate negotiations. However, India's position is that major methane emissions from the country are 'survival' emissions and not luxury emissions. Two major sources of methane are enteric fermentation and paddy cultivation, and these are essential for livelihood and food security. Participation in this pledge could therefore impact India's trade and economic prospect, as stated by the Ministry of Environment, Forest, and Climate Change (MoEFCC)²⁰.

India is a partnering country of the **Global Methane Initiative (GMI)** which pre-dates GMP but is primarily focused on technical cooperation, data sharing, and capacity building.

18. SATAT (*Sustainable Alternative Towards Affordable Transportation*) [Website].
<https://satat.co.in/satat/#/>

19. Government of India. GOBARdhan (*Galvanizing Organic Bio-Agro Resources Dhan*) [Web page].
<https://www.india.gov.in/spotlight/gobardhan-galvanizing-organic-bio-agro-resources-dhan>

20. Sansad (Lok Sabha). Annex: AU2970 [Parliamentary question / PDF].
<https://sansad.in/getFile/loksabhaquestions/annex/1712/AU2970.pdf>

06

CHALLENGES IN EFFECTIVE ORGANIC WASTE MANAGEMENT

Despite the presence of rules and policies to drive effective organic waste management, and thereby curb methane emissions from organic waste, illegal dumping of organic waste as mixed waste at dumpsites and landfills is rampant. Some factors enabling this mismanagement are:

A. Poor segregation at source

For each waste type to reach its intended destination, including organic waste to reach composting or bio-methanation sites, segregation of waste at source is the foundational requirement. Despite being mandated by solid waste management rules since the Municipal Solid Waste (Management and Handling) Rules, 2000, and the provision to impose penalties for not segregating, waste continues to be disposed of as mixed waste that finds its way to dumpsites and landfills.

Levels of segregation vary across cities and regions, and across urban and rural areas. According to the data presented by Ministry of State for Jal Shakti, based on a survey conducted under Swachh Survekshan Grameen (Rural) in 2023-24, only 39.9 per cent households reported segregating waste into biodegradable and non-biodegradable categories²¹. In the national capital Delhi, as reported by the Municipal Corporation of Delhi (MCD) to the Supreme Court in 2024, close to 55% of the solid waste generated in the city is being segregated at source²². As per the Swachh Survekshan Urban (2023) dashboard, in the Gurgaon district, in the Gurgaon urban local body, only 15% source segregation was observed²³. The state of Kerala have achieved close to 95% coverage of door to door waste collection and ensured 80-90% source segregation through segregated waste collection programme using Haritha Karma Sena who collects waste based on a calendar to ensure source segregation.

While the Swachh Bharat Mission, since its launch in 2014, has made significant progress toward a cleaner India, poor enforcement of source segregation by local agencies, coupled with public indifference and a lack of accountability, remains a major hurdle.

21. Press Trust of India. (2025, July 24). 95.1 % rural households have access to toilets: Govt tells Lok Sabha. Business Standard. https://www.business-standard.com/india-news/95-1-rural-households-have-access-to-toilets-govt-tells-lok-sabha-125072401302_1.html

22. Singh, P. (2024, September 24). 55 % of waste segregated at source, MCD tells SC. Hindustan Times. <https://www.hindustantimes.com/cities/delhi-news/55-of-waste-segregated-at-source-mcd-tells-sc-101727201757504.html>

23. Swachh Bharat Mission Urban. (2023). SS2023 scorecard / Swachh Survekshan 2023 [Website]. <https://ss2023.sbmurban.org/#/scorecard>

B. Knowledge gap

Knowledge is the precursor to change. But in the case of organic waste, linkages to methane, climate change, air pollution, and health are not apparent to a large section of the population. A survey to inform FAQs to be included in this primer further highlighted this knowledge gap.

The survey of 189 respondents across 3 cities in northern India – Delhi, Ayodhya, and Lucknow – revealed the following:

- When asked to rank six causes of climate change, 55 per cent of respondents ranked improper waste management as one of the bottom two causes.
- Only 16 per cent of respondents had heard the term greenhouse gas.
- Only 21 per cent of respondents believed that organic waste has some connection with climate change, and only 14 per cent of respondents believed that organic waste has some connection with methane.
- 55 per cent of respondents believed that it is best to send organic waste to landfills.
- Only 26 per cent of respondents know that methane is highly flammable and only 32 per cent of respondents know that methane traps heat.

The success of information, education, and communication (IEC) campaigns around organic waste is incumbent upon involvement of a broad set of stakeholders which includes urban local bodies, pollution control boards, non-profits, civil society organizations, educational institutions, private sector, and media to name a few. Focusing on children and youth can have an amplifying effect on the messaging as they serve as enthusiastic influencers in their households, communities, and peer groups.

C. Complexity of value chains, market links, and economic viability

Municipal Solid Waste Management Rules, 2016, require bulk waste generators, such as hotels, to process, treat, and dispose of biodegradable (organic) waste within their premises via composting or biomethanation. However, the requirement is diluted by the inclusion of the phrase “as far as possible”. The Draft Solid Waste Management Rules, 2024, expected to come into effect in the last quarter of 2025, expand the definition of what qualifies as a bulk generator and mandate on-site biodegradable waste processing.

Proven technologies in organic waste management exist and are being implemented across the country. This includes composting, biomethanation and compressed biogas plants, and black soldier fly technology. Black soldier flies’ larvae are used to convert organic waste into

larval biomass, which finds many uses including as pet feed, and frass, which is organic fertilizer used for soil amendment. India's tropical climate is well suited for BSF technology.

Recognising that weak markets for compost have been a major bottleneck to scaling organic waste management, the Solid Waste Management Rules, 2026 introduce several measures to strengthen forward market linkages. The Rules assign specific responsibilities to the Department of Fertilisers to develop and update standards for organic manure under the Fertiliser (Control) Order, promote market development assistance for city compost, and support co-marketing of organic manure. The Department of Agriculture and Farmers' Welfare is tasked with developing guidelines for the application of compost and other organic manures in agriculture, including their appropriate use alongside chemical fertilisers, while also promoting quality assurance and farmer awareness. These measures are intended to improve confidence in compost quality, create stable markets for organic manure, and enhance the economic viability of decentralised composting and biomethanation systems.

However, these technologies are yet to achieve scale, maturity, and economic viability that would result in sustainable value chains and thus effective organic waste management. Some reasons include:

- **Supply challenges:** Consistent and clean supply of organic waste is necessary for feasibility of these organic waste management solutions. Lack of source segregation, economically unviable transportation, and fluctuating quantities of input feedstock of organic waste result in frequent closures of organic waste management facilities.
- **Demand challenges:** The demand for outputs of the organic waste management solution is a work in progress. For example, organic fertilizers cannot compete against chemical fertilizers on price. Trust in quality, which could generate demand at higher price points, requires greater awareness-building and quality-assurance efforts. The variation in inputs for composting results in skepticism around the quality of compost among potential buyers.
- **Infrastructure challenges:** The capital cost for setting-up bio-methanation plants is high. Operational and maintenance costs too are substantial. While subsidy schemes exist, access is not always easy. The risks associated with supply and demand compound the difficulty in accessing financing for setting up plants.

D. High levels of food waste

As per the United Nations Environment Programme's Food Waste Index Report 2024, the estimated food wastage in India is 55 kilograms per capita per year²⁴. While this is significant-

24. *Sansad (Lok Sabha). Annex: AU2181* [Parliamentary question / PDF]. https://sansad.in/getFile/loksabhaquestions/annex/184/AU2181_Fi7cCy.pdf

ly lower than the global average of 79 kilograms per capita per year²⁴, there is an opportunity to reduce this wastage.

Traditionally, the ethos of reuse has been built into Indian eating habits as well. Whether using leftover dal (a type of lentils) to make parathas (a type of Indian bread) or transforming leftover rice to panta bhaat (leftover cooked rice soaked and fermented overnight in water) or lemon rice, eating leftover food has been an integral part of life. But changing behaviours and consumption patterns, such as greater reliance on fast food delivery, are a reality.

As with any other waste, reducing consumption and engaging in more mindful consumption that reduce wastage is the best solution. There are lessons to be learnt on the policy design front from elsewhere in the world. The first step towards such policy measures is to define what qualifies as food waste and then monitor and gather quality data around it. Reliable estimates of food waste data are currently lacking in India.

Policy measures such as 'Pay-As-You-Throw' (PAYT) policy implemented in South Korea, complete ban on food reaching landfills, and prohibition on destruction of edible food (by food distributors, wholesalers etc.) and food donation contract requirement (on food retailers etc.) in France are some examples of policy measures that could find application in India as well.

E. Lack of integration of the informal sector in organic waste management

The importance of the informal sector's role in solid waste management cannot be overstated. But the precise scope of their role, as determined by complex scenarios that are out of their control, vary from waste to waste. On one hand, biodegradable waste such as plastics provides economic potential, which therefore attracts large and many profit-seeking entities in the value chain. Although this provides the informal sector with the opportunity to generate livelihood, they do not have any bargaining power or leverage to demand better rates for the plastics they collect, sort, and transport. Nor are they fairly compensated for the service that they provide. The net result is of the poor subsidizing the richer, whether it is other citizens, urban local bodies, recyclers, or producers.

On the other hand, organic waste management value chains currently are not as mature, consistent, or on a scale comparable to non-biodegradable value chains. Therefore, livelihood generating opportunities are even fewer. Ironically, as profit-making pathways appear, pathways that would invariably be built on the pioneering work of the informal sector, other

entities will once again appear, get plugged in the value chain, and squeeze the livelihood of the informal sector.

The role and livelihood of the informal sector in organic waste management is essential not only on moral grounds but also on rational grounds. Decentralized management of organic waste is critical to reducing the pressure on our cities and landfills. Organic waste, unlike non-biodegradable waste, must be collected and processed regularly, and cannot be stored for long periods of time. Transportation of organic waste across the city for processing further adds to the carbon footprint and traffic congestion. In this context, the informal sector provides a skilled workforce that can enable organic waste management right at the source. The informal sector provides an avenue for small-scale decentralized processing of organic waste. Upskilling of the informal sector in sales and finance domain provide additional income opportunities while simultaneously opening niche markets for selling the outputs such as high-quality compost.

Reducing Methane and Empowering Wastepicker Women Through Composting

Background — In compliance with the Solid Waste Management Rules, 2016 and the Swachh Bharat Mission- Urban 2.0, Chintan creates models for waste management which are inclusive of the informal sector. The particular vulnerability of wastepicker women and the gender-based discrimination they face in accessing lucrative waste and consequent incomes is also recognized. Therefore, Chintan's approach involves generating livelihoods for wastepicker women, and organize and build leadership capacity.

Model — Under the Magic Mitti initiative, which started in 2023, six locations were identified in Delhi NCR. Partnerships were developed with local authorities and resident welfare associations to establish compost pit and convert wet waste to compost. Simultaneously, local wastepicker women were identified in these six locations and were organized as Self Help Groups (SHGs) under National Urban Livelihoods Mission. A total of 79 women are engaged in 6 SHGs under the initiative. With an aim to handhold the women to run this independently, they were trained in the following:

- Waste segregation, pit composting and packaging of compost: to develop the product.
- Sales and marketing: to sell the product and increase customer base.
- Leadership and communications: to pitch the product confidently, independently, and effectively.
- Entrepreneurship, financial and digital literacy: to financially sustain and grow this initiative independently.

As part of the initiative, the women undertake the following work:

- Door to door collection of waste from households and bulk waste generators: 7000 kgs of wet waste collected per month.

CASE STUDY 1 • DELHI NCR

- Conversion of wet waste to compost in compost pits across 6 locations over 30-45 days including managing and monitoring the facility. The compost is tested and is following the national compost standards under the Solid Waste Management Rules, 2016.
- Packaging of compost and selling across different locations in Delhi NCR via pop up stalls.
- The product is also advertised via social media with support from Chintan.

Key Results — Diversion of wet waste from the landfills which in turn reduces methane emissions, landfill fires, and air pollution.

- Compliance with the Solid Waste Management Rules, 2016 and Swachh Bharat Mission Urban 2.0 for inclusive solid waste management.
- Livelihoods and incomes of 79 wastepicker women augmented.
- Better quality of life and increased sense of agency amongst marginalized women through capacity building.
- Awareness about benefits of segregation and composting amongst public who come across the product.

Composting models in Port Blair, Andaman & Nicobar Islands

Background — Port Blair, the capital of the Andaman and Nicobar Islands, has experimented with two models of composting to manage wet waste and reduce environmental impact. Both approaches provide valuable insights into decentralized waste management and the role of market linkages in sustaining such initiatives.

Model 1- Municipality-Managed Composting — In the first model, the Port Blair Municipality composted wet waste from nearby areas - approximately 400 kilograms per day. About 2 municipal workers spent about one to one and a half hours daily managing the composting process. The compost produced was used internally by the municipality, ensuring that wet waste was processed as well as absorbed locally, without relying on external buyers.

Model 2- Women's Cooperative Composting — In the second model, a cooperative of seven women was provided space to run a composting unit independently. They priced the compost at ₹75 per kilogram. However, sales were negligible due to poor compost quality and unrealistic pricing. By 2024, only two of the seven members remained active.

A quick market assessment by Chintan revealed that compost from waste in Western and Southern India typically sells for ₹1–₹10 per kilogram, far below their price point. The women felt the effort was not worthwhile given the low potential earnings.

Key Insights —

- Economic sustainability is a critical barrier for decentralized composting initiatives that rely on weak or absent markets.
- Municipality-led composting—using trained staff and absorbing compost internally—can ensure consistent processing of wet waste without dependence on uncertain market dynamics.
- Market development for compost must go hand in hand with capacity-building and technical support to improve compost quality and profitability.

CASE STUDY 2 ANDAMAN & NICOBAR

In regions like the Andamans, where landfills are bio-mined and waste dumping is limited, municipal responsibility for composting becomes even more essential to prevent further wet waste in newer landfills, which will result in environmental hazards such as spontaneous fires due to heat and methane emissions.

Conclusion — The Port Blair experience shows that while composting is vital for reducing methane emissions and advancing Swachh Bharat Mission Urban 2.0 goals, economic viability remains a challenge. In the interim, direct municipal involvement and institutional support are key to sustaining composting efforts until robust markets for compost mature.

07

RECOMMENDATIONS

The management of organic waste in India presents both a critical challenge and a significant opportunity. Effective organic waste management can simultaneously reduce greenhouse gas emissions, improve air quality, enhance public health, and create livelihoods. To achieve this, a multi-pronged approach is required that integrates awareness, enforcement, infrastructure development, inclusion of informal workers, and innovative financing mechanisms.

- Reducing the amount of organic waste reaching landfills should be India's highest priority for reducing methane emissions from the waste sector. This requires a shift from a collection-and-disposal approach to a prevention-and-resource recovery approach based on source segregation, decentralised composting, biomethanation, Bio-CNG production, and nutrient recovery. Urban Local Bodies should be encouraged to prepare City Methane Action Plans that integrate methane reduction into city-level solid waste management and climate action plans, with measurable targets for diversion of organic waste, methane emission reductions, and scientific remediation of legacy dumpsites. Swachh Bharat Mission should further strengthen its climate focus by incorporating indicators to monitor greenhouse gas and methane emission reductions achieved through improved waste management systems.
- The Government of India should continue strengthening technical and financial support for cities to implement zero-waste systems centred on decentralised and source-level management of organic waste. Policy incentives should promote nutrient recovery through compost and digestate, strengthen market linkages for recovered products, and support measures to reduce food loss and food waste across the supply chain. At the same time, investment and policy support should prioritise waste prevention, segregation, composting, biomethanation, and resource recovery over mixed-waste incineration, ensuring that waste management contributes simultaneously to climate mitigation, public health, circular economy objectives, and sustainable urban development.
- The inclusion of the informal sector must be prioritized and incentivized, particularly in decentralized organic waste management systems. Composting, biogas generation, and community-led segregation initiatives can provide meaningful livelihood pathways for informal workers, supporting social equity and safer work environments, without relying on jargon-heavy notions like “just transition,” which have limited operational relevance in this context.

An awareness campaign is needed to connect organic waste with its wider environmental and health impacts, linking methane emissions to climate change, air pollution, and local health burdens. This awareness would be foundational to other actions towards reducing and effectively managing organic waste.

RECOMMENDATIONS

- Source segregation of waste must be strictly enforced, and penalties must be applied for non-compliance. A combination of incentives and disincentives should be applied to encourage the desired behavior. For instance, door-to-door waste collection service should be denied if waste is not segregated in required categories. Differential service fees could be charged to households and establishments based on the type, quantity, and segregation of waste. In this model, lower fees would be applied for proper source segregation and reduced waste generation, while mixed or high-volume waste incurs higher charges.
- The organic waste management value chain currently requires targeted technical support and viability gap funding to strengthen infrastructure, build processing capacity, and ensure market demand for compost and other end products. Financing mechanisms—such as performance-linked grants or climate action plan allocations—should be developed within national and local climate action frameworks, rather than through climate finance pipelines that typically favor large corporate waste management systems. This ensures that funding reaches decentralized, people-centered solutions aligned with India’s climate and waste goals.
- Standardization and easily accessible quality assurance for outputs of organic waste management processes can help drive demand.
- Food waste should be defined, monitored, and measured to establish a baseline for effective policy design.
- Policy design measures that have proven successful internationally, such as mandatory food waste reporting, “pay-as-you-throw” models, or surplus food redistribution can be adapted to the Indian context in a phased manner.
- While the Swachh Bharat Mission dashboards currently provide indicators related to solid waste collection, wet waste processing thresholds, and aggregate waste processing volumes, they do not offer real-time tracking of organic waste diversion or direct estimates of greenhouse gas/methane reductions. Thus, a dedicated dashboard that bridges this gap is needed to strengthen transparency, accountability and climate linkages.

Organic waste management is far more than a matter of aesthetics, odour control or complex space and logistical challenges. It has profound implications for climate, air quality, and public health. Proper handling reduces methane emissions, lowers air pollution, and mitigates climate change impacts, while creating safe, dignified livelihoods for informal workers. By combining awareness, enforcement, decentralization, financial innovation, and equity, India can build a resilient organic waste management system that protects health, preserves the environment, and fosters inclusive, sustainable communities.

FREQUENTLY ASKED QUESTIONS (FAQS)

FREQUENTLY ASKED QUESTIONS (FAQS)

01 What is climate change?

Climate change refers to long-term shifts in temperatures and weather patterns. Natural events, such as volcanic eruptions, and human activities are responsible for climate change. But since the 1800s, human activities have been primarily responsible for climate change via increase in release of greenhouses gases (GHGs).

02 What are greenhouse gases (GHGs)?

GHGs are gases in the earth's atmosphere that trap heat. During the day, the sun warms the earth's surface. At night, when the earth's surface cools, it releases heat back into the air. But the GHGs in the atmosphere trap some of this heat and thus increase the earth's temperature. As human activities increase the release of these GHGs, more and more heat is getting trapped, which causes global warming and shifts weather patterns. The results of climate change are manifested in more frequent and stronger weather events such as storms, droughts etc.

Carbon dioxide, methane, nitrous oxide, and water vapour are four GHGs that also occur naturally in the environment. Hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride are GHGs that are purely human made through industrial processes.

03 What is Global Warming Potential (GWP)?

Global warming potential (GWP) is used to compare the global warming impacts of different GHGs, over a specific period of time, against the reference gas carbon dioxide which is the most abundant among the GHGs. The reference gas, carbon dioxide, thus has a GWP of 1.

04 What is Carbon Dioxide Equivalent (CO₂e)?

CO₂e is used to express the actual emission quantity of a gas in terms of the amount of carbon dioxide that would cause the same warming.

$$\text{CO}_2\text{e} = \text{Mass of GHG emitted} \times \text{GWP of that GHG}$$

Example: If a landfill emits 1 tonne of methane gas, then:

$$1 \text{ tonne (of methane)} \times 27 \text{ (GWP of methane)} = 27 \text{ tonnes of CO}_2\text{e}$$

05 What is organic waste?

Organic waste, also known as biodegradable waste, since organic waste can be degraded by micro-organisms into simpler stabler compounds, consists of waste generated from living things. Thus, a variety of wastes fall into this category, such as leftover food, vegetable and fruit peels, dry leaves, crop residue, cattle dung, and eggshells. Colloquially, organic waste is also known as wet waste.

06 What is a landfill?

A landfill is a designated site for the disposal of waste, but it is important to distinguish between a sanitary landfill, a dumpsite, and legacy waste. A sanitary landfill is a scientifically engineered facility designed to safely dispose of only residual and inert waste, with systems to collect leachate and landfill gas, prevent groundwater contamination, and minimise environmental impacts. In contrast, a waste dumpsite is an unscientific disposal site where mixed waste is openly dumped without these safeguards, making it a major source of methane emissions, leachate, and landfill fires. Most sites commonly referred to as "landfills" in India are actually legacy dumpsites—large accumulations of old waste built up over decades through unscientific dumping. These legacy waste sites require remediation through biomining and bioremediation before the land can be safely restored or reused.

07 What is aerobic decomposition?

Aerobic decomposition is the process by which microorganisms break down organic matter in the presence of oxygen. Composting is an example of a process that uses aerobic decomposition.

08 What is anaerobic decomposition?

Anaerobic decomposition is the process by which microorganisms break down organic matter in the absence of oxygen. Methane is a primary output of anaerobic decomposition. Biomethanation is an example of a process that uses anaerobic decomposition.

In landfills, anerobic decomposition of organic waste results in release of methane gas.

FREQUENTLY ASKED QUESTIONS (FAQS)

09 How does organic waste contribute to climate change?

Ideally, only inert waste must reach landfills. But mixed waste, which includes organic waste as well as non-biodegradable waste, reaches the landfills. When waste is dumped repeatedly in landfills, compact layers of waste are formed. Oxygen is unable to penetrate deep into these layers where, in the absence of oxygen, microbes decompose the organic waste anaerobically. This release methane which is a highly potent greenhouse gas which traps heat and thus contributes to climate change.

10 How are landfill fires caused?

Methane is a highly flammable gas. When methane is formed in the compact layers of landfills due to anaerobic decomposition, it slowly moves through the layers and accumulates. Upon coming into contact with oxygen, typically near the surface, it catches fire. The ignition for the fire comes from heat generated within the landfill, such as from microbial activity, external sources such as high temperatures, cigarettes etc., or both. While non-biodegradable waste does not emit methane, its presence in the mixed waste at landfills aids landfill fires by acting as hot load. Wastes such as plastics, textiles, paper etc. easily catch fire and sustain fire for days and weeks.

11 How does organic waste contribute to air pollution?

Organic waste in landfills contributes to air pollution in two ways:

A. During landfill fires: The burning releases several pollutants, one of the most dangerous being particulate matter (PM), especially PM_{2.5} – these are extremely fine particulate matter that are 2.5 micrometres or smaller in diameter. Their small size allows them to be inhaled deep into the lungs and enter the bloodstream. One research estimated that PM_{2.5} emissions from waste combustion results in 270,000 premature adult mortalities globally. These health impacts include lung cancer, asthma, and chronic obstructive pulmonary disease.

While the exact composition of air pollutants released depend upon factors such as contents, age, and design of the landfill, carbon monoxide (CO), carbon dioxide (CO₂), sulphur oxides (SOX), nitrogen oxides (NO_x), particulate matters (PM), volatile organic compounds (VOCs) and persistent organic pollutants (POPs) are some other harmful pollutants that have been known to be released during the landfill fires.

B. Without fires: Even when landfills and dumpsites are not on fire, they continue to release air pollutants into the atmosphere via decomposition of organic waste. Some major ones and their impacts are listed below:

I. Methane: Methane is not only a potent greenhouse gas but also a major source of air pollution. Methane reacts with other pollutants in the air, in the presence of sunlight, to form ground-level (tropospheric) ozone. Exposure to ground-level ozone is correlated to cardiovascular diseases, asthma, respiratory illness, and even pre-mature death.

II. Carbon Dioxide: Besides being the most abundant greenhouse gas, carbon dioxide contributes to the formation of ground-level ozone by creating the optimal conditions for its formation. Researchers have shown that rising carbon dioxide levels in the atmosphere will significantly impact the nutrient content of crops. It is estimated that levels of zinc, iron and protein are likely to be reduced up to 10% in wheat and rice by 2050.

III. Ammonia: Exposure to ammonia can cause irritation in eyes, nose and throat, headache, and nausea. Exposure to higher concentrations can lead to more severe damage to the respiratory tract and lungs.

IV. Hydrogen Sulphide: This is a foul-smelling gas – smells like rotten eggs. At low concentrations, it causes eye, nose, and throat irritation. It also causes headaches, nausea, and dizziness. At higher concentration, it can cause pulmonary edema, loss of consciousness, and potential nerve damage.

V. Volatile Organic Compounds (VOCs): VOCs from organic waste cause eyes and throat irritation, headaches, nausea, dizziness, respiratory challenges.

12 What is source segregation of waste?

Source segregation of waste is the process of sorting and separating waste into different types at the point of generation. This allows each waste type to reach its proper destination to be managed effectively to extract optimal value while minimizing its environmental impact.

Waste management rules in India require source segregation of waste. Organic (biodegradable/wet) waste is one of the categories.

FREQUENTLY ASKED QUESTIONS (FAQS)

13 What is decentralized waste management?

Decentralized waste management refers to processing of the waste close to the place where it is generated, as opposed to transporting great distances to process in large centrally located facilities.

Once the waste is segregated at source:

1. Non-biodegradable waste that is recyclable can be sorted at micro-material recovery facilities close to the point of waste generation to send for recycling.
 2. Biodegradable (organic/wet) waste can be composted or used for biomethanation close to the point of waste generation.
 3. Hazardous waste, including sanitary waste, can be sent for incineration.
 4. Non-recyclable non-biodegradable waste can be sent for end-of-life use such as in road construction.
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14 What is UNFCCC?

The United Nations Framework Convention on Climate Change (UNFCCC) is the international treaty that provides the overarching framework for global cooperation on climate change. It aims to stabilise greenhouse gas concentrations in the atmosphere to prevent dangerous human interference with the climate system.

15 What is Climate COP?

The Conference of the Parties (COP) is the annual decision-making forum under the UNFCCC where countries negotiate climate commitments, review progress, and adopt agreements related to mitigation, adaptation, finance, and transparency.

16 What are Nationally Determined Contributions (NDCs)?

NDCs are national climate action plans submitted by countries under the Paris Agreement, outlining their targets and strategies for reducing greenhouse gas emissions and adapting to climate impacts. Waste and methane reduction are increasingly recognised as key components of NDCs.

Key figures relevant to the waste sector include:

- Reduce the emissions intensity of GDP by 45% by 2030 from 2005 levels (Updated First NDC, 2022).
- Achieve about 50% cumulative installed electric power capacity from non-fossil fuel-based energy resources by 2030 (Updated First NDC, 2022).

- Create an additional carbon sink of 2.5–3.0 billion tonnes of CO₂ equivalent through additional forest and tree cover by 2030.
 - According to India's Fourth Biennial Update Report (BUR-4), the waste sector contributed approximately 76 MtCO₂e (2.56% of national greenhouse gas emissions) in 2020, with methane from solid waste disposal and wastewater representing a significant source of emissions.
 - Diverting organic waste from landfills through source segregation, composting, biomethanation, Bio-CNG production, and biomining of legacy waste can therefore make an important contribution towards achieving India's climate commitments by reducing methane emissions, a greenhouse gas that is approximately 82 times more potent than carbon dioxide over a 20-year period.
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17 What do the 1.5°C and 2°C targets mean?

The 1.5°C and 2°C targets refer to limiting the increase in the Earth's average global temperature above pre-industrial levels (approximately 1850–1900), before large-scale industrialisation and the widespread use of coal, oil, and natural gas. During the pre-industrial period, the global average surface temperature was approximately 13.7–13.8°C. Since the Industrial Revolution, human activities have released large quantities of greenhouse gases, causing the Earth's average temperature to rise by about 1.3°C above the pre-industrial baseline. Under the Paris Agreement, countries agreed to pursue efforts to limit global warming to 1.5°C and keep it well below 2°C above pre-industrial levels because every additional fraction of a degree increases the frequency and intensity of heatwaves, floods, droughts, sea-level rise, biodiversity loss, and food and water insecurity. Limiting warming to 1.5°C, rather than 2°C, can substantially reduce these risks. Achieving this goal requires rapid reductions in greenhouse gas emissions, particularly short-lived climate pollutants such as methane, making improved organic waste management an important climate mitigation strategy.

18 What do Mitigation, Adaptation, and Climate Resilience mean?

Mitigation refers to actions that reduce or prevent greenhouse gas emissions, thereby slowing climate change. Example: Diverting organic waste from landfills through source segregation, composting, or biomethanation prevents methane emissions. India's SATAT initiative, which converts organic waste into Compressed Biogas (Bio-CNG), is another example of a mitigation measure.

FREQUENTLY ASKED QUESTIONS (FAQS)

- Adaptation refers to adjustments in policies, infrastructure, and practices that help people and ecosystems cope with the impacts of climate change. Example: Developing decentralised waste management systems that continue functioning during floods, heatwaves, or extreme weather events, or designing scientific landfills with proper leachate management to prevent groundwater contamination during heavy monsoon rains.
 - Climate resilience is the ability of individuals, communities, cities, and ecosystems to anticipate, withstand, recover from, and adapt to climate-related shocks and stresses. Example: Cities that implement source segregation, decentralised composting, biomethanation, biomining of legacy waste, and scientific waste management are more resilient because they reduce methane emissions, minimise landfill fires and flooding caused by clogged drains, protect public health, and recover more quickly from extreme weather events.
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19 What are Environmental Justice principles?

Environmental Justice principles provide a framework for ensuring that waste management and climate action are fair, inclusive, and equitable, particularly for communities most affected by pollution and poor waste management. In the context of organic waste and methane mitigation, five key principles should guide policy and practice: (1) **Respect planetary boundaries to ensure intergenerational equity**, recognising ecological limits and safeguarding the rights of future generations; (2) **Respect all waste pickers and waste workers**, ensuring safe working conditions, dignified livelihoods, and protection of their rights; (3) **Enhance inclusion and build from local knowledge**, by meaningfully involving communities, waste pickers, and Indigenous Peoples in decision-making and recognising their knowledge and experience; (4) **Respond to pollution and environmental harm with accountability**, ensuring that those responsible for environmental damage are held accountable and that affected communities have access to justice and remedies; and (5) **Support holistic solutions through system change**, prioritising zero waste approaches, waste prevention, source segregation, composting, recycling, and other circular economy solutions over end-of-pipe disposal technologies. Together, these principles promote climate action that is not only environmentally effective but also socially just and sustainable.

20 What is a Just Transition?

A Just Transition ensures that climate and environmental actions—such as shifting away from landfilling organic waste—do not disproportionately harm workers or vulnerable communities. It prioritises decent work, social protection, and inclusive livelihoods, especially for informal waste workers.

21 What is Climate Finance?

Climate finance refers to financial resources mobilised to support mitigation and adaptation efforts in developing countries. Investments in organic waste management—such as composting, bimethanation, and decentralised systems—are increasingly recognised as cost-effective climate solutions.

22 What is the Global Methane Pledge?

The Global Methane Pledge is a voluntary international commitment to reduce global methane emissions by at least 30% from 2020 levels by 2030. Managing organic waste and reducing landfill methane are critical pathways for achieving this target. India is not a signatory to GMP.

23 What is the Reducing Organic Waste Declaration?

This declaration calls on governments and cities to prioritise the reduction and separate management of organic waste in order to cut methane emissions, improve public health, and strengthen circular economy systems.

24 What is the LOW-M Cities initiative?

LOW-M Cities (Lowering Organic Waste Methane) is a global initiative that supports cities in reducing methane emissions from organic waste through improved source segregation, decentralised composting, bimethanation, methane monitoring, and policy alignment with climate and circular economy goals. The initiative helps cities develop practical strategies for reducing methane emissions while strengthening public health, resource recovery, and climate resilience. As part of the initiative, cities including **Dhaka (Bangladesh)**, **Jakarta (Indonesia)**, and **Quezon City (Philippines)** are preparing and implementing city-level LOW-M strategies to strengthen organic waste management, reduce methane emissions, and demonstrate scalable models that can be replicated across the Asia-Pacific region.

FREQUENTLY ASKED QUESTIONS (FAQS)

25 What is the International Zero Waste Cities Network?

The International Zero Waste Cities Network, facilitated by the Global Alliance for Incinerator Alternatives (GAIA), brings together cities, local governments, practitioners, and partner organisations committed to advancing zero waste systems as a climate solution. The network provides a platform for cities to share experiences, collaborate, learn from one another, and inspire the design, development, and implementation of zero waste systems that prioritise waste prevention, source segregation, composting, recycling, and organic waste diversion over landfilling and incineration. By promoting community-centred, inclusive, and circular approaches to waste management, the network supports cities in reducing greenhouse gas emissions, improving public health, strengthening climate resilience, and accelerating the transition towards sustainable and just urban development.

26 What is the Cities and Local Governments Methane Pledge?

The Cities and Local Governments Methane Pledge, facilitated by the Global Alliance for Incinerator Alternatives (GAIA), is a global initiative that encourages cities and local governments to take leadership in reducing methane emissions from organic waste through the implementation of zero waste systems. The pledge calls on local governments to prioritise waste prevention, source segregation, decentralised composting and biomethanation, and the recovery of at least 70% of organic waste by 2030. It also emphasises a just transition by integrating informal waste pickers and waste workers into formal waste management systems, ensuring environmental justice, protecting livelihoods, and promoting inclusive, community-centred climate solutions. By joining the pledge, cities commit to reducing methane emissions while advancing public health, circular economy objectives, and climate resilience through equitable and sustainable waste management.

About Chintan Environmental Research and Action Group:

Chintan, is a do-tank that works on the burning issues of circular economy, waste, air pollution, and climate change. Our interventions are at the intersection of environmental sustainability, social justice, gender equity, and climate resilience. We focus on the people most affected by these challenges.

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