Choking on Toxic Smoke

The Brahmapuram Garbage Disaster in Kochi and Municipal Solid Waste Management in Kerala

M Suchitra
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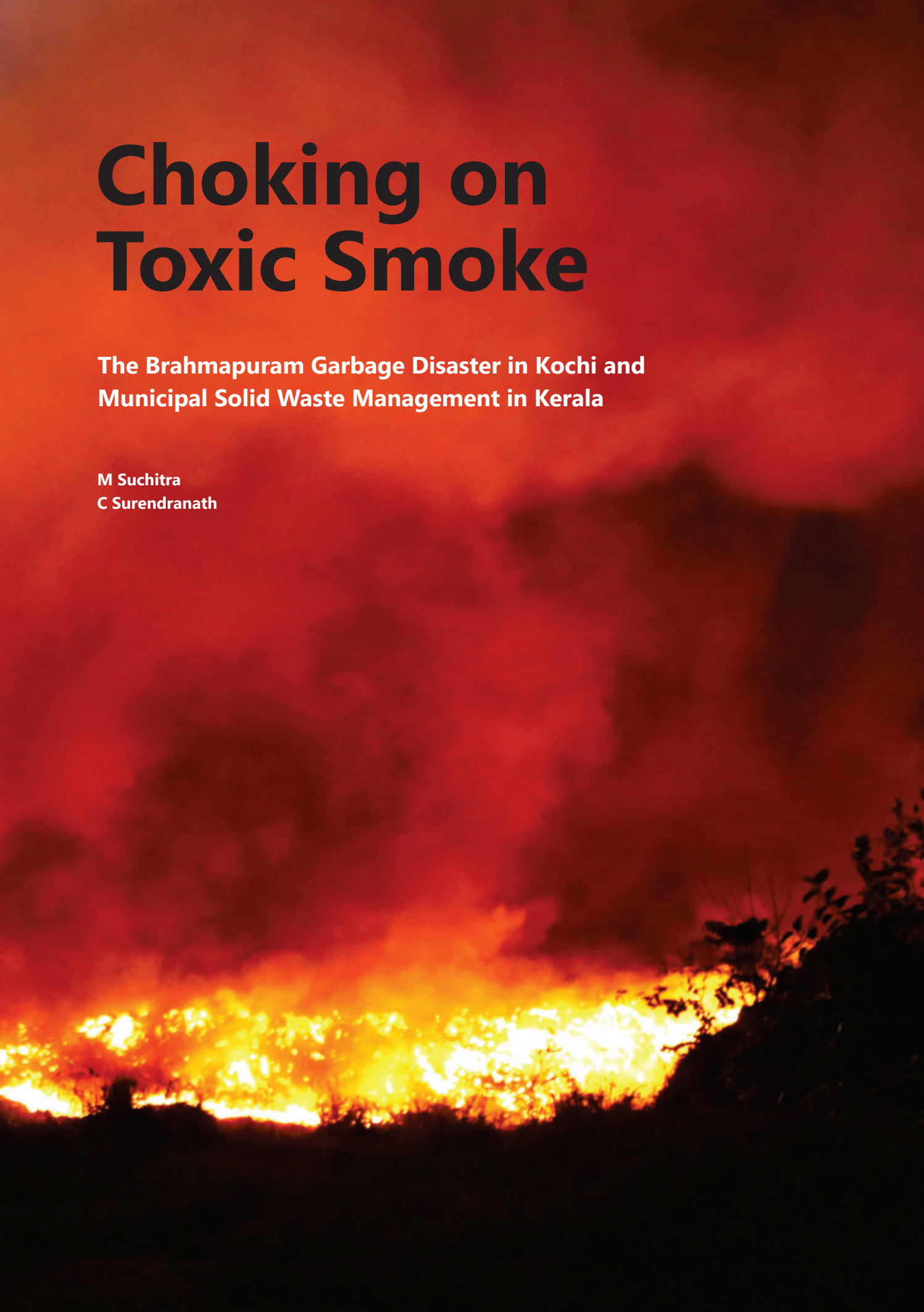

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Published by
Asar Social Impact Advisors
No.16, 7th Temple Road, 15th Cross Road,
Malleshwaram, Bangalore - 560 003

December, 2024

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Genesis of this Report

On March 2, 2023, a massive fire broke out at the municipal waste dump site at Brahmapuram in Kochi, the commercial capital of the south Indian state of Kerala. The fire spread from mounds to mounds of nearly 8,00,000 tonnes of 'legacy waste' dumped in the previous 16 years at the waste processing facility–a euphemism for a vast yard with all sorts of unsegregated discards and a fractured windrow composting plant that stood as a scarecrow.

The fire that took a fortnight to be doused cannot be seen as a one-off incident that went out of hand. It has done more than just expose the citizens of Kochi to highly toxic gases for a few days; it uncovered the callous negligence of the Kochi Municipal Corporation (KMC) in dealing with its garbage over the years. The disaster also brought into light the limitations, lapses and loopholes in the governance system–lack of adequate coordination among various government departments, failures and delays in enforcing legal provisions by the statutory authorities and the incapacities and apathy of the implementing and monitoring bodies. More particularly, the indifference towards environmental sustainability, public health and social justice.

Brahmapuram is a typical example of "slow violence" perpetrated by the state against its people. Rob Nixon, author of the book *Slow Violence and the Environmentalism of the Poor*, describes such violence as one that "occurs gradually and out of sight, a violence of delayed destruction ... an attritional violence that is typically not viewed as violence at all."

Municipal waste management is increasingly challenging as global population grows and urbanises. The escalating issue of garbage is a significant concern worldwide. Nations are driven by a fervent desire for production-based growth and wealth accumulation within a capitalist framework, leading to the indiscriminate extraction and utilisation of natural resources. This rapid industrialisation and urbanisation result in soaring manufacturing outputs and a wider array of products available in the market. Consequently, consumption patterns and lifestyles evolve, leading to a rise in waste generation both in absolute terms and on a per capita basis.

The latest Global Waste Management Outlook 2024, a collective report of the United Nations Environment Programme (UNEP) and the International Solid Waste Association (ISWA), predicts that municipal solid waste generation is estimated to grow from 2.1 billion tonnes in 2020 to 3.8 billion tonnes by 2050, an increase of 56 percent. The estimated global annual cost of waste management could be a staggering USD 640 billion in 2050.

The first Global Waste Management Outlook published in 2015 had provided a global assessment of the state of waste management. It was also a call for action to the international community to recognise waste and resource

management as a significant contributor to sustainable development and climate change mitigation. "Since then, despite some concerted efforts, little has changed. If anything, humanity has moved backwards–generating more waste, more pollution and more greenhouse gas (GHG) emissions," observes UNEP in Outlook 2024. This report also highlights the linkages of municipal waste with the triple planetary crisis of climate change, pollution and biodiversity loss.

Kerala, located on the western coast of the Indian peninsula, is sandwiched between the warming Arabian Sea and the degrading Western Ghats mountain ranges, both playing crucial roles in determining the state's climate patterns. According to Kerala State Action Plan on Climate Change (2023-2030), the state has been experiencing increased climate disasters such as extreme rain events, floods and droughts, since 2012. It is high time that the state recognised waste as a crucial contributor to climate change, globally and locally, and took a holistic approach towards sustainable and inclusive waste management.

It has been over a year and a half since the massive fire at Brahmapuram occurred. Disasters and the controversies surrounding them often generate significant public outcry initially, but as time passes, the urgency fades, and life returns to a business-as-usual routine.

We present this report to our readers with the hope of prompting reflection on the disaster and fostering discussion about the recovery achievements and shortcomings that have followed. We believe that a participatory and inclusive approach to seeking solutions will be more effective. As Dr. Paul Connett, a waste management expert and author of *The Zero Waste Solution: Untrashing the Planet One Community at a Time* (2010), aptly states, "A threatened community is a strengthened one if people work together."

M Suchitra, C Surendranath

Acknowledgements

We express our sincere thanks to Vinuta Gopal (Co-founder & CEO, Asar) and Priya Pillai (Director, State Climate Action, Asar) for encouraging and supporting the idea of bringing out a detailed report on the waste management in Kerala in the context of the Brahmapuram disaster, Kochi.

We also thank the government officials, current and former office-bearers of the Kochi Municipal Corporation, political leaders, people's representatives, residents' associations, residents of Kochi Corporation and Vadavucode-Puthencruz panchayat, waste management experts, service providers, scientists, health professionals, legal experts, activists, media persons, and all others who spent their valuable time and energy for providing us with views, data and information on the Brahmapuram disaster and waste management.

For ideas, inputs and insights, our heartfelt thanks to Shibu K N, P Vijaya Kumar, Shyama Kuriakose, Amina Akbar, C G Madhusoodhanan, Reshma S, Jayaraman C, Hari Subbish Kumar, Priya Pillai, Sreeja K G, Trideep Kumar and Sridhar R.

We are extremely grateful to Geo Damin M, Kezia Shah and Vamsi Sankar Kapilavai for reviewing the content of this report and giving us suggestions.

Our warm thanks to Amjad Anwar and Indu Periodi for their collaboration in bringing this report to life through their engaging infographics.

Executive Summary

On March 2, 2023, a significant fire erupted at the Brahmapuram municipal waste dump site in Kochi, Kerala, igniting from approximately 8,00,000 tonnes of accumulated legacy waste. This site, filled with unsegregated refuse and a dilapidated composting facility, had a history of multiple fire incidents, with 15 reported between 2019 and 2023. The fire produced toxic smoke that affected the city and its surrounding areas for 12 days. Scientific analyses indicated alarming levels of pollutants. Yet, no comprehensive study on the impact of the chemicals on human health and the environment has been done so far.

The incident reveals reckless disregard by the Kochi Municipal Corporation (KMC), including poor site selection on a wetland, continued dumping of unsegregated waste without consent from the Kerala State Pollution Control Board (KSPCB) since 2010 and lack of effective pollution management. This has led to violations of key environmental laws and inadequate disaster preparedness, with a Standard Operating Procedure (SOP) being established only a year after the fire.

Waste Grows

Globally, municipal solid waste generation is projected to increase significantly. The Global Waste Management Outlook 2024, a collective report of the United Nations Environment Programme (UNEP) and the International Solid Waste Association (ISWA), predicts that municipal solid waste generation is estimated to grow from 2.1 billion tonnes in 2020 to 3.8 billion tonnes by 2050, an increase of 56 percent. The estimated global annual cost of waste management could be a staggering USD 640 billion in 2050.

Every year, between 4,00,000 and 10,00,000 people worldwide die from diseases related to mismanaged waste, including diarrhoea, malaria, heart disease, and cancer. Furthermore, municipal solid waste is intrinsically connected to the triple planetary crisis of climate change, biodiversity loss, and pollution. This calls for urgent actions for sustainable municipal solid waste management.

India's Garbage Trouble

As one of the world's top 10 municipal solid waste generators, India, with a population of 1.4 billion, produces over 62 million tonnes of waste annually. Only 43 million tonnes (69%) is collected, 12 million tonnes is processed, and a staggering 31 million tonnes is simply discarded. This inadequate waste collection, transport, treatment, and disposal has led to serious environmental and public health concerns across the country.

Until 2000, India did not even have any law specifically to deal with municipal solid waste. Despite the enactment of the Municipal Solid Waste (Management & Handling) Rules in 2000, and the Solid Waste Management Rules in 2016, substantial gaps remain in implementation of rules, underscoring the necessity for a more robust and sustainable approach to waste management.

Kerala's Waste Worries

The fire disaster at Brahmapuram highlights a critical need for Kerala to reassess its waste management practices in the light of its rapid urbanisation, increasing waste generation, environmental degradation and geographical-climate vulnerabilities.

The state has been urbanising more rapidly than the national average, with an annual urban population growth rate of 6.5 percent. With six corporations, 87 municipalities, and 941 panchayats, Kerala generates approximately 11,449 tonnes of municipal solid waste every day (State Environment Plan 2022).

Since 1994, sanitation and health responsibilities in Kerala have been assigned to Local Self-Government Institutions (LSGIs) under the Kerala Municipalities Act and the Kerala Panchayat Raj Act. Early initiatives in the state included the Total Sanitation and Health Mission and the Clean Kerala Mission, which were merged in 2008 to form the Suchitwa Mission for providing technical support for effective waste management.

Trash Triggers Unrest

The Solid Waste Rules 2000 had made it mandatory for the urban local bodies to set up centralised facilities for waste disposal. Many urban local bodies in Kerala constructed centralised composting plants; but these facilities often performed poorly. The main reasons for their failures included inaccurate assessments of waste generation, insufficient waste segregation at source, selection of unsuitable technologies and operational-maintenance issues.

The result of poor waste management was the accumulation of unsegregated, decaying waste in vacant lots, wetlands, water bodies and even protected forest areas. The state has 44 identified legacy waste dumps, many of which are located near water bodies, leading to water contamination. This open dumping has contributed to increased morbidity in the state (The State Planning Board, 2017). Poor waste management led also to strong public protests.

The Decentralised Path

Kerala launched the Haritha Keralam Mission in 2016 and made waste management one of its three missions. The state formalised its solid waste management policy in 2018, after reprimands from the Supreme Court of India, and the strategies to implement the rules in 2020. The state's policy

emphasises a healthy, resource-efficient society focused on reducing, reusing, and recycling waste, with a strong commitment to decentralised waste management, driven by public protests against open dumping of waste.

Building on the successful, community-led, decentralised waste management models in Alappuzha Municipality and Thiruvananthapuram Corporation, Kerala has developed a comprehensive system for waste handling that includes segregation, collection, storage, sorting, transportation, and disposal. Residents are encouraged to compost wet waste at home and at community level, while non-biodegradable waste is managed through Material Collection Facilities (MCFs) and Resource Recovery Facilities (RRFs).

The local self-government institutions, along with various state agencies, are integral to this decentralised waste management framework, including the State Environment Department, Directorate of Urban Affairs, Directorate of Panchayats, Kerala State Pollution Control Board, Suchitwa Mission, Haritha Keralam Mission, Kudumbashree Mission, Haritha Karma Sena (HKS), the Clean Kerala Company (CKCL) and several other service providers.

Despite the elaborate decentralised waste management mechanism set up in the state, audits have revealed deficiencies such as insufficient infrastructure, underutilisation of existing facilities, inadequate segregation, collection, sorting and disposal of waste, poor fund utilisation, lack of detailed waste management plans and bylaws at the local body level and deficient pollution monitoring.

Fast-track Efforts

In the aftermath of the Brahmapuram fire disaster, and in response to pressure from the Kerala High Court and the National Green Tribunal, the state government has undertaken significant efforts to address the shortcomings in the waste management system. Recent initiatives have focused on improving source segregation and enhancing door-to-door waste collection and disposal. Local bodies have launched several waste management projects with increased budget allocations. Additionally, biomining of legacy waste has commenced in various locations, and the government has doubled fines for illegal dumping. Public awareness campaigns promoting the message "My Waste, My Responsibility" under the Malinya Muktham Nava Keralam initiative have now entered their second year, aiming to make Kerala waste-free by March 2025.

Big Challenges

Despite the revitalised efforts, Kerala faces a few challenges in achieving sustainable and efficient waste management:

1. Unreliable Data

A crucial challenge in municipal solid waste management is the absence of

reliable data regarding fundamental aspects, such as waste quantity and composition. An audit conducted by the Comptroller and Auditor General of India in 2022, covering the period 2016-2021, revealed that none of the audited urban local bodies performed the scientific surveys mandated by the Solid Waste Management Manual 2020. Instead, they relied on per capita waste generation estimates, which proved to be unreliable. The estimates adopted by local self-government institutions were notably lower than those reported by state and central agencies. Additionally, local bodies did not quantify plastic waste, e-waste, construction and demolition waste, or domestic hazardous waste separately.

Official data suggest that annual municipal solid waste generation in the state remains stagnant at approximately 3.7 million tonnes since 2017, despite Kerala's rapid urban growth and evolving lifestyles and consumption patterns. However, daily waste generation figures differ across various documents. The State Planning Board's Economic Review 2022 estimated daily municipal solid waste (MSW) generation at 10,504 tonnes, whereas the Kerala State Environment Plan 2022 indicated a significantly higher figure of 11,449 tonnes per day–a discrepancy exceeding 1,000 tonnes! Moreover, data on plastic waste generated, as reported by the State Pollution Control Board, show a declining trend over the years. Often, only waste generated in urban local bodies is reported by the SPCB, neglecting the substantial contributions from rural local bodies in the state.

2. Plastic Peril

Kerala continues to grapple with plastic pollution despite implementing a ban on single-use plastics in 2020. Studies reveal an alarming concentration of plastic litter along the Kerala coast, significantly exceeding global average. Banned single-use plastic items account for a substantial portion (46%) of the litter found on open public lands. Major water bodies, such as the Vembanad Lake and the Ashtamudi Lake, exhibit concerning levels of microplastic contamination, with various species of commonly consumed fish in Kerala testing positive for microplastics.

Inconsistent policies of the central government have further complicated the situation, allowing banned single use plastics (SUPs) and multi-layer plastic (MLP) to remain in production and contribute significantly to the plastic waste generated in the state.

3. E-Waste Emergency

The E-Waste (Management) Rules of 2016 mandate that all procedures related to e-waste–such as loading, unloading, and storage–must prioritise environmental safety and public health. However, compliance has been inadequate, with hazardous materials, including computer monitors and refrigerators, left exposed in scrap shops and local collection facilities without appropriate safeguards.

Scrap dealers play a vital role in managing non-biodegradable waste in Kerala, with over 10,000 centres employing approximately 3,50,000 people. However, a staggering 73 percent of these scrap shops operate without the necessary authorisations and licences. As the market for electrical and electronic equipment continues to expand in the state, e-waste generation is predicted to increase in the coming decade. However, the state lacks a comprehensive e-waste management plan and adequate facilities for safely managing e-waste. Furthermore, many urban local bodies inadequately regulate scrap dealers through Dangerous and Offensive (D&O) trade licences, often failing to specify waste collection parameters or establish partnerships with authorised recyclers. Consequently, unauthorised transportation and dumping of e-waste have been reported, exacerbating environmental degradation and health risks.

4. Extended Producer Responsibility

Extended Producer Responsibility (EPR) is a powerful but under-implemented policy and regulatory framework that holds producers accountable for the environmental impact of their products throughout their life cycle and intends to shift the burden of managing post-consumer waste from municipalities and governments. Under EPR, Producers, Importers and Brand Owners (PIBOs) are responsible for the end-of-life management of their products, including recycling, reuse, and disposal.

EPR is mandated under the Plastic Waste Management Rules and the E-Waste Management Rules.

Kerala has initiated some awareness and capacity-building programmes on EPR, and a registration process for PIBOs and local bodies has been established. However, various EPR instruments—such as take-back schemes and deposit refund schemes are yet to be rigorously and effectively enforced. Efforts to enforce EPR have faced significant systemic challenges. Even state-owned cooperatives such as Milma and Bevco have failed to implement effective measures to reduce, take back or recycle the plastic waste they generate.

5. Shifting the Waste Burden

While Kerala has significantly boosted its capacity for managing biodegradable waste, its ability to sustainably manage non-biodegradable waste remains limited, particularly for plastics and e-waste. The state has been shifting the burden of disposal of non-biodegradable waste to neighbouring states, primarily Tamil Nadu, by transporting plastic and e-waste for recycling and incineration in cement factories.

The National Green Tribunal (NGT) has initiated two *suo motu* cases against Kerala for dumping waste in Tamil Nadu since March 2023. Based on NGT orders, the Central Pollution Control Board (CPCB) in November 2023

uncovered different cases of waste handlers from Kerala dumping mixed waste at several locations within Tamil Nadu along the interstate border. In the latest case in December 2024 KSPCB was forced to collect back the waste and also issue notices to the viloators..

In addition to Tamil Nadu, Kerala sends its plastic waste to five other states: Karnataka, Andhra Pradesh, Maharashtra, Gujarat, and Uttar Pradesh. The October 2024 Compliance Report submitted by the Kerala government to the NGT indicates that more than 800 tonnes of Refuse Derived Fuel (RDF) are transported daily for co-incineration in 17 cement factories in these states. Eight of these factories are located in Tamil Nadu.

6. Climate Change Implications

Kerala has been experiencing increased climate disasters such as extreme rain events, floods and droughts, since 2012. The state prepared its Action Plan on Climate Change (SAPCC 1.0) in 2014 and revised the document in 2022. According to the Greenhouse Gas Inventory for the state prepared in 2024, the waste sector is the second-largest emitter of greenhouse gases, accounting for approximately eight percent of the state's total emissions. SAPCC needs to be strengthened in the light of the new findings and the state's harrowing experience of climate impacts which are projected to be graver in the years to come.

7. Unsustainable WTE Technologies

While Kerala has embraced decentralised waste management as its primary strategy, there remains a strong inclination to promote and establish high-cost, energy-intensive, and polluting centralised Waste-to-Energy (WTE) plants. This reliance persists despite the incompatibility of WTE technologies with the high moisture content and low calorific value of municipal solid waste in the state.

The centralised Compressed Biogas (CBG) plant being developed at Brahmapuram threatens to undermine sustainable waste management practices and contradicts public commitments made following the fire disaster in 2023.

8. Reimagining Kerala

Reimagining the relationship between the environment and development is vital for creating 'Nava Keralam' (New Kerala)–a sustainable and equitable society. Effective waste management is a critical area where Kerala's aspirations for a zero-waste environment often collide with its neoliberal growth trajectory, marked by a relentless pursuit of large-scale and rapid infrastructure development.

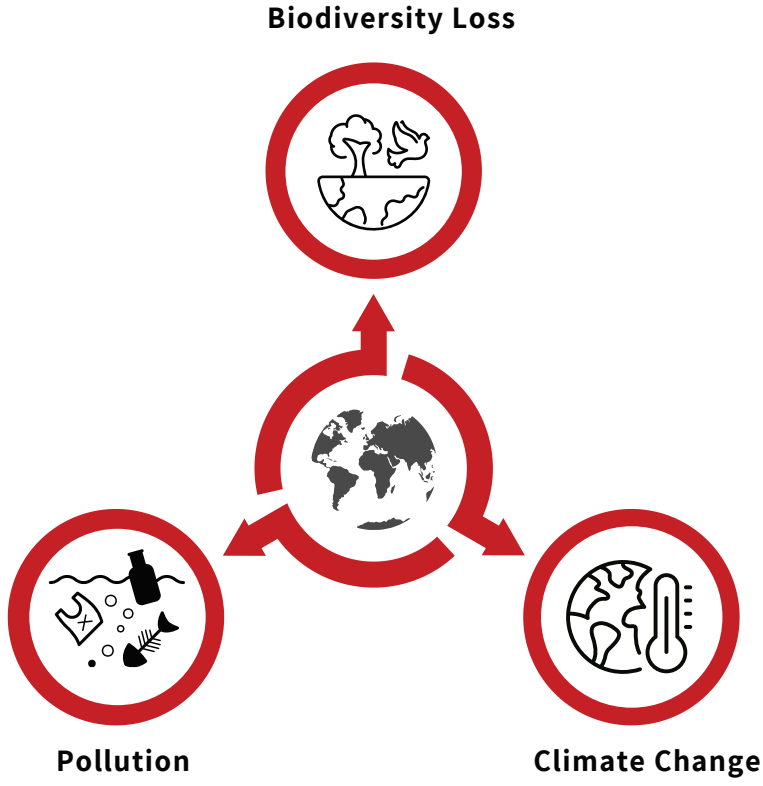
By addressing these challenges, Kerala can pave the way for a more sustainable future, ensuring that development aligns harmoniously with environmental preservation and social justice.

Waste Kills

Between 4,00,000 and 10,00,000 people die every year worldwide as a result of diseases related to mismanaged waste that includes diarrhoea, malaria, heart disease and cancer.

Photo: Nithin Krishnan

Triple Planetary Crisis



Municipal solid waste is intrinsically linked to the triple planetary crisis of climate change, biodiversity loss and pollution.

Climate Change

Transporting, processing and disposing of waste generates CO_2 and other greenhouse gases and airborne pollutants that contribute to climate change. Methane is released from the decomposition of organic waste in landfills and dump sites.

Biodiversity Loss

Indiscriminate waste disposal practices can introduce hazardous chemicals into soil, water bodies and the air, causing long-term, potentially irreversible damage to local flora and fauna, negatively impacting biodiversity, harming entire ecosystems, and entering the human food chain.

Pollution

Waste disposed on land can cause long-term pollution of freshwater sources by pathogens, heavy metals, endocrine-disrupting chemicals and other hazardous compounds. Open burning of waste releases Unintentional Persistent Organic Pollutants, "forever chemicals'' that can be carried long distances in the air, persist in the environment, biomagnify and bioaccumulate in ecosystems, and have significant negative effects on human health and the environment.

Source: Global Waste Management Outlook 2024

Waste Management in India & Kerala:

Neglected & Delayed

Until 2000, India did not even have any law specifically on how to deal with municipal solid waste. Environment-related legislations such as the Water (Prevention & Control of Pollution) Act, 1974; the Air (Prevention and Control of Pollution) Act, 1981; and the Environment Protection Act, 1986 were introduced but the subject of municipal solid waste management was largely neglected. Certain rules like the Hazardous Wastes (Management and Handling) Rules, 1989 and the Biomedical Waste (Management and Handling) Rules, 1998 dealt with the subject only tangentially.

The Central Government formulated the Municipal Solid Waste (Management and Handling) Rules in 2000 following the Supreme Court ruling on the Public Interest Litigation (PIL) filed by Almitra H. Patel, a Delhi-based lawyer. The case, filed in 1996, sought proper disposal of municipal solid waste. Almitra Patel argued that the agencies in charge of pollution management and environmental conservation had miserably failed in providing a clean and healthy atmosphere in Delhi, one of the world's most polluted cities. She had sought an immediate improvement in the treatment and disposal of municipal solid waste.

The MSWM Rules, 2000 were replaced by the Solid Waste Management Rules in 2016.

Kerala introduced its policy–the Kerala State Policy on Solid Waste Management–only in 2018, after repeated reprimands from the Supreme Court. The official strategy for implementing the policy was formed after further delay in 2020.

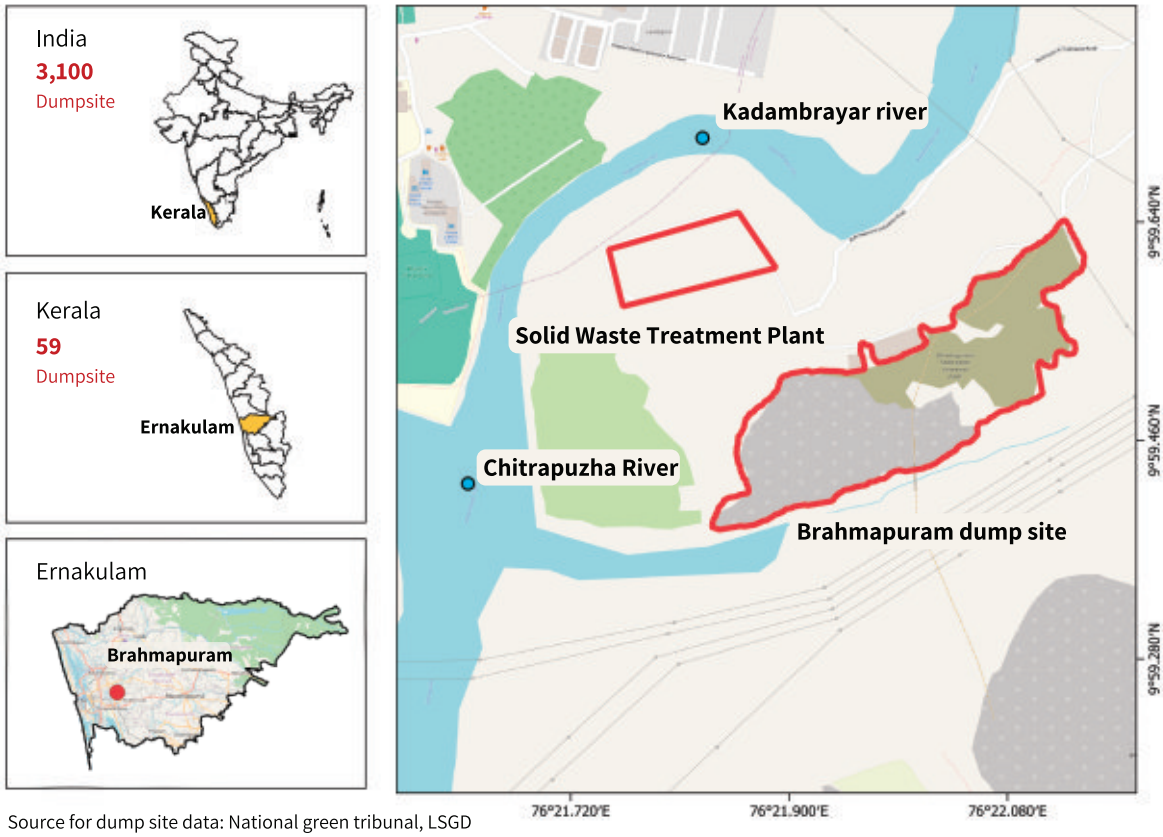
1 Brahmapuram

Photo: **Melton Francis**

Chapter 1

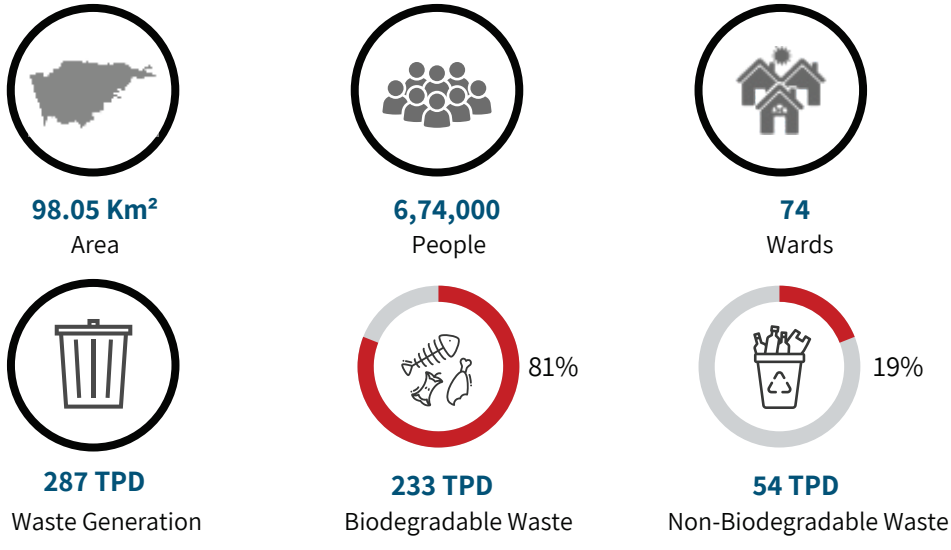
The Disaster

Location map of Brahmapuram dump site



Source for dump site data: National green tribunal, LSGD

Kochi and its Garbage



Source: Kochi Municipal Corporation, 2023

Kochi (Ernakulam), a rapidly growing port city and the business hub of Kerala in southern India along the Arabian Sea coast, made international headlines in 2023 due to a significant environmental disaster. The city was engulfed in toxic smoke for nearly two weeks following a massive fire that erupted on March 2 at Brahmapuram, its municipal solid waste treatment site.

Originally a dump yard with vast unsegregated garbage heaps and a damaged windrow composting plant, Brahmapuram spans about 110 acres and is situated in Vadavucode-Puthencruz Grama Panchayat on the outskirts of Kochi. The site, once a wetland on the floodplains of the Kadambrayar and Chitrapuzha rivers, was bought by the Kochi Municipal Corporation in 1998.

According to a report by the Kochi Police Commissioner, the fire at Brahmapuram began at 3:58 pm, rapidly spreading due to high daytime temperatures and windy conditions. By 4:03 pm, the blaze had engulfed a vast area, emitting thick, black smoke. Multiple units of the State Fire and Rescue Department, along with support from the Indian Air Force and the Indian Navy, were mobilised to combat the fire. Dismissing initial suspicions of deliberate arson, the police suggested that subsurface fires might have triggered the disaster, complicating firefighting efforts. About 350 fire and rescue personnel and 150 support staff worked tirelessly day and night, pumping 60,000 litres of water per minute to extinguish the flames. The operation involved 30 fire tenders, 45 excavators, and 14 high-capacity water pumps. Over 500 civil defence volunteers contributed to the effort, which concluded with the official declaration of the fire being extinguished on March 14, 2023.

During the crisis, much of the city and its suburbs were enveloped by hazardous smoke. Two weeks later, Kerala Chief Minister Pinarayi Vijayan informed the state legislative assembly that 1,335 people had sought medical attention in government and private hospitals. Among them were 128 children aged under 10 and 262 adults over 60 reporting symptoms like

During the fire breakout, much of the city and its suburbs were enveloped by hazardous smoke

Photo: Melton Francis

Garbage Fires

Unsegregated municipal solid waste (MSW) comprises a wide array of materials including food, paper, flammable low-grade plastics, textiles, leather, wood, glass, metals, sanitary waste, and other discarded items.

Organic waste undergoes decomposition, generating heat. If this heat is not managed, it can ignite the waste, potentially starting a fire. During summer, when atmospheric temperatures rise, decomposition accelerates, causing temperatures in garbage heaps to exceed 70-80°C. Coupled with the presence of flammable materials, these conditions heighten the risk of fires. Dry and hot weather conditions further exacerbate the flammability of waste materials, increasing fire risks.

Fires in dump sites or landfills can occur in two forms: surface fires and subsurface fires. Surface fires involve recently dumped, buried, or compacted waste near the landfill's surface. These fires typically burn at lower temperatures, producing thick white smoke and incomplete combustion products. Surface fires may result from discarded smouldering materials, spontaneous ignition, or inadequate landfill gas control systems. They can also spread beyond the landfill, contributing to heat and air pollution. However, they are generally easier to extinguish compared to subsurface fires.

Subsurface fires occur deep within the landfill, involving older waste materials. Biodegradable materials trapped beneath the surface decompose without oxygen, producing landfill gases such as methane, a highly flammable gas. This can lead to uncontrollable fire incidents within landfill sites. Fires at open dump yards and landfills contribute to air, water, and soil contamination, posing severe health risks to nearby communities.

Landfill Dilemma

All landfills and waste dumps lead to environmental pollution, whether they are active or closed.

Even the so-called scientific landfills may fail, owing to design failures, operation and maintenance failures or eventual corrosion of the liner and capping materials used to cover up the waste. The very best landfill liners are made of a tough plastic film called high density polyethylene (HDPE). A number of household chemicals will degrade HDPE, permeating it, making it lose its strength, softening it, or making it become brittle and crack. Not only will household chemicals such as moth balls degrade HDPE, but much more benign things including margarine, vinegar, ethyl alcohol (booze), shoe polish and peppermint oil can cause stress cracks on HDPE.

A landfill cap is intended to be impermeable–to keep water out. This means water is supposed to run off the surface. But this, in turn, invites soil erosion. To minimise soil erosion, you need to establish vegetation on the ground above the landfill cap. However, plants gather water and nutrients, through roots, which can penetrate a landfill cap, destroying the cap's strength and durability. Furthermore, plants provide cover (and food) for burrowing animals, which then burrow into the cap, destroying it. Earthworms alone can have a devastating impact on a landfill cap. The forces of nature, left to themselves, will destroy landfill caps.

Landfill waste can take hundreds, if not thousands, of years to fully decompose. Open landfills pose a greater environmental contamination risk compared to closed ones. However, closed landfills, especially those that are dry, slow down the decomposition process, leading to prolonged generation of landfill gases and leachate.

Source: *Landfill Failures: The Buried Truth*[2]

breathlessness, dizziness, severe headaches, nausea, and weakness. Media reports[1] also highlighted the unfortunate death of an 80-year-old asthma patient from Vazhakkala, six kilometres away from the site, allegedly exacerbated by the smoke (although this has not been officially confirmed). During the fire, the State Health Department issued an advisory urging residents to stay indoors and instructed hospitals to prepare for emergency admissions of patients experiencing respiratory distress.

About eight lakh tonnes of unsegregated waste had accumulated at Brahmapuram

In 2009, a windrow composting plant with a capacity of 250 tonnes per day (TPD) was constructed at Brahmapuram. However, it suffered a breakdown within two years due to faulty construction, as reported by the Kerala State Pollution Control Board (KSPCB) to the National Green Tribunal.

According to the Performance Audit Report of the Comptroller and Auditor General (CAG) of India,[3] for the audit period 2016-2021 submitted before the Kerala Legislative Assembly in September 2023, out of the 3,85,555 tonnes of waste that reached Brahmapuram, only 1,00,138 tonnes (26%) were processed. The rest 2,85,417 tonnes (74%) accumulated at the site.

In June 2021, the National Institute of Technology (NIT), Kozhikode, estimated the quantity of legacy waste at Brahmapuram as 3,25,816 cubic metres (M^3) above ground level and 2,26,087 M^3 below ground level.[4]

Legacy of Waste

At the time of the 2023 fire, according to the Ernakulam district administration, which is also the District Disaster Management Authority, 8,43,954 tonnes of legacy waste had accumulated on the premises. About 70-80 percent of this waste consisted of unsegregated biodegradable and non-biodegradable materials, including food scraps, paper, plastic, sanitary napkins, household hazardous waste, discarded items from streets, and even biomedical waste.

Photo: Melton Francis

What is Legacy Waste?

Legacy Waste refers to Municipal Solid Waste (MSW) that has been accumulated and left untreated for years, often decades, at the same location or landfill. The term "legacy" denotes something inherited from the past, in this context referring to waste materials left over from historical dumping practices rather than the practices themselves.

Before the environmental risks became widely understood, both in India and globally, waste disposal commonly involved open dumping along roadsides, in remote areas known as 'no-man's-lands', and even into rivers. Continuous and unregulated dumping of MSW over extended periods at the same site led to the formation of massive accumulations of legacy waste. For instance, the garbage mound at Ghazipur, Delhi, was nearly as tall as the Qutub Minar (72 metres), according to media reports.[5]

Until 1970, only a few dump sites existed in India. Historically, urban waste, primarily biodegradable food waste, was often collected, and sometimes purchased by farmers in villages for composting. However, with the rise of plastic consumption, the composition of urban waste changed significantly, and farmers ceased collecting waste.

Initially located outside city boundaries, many dump sites found themselves engulfed within expanding urban areas as cities grew. The National Green Tribunal has estimated that more than 10,000 hectares of valuable urban land in India are taken up by 3,159 legacy waste dump sites, reports Down to Earth.[6]

Besides the Kochi Municipal Corporation (KMC), five neighbouring municipalities (Aluva, Angamaly, Kalamassery, Tripunithura, and Thrikkakara) along with two grama panchayats (Cheranalloor and Vadavucode-Puthencruz) were also transporting their garbage to Brahmapuram under contracts with KMC. They paid Rs 1200 per tonne for this service.

"The agreement executed by Kochi Corporation with the neighbouring local bodies specified that only biodegradable waste were to be transported to Brahmapuram. However, the local bodies transported 79,996 tonnes of unsegregated mixed waste to the facility. Had the local bodies effectively segregated waste at source point itself, there would have been considerable drop in the quantum of rejects which reached the centralised facility," observes the CAG report.

(The authors did not receive a satisfactory response from KMC regarding why it had entered into such contracts.) At the time of the fire disaster, Brahmapuram was receiving approximately 390 tonnes of waste every day.

The Brahmapuram dump yard was segregated into two sectors: the Plastic Waste Sector and the Legacy Waste Sector. Police investigations determined that the fire originated from the legacy waste sector. A study conducted by the Indian Institute of Technology (IIT), Chennai, immediately following the massive fire, cautioned that if legacy waste continues to produce methane in favourable conditions, there is a risk of similar fire incidents recurring.[7]

LSGIs that were sending waste to Brahmapuram

According to the study, the fire resulted in the generation of approximately 95,932 tonnes of residue, which took the form of toxic ash mixed with sand within the yard.

Repeated Fires

The fire that erupted on March 2, 2023, marked the largest in the history of Brahmapuram, yet it was not the first. Brahmapuram has experienced numerous fires of varying intensity and duration during summer seasons since 2009, two years after waste began to be dumped there. "It is said that there were fire incidents in the yard in the years 2009, 2010, 2013, 2014, 2015," noted Justice A V Ramakrishna Pillai, Chairperson of the State Level Monitoring Committee (SLMC), constituted in compliance with the direction of the National Green Tribunal (NGT), in his report submitted to NGT immediately after the fire breakout in 2019.[8]

Local residents near the Brahmapuram dump site recounted witnessing several fire incidents over the years, though they often go unnoticed or unrecorded unless they escalate significantly and affect the city with the smoke.

According to the Kochi Police Commissioner, there were a total of 15 reported fire incidents at Brahmapuram between 2019 and 2023, and this led to four cases being registered on unnatural fire incidents. The cases were eventually dropped, as the police couldn't identify any culprit. The conspiracy theories and political blame games that immediately follow such incidents, only serve to distract attention from the reality that fires can naturally occur at dump sites.

NIIST studies found high levels of toxic dioxins and other chemicals in air and soil

Several fire breakouts had occurred at Brahmapuram in February 2019, February 2020, and March 2023 with different intensity, potential environmental and health impacts, and challenges in containment and mitigation. The authorities managed to extinguish the fires within 72 hours during the first two instances.

The repeated fires at Brahmapuram burnt up 1,800 tonnes of municipal solid waste in 2019, 1,300 tonnes in 2020, and a staggering 95,932 tonnes in 2023, as estimated by studies done by scientists of the Environmental Technology Division at the National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram.[9,10,11]

Poisonous Emissions

Studies done by the NIIST in 2019 and 2020 after fire breakouts at Brahmapuram had rung the alarm bells: they found high levels of toxic dioxins and dioxin-like chemicals in the ambient air as well as soil. In 2019, the air samples collected on the next day of the fire breakout showed dioxin levels 50 times higher than reference values. The 72 mg TEQ (Toxicity Equivalence) of dioxins generated during the fire was "sufficient to exceed the tolerable annual intake of 1.3 million people," the NIIST study said in 2019.

As the dump site fires erupted again (six more times in 2019), NIIST repeated the dioxin emission estimation in 2020 and observed that "a low level of

Photo: Melton Francis

cancer risk persists at the site due to the toxic emissions." As human exposure to dioxins mostly occurs through consumption of eggs, milk, fish, meat etc., NIIST repeated its suggestion made in 2019 that a systematic study of the levels of dioxins in food samples from the surrounding region should be conducted to assess the human health risks.

The study on dioxin contamination and its health impacts is yet to be published

In 2023, NIIST sought to quantify the extent of burnt and contaminated MSW and residual ash left by the fire at the dump site with the objective to suggest a biomining plan to control or minimise the contaminated waste leaching out to the soil and water bodies nearby. The study was conducted on the premise that the extensive fire incident (that covered an area of 95,249 sq metres and. 2.09 lakh tonnes of mixed solid waste) would have released "large quantities of burned residue or ash contaminated with toxic substances such as dioxins, furans, PCBs and heavy metals."

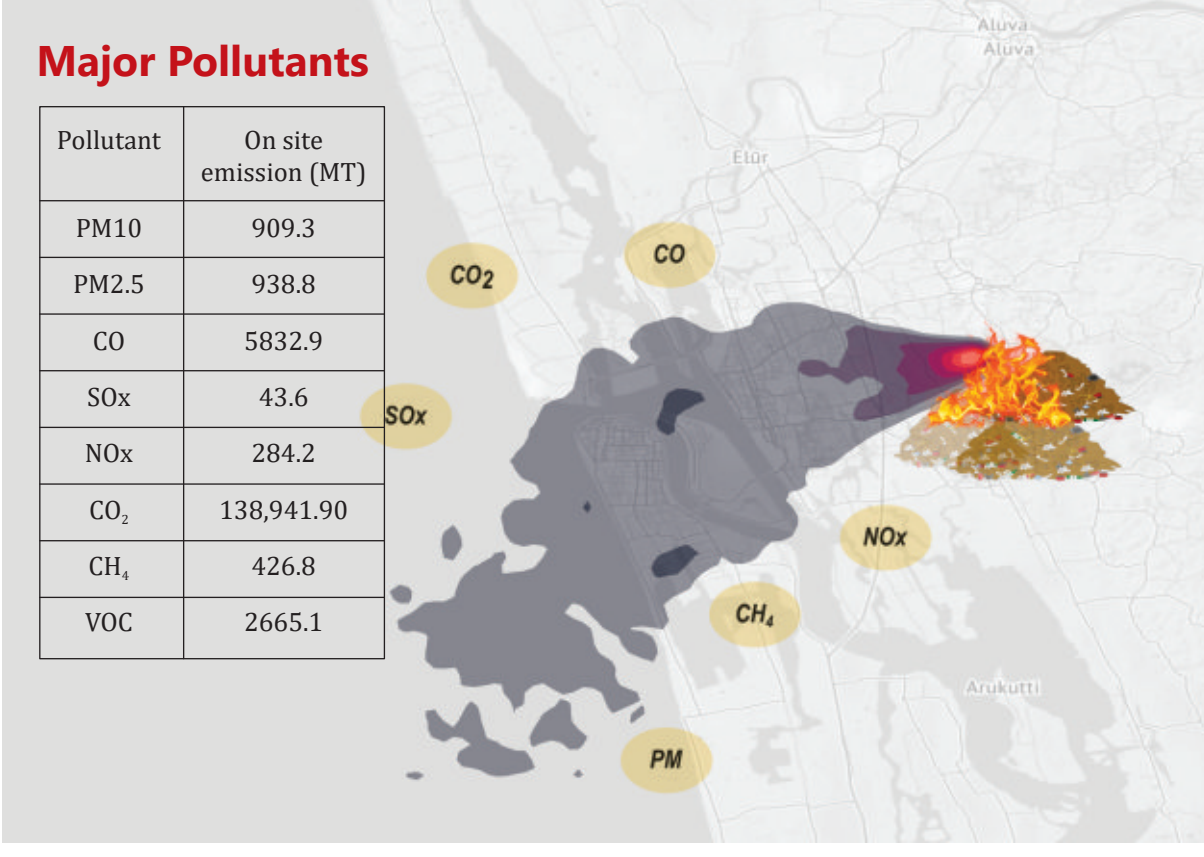
Health Risks Ignored

"Studies by CSIR-NIIST have emphasised that dangerously high dioxin emissions pose serious health risks," SLMC reported to NGT subsequently. After the 2023 fire, the government commissioned a team of experts to study the immediate and long-term health impacts. The study report remains to be published.

Scientists at the Cochin University of Science and Technology (CUSAT) have estimated the quantity of 8 major pollutants, toxins and Green House Gases emitted during three fire events at Brahmapuram 12 and suggested limiting further dumping of waste at the site.

Major Pollutants

Pollutant	On site emission (MT)
PM10	909.3
PM2.5	938.8
CO	5832.9
SOx	43.6
NOx	284.2
CO_2	138,941.90
CH_4	426.8
VOC	2665.1



Source: CUSAT study 2024: Graphical abstract of spread of pollutants from Brahmapuram fire over Kochi.

Lethal Effects

PM10

PM10 refers to fine particles smaller than 10 micrometres in diameter, capable of deeply penetrating the lungs upon inhalation. High concentrations of PM10 can lead to various health issues, from coughing and wheezing to more severe conditions like asthma attacks, bronchitis, high blood pressure, heart attacks, strokes, and even premature death.

PM2.5

Even smaller particles at 2.5 micrometres or less, are invisible but form noticeable particle smog in highly polluted areas. They also penetrate deep into the lungs and bloodstream, significantly increasing the risk of death from heart and lung diseases, strokes, and cancer.

CO

Carbon monoxide, known as the "silent killer," is a poisonous, colourless, odourless, and tasteless gas. It displaces oxygen in red blood cells, leading to symptoms ranging from coma to death. Prolonged exposure damages the brain, heart, and tissues.

CO_2

At elevated levels, CO_2 causes a range of health issues including headaches, dizziness, difficulty breathing, fatigue, increased heart rate, high blood pressure, coma, and convulsions. Extreme concentrations can result in suffocation and death.

CH_4

High levels of methane reduce oxygen intake, leading to symptoms like mood changes, impaired speech and vision, memory loss, nausea, vomiting, headaches, and in severe cases, breathing and heart-rate abnormalities, numbness, and unconsciousness. Long-term exposure can lead to coma and death, contributing globally to increased ground-level ozone levels and respiratory deaths.

SOx

Compounds of sulphur and oxygen, including sulphur dioxide (SO_2), irritate the respiratory tract, exacerbate conditions like asthma and chronic bronchitis, and increase the risk of respiratory infections through coughing and increased mucus secretion.

NOx

A group of air pollutants including nitrogen dioxide (NO_2), poses significant health risks by damaging the heart and lungs, particularly NO_2, which is highly harmful.

VOCs

Volatile organic compounds are vapours that cause irritation of the eyes, nose, and throat, headaches, loss of coordination, nausea, and potential damage to vital organs such as the liver, kidneys, and central nervous system. Certain VOCs are also suspected or proven carcinogens.

Eternal Hazards: Understanding POPs

During fire outbreaks in landfills or open dump yards, significant quantities of hazardous gases, including highly toxic Persistent Organic Pollutants (POPs), are rapidly emitted.

POPs encompass a group of carbon-based synthetic chemicals resistant to natural degradation processes, leading to their accumulation in soil, water, and air. These chemicals can evaporate into the atmosphere, travel via water currents, and redeposit in distant regions due to wind and water transport. Their unique physical and chemical properties enable them to persist in the environment for decades or even centuries, earning them the nickname 'Forever Chemicals'.[13]

Persistent in ecosystems and prone to biomagnification up the food chain, POPs pose substantial risks to human health and the environment. Scientific research indicates that even low-level, long-term exposure to POPs can increase the risk of cancer, reproductive disorders, immune system alterations, neuro-behavioural impairments, endocrine disruptions, genotoxicity, and birth defects.[14]

POPs are produced intentionally for various uses, including as pesticides, while Unintentional Persistent Organic Pollutants (UPOPs)[15] are anthropogenic by-products released during incomplete combustion processes involving organic matter (such as municipal solid waste) and chlorine. They also result from the manufacturing of other chemicals. UPOPs include polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs), collectively referred to as 'dioxins'.

Open burning of municipal solid waste is the largest but often overlooked source of Unintentional Persistent Organic Pollutant (UPOP) emissions.

The Stockholm Convention, which addresses the global impact of Persistent Organic Pollutants (POPs), has garnered significant international attention over recent decades. Enforced since May 2004, the convention mandates countries to reduce or eliminate the release of POPs worldwide. Parties to the convention are required to develop action plans aimed at eliminating, restricting, and reducing the production and use of various POPs, as well as ensuring the proper management of stockpiles and waste containing these chemicals.

As of January 2024, 185 countries and the European Union have ratified the Stockholm Convention, committing to the elimination of 39 POPs categorised as 17 pesticides, 15 industrial chemicals, and seven unintentional by-products.[16] India ratified the convention in 2006 and submitted its National Implementation Plan (NIP) for POPs management in 2011.

Persistent Disasters

Frequent fire outbreaks are just one facet of the hazards posed by dump sites. While a disaster is often perceived as an immediate, explosive event that gains sensational attention, a dump site itself constitutes a persistent disaster.

"Since 2007, we have been grappling with foul odours, polluted air, and contaminated water. Many of us suffer from chronic allergies, asthma, and respiratory disorders. But who cares about our health?" ask residents living near the dump site.[17] Their statement encapsulates the ongoing challenges of living in proximity to waste.

During heavy rainfall, leachate (leachate is the liquid that forms when water percolates through waste materials and picks up contaminants) from the Brahmapuram plant gains easier access to streams and rivers, mixing with rainwater runoffs. Compounding the issue, the plant had been established in a wetland adjacent to the Kadambrayar river. "Due to inadequate scientific disposal practices at the Brahmapuram plant, leachate flows into the Kadambrayar," says the Kerala State Pollution Control Board (KSPCB) in a 2018 report outlining an action plan for restoring the river.[18]

KSPCB had imposed a fine of Rs 1.12 crore on KMC as environmental compensation for the pollution it caused through leachate from 22 November 2018 to 30 November 2019. Even after the fine was imposed, KMC did not set up the leachate treatment plant.

Contamination by Leachate

It typically occurs in landfills or dump sites where rainwater or other liquids come into contact with decomposing organic matter, chemicals, heavy metals, and other pollutants present in the waste. As water moves through the waste, it leaches out dissolved and suspended materials, forming a highly polluted and toxic liquid known as leachate.

Leachate can vary widely in composition depending on the types of waste present, the age of the dump yard, and environmental conditions such as temperature and rainfall. It often contains a mixture of organic and inorganic substances, including pathogens, heavy metals, and organic chemicals. This hazardous liquid pollutes groundwater, which, once contaminated, is difficult to remediate. Groundwater movement spreads the leachate plume several hundred metres from the point of seepage, where it eventually mixes with surface water and flows into streams, rivers, and oceans.

The interplay between groundwater and surface water is particularly critical in humid tropical climates like that of Kerala, where annual precipitation averages 3000 mm. In Kochi, a coastal city with a delicate canal-backwater ecosystem situated mostly at sea level, the dynamics of water and wind are crucial.

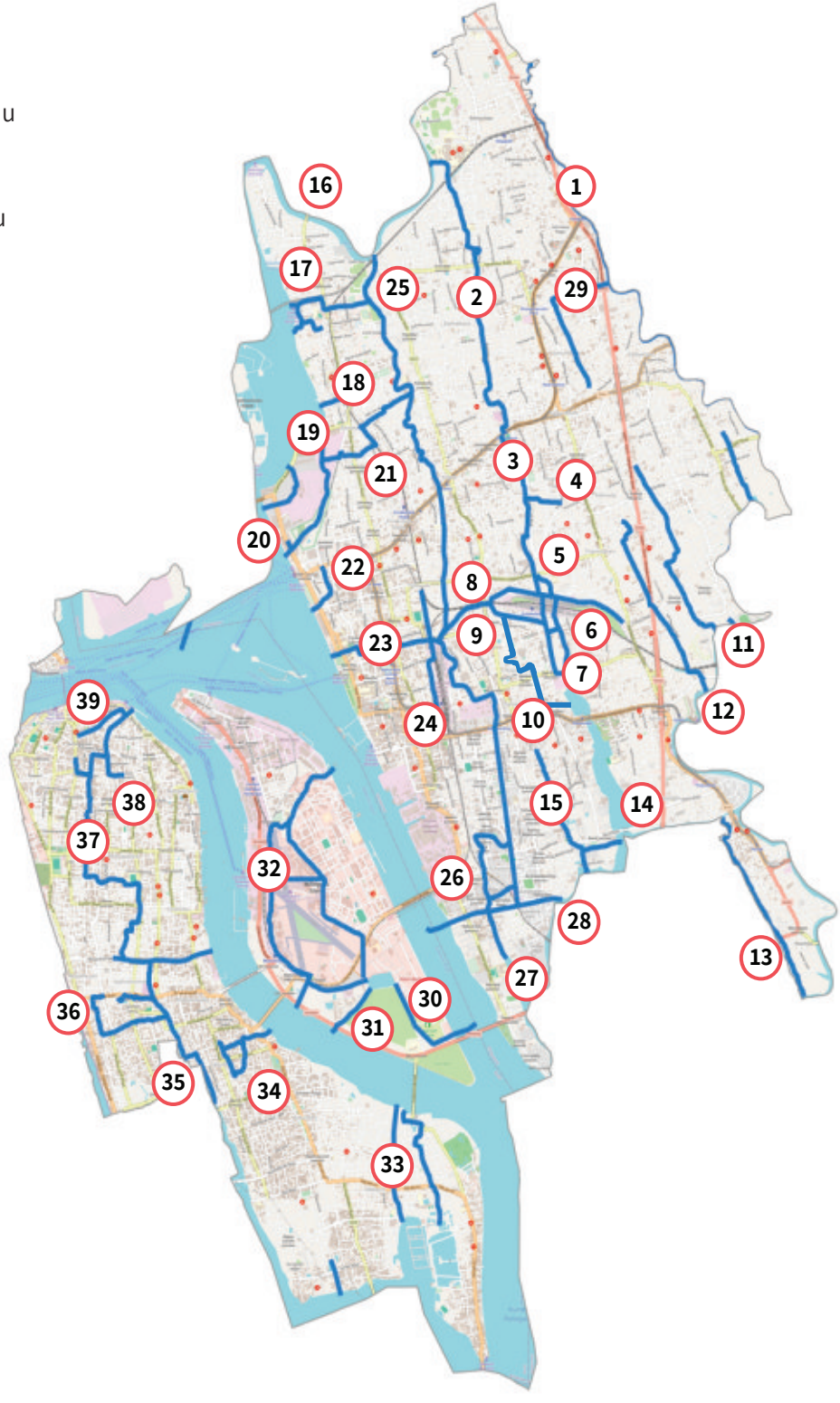
Chemicals in MSW Leachate and Health Risks

Major Chemicals	Health Risks	Waste Source
Cobalt	Heart and lung damage, dermatitis	Magnets, cutting tools, alloys, coloured glass or ceramics
Ammonia	Skin, mouth, lung and throat irritation	Fertilisers, household cleaners
Arsenic	Skin discolouration, blood vessel damage, abnormal heart rhythm, cancer	Wood preservatives, pesticides, sawdust
Lead	Brain and kidney damage, muscle weakness, decreased mental abilities	Cathode ray tubes, batteries, metal pipes, old paints
Mercury	Brain and kidney damage, lung damage, skin rashes	Electronics, thermometers, batteries
Toluene	Anaemia, leukaemia, bone marrow damage, immune system damage	Plastics, resins, nylons, rubbers, dyes, lubricants, pesticides, detergents
Di(2-ethylhexyl) phthalate (DEHP)	High, prolonged levels may cause liver damage	Plastic products like tablecloths, floor tiles, upholstery, dolls, shoes, rainwear

Kochi Corporation: Canal Network

Names of Canals

1. Edappallythodu
2. Changadampokkuthodu
3. Karanakodamthodu
4. Adimurithodu
5. Marshalling Yard Thodu
6. Marshalling Yard thodu
7. Puthenpalamthodu
8. Dry Thodu Br
9. Dry Thodu South
10. Punchathodu
11. Kareethodu
12. New Punchathodu
13. Athirthythodu
14. Chilavannoorthodu
15. Ambanattuchirathodu
16. Chittoorpuzhathodu
17. Thattazhamthodu
18. Kattungalthodu
19. Chathiyaththodu
20. Mangalavanamthodu
21. Kannachanthodu
22. Market Canal
23. Mullasserythodu
24. Vivekanandathodu
25. T P Canal
26. Koitharathodu
27. Thevara Canal
28. Konthuruthythodu
29. Vadathodu
30. Vathuruthy Canal
31. Mattanchery Canal
32. Wellington Canal
33. Pashnithodu
34. Pallichalthodu Br
35. Pandarachirathodu
36. Athipozhithodu
37. Rameswaramthodu
38. Karippalamthodu
39. Eruveli Branch canal



Source : Kerala State Irrigation Department, Ernakulam

The Kadambrayar is an urban river coursing through residential, industrial, and commercial areas in Kochi, ultimately merging with the Chitrapuzha river before flowing southward into Vembanad Lake. The Vembanad lake is part of the globally recognized Vembanad Wetland System, designated as a Ramsar Site under an international treaty aimed at conserving wetland ecosystems of importance. Established by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 1971 and enforced in 1975, the Ramsar Convention underscores the ecological significance of such areas.

Functioning as a vital link between the Western Ghats and the Arabian Sea, the Vembanad Wetland System supports the livelihoods of approximately 1.6 million people residing along its banks, with fishing being a prominent traditional occupation. However, studies conducted by SCMS College of Engineering and Technology in 2022 and 2023 have identified the Kadambrayar as a significant pathway for transporting microplastics and chemicals, including toxic heavy metals like arsenic and chromium, from Brahmapuram into Vembanad Lake.[19,20]

A 2021 study conducted by the Kerala State Irrigation Department identified 39 main canals traversing the Kochi Corporation area.[21] These canals channel stormwater from small drains to the backwaters. Given that a majority of places in the city are at or below mean sea level, tidal variations significantly influence water flow into the backwaters. People use these canals for dumping waste, violating the Kerala Irrigation and Water Conservation Act 2003.

Pollution from Dump Site Gases

In addition to leachate, open dump yards and landfills emit a variety of gases produced through the decomposition of organic waste by bacteria, chemical reactions, and volatilization. These gases comprise a complex mixture of hundreds of different compounds. Typically, landfill gas contains approximately 45-60 percent methane and 40-60 percent carbon dioxide by volume. It also includes small amounts of nitrogen (2-5%), oxygen (0.1-1%), ammonia (0.1-1%), sulphides (0-1%), hydrogen (0-0.2%), carbon monoxide (0-0.2%), and non-methane organic compounds (NMOCs) like trichloroethylene, benzene, and vinyl chloride (0.01-0.6%). The composition of these gases depends on factors such as the type of waste, its age, oxygen levels, moisture content, and temperature.

1. **Waste Composition:** Higher levels of organic waste in landfills lead to increased production of landfill gases such as carbon dioxide, methane, nitrogen, and hydrogen sulphide during bacterial decomposition. Chemical disposal in landfills can also increase the production of NMOCs and other gases through volatilization or chemical reactions.

2. **Age of Refuse:** Newly buried waste (less than 10 years old) generally produces more landfill gas through bacterial activity, volatilization, and chemical reactions compared to older waste (buried over 10 years). Peak gas production typically occurs 5 to 7 years after burial.

Photo: Melton Francis

3. **Oxygen Presence:** Methane production in landfills occurs only in the absence of oxygen.

4. **Moisture Content:** Moisture in landfills (unsaturated conditions) enhances gas production by promoting bacterial decomposition and facilitating chemical reactions that generate gases.

Exposure to elevated levels of these gases, even for short periods (typically up to two weeks), poses serious health risks including breathing difficulties, insomnia, weight loss, chest pain, and exacerbation of asthma.

Landfill Gas Composition

Type of Gas	Percentage Range
Methane CH_4	45 - 60%
Carbon Dioxide CO_2	40 - 60%
Nitrogen N_2	2 - 5%
Oxygen O_2	0.1 - 1%
Ammonia NH_3	0.1 - 1%
Sulphides S^{2-}	0 - 1%
Hydrogen H_2	0 - 0.2%
Carbon Monoxide CO	0 - 0.2%
HMOCs (Non-methane Organic Compounds)	0.01 - 0.6%

Source: *Landfill Gas Basics; Agency for Toxic Substances and Disease Registry, USA*

Chapter 2

Reckless Disregard

The crisis at Brahmapuram is a result of the flagrant, prolonged neglect of the civic authorities towards municipal waste management and environmental governance. For the past 25 years, Kochi Municipal Corporation (KMC) has been resorting to unscientific, open dumping of waste. This method not only violates various regulations such as the Kerala Municipality Act 1994, the Municipal Solid Waste Management Rules 2000 (amended in 2016), and the Solid Waste Management Rules 2016 but also disregards the responsibilities assigned to corporations, municipalities and village panchayats for ensuring the sanitation and health of their residents.

According to the regulations, it is mandatory for all Local Self Government Institutions (LSGIs) to implement an integrated Municipal Solid Waste (MSW) management system. However, Kochi has continuously failed to establish adequate and effective solid waste treatment facilities, consistently flouting laws, rules, and regulations. Moreover, KMC has neglected the implementation of the Kerala State Municipal Solid Waste Management Policy 2018, which emphasises the importance of waste reduction, reuse, recycling, and decentralised, scientific waste treatment practices to minimise garbage generation.

Photo: **Nithin Krishnan**

Photo: Melton Francis

Wetland Turns Wasteland

The Kochi Municipal Corporation (KMC) bought 37.33 acres of land in Chellipadam village in Vadavucode-Puthencruz Grama Panchayat in 1996-1998 for setting up a windrow composting plant, after it was forced to abandon the landfill at Cheranalloor Grama Panchayat in 1998 due to public dissent against open waste dumping. In 2010, KMC bought more land here. It is a wetland bordered by Kadambrayar and the Chitrapuzha rivers. Chellippadam, once thriving with paddy fields and coconut groves, supported 53 families, primarily engaged in farming, cattle breeding and fishing, predominantly from minority and dalit communities.[22] The dependence of six nearby gram panchayats (Vadavucode-Puthencruz, Kizhakkambalam, Thiruvankulam, Kunnathunadu, Thrikkakara and Edathala) on the water of Kadambrayar added to the gravity of the situation.

Even after purchasing the land, KMC failed to establish the intended waste treatment plant. Since 2002, KMC had been dumping waste at a site close to the headquarters of the Southern Naval Command on Wellingdon Island. The Navy had been repeatedly taking up the issue of bird hits and flight safety, but KMC ignored the warnings. The Navy finally withdrew its permission in November 2006 when a Dornier aircraft of the Coast Guard suffered a bird hit in the vicinity of INS Garuda, the Naval Air Station.

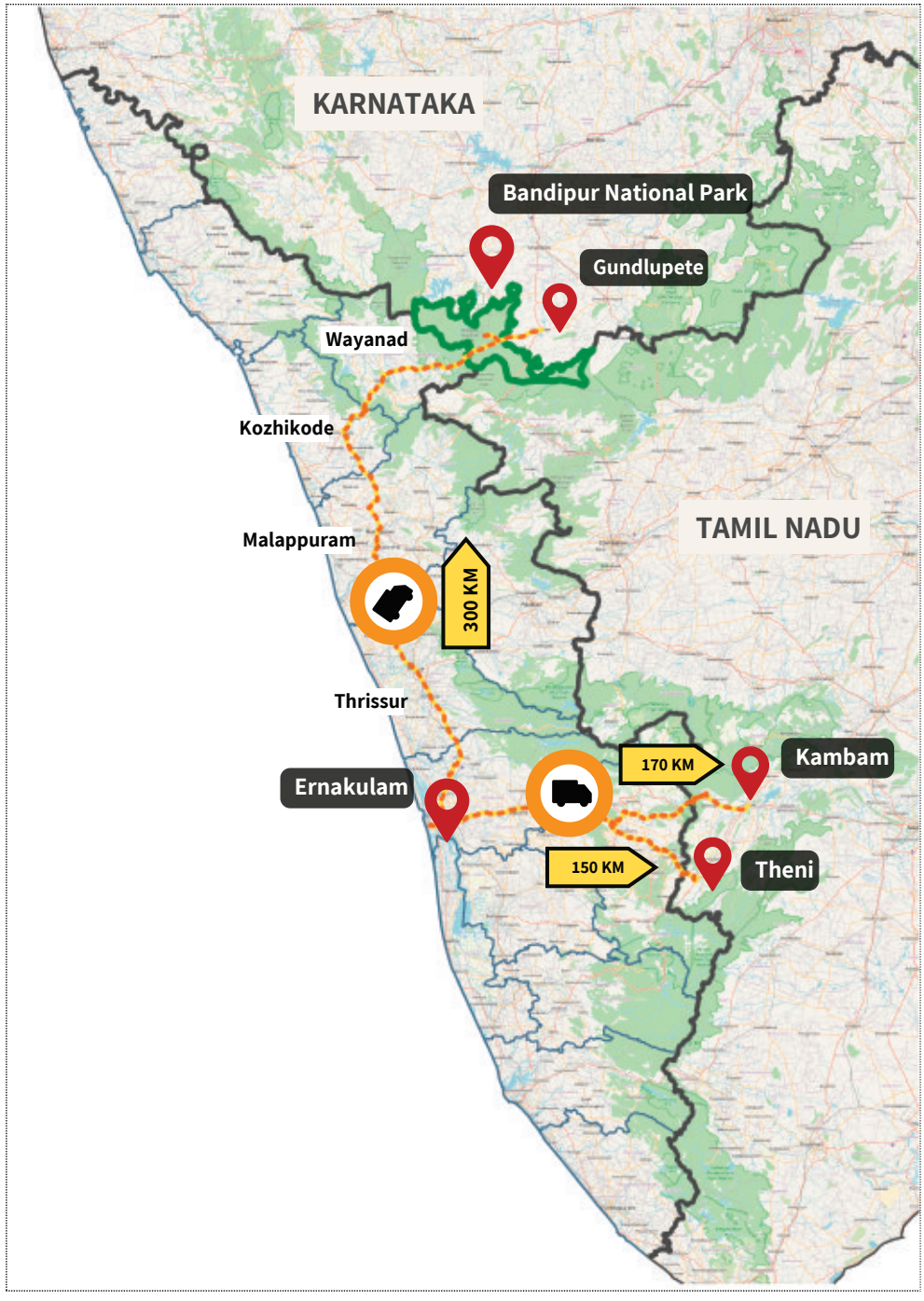
Garbage & Bird Hits

The Cochin International Airport with 187 bird hits stands fifth among all the airports in India for the number of bird hits from 2018 to 2023. Close to 350 cases of bird hits on aircraft were reported in Kerala with the Cochin Airport accounting for the majority, according to a newspaper report.[23] Rule 91 of The Aircraft Rule 1937 prohibits dumping of garbage and slaughter of animals that may attract wildlife within 10 km of Aerodrome Reference Point.

Garbage Trail

Caught in a spot, the corporation resorted to the easy way out by transporting rotten garbage to remote villages in the neighbouring states. On 6 December 2006, a convoy of 19 trucks loaded with stinking waste reached Moolahalli check post near Bandipur National Park in Karnataka, traversing through five districts in Kerala. The waste was finally dumped in a private land at Gundlupet, a small village 20 kms from the Kerala border. Similiar trips have been made to Kambam and Theni in Tamil Nadu but the trucks were sent back by the police and local residents.

Kochi's Garbage Trail 2006



City Stinks

With a firm "No" to open dumping from the Indian Navy, neighbouring LSGIs and neighbouring states, KMC's waste disposal came to a halt. The city started stinking with rotten garbage piling up on roadsides. Mounds of plastic were burnt continuously in many parts of the city. Dumping grounds overflowed. Canals were choked with bags of discards from slaughterhouses. Even the proceedings of the Kerala High Court had to be stopped for a day due to the unbearable stench.

Court Orders Dumping!

On 22 January 2007, while hearing a public interest litigation against garbage piling up within the city, the Kerala High Court ruled that "till a permanent waste disposal plant is established and made functional at Brahmapuram, the said land shall be used for dumping or storage of wastes."[24] The court further ruled that the Ernakulam district collector, the commissioner of police and other officials should see to it that no hurdles were caused by anybody against dumping and storage of waste by KMC at Brahmapuram. If the dumping causes any pollution or nuisances, KMC should take proper steps to avoid it, said the court.

Interestingly, while passing this order, the High Court ignored the Vadavucode-Puthencruz Grama Panchayat's argument that the site was a water-logged wetland and dumping garbage would lead to severe water contamination and environment pollution.

Brahmapuram Police Action

KMC started dumping solid waste at Brahmapuram on 30 June 2007. A convoy of 27 trucks carrying rotten, stinking garbage from the city reached the village with a heavy police escort.[25] The entire village gathered on the road to prevent the trucks entering the area. The police started beating up the protesters. Even women and children were not spared. Some of the protesters were arrested. The stench made many residents sick. Some of them fainted; some others had severe headaches, dizziness and nausea. By that evening, 30 of them were hospitalised. Police booked cases against those who led the struggle.

Eventually, the Chellippadam residents had no other option but to accept the compensation offered by the government and leave their village. Some of them had to fight cases based on false charges framed by the police.

Probe by Independent Committee

An independent fact finding committee formed by prominent environmental and human rights organisations in the state had visited the dump site on 3rd, 4th and 7th July 2007 when dumping of waste at Brahmapuram was at its peak. The committee, chaired by Advocate P K Ibrahim, observed that by dumping unsegregated garbage at Brahmapuram, KMC violated several laws.[26]

Violation of Laws

The independent fact finding committee found that huge quantities of unsegregated rotten garbage was being dumped into the flooded wetland and it was leaking into the Kadambrayar. Dumping was done in clear violation of the Land Utilisation Order 1967, the Water (Prevention and Control of Pollution) Act 1974, the Environmental Protection Act 1986, the Kerala Panchayat Raj Act and the Municipality Act and also without complying with any of the procedural safeguards specified in the Municipal Solid Waste Management and Handling Rules, 2000 to prevent contamination and pollution of soil, water and air.

"The most shocking aspect of such a naked violation is that this activity (garbage dumping) is being allowed to be carried on the orders of the Hon'ble Court with police protection. The Monitoring Committee appointed by the High Court is monitoring the breach of law rather than ensuring compliance of the minimum legal safeguards. This gives an impression that the Hon'ble High Court has given sanction to the present illegal activities of the Corporation of Kochi," noted the report.

"The statutory bodies such as the Kerala State Pollution Control Board, Corporation of Cochin and other government departments, for reasons best known to them, did not appraise the court of the ground realities in its proper perspective," the report noted.

Unauthorised Operation

The windrow composting plant built at the marshy Brahmapuram site in 2009 broke down within one year. Since then the plant could process only 10-20 percent of the total daily waste, and the rest accumulated on the site.

KMC has been maintaining the plant without the mandatory authorisation from the Kerala State Pollution Control Board since 30 April 2010.[27] The Board decided not to renew the authorisation after observing that the waste treatment facility was damaged and the yard was poorly managed.

How KMC could continue to run the plant without authorisation from the KSPCB and why the board didn't act on this violation for over a decade is a pointer to the indifference, inefficiency and dereliction of duty of both the authorities.

SWM Rules 2016

The Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, revamped the Municipal Solid Wastes (Management and Handling) Rules 2000 and notified the new Solid Waste Management Rules, 2016 on 8 April 2016.

These rules are the sixth in the list of specific rules for management of different categories of waste–plastic waste, e-waste, biomedical waste, hazardous waste and construction and demolition waste. All these rules were formed under the ambit of the stringent Environmental Protection Act, 1986.

The new rule authorises the LSGIs (corporation/municipality/panchayat) to manage and control the waste generated within their jurisdiction.

Major Highlights :

(i) Segregation at Source

The new rules have mandated at-source segregation of waste in order to streamline solid waste management, adhering to the principles of Reduce, Recovery, Reuse and Recycle. Waste generators (households, institutions, market associations, event organisers, hotels etc.) should segregate waste into three streams–biodegradables, dry waste (plastic, paper, metal, wood etc.) and domestic hazardous waste (diapers, napkins, mosquito repellants, cleaning agents etc.) before handing them over to the collectors authorised by the LSGIs. The manufacturers or brand owners of sanitary napkins are responsible for building awareness for proper disposal of such waste by the generator and providing a pouch or wrapper for disposal of each napkin or diaper along with the packet of the sanitary product.

(ii) Biodegradable Waste Processing and Treatment:

The biodegradable waste should be processed, treated and disposed of through composting or biomethanation within the premises as far as possible and the residual waste shall be given to the waste collectors or agency as directed by the local authority. All hotels and restaurants will also be required to segregate biodegradable waste and set up a system of collection to ensure that such food waste is utilised for composting or biomethanation.

(iii) Collect Back Scheme for Packaging Waste

As per the rules, brand owners who sell or market their products in packaging material which are non-biodegradable should put in place a system to collect back the packaging waste that they generate.

(iv) Revision of Parameters for Landfill Sites

As per the new rules, any landfill site shall be 100 metre away from river, 200 metre from a pond, 200 metre from highways, habitations, public parks and water supply wells and 20 km away from airports or airbase. However, in special cases, landfill sites may be set up within a distance of 10 and 20 km away from the Airport/Airbase after obtaining no objection certificate from the civil aviation authority/ Air force as the case may be.

Emission Standards have also been amended in the 2016 Rules, and this includes parameters for dioxins and furans. The limit for PM10 has been reduced from 150 to 50 micrograms per cubic metre.

(v) Promotion of Waste to Energy

The rules emphasise promotion of waste-to-energy (WTE) plants and co-incineration facilities.

Non-recyclable waste having calorific value of 1500 Kcal/kg or more shall not be disposed of on landfills and shall only be utilised for generating energy either through Refuse Derived Fuel (RDF) or by giving away as feedstock for preparing RDF.

High calorific wastes shall be used for co-processing in cement or thermal power plants.

The rules mandate all industrial units using fuel and located within 100 km from a solid waste-based RDF plant to make arrangements within six months from the date of notification of the rules to replace at least five percent of their fuel requirement with the RDF so produced.

The developers of Special Economic Zone, industrial estate and industrial park shall earmark at least five percent of the total area of the plot for setting up recovery and recycling facilities.

Time Frames for Implementation of SWM Rules:

- Landfill Identification: 1 year
- Procurement of waste processing facilities: 2 years
- Ensuring segregation of waste: 2 years
- Setting up sanitary landfills: 3 years
- Bioremediation/capping of old landfills: 5 years

Rules Are in Place But...

The Ministry of Environment, Forest & Climate Change (MoEF&CC) has notified several waste management rules under Environment (Protection) Act, 1986, for environmentally sound management of wastes:

(i) Solid Waste Management Rules, 2016

(ii) Plastic Waste Management Rules, 2016

(iii) Bio-medical Waste Management Rules, 2016

(iv) Construction and Demolition Waste Management Rules, 2016

(v) Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016

(vi) E-waste Management Rules, 2022

(vii) Battery Waste Management Rules, 2022

In 2022, Extended Producer Responsibility (EPR) based on market mechanism has also been incorporated within the waste management framework for environmentally sound management of plastic packaging waste, e-waste, waste tyres, battery waste and used oil.

Wasted Projects

Between 2009 and 2023, KMC had made plans for at least five waste management projects at Brahmapuram. None of them succeeded. In 2016, KMC made agreements with a private firm for a 500 TPD waste to energy project. But the project did not take off. In 2020, after a fire breakout, the state government intervened in KMC's waste management by invoking the provisions of the Disaster Management Act, 2005. Plans to carry out biomining and set up a waste-to-energy plant were initiated by the Kerala State Industrial Development Corporation (KSIDC). In 2021, KMC made

Failed Plans

2009: A windrow composting plant with a capacity of 250 tonnes/day was inaugurated. However, the building partially collapsed within a year due to faulty construction.

2011: KMC planned for a WTE plant under public-private partnership.

2012: KMC signed an agreement with a private company, Bharat Traders, to sell plastic waste stored at Brahmapuram at the rate Rs 1.50 per kg. However, the company bought only the recyclable plastic and the rest was dumped at the plant.

2014: KMC invited international tender for a WTE Project.

2016: KMC signed a contract for a 500 TPD WTE plant with 12.4 MW capacity (cost Rs 295 crore) with a consortium led by GJ Nature Care & Energy Private Ltd. and formed GJ Eco Power Ltd., the special purpose vehicle for project implementation. KMC was supposed to provide 300 tonnes of waste per day; the rest was to be taken from the legacy waste. The foundation stone for the plant was laid by the chief minister in 2018. GJ Eco Power got the mandatory clearances in 2019. The project was supposed to take off in 2021. However, the private firm failed to start work, citing financial constraints.

2020: After a fire breakout, the state government took over the waste management at Brahmapuram plant from KMC, invoking the provisions of the Disaster Management Act 2005. The Kerala State Industrial Development Corporation (KSIDC) was entrusted to identify an agency for biomining at Brahmapuram. The contract with GJ Eco Power was cancelled in April 2020.

2021: KMC decided to set up a new 300 TPD windrow compost plant. But the project failed to take off.

2021: KSIDC proceeded with plans for biomining and a WTE plant. Bengaluru-based Zonta Infratech Private Limited selected for biomining. Under the state government's instruction, KMC entered into a Rs 54 crore contract with Zonta. The company was supposed to move the Refuse Derived Fuel (RDF) from the site after biomining. However, the state government allowed Zonta to store the RDF in 20 acres of land leased out to KSIDC to build a WTE plant.

May 2023: After the massive fire in March, it was found that biomining had not been done in a proper way and the firm had completed only about a third of the work. Faced with severe criticisms, KMC cancelled the contract with Zonta. The company was paid around Rs 10 crore till then.

agreements with another firm for biomining but the project could not achieve much progress. The dismal conditions of the dumping yard continued, leading to repeated fire incidents.

Illegal dumping

Interestingly, even after the state formulated its policy on solid waste management in 2018 with a focus on decentralised waste management, waste reduction, reuse and recycling to finally attain a zero waste scenario, KMC remained indifferent towards streamlining its garbage management. Despite several inspections and directions by KSPCB and SLMC, KMC neither bothered to repair the damaged plant nor comply with the municipal solid waste management rules.[27]

After conducting an inspection at Brahmapuram on 3 March 2021, the SLMC reported that the facility was yet to conform to the standards prescribed under SWM Rules, 2016. In a report submitted to NGT, SLMC pointed out that the windrow composting facility was in a dilapidated condition, unsegregated garbage from KMC and other local bodies was being dumped over the legacy waste, and there was heavy flow of leachate into the marshy land and contamination of the Kadambrayar. In 2018, the Central Pollution Control Board (CPCB) reported that a stretch of the Kadambrayar between Manackakadavu and Brahmapuram was severely polluted and did not meet the water quality criteria.

The poorly-maintained waste treatment plant with cracked beams and a sinking floor was frequently in the news, but dumping of garbage continued.

NGT Orders, High Court Stays

- The National Green Tribunal in 2016 directed KSPCB to prosecute the officers who were responsible for consistent violation of SWM Rules 2016 (Order issued on 31 May 2016) in the case of Brahmapuram. This order was stayed by the Kerala High Court.[28]
- In 2018, NGT ordered (In OA Nos.533-535/2018) to establish an integrated solid waste treatment plant at Brahmapuram to be completed within six months. The court also ordered treatment of the legacy waste in accordance with SWM Rules 2016. For the inordinate delay in taking up the work, a penalty of Rs. 1 crore was imposed on KMC. Another direction by NGT was to submit a Performance Guarantee of Rs. 3 crores with KSPCB within 15 days. KMC challenged this in the Kerala High Court and obtained a stay. This stay was vacated by the HC in March 2023 soon after the fire disaster.
- KSPCB issued a direction to KMC on 13 January 2021 imposing a compensation of Rs.14.92 crores for non-compliance of the SWM Rules, 2016 after assessing the environmental impacts of dumping garbage at Brahmapuram. This order was challenged by KMC in the Kerala High Court WP (C) No. 3478/2021 and obtained a stay against the order on 9 March 2021.

CAG Slaps KMC

The Performance Audit Report of the Comptroller and Auditor General (CAG) of India, 'Waste management in Urban Local Bodies,' (ULBs) for the audit period 2016-2021 submitted before the Kerala Legislative Assembly in 2022 had made several critical observations on the state of solid waste management in Kerala, and on the Brahmapuram waste processing site in particular. Some of the comments of the CAG report on the Brahmapuram plant are given below:

- Dilapidated conditions of the windrow composting plant resulted in poor processing of bio waste into compost at Brahmapuram.
- Between 2016-2021 alone, KMC paid a tipping fee to the contractor at the rate of Rs 550 per tonne for the entire amount of waste supplied to the plant, though the plant processed only 33 percent of the waste. Despite the agency having no role in transportation of waste to the plant, payment of tipping fee was linked in the contract to the total quantum of waste brought into the treatment plant and not to the waste processed by the agency. Excess payment attributable to this unjustifiable clause amounted to Rs 11.72 crore.
- The State government in November 2015 directed all departments and local bodies to adhere to e-tender procedure while awarding works with estimated cost of Rs five lakh and above. In violation of the above, Kochi Corporation selected the same contractor, who failed to do the work in the best interest of the corporation, for MSW treatment during 2012-2021, by extending the period of contract and not uploading e-tenders.
- KMC was in possession of 97 vehicles for waste removal. Of these, 66 vehicles were kept off the road for the five years covered under the audit for want of fitness certificate.
- The total quantity of plastic waste collected and transported to the Brahmapuram plant during 2017-2021 was 1,69,293 tonnes. The total expenditure incurred towards transportation and hiring of Hitachi/ JCB was Rs 14.16 crore. Thus, on one tonne of plastic waste collected, the Corporation was incurring an expenditure of Rs 836 towards transportation and vehicle hiring charges.
- Out of the total of 1,69,293 tonnes of plastic waste collected, recyclable plastic waste recovered was just 769.3 tonnes (0.45 per cent). This was sold by the Corporation at the rate of Rs 1.50 per kg to a contractor, recovering a revenue of just Rs 11.54 lakhs.

Source : Performance Audit Report of CAG, 2022

Chapter 3

Recovery Efforts

Following the massive fire on March 2, 2023 at Brahmapuram, KMC's negligence in complying with SWM Rules 2016 and the state's municipal solid waste management policy assumed sudden importance and became hot topics of discussion for many days. It also brought to attention the inadequate disaster preparedness and management at the local, district and state level.

Despite being the largest dump site in the state, monitoring systems and warning mechanisms that enable early detection and rapid response to prevent fires from escalating and causing extensive damage were absent at Brahmapuram. The affidavit filed by the Additional Chief Secretary, Environment Department, Government of Kerala, before NGT on 14 March 2023 pointed out that at the time of the fire breakout, "the waste in the yard had been dumped in huge heaps preventing free movement of fire tenders and other equipment. None of the hydrants in the yard were working. There was also no CCTV surveillance".

Specialised fire-fighting equipment that can surmount the unstable heights of mountains of waste should have been provided at the facility. Essential security measures such as fencing, police patrolling, and the presence of fire tenders were not adequately implemented, leaving the dump site vulnerable to unauthorised access and uncontrolled fires. A dedicated fire and emergency services division responsible for responding to and managing dump site fires equipped with trained personnel, specialised fire-fighting equipment, and resources to effectively handle such incidents was missing.

Managing a fire disaster at a dump site involves coordination among various agencies including disaster management authorities, local bodies and the fire and police departments. Inadequate coordination results in delays in responses as well as lack of communication, collaboration and allocation of responsibilities and funds. This lack of coordination was evident during the first few days of the fire at Brahmapuram.

Immediate Responses

Fire detection systems and early warning mechanisms were absent at Brahmapuram

Initially, the disaster created a public outcry and knee-jerk responses from the state machinery. KMC and the state government engaged in blame games for a few days:

KMC: "The fire could be an act of sabotage. As for the management of the Brahmapuram site, the state government has an equal responsibility since it took over the waste management in 2020 invoking the Disaster Management Act. The company engaged in biomining at the time of the fire incident was selected by KSIDC".

State Government: "The KMC has utterly failed in delivering its duties regarding waste management and complying with SWM Rules, 2016 and the state's SWM policy 2018. KMC has been ignoring the directions from NGT and KSPCB".

Brahmapuram plant worked without KSPCB's consent since 2010

HC & NGT: After the High Court and the NGT intervened, the dimensions of the issue changed drastically. Observing that the city has turned into a gas chamber, the Kerala High Court–which had ordered the dumping of garbage at Brahmapuram in 2007–now initiated a suo motu writ petition [WP(C) No. 7844 of 2023(S)] immediately after the fire. The court impleaded an array of officials including the Chief Secretary and Additional Chief Secretary (LSGD) of the Kerala Government; the District Collector; the Chairperson and Secretary of KMC; the Chairperson of KSPCB; the Director General of the Fire and Safety Department and the State Police Chief. The court put pressure on the officialdom to expedite short-term and long-term measures to prevent further mishaps at Brahmapuram. Going further deeper, "to improve the future and also ensure the complete implementation of SWM 2016 Rules," the writ petition sought definite deadlines for the completion of the state's commitments under the rules.

The High Court also observed that environmental degradation is a disaster under the Disaster Management Act 2005 and the District Collector should oversee the implementation of the SWM Rules, 2016. The court appointed a high-level monitoring committee and a three-member team of amici curiae to evaluate the developments at Brahmapuram and intimate the court.

A report submitted by the high-level committee observed that the available area for the windrow composting plant at Brahmapuram was not adequate to treat the huge quantity of waste brought to the site and that the dilapidated plant could collapse at any time. The committee also found that the capacity of the biomining machinery was inadequate for the completion of the work within the stipulated time frame. The segregation and sorting of legacy waste at the site were not in accordance with the Central Pollution Control Board's guidelines.

NGT too took immediate action and imposed a fine of Rs 100 crore as environmental compensation on KMC for flouting SWM Rules 2016. KSPCB also imposed a fine of Rs 1.8 crore on KMC as environmental compensation for non-compliance with SWM Rules 2016 and causing pollution and contamination of air, water and soil. KMC secured stays from the Kerala High Court in both cases.

KMC has been operating the Brahmapuram site without the mandatory authorisation from the Board since April 2010. KSPCB had conducted periodic inspections and served notices directing KMC to comply with the Environmental Protection Act 1986 and the waste management rules. However, KMC kept on ignoring the Board's directions.

Action Plans

The interventions by the statutory bodies as well as public pressure forced KMC, the District Disaster Management Authority (DDMA) and the state

government to come up with short-term and long-term action plans for waste management in Kochi (also for the state), apart from improving facilities at Brahmapuram.

Waste Management:

- KMC will repair the existing plant or set up a new windrow composting plant within a year. Until then, a temporary system to treat biowaste will be set up.
- Biodegradable waste coming to Brahmapuram would be reduced.
- Composting bio-waste at source of biowaste at source would be made compulsory, providing necessary simple facilities such as bio-bins to households and institutions through the Suchitwa Mission, the technical support agency in the waste management sector under the Local Self Government Department, Government of Kerala.
- Bulk waste generators such as hotels, restaurants and residential flats will be instructed to dispose of biowaste on their own.
- Plastic and other non-biodegradables would not be sent to Brahmapuram.
- Adequate number of Material Collection Facilities (MCF) and Resource Recovery Facilities would be set up in the city. Non-biodegradable waste would be collected by Haritha Karma Sena, segregated and sent for further processing through approved service providers.

Tangible Progress

KMC has increased the number of simple facilities such as pipe composting, vermicomposting and organic waste converters in some divisions. According to Suchitwa Mission documents,[29] more composting facilities such as pipe composting and vermi-compsting were provided to households in Ernakulam district for treating biodegradable waste. As for overflow biodegradable waste, biogas plants, windrow composting plants and Thumboormuzhi plants were established at the community level.

For non-biodegradable waste, more Material Collection Facilities (MCFs) and Resource Recovery Facilities (RRFs) were established. Projects were taken up to establish three community-level sanitary napkin destroyers. As part of the project to turn former open waste dumps to parks and gardens called Sneharamam, several garbage vulnerable points were identified in the district and accumulated wastes removed from them.

KMC has set up more composting facilities to process food waste

As of 18 September 2023, the quantity of biodegradable waste reaching Brahmapuram got reduced to 180 TPD; 150 tonnes from households and 30 tonnes from commercial institutions.

Stabilising Legacy Waste

After the fire disaster, KMC engaged Bhumi Green Energy, a Pune-based company, for biomining the legacy waste. As of October 2024, according to

Pipe Composting

This is a simple facility in which biodegradable waste is converted into compost naturally by putting it in two one metre long, 20 cm wide PVC pipes with caps that remain fixed vertically on the ground. It is suitable for a small family.

Vermicomposting

Worm composting or vermicomposting, uses the digestive power of earthworms to consume and recycle kitchen waste and other organic matter to create a nutrient rich soil amendment called worm or vermicompost.

Thumburmuzhi Model Composting

This composting facility, developed in the Thumburmuzhi campus of the Kerala Veterinary and Animal Sciences University, consists of a 4x4 feet ferro-cement or brick tank. About two tonnes of waste can be processed into compost in 90 days in this tank.

Organic Waste Converter

It is a machine to convert organic waste into compost. The collected waste is shredded to reduce size. The decomposed waste is moved into a chamber to mature into compost. The curing process takes about seven days.

KMC, about 55 percent of the work was over. The work is expected to be completed by April 2025.

Adopting DM Act

Under pressure from the Kerala High Court and arming itself with the extraordinary powers of the Disaster Management Act 2005, the District Disaster Management Authority (DDMA) expedited several actions at the Brahmapuram site which had been pending for long under the business as usual situation.

SOP for Brahmapuram

To enhance safety measures and mitigate potential hazards, DDMA prepared a comprehensive Standard Operating Procedure (SOP) for the Brahmapuram Waste Yard to ensure the safety of personnel, mitigate property damage, and protect the environment during emergency situations.

The SOP outlines the protocols and procedures to be followed in the event of a fire emergency, including prevention, detection, response, and mitigation efforts. It covers the coordination of various teams, such as firefighting, security, medical response, and technical support, to ensure an efficient and effective response to fire incidents. Additionally, this SOP encompasses measures for surveillance, access control, training, equipment maintenance, and collaboration with external agencies like law enforcement and medical services. The SOP is to

be regularly reviewed, updated, and practised through drills to ensure readiness and effectiveness in responding to fire incidents at Brahmapuram.

Facility Enhancement

In order to facilitate the movement of fire tenders and reduce the possibility of spreading of fire, a seven-metre gap is cleared out among the seven clusters of garbage. Hitherto dysfunctional fire hydrants and CCTV cameras were repaired, high capacity water pumps and a water tank were installed, and a watch tower constructed. More fire watchers were employed for round-the-clock surveillance of the waste heaps. The legacy waste heaps at Brahmapuram were covered with tarpaulin sheets. The overriding powers of the DM Act were used to provide fast-track authorisation for setting up a new windrow composting plant at the facility.

To prevent the seepage of toxic ash and other residues to the surrounding water body, the Chithrapuzha, protective walls were constructed at the boundaries of the waste treatment plant.

Medical Plan

- An institutional protocol has been established by the department of health and guidelines were issued to provide immediate medical assistance to firefighters and other personnel during an emergency.
- Vadavucode Community Health Centre has been designated as the First Response Unit to provide medical assistance for minor burns sand breathing difficulties.
- Medical Officer of Vadavucode Community Health Centre has been assigned the status of Field Nodal Officer of Brahmapuram. Coordination with the District Medical Officer and other district level officers will be done by the Field Nodal Officer Guidelines have been drawn up to mobilise emergency medicines and oxygen cylinders and to activate the Emergency Rapid Response Team immediately.

If a situation arises where patients need to be shifted to private hospitals with tertiary-level treatment facilities, an expert team led by the DMO shall enable emergency coordination.

Yet Another Centralised Plant

While on the one hand, plans were declared and efforts were started to make the Kochi city adopt decentralised waste management methods, the state government reverted to the same old path of centralised, large-scale, technology-driven and expensive solutions. Four months after the 2023 fire breakout, the government sanctioned a centralised compressed biogas (CBG) plant at Brahmapuram proposed by the Kochi Refinery unit of Bharat Petroleum Corporation Ltd (BPCL).[30] The project would once again make continuous supply of biodegradable waste to the plant necessary. The Detailed Project Report was approved in November 2023. The CBG plant is expected to be operational in January 2025.

The waste treatment capacity of the proposed plant is 150 tonnes a day. KMC

What is CBG?

Biodegradable wastes such as food waste, cow dung, poultry litter, agri residues, biomass, animal waste and waste from sewage treatment plants produce biogas through the process of anaerobic decomposition. The raw biogas is purified to remove hydrogen sulphide (H_2S), carbon dioxide (CO_2), water vapour and then compressed as Compressed BioGas (CBG), which contains more than 90 percent methane (CH_4), a highly combustible gas.

Compressed Biogas (CBG) production involves the following steps:

1. Feedstock collection: Gathering organic matter like food waste, agricultural waste, or animal manure.

2. Anaerobic digestion: Microorganisms break down the organic matter in the absence of oxygen, producing biogas (CH_4 & CO_2).

3. Biogas cleaning: Removing impurities like H_2S, H_2O, and CO_2 to increase CH_4 content.

4. Compression: Raising the pressure of the cleaned biogas to 200-250 bar for storage and transportation.

handed over 10 acres of land free of cost at Brahmapuram to BPCL for setting up the plant. The construction cost of the plant is estimated to be Rs 150 crore which would be borne by BPCL. Water and electricity required for the plant would be provided at a lower cost.

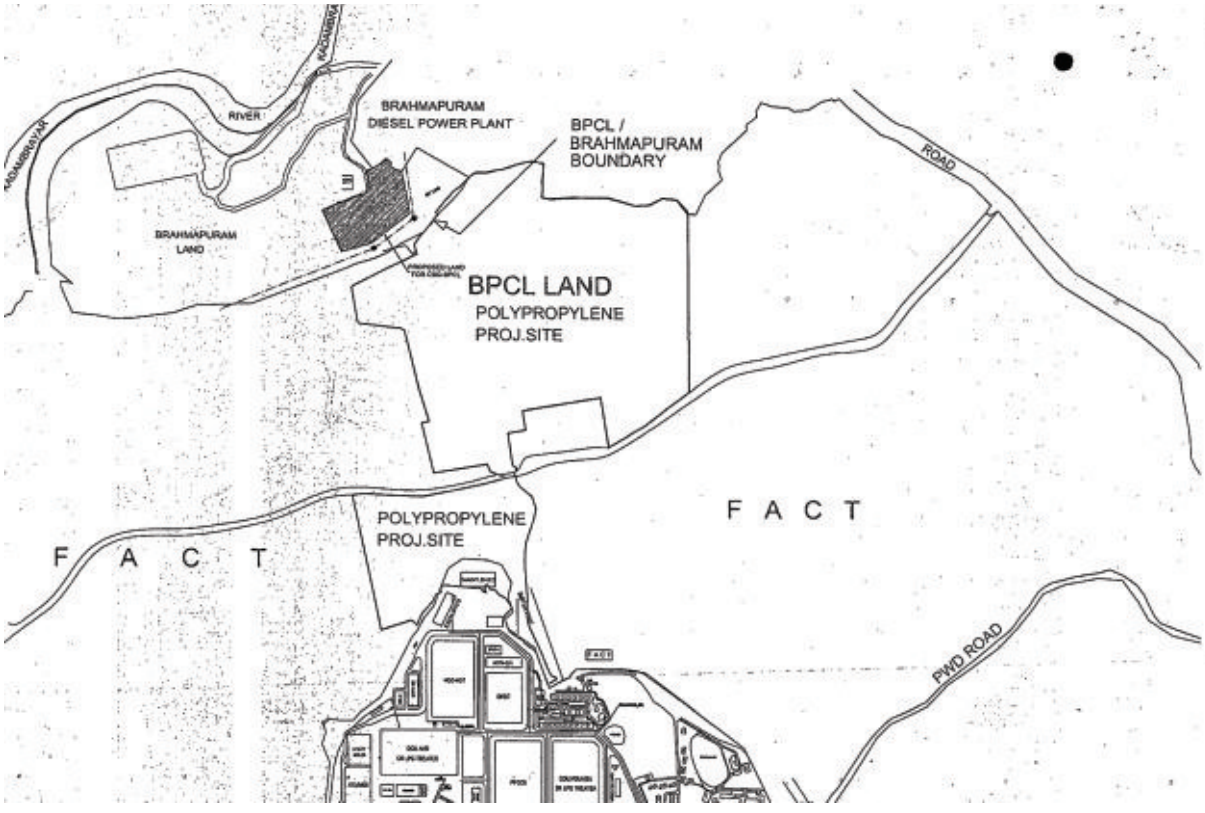
Though the state government initially suggested supplying 240 TPD of waste–180 TPD of biodegradable waste from KMC area and 60 TPD from neighbouring LSGIs–KMC's commitment was later reduced to 150 TPD. KMC will have to ensure supply of source segregated organic fraction of MSW at the Brahmapuram plant using waste transportation trucks.

The CBG Path

The National Policy on Biofuels 2018 emphasises promotion of advanced Biofuels including CBG. The Ministry of Road Transport and Highways permits usage of bio-compressed natural gas (bio-CNG) for motor vehicles as an alternative to compressed natural gas (CNG).

The BPCL project at Brahmapuram has been conceived in such a way that the compressed biogas would be used as a fuel within its Kochi Refinery plant. If the methane content of the upgraded CBG is above 90 percent, it can be used directly as a transportation fuel to replace Compressed Natural Gas (CNG) or injected into the gas grid as compressed biogas.

However, "based on the criticality from environment and safety point of view and having very stringent timelines, the project has been conceived considering CBG as a fuel in Kochi Refinery," says the BPCL proposal. "As CBG market is emerging in terms of its usage in vehicular, CNG (Transport) and PNG (Domestic) segments also, feasibility of the same shall be explored in due course of time."



Source: BPCL. Detailed Project Proposal

BPCL claims that the CBG project will give relief from increasing garbage issues and pollution. It will help KMC to align with the central government's initiatives such as Swachh Bharat Mission and Smart and Sustainable Cities and gain subsidies and benefits. It will also reduce greenhouse gas emissions and help in achieving national commitments on climate change.

CBG Status in India

In India, the technology for CBG, dubbed as the "Fuel of the Future," is being promoted under the National Policy on Biofuels 2018, the Galvanizing Organic Bio-Agro Resources Dhan (GOBAR-DHAN) scheme, the Central Financial Assistance (CFA) for Bio-CNG promoted by the Ministry of New and Renewable Energy, etc.

Recent facilitative measures for CBG include the establishment of a special fund for partial guarantee funded through the Swachh Bharat Mission and a special subsidy for waste processing.

The Sustainable Alternative towards Affordable Transportation (SATAT) scheme of the Government of India had aimed at achieving 15 MT (Million Metric tonnes) of CBG production by 2023 from 5,000 plants across India. But "there are currently 74 operational CBG plants, while 432 plants are either in the process of development or are yet to commence construction," said a 2023 report in Down To Earth.[31]

Despite significant support from the central government and a few state governments, more than 90 per cent of the operational CBG plants are functioning below intended production capacity, the report said.

CBG Requires Quality Segregation

For a CBG plant to be viable, continuous supply of stipulated quantity of quality feedstock is required. A report by the Centre for Science and Environment (CSE), New Delhi, in 2019, points out that inefficient source segregation of municipal solid waste is a problem for biogas plants because it can lead to contamination of the feedstock used in the production process.[32] When waste is not properly sorted, it may contain non-biodegradable materials, such as plastics and metals, which can damage the equipment used in the plant and reduce the production efficiency. Besides, this could reduce the quality of biogas. In order to get a considerable yield of gas, the segregation level should be more than 90 percent.

Some other characteristics of MSW that can negatively affect the production of CBG are low carbon to nitrogen ratio and the presence of toxic substances such as ammonia, pesticides, detergents and heavy metals. Feedstock that requires extensive pre-processing leads to higher operational costs.

CBG Needs Landfill

The solid wastes from the plant have to be disposed of in a sanitary landfill. BPCL has sought the required support from the government since it lacks expertise and experience in managing landfill. The state government has committed that it would set up the required facilities. For sewage treatment, the CBG plant proposed at Brahmapuram would require 100 MLD capacity. The STP at Brahmapuram has only 100 KLD capacity presently.

'Black Soldiers' to Treat Waste

Until BPCL's CBG project is commissioned, KMC has decided to treat its biodegradable waste with Black Soldier Flies. It has given the work to two private firms, Zigma Global Enviro Solutions and Fabco-Food Waste Management. Each firm is assigned a target of processing 25 tonnes of fresh food waste per day. The trial run began in February 2024. Based on efficiency, one firm would be selected to handle further work, and the plant's capacity would be enhanced. The corporation will pay the firms Rs 250 per kg for treating biowaste.

How do the Flies Work?

Black soldier flies are one of the most versatile insects that can be used to upcycle organic waste materials. This scavenger insect is native to the southern part of the US, South America, Central America and the Caribbean Islands but now it's found globally.

The adult flies are harmless and do not feed. However, the immature legless stage of the fly, called larvae or maggots are decomposers. They feed voraciously on a wide range of organic materials, including food waste, paper mill sludge and dead animals. BSF can be used to compost organic waste by harvesting the larvae or pupae. Black Soldier Fly Larvae (BSFL) can consume 25-500 mg of fresh matter per day, depending on their size and reduce the initial weight of the organic waste by about 50 percent in a shorter period than the conventional composting methods.

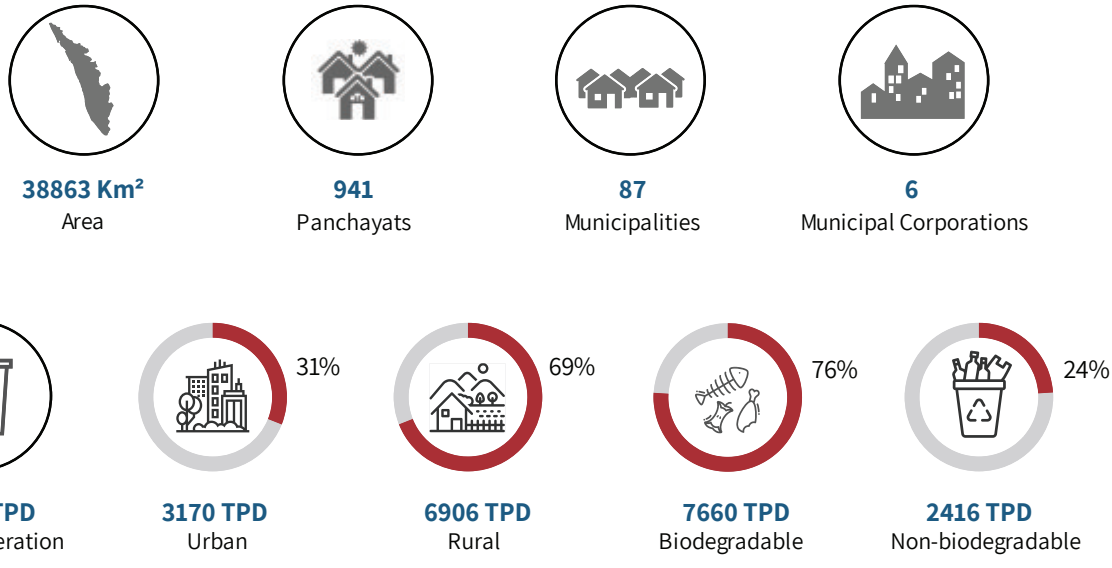
2 Kerala

Photo: **Nithin Krishnan**

Chapter 4

Waste Worries

Kerala and its Garbage



*TPD - Tonnes Per Day

Source: Compliance Report submitted before NGT by Government of Kerala, October 2024.

"In a way, it's good that a massive fire broke out at Brahmapuram because it forced everyone to focus attention on Kerala's waste management crisis," said an official of Suchitwa Mission, the state government agency that gives technical guidance on waste management. "For many days at a stretch, everyone, judiciary, state government, the Kochi corporation, media and the public were all talking about the waste issues."

The sarcasm is inevitable. Behind Kerala's self-proclaimed and glorified "God's Own Country" image, there lurked mountains of waste dumps, polluted water bodies and choked drains. Massive protests, voluminous pollution studies, judicial warnings, wide-spread efforts for decentralised governance, mission-mode sanitation initiatives, specialised projects aided by international financial institutions and token cleanups could not achieve the required results. Brahmapuram provided the heat and the fire needed to

rekindle the state's collective responsibility in addressing the waste management crisis.

Even before the Kerala High Court coming down heavily upon the state in the context of Brahmapuram and impleading top officials, the Supreme Court of India, the National Green Tribunal (NGT), the Comptroller and Auditor General of India (CAG), the state planning board and other agencies had pointed out that something was rotten in the state of Kerala.

Between the Mountains and the Sea

Kerala is located in the southern tip of the Indian Peninsula between the Arabian Sea in the west and the Western Ghats in the east with a land area of 38863 sq.km. The state has a population of 3.34 crore with a density of 860/km^2 (Census of India, 2011), which is more than twice the national average.

Stretching from north to south, Kerala has a coastline of 592.9 km, and the width of the state ranges from 30 to 120 km from east to west. The state has three specific physiographic regions: the eastern highlands with the mountains of the Western Ghats, the central midlands with undulating hills and valleys that are intensively cultivated, and the western lowlands with a large and unique network of estuaries, backwaters and the coastal regions. The Western Ghats forming the eastern border of the state is a unique mountain landscape that houses the highest peaks south of the Himalayas. The state has 44 rivers of which 41 are west-flowing and joining the Arabian Sea.[33]

Photo: Nithin Krishnan

In managing waste, the state could not match with urbanisation

Trash Sprawl

Kerala has been urbanising more rapidly than the national average with an annual urban population growth of 6.5 percent, as Census of India figures indicate.[34] The share of urban population of the state has shown a sharp increase from 25.96 percent in 2001 to 47.72 per cent in 2011. Corresponding figures for India were 25.52 percent in 2001 and 31.16 per cent in 2011. With fast-paced urbanisation, human settlements too have increased, making the state a string of urban and semi-urban areas. Urbanisation and associated changes in lifestyle has promoted conspicuous consumption of materials and energy and waste generation too.

As for managing its growing waste, the state could not keep pace with urbanisation, and the waste management service levels remained substantially below the national benchmarks, observes the Implementation Report of the World Bank-aided Kerala State Solid Waste Management Project (KSWMP) 2021.

Even though the Municipal Solid Wastes (Management & Handling) Rules 2000 had made waste management mandatory functions of the local bodies and recommended setting up centralised facilities in towns and cities, land-scarce Kerala found it difficult to implement this. Besides, the centralised composting plants in the state failed due to wrong assessment of quantity of waste generated, lack of segregation of waste at source, incompatability of technologies chosen, poor construction, operation and maintenance failures and also the indifference of authorities as happened at Brahmapuram in Kochi and Vilappilsala in Thiruvananthapuram. The long monsoon period stretching up to six months aggravated the state's waste woes. [35]

All this resulted in accumulation of unsegregated, decaying municipal waste in vacant lands, marshlands, canals, streams, rivers, seashores, street sides, sides of railway tracks and even within the protected forests. Waste from cities and towns ended up in villages. Open dumping of solid waste resulted in mounting of legacy waste.

There are 59 identified legacy waste sites in the state, as per the report submitted by the state government before NGT in October 2024.[36] Some of them are six to seven decades old. Most of them are located close to water bodies and cause contamination of water.

People's Plan Falters

In fact, there has been no shortage of sanitation initiatives in Kerala. Following the 73rd and 74th amendments to the Constitution, Kerala had placed the responsibility for sanitation and health in the hands of the urban and rural local self-governments by enacting the Kerala Municipality Act and the Kerala Panchayat Raj Act in 1994. To transfer powers to the Local Self-government Institutions (LSGIs), Kerala also launched a massive participatory programme called Janakeeyaasoothranam or People's Campaign for Decentralised Planning in August 1996. The People's Plan Campaign strengthened Kerala's three-tier local self-government system with better financial devolution, greater roles played by local bodies in formulating and implementing annual plans, and the greater extent of people's participation in development planning.

Waste Hurts Health

Open dumping and accumulation of waste has led to increased morbidity in the state. Kerala is facing an increasing burden of both communicable and non-communicable diseases. Although the state has previously been successful in controlling a number of communicable diseases, the emergence of chikungunya, leptospirosis (rat fever), hepatitis, and H1N1 in recent years has resulted in considerable morbidity and mortality. Instances of vector-borne diseases, such as dengue, malaria, Japanese encephalitis (Japan fever), and scrub typhus, have seen a marked increase in many districts. Waterborne infections, including various types of diarrheal diseases, typhoid, and hepatitis, continue to persist in several areas. Cholera has re-emerged in many districts after a few years of relatively low incidence. The prevalence of dengue is expanding rapidly, particularly in the coastal areas of Kerala in recent years.

"The increase in vector-born and water-borne diseases are directly attributable to the lack of sanitation and hygiene, environmental pollution and unsafe drinking water," noted the State Planning Board in 2017.[37]

The monthly per-capita medical expenditure of a person in Kerala is the highest in the country at 17.9 percent in the villages (national average 13.3%) and 14.4 percent in urban areas (national average of 9.7%), as per the national Household Consumption Expenditure Survey 2022-23.[38]

Much importance had been given to health and sanitation in the People's Plan campaign. However, the campaign could not create the needed improvements in environmental governance in general and waste management in particular.

Mission After Mission

In line with the Central government's Total Sanitation Campaign, the state, in 2000, had started an initiative called Kerala Total Sanitation and Health

Clean Kerala Initiatives

- 2000 - Kerala Total Sanitation and Health Mission (KTSHM)
- 2004 - Clean Kerala Mission (CKM)
- 2007 - Zero Waste Kerala Action Plan
- 2008 - Suchitwa Mission & Malinya Muktha Keralam campaign
- 2012 - Suchitwa Varsham 2012
- 2016 - Haritha Keralam Mission and Nava Keralam Karma Padhathi
- 2017 - Freedom from Waste campaign
- 2021- World Bank-aided Rs 105 million dollar KSWMP Project
- 2023 - Malinya Muktham Nava Keralam (Waste-free New Kerala) campaign
- 2024 - Six-month long Peoples' Campaign ahead of declaring the state as waste-free.

Mission (KTSHM) for rural areas, and in 2004, the Clean Kerala Mission (CKM) for urban areas.

"Nevertheless, by 2006, Kerala's overall score in municipal solid waste management at 24 percent stood below the national average of 34 percent," notes R. Ajayakumar Varma, a scientist and former Executive Director, Suchitwa Mission.[39] Segregation of waste at source stood at just four percent and collection of waste from households was only 33 percent. Only about half of the collected waste could be transported safely to the dump sites, the only means for disposing of waste in the absence of a sanitary landfill anywhere in Kerala.

Scientific Landfill

The site which is used to dispose of residual, non-biodegradable, non-recyclable, non-combustible waste, is called a landfill. A scientifically designed landfill should not pollute the soil, air or water around them. Such landfills should have an impermeable liner at the bottom consisting of clay or high density polyethylene (HDPE) to prevent liquid contaminants (leachate) seeping into the soil and polluting groundwater. It should have a collection mechanism to trap and remove leachate as well as landfill gases emitted from the waste. In a properly managed landfill, residual waste is compacted to conserve space, and a cover material is applied over every new layer of waste to control odour, wind-blown dispersal of waste and dust, and rats and birds feeding on waste. When a landfill is full, it is usually sealed with a cap and covered with topsoil.

Striving for Zero Waste

In November 2007 while implementing the 11th Five Year Plan, the state government formulated a comprehensive action plan involving all the urban and rural local bodies aiming at a 'Zero Waste' scenario in which waste reduction is prioritised through reuse, recycle and recovery of materials.

The Kerala Total Sanitation and Health Mission, and the Clean Kerala Mission were merged to form the Suchitwa Mission in order to provide technical and institutional support to all kinds of activities related to sanitation, including solid and liquid waste management.

With this, an elaborate waste management capacity building process was begun in the state. The LSGIs were directed to formulate their own waste management plans. Sanitation projects were restructured to include solid waste management. But the programme did not go beyond that. A majority of the local bodies failed to implement several key activities, partly because they lacked expertise to plan and implement scientific waste management, and partly because of their political leanings.

Losing Momentum

The campaigns and activities for decentralised waste management lost much of its momentum with the change in government at the state-level in 2011. The new government was inclined to promote 'modern', centralised waste management systems such as mechanised segregation of waste at the dump sites and high-cost, energy-intensive and highly polluting Waste to Energy plants.

Zero Waste Path

Zero Waste is a path towards conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health.

On a practical level, zero waste is both a goal and a plan of action. The goal is to ensure resource recovery and protection of scarce natural resources by ending toxic waste disposal in incinerators, dumps and landfills, and to establish systems that are based on social and environmental justice. The plan encompasses waste reduction, reuse, composting, recycling, changes in consumption habits and industrial redesign - strategies that create more resilient communities, climate solutions, social equity, and healthier environments.

The path to zero waste will be unique to every city and community but the underlying values that direct zero waste efforts are shared and unwavering.

(Souce: Zero Waste International Alliance)

Zero waste is a Revolution in the way we Take, Make, and Waste

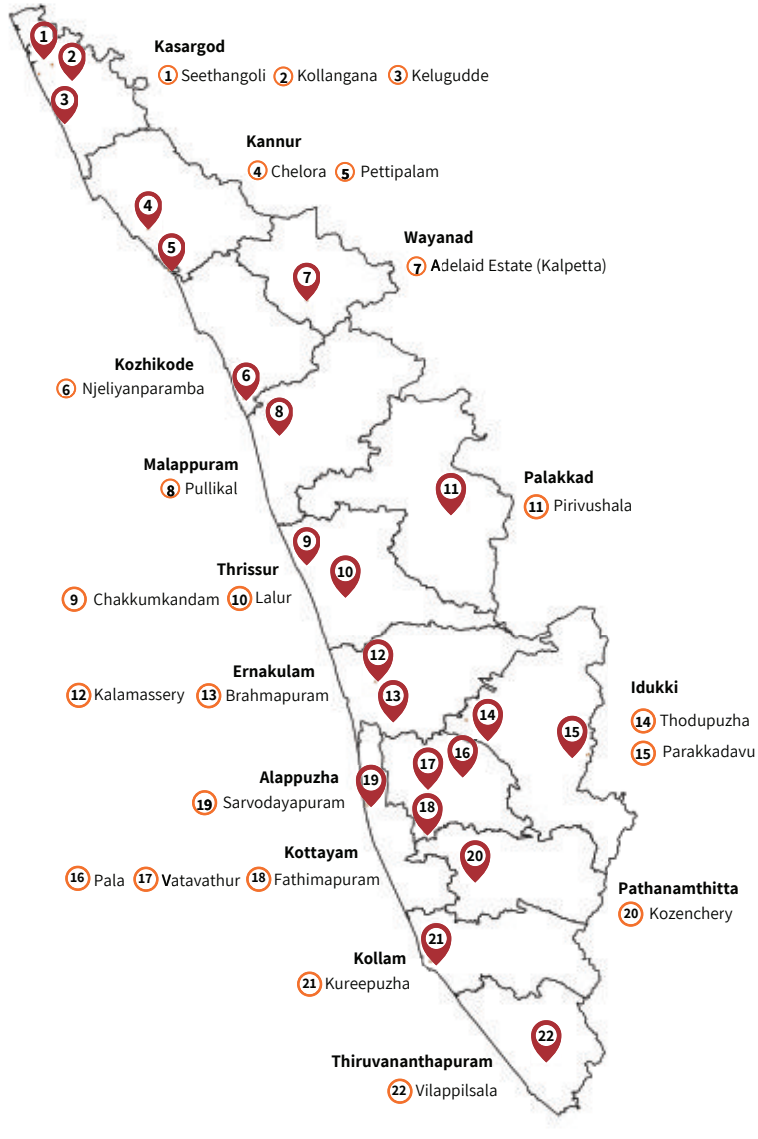
– Global Alliance for Incinerator Alternatives (GAIA)

Chapter 5

Trash Triggers Unrest

Poor waste management in the state and the consequent socio-economic, environmental and health issues forced people living near waste dumps to take up the cudgels to enforce their constitutional rights. During 2010-12, the state witnessed intense non-violent protests and police actions in many places including Sarvodayapuram in Alappuzha and Vilappilsala in Thiruvananthapuram.[40,41] In these two places, protests by people living in panchayats resulted in closure of the poorly managed centralised composting facilities set up by the urban local bodies.

Protest Hotspots (2010-2012)



The storyline follows a familiar pattern: to tackle the city's waste crisis, a municipal authority purchases a plot of land in a village on the outskirts of town. They then enter into a contract with a private waste management company, which often lacks the necessary experience and expertise in waste treatment. These contracts are often based on unrealistic estimates of waste generation. As the project unfolds, the company fails to meet construction deadlines for the waste treatment plant. Simultaneously, the urban local body struggles to deliver the agreed-upon quantity of segregated waste to the facility. As a result, various types of waste accumulate on the site, complicating the waste management process and shrouding it in opacity.

Vilappil Panchayat defied the Supreme Court order favouring TMC

After years of bearing the stench, pollution and the health impacts of garbage dumps in their backyards, people start to protest. Their complaints get ignored and protests are met with brutal police force. In some cases, the conflicts turned into prolonged legal battles between the rural and urban local bodies.

The case between the Thiruvananthapuram Corporation and the Vilappil Grama Panchayat even went to the Supreme Court of India. Under pressure from people's protests, the Vilappil Panchayat even decided to disobey the Supreme Court's order that favoured the corporation. The panchayat made a firm decision not to allow a single garbage truck from the corporation to enter the village.[42] "We will not budge even if the Almighty God orders us, let alone the Supreme Court," the people of Vilappil said in unison.

They Showed The Way

Alappuzha:
Clean Home, Clean City

Decentralised waste management started getting much attention, encouragement and promotion in Kerala after the Alappuzha Municipality's 'Nirmala Bhavanam, Nirmala Nagaram' (Clean Home, Clean City) campaign started in 2012 became a success.

A town with a vast network of 104 small canals, backwaters, lagoons and beaches, Alappuzha is often described as the Venice of the East, and it is one of the most sought-after tourist destinations in India. With an area of 46 sq km and 1,74,000 residents (2011 census) living in 52 wards, the municipality had the highest population density (3675 people/sq.km) among the ULBs in the state. In 2012, the city produced 58 tonnes of waste in a day. About three-fourth of the waste was biodegradable and a large chunk of this came from households.

Alappuzha municipality launched the 'Clean Home Clean City' campaign

The municipality had been dumping its waste for decades in a six hectare-plot owned by it in Sarvodayapuram, a village located in Mararikulam grama panchayat. This plot used to be a night soil dumping ground for Alappuzha town decades ago. The municipality entered into an agreement with a private service provider to set up a windrow composting plant that could treat 50 tonnes of wet waste daily. The company was supposed to set up the plant in 10 months but failed to do so. The municipality too violated the contract by sending unsegregated garbage to the facility. The plant was inaugurated in 2010, but it could only treat 5-10 tonnes a day. The rest of the rotten garbage accumulated on the premises of the plant along with the waste already dumped earlier.

People Oppose Dumping: Years of waste dumping by the municipality caused severe contamination of soil and water resources, stench, and diseases in Sarvodayapuram and its neighbourhood. The villagers rose up in arms against the municipality's waste dumping and held continuous protests, hunger strikes and finally blocked the road leading to the plant. In November 2012, the panchayat decided not to allow any more waste from the municipality. With this, the Alappuzha town turned into a vast dump yard.

New Beginning: Having no alternatives, the municipality launched the 'Clean Home Clean City' campaign, first as a pilot project in its 12 most urbanised wards involving 12,000 households. The campaign's focus was on making households segregate their waste and treat wet waste using simple composting techniques such as pipe composting and portable or fixed biogas plants.

Community Facilities: As the next step, wet-waste collection centres were set up in all the 12 wards. To treat the waste, Thumburmuzhi Model community bins were introduced in Alappuzha, for the first time in the state, at public places and old dumping spots. These bins were developed in the Thumburmuzhi campus of the Kerala Veterinary and Animal Science University, initially for decomposing carcasses. Households and small shops that didn't have their own bins were connected to these community composting facilities. Compost from them was given free of cost to farmers.

Arrangement For Bulk Waste Generators: While the 'Clean Home, Clean City' campaign focussed on the households, the municipality also initiated steps for linking the big shops, hotels and markets with authorised private service providers for collecting and disposing of their wastes. Peoples' squads and the municipality kept vigil for detecting violations in the system and imposing fines when required. Phase by phase, other wards too were brought under the campaign. Within five years, the municipality succeeded in making around 80 percent of the households segregate their waste and in treating 45 percent of its biowaste through simple, decentralised, low-cost processes.

Non-Biodegradable Waste

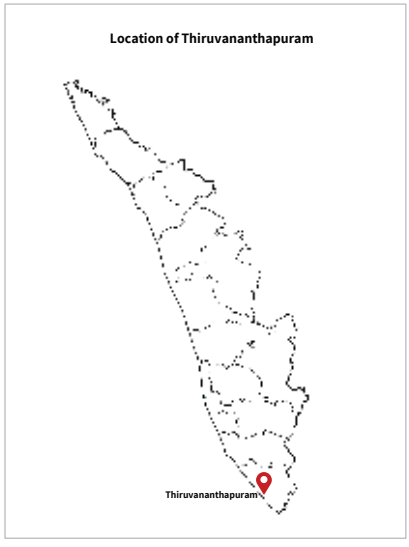
Of the total municipal waste in Alappuzha, plastics made up 4-5 percent. All the wards in the municipality conducted plastic collection drives once in two-three months. To store and sort its non-biodegradable waste, the municipality

set up 10 mini material collection facilities (mini-MCFs) and one centralised MCF. This was then collected by the Clean Kerala Company.

The Alappuzha Municipality has won many regional, national and international awards and recognitions for its decentralised waste management efforts.

Alappuzha's successful experiment was identified by the United Nations Environment Programme as one of the five adoptable models in the world.

Thiruvananthapuram:
My City, Beautiful City



The Thiruvananthapuram Municipal Corporation (TMC) was forced to seek other ways to manage waste when its centralised municipal waste treatment plant, a much-hyped windrow composting facility in Vilappil panchayat failed and was closed down in December 2011 after prolonged protests by the local residents. TMC had secured a favourable order from the Supreme Court in its legal fight with the grama panchayat on sending garbage to the plant. But the people of the Vilappil village stood firm on their stand against bringing the city waste to the village.[44]

TMC then tried to set up another centralised plant elsewhere, but couldn't succeed because of people's resistance. For almost two years, in order to keep the capital city clean, TMC burned and buried waste in its own public lands which soon got exhausted.

Back To The People: Having no other way, TMC started popularising source-level waste treatment through pipe composting, bio bins, kitchen bins and small biogas plants, offering residents subsidies in the range of 75-90 percent. However, these efforts could take care of only one-third of the city's total waste generation (300 TPD at that time).[45]

It was then that TMC decided to adopt the Alappuzha Model and implement it on a bigger scale. TMC formulated a comprehensive municipal waste management plan and started the campaign Ente Nagaram, Sundara Nagaram (My City, Beautiful City).

Total Sanitation Wards: In the first phase of this plan, a few divisions of the corporation were identified to be transformed as Total Sanitation Wards based on certain standards including 80 percent segregation and 60 percent source-level treatment in households. Establishment of facilities for community-level composting and collection of non-biodegradable waste through Kudumbashree groups were the other systems put in place.

TMC adopted the Alappuzha model on a bigger scale

During the 2015 National Games, Green Protocol was introduced for the first time in India

Private sector service providers, college students, technology professionals and a host of others joined hands in the campaign. Scrap dealers were made a part of the waste management system. Bulk waste generators or commercial establishments were required to take responsibility for their own waste. The Clean Kerala Company was made responsible for managing and processing electronic and domestic hazardous waste.

Collection calendars were prepared, monthly collection drives were organised and people were regularly informed about them. Along with this, TMC launched a massive sanitation campaign for spreading awareness in schools and colleges. 'Green Armies' were formed with the help of National Service Scheme (NSS) volunteers

For residential flats and gated communities, TMC offered a 50 per cent subsidy for setting up organic waste management facilities. CSR funds were also pooled in for paying stipend to volunteers and students.

TMC adopted a sustainable economic model in which revenue could be generated from waste. Chicken and meat waste was turned into fertiliser, fetching a reasonable market value. Service providers paid a fee to the corporation. Segregated recyclables were sold to authorised recyclers.

During the 2015 National Games, TMC brought in a 'Green Protocol', for the first time in India, to reduce the usage of plastics and promote alternatives. At all 29 venues of the event, disposable water bottles were banned. The Green Protocol has now become a norm in the state, at government offices and functions. Even some community events such as marriages follow the protocol.

Waste as Poll Plank

Doing away with garbage and making Kerala clean became an electoral plank for the first time in the state during the 2016 elections to the state legislative assembly. The main driving factor for this was people's not-in-my-backyard (NIMBY) attitude and the protests.

Green Protocol

- Reduce the use of all types of disposables (including plastic, paper) in daily life
- Use cups, containers and plates that can be washed and reused
- Avoid banned plastic materials; follow government rules in this regard
- Segregate bio and non-bio degradable things; compost the biodegradables at source
- Keep the non-bio degradables clean and dry and store separately based on the type; hand them over to local body systems or scrap dealer for recycling
- Stop using single-use plastic carry bags: use eco-friendly alternatives
- Use cloth banners instead of flex
- Use natural materials like leaves and flowers for decoration and bouquets

The new government that came into power in May 2016 formed the Haritha Keralam Mission with three focal points: sustainable waste management, conservation and rejuvenation of water resources and organic farming.

Policy Lag

As per the National Solid Waste Management Rules 2016, every state and union territory was supposed to prepare its policy within six months of publishing the rules. It was also mandatory for every local body to prepare a comprehensive plan for managing its municipal solid waste. Kerala published its policy in September 2018 after repeated reprimands from and imposition of a fine of Rs 1 lakh by the Supreme Court of India. It took two more years for the state to frame the strategies to implement the policy.

Kerala's SWM Policy 2018

The state policy envisages a healthy, prosperous, and resource-efficient society in which wastes are reduced, reused, recycled and prevented wherever feasible and beneficial and disposed of in an environmentally safe manner. The policy promotes decentralised solid waste management.

Highlights:

- Waste should be segregated at the source; biodegradable waste should be treated through simple techniques and converted into compost or biogas.
- Every household and apartment should treat its biodegradable waste by itself or at the community facilities set up in each ward.
- Each local body should do door-to-door collection of non-biodegradable waste and store them in Material Collection facilities (MCFs) and Resource Recovery Facilities (RRFs), streamline the management of non-biodegradable waste through approved agencies and the Clean Kerala Company.
- Scrap dealers should be made an important part of the waste management system. Producers should be made legally responsible for the environmental impacts of their products throughout their life cycle under the Extended Producer Responsibility (EPR) policy.
- EPR should encourage companies to design more sustainable manufacturing processes and products. At the end of the lifecycle of products, I.e., after exhausting all options for reuse, recycling and recovery of value/energy, the producers should be made responsible for the safe disposal of their products.

Chapter 6

The Decentralised Path

Building on the successful initiatives undertaken by the Alappuzha municipality and Thiruvananthapuram Corporation, several local bodies began to adopt decentralised waste management strategies. The holistic decentralised solid waste management system in the state encompasses every stage of waste management, including segregation, collection, storage, sorting, transportation, and disposal. Essential components of the system include public campaigns aimed at promoting behavioural change, strengthening institutional capacities, improving the efficiency of technical systems, and enhancing the monitoring and enforcement of regulations. Together, these elements contribute to a more effective and sustainable approach to waste management.

The local self-government institutions, the state Environment Department, Directorate of Urban Affairs, Directorate of Panchayats, Kerala State Pollution Control Board, Suchitwa Mission, Haritha Keralam Mission, Kudumbashree

Photo: Surendranath C

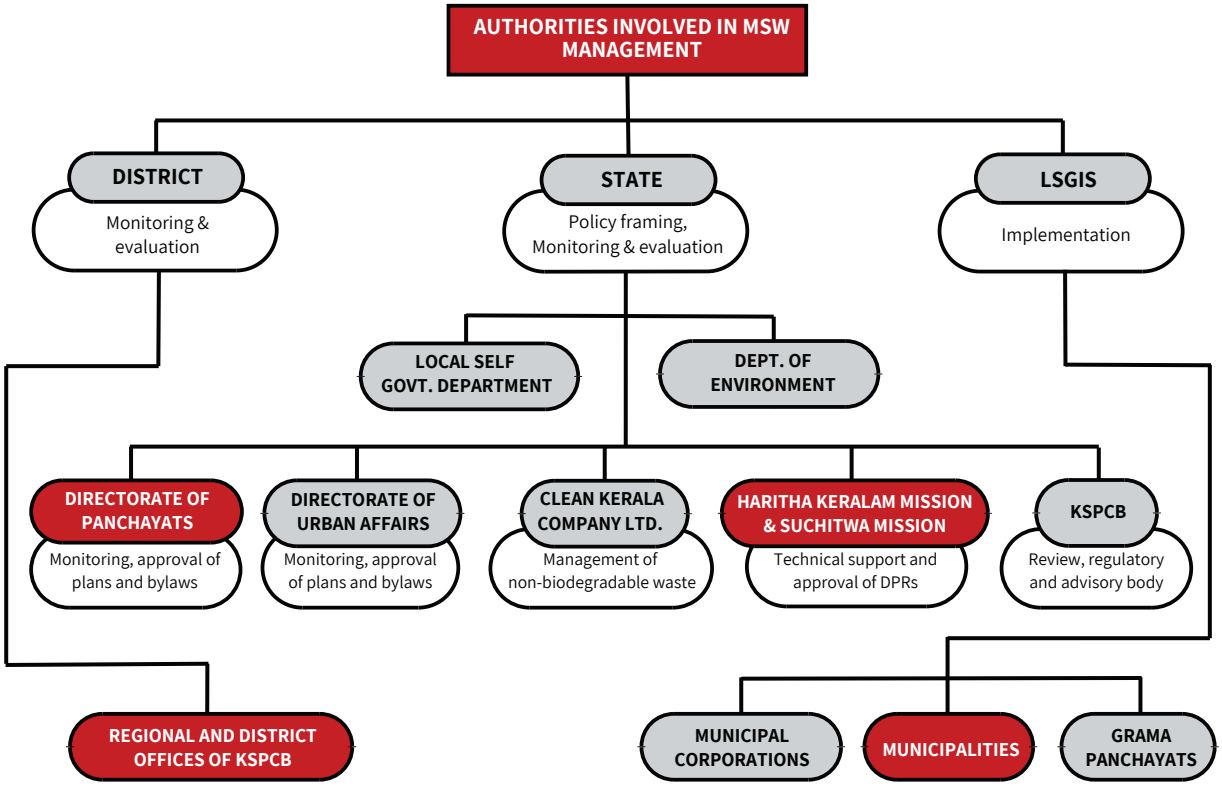
Mission, Haritha Karma Sena (HKS), the Clean Kerala Company (CKCL) and approved service providers are the main agencies involved in decentralised waste management in the state.

Haritha Karma Sena (HKS)

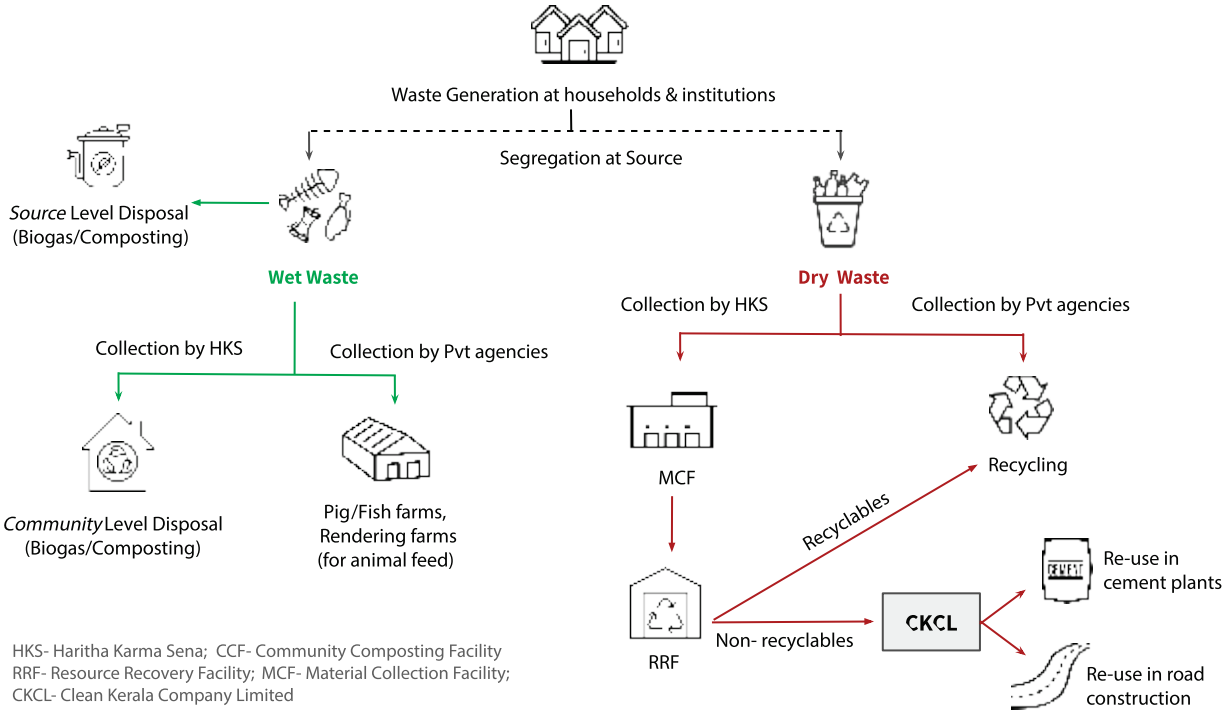
The Haritha Karma Sena (Green Task Force) are teams of women entrepreneurs under the Kudumbashree Mission, the state's poverty alleviation agency for women. These teams are trained in waste management. The HKS members are recruited by LSGIs to collect waste from households, gated communities, institutions and markets, and to transport, store and sort the waste for further processing. As of April 2024, Kerala has 35,500 members in the Haritha Karma Sena as per the government figures. Each HKS worker is supposed to visit 250 houses in a day. The collection is based on user fee.

Clean Kerala Company Limited (CKCL)

CKCL is a state-owned company that was formed in 2012 under the Local Self-Government Department to address the growing concerns of waste management, pollution and environmental degradation. Its mission is to make Kerala a cleaner, greener and healthier state through effective waste management and sanitation practices with the adoption of innovative and scientific methods. The company works in collaboration with local self-governments, communities, and other stakeholders to collect non-



Waste Management in Kerala - Process flow



HKS- Haritha Karma Sena; CCF- Community Composting Facility
RRF- Resource Recovery Facility; MCF- Material Collection Facility;
CKCL- Clean Kerala Company Limited

Source: Local Self-Government Department, Government of Kerala

biodegradables such as plastics and E-waste and hand them over to other agencies for recycling and disposal.

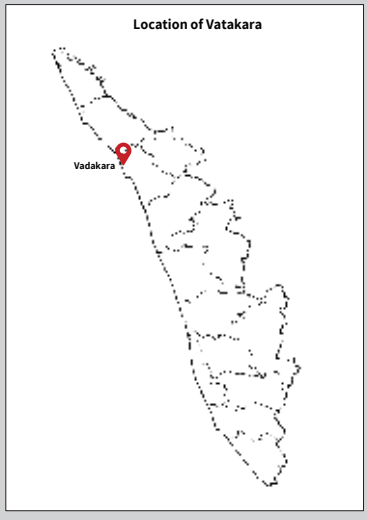
The primary focus of the state's solid waste management system is the segregation of wet and dry wastes at the source. Biowaste is intended to be disposed of using simple composting techniques or by generating biogas at both individual and community levels.

Non-biodegradable waste is collected from various sources, stored in Material Collection Facilities (MCFs), and sorted at Resource Recovery Facilities (RRFs) by the Haritha Karma Sena. Recyclable plastics and glass are then sent to recycling plants through approved service providers.

Non-recyclable waste is directed to cement factories for use as fuel, while inert materials and construction waste are repurposed for road construction. e-waste is collected by the Clean Kerala Company for proper disposal.[46]

Kerala's decentralised waste management system has garnered national and international attention due to significant achievements by some local bodies. A notable example is the Vatakara Municipality in Kozhikode district, which earned the distinction of being the first 'zero waste' local body in Kerala in 2021 by successfully collecting and treating over 90 percent of the waste generated within its jurisdiction.

Zero Waste Vatakara

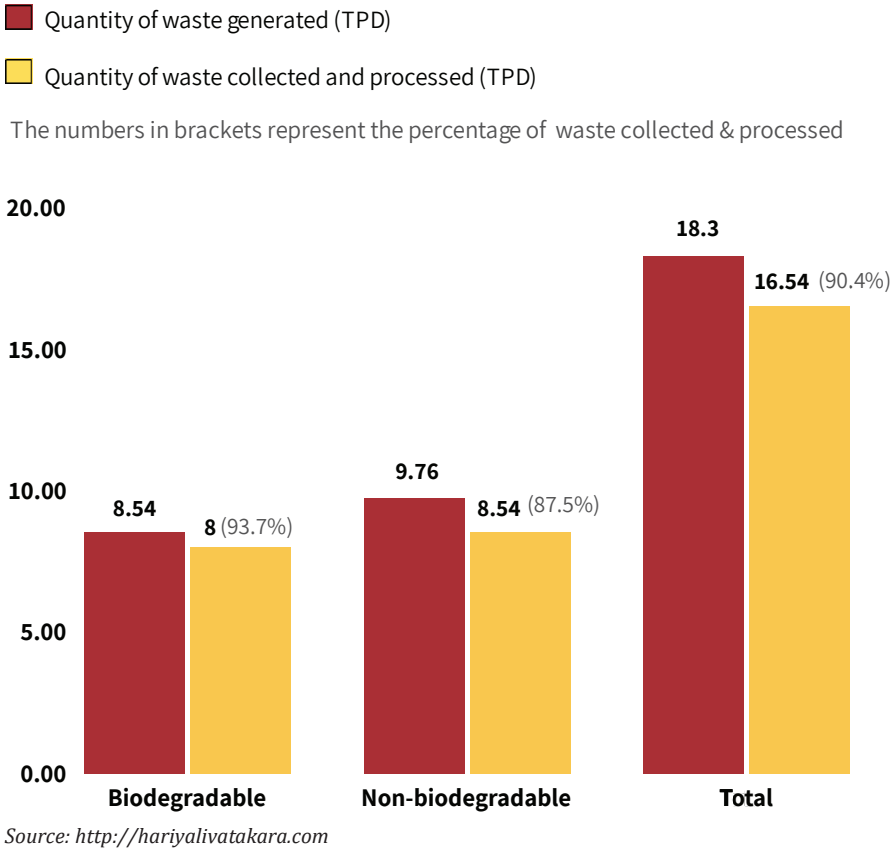


The Vatakara municipality, with a population of 75,295, had started implementing the 'Clean City - Green City- Zero waste Vatakara' project as a people's initiative in 2017, soon after the enactment of SWM Rules 2016 and even before Kerala came out with a strategy emphasising the zero waste principles: Reduce, Reuse and Recycle.[47]

One of the first steps adopted by the municipality was to educate the people on sustainable waste management practices and mobilise their involvement. Attention was also given on building up an elaborate organisational network. A team of 64 Kudumbasree workers were mobilised and registered as a distinct society named Hariyali Haritha Karma Sena in 2018. The 18,000 houses in the 47 wards of the municipality were grouped into 445 clusters of around 50 houses each, further decentralising the focus. Every cluster was looked after by five Suchitwa volunteers. Each ward had a Green Ward leader to coordinate the activities.

The emphasis was on segregation of waste, treatment of biodegradable waste at source using simple techniques and collection of non-biodegradable waste at doorsteps.

Vatakara Municipality: Waste Generation & Collection



Source: http://hariyalivatakara.com

Practising 3Rs:

The turnover of Hariyali stood at Rs 1.07 crores in 2020 and the society earned Rs 3.7 lakh in 2020-21 through the sale of shredded plastics for laying of roads. Apart from gaining income through sale of recyclables, the society has promoted several innovative micro enterprises.

- **Green Shop:** The shop is run by five trained members of the Haritha Karma Sena who produce cloth bags, fish bags, school bags, multi purpose shopper bags and travel bags.
- **Repair Shop:** This facility repairs electronics items like television, mixer grinder and other gadgets that can be reused. It is run with the help of electronics technicians and students from polytechnic colleges. The centre was in the news when it handed over 30 repaired TVs to the economically backward students for online learning at the time of Covid .
- **Swap Shop:** Haritha Karma Sena runs a swap shop through which items like saree, churidar and other clothing are exchanged.
- **Rent Shop:** Creating an economic opportunity from the Green Protocol, the centre rents out steel plates, glasses and other utensils required for functions like marriages, in the process reducing the use of disposables.
- **Green Army:** HKS has a 5-member Green Army providing services related to agriculture, fish farming and rainwater harvesting.
- **Cleanliness Centre:** Hariyali runs a centre to demonstrate the use of various composting techniques and devices.

Source: http://hariyalivatakara.com

Integrated Approach

In 2021, the state started implementing yet another programme - Kerala Solid Waste Management Project (KSWMP) with 105 million dollar aid from the World Bank. This project, which is being implemented by all the 93 urban local bodies in the state, has an integrated approach with centralised and decentralised waste management components. The project is a part of the Rebuilding Kerala Initiative taken up by the state government in 2018 after a devastating flood.

According to the State Planning Board's Economic Review 2023, the solid waste management in the state has improved to a great extent. For instance, the Municipal Solid Waste treatment was 52 per cent in 2019-20, which has increased to 93 per cent in 2022-23.

Gaps in the Grid

The Local Self-Government Department, during an internal review in 2021,[48] found many gaps in the state's elaborate waste management system including:

- **Formation of HKS:** Around 97% of the LSGIs in Kerala had formed Haritha Karma Sena in their respective jurisdictions but only less than half (47%) of the households in the state handed over their non-biodegradable waste to HKS.
- **Household Collection Of Non-Biodegradable Waste:** Household waste collection by HKS was not adequate as only 44% of waste was collected in the corporations, 45 % in municipalities and 48 % in grama panchayats.
- **Institutional Collection:** In the case of institutional non-biodegradable waste, corporations were at the top with more than 53% of institutions in the six corporations handing over their waste to HKS, compared to 26 % in municipalities and 31 % in grama panchayats.
- **User Fees Not Fixed:** 95 % of the gram panchayats, 77 %of the municipalities and 50 %of the corporations had not fixed user fees for collection of biodegradable wastes.
- **Non-Payment Of User Fees:** Barely 1% of the households paid user fees for collection of non-biodegradable waste. For the corporations, the figure was more dismal, with only 0.1 % of households paying user fees.[49]
- **MCF:** Only 15 % of the MCFs had weighing machines.[50]

Towards 'Waste-Free New Kerala'

In response to the Brahmapuram fire and the directives from the High Court, the state government launched a comprehensive three-phase initiative called Malinya Muktha Nava Keralam (Waste-Free New Kerala) in May 2023, aiming to eliminate waste across the state within one year.

Out of the 59 legacy waste sites in the state, remediation completed at 24

To effectively coordinate and mobilise these efforts, a dedicated 'war room' was established within the Suchitwa Mission, operating under the direct supervision of the Additional Chief Secretary for the Local Self-Government Department (LSGD). The initiative aims to address the infrastructural and implementation deficiencies within the state's decentralised waste management system.

Increasing Infrastructure: The focus of the activities was on enhancing the physical infrastructure for waste collection, composting, storage, segregation, transport, and disposal. The report submitted by the state government to the National Green Tribunal in October 2024 highlights significant advancements in the waste management infrastructure.

Increase in Waste Management Facilities

Facility	Up to March 2023	Up to October 2024
RRF	93 Nos	167 Nos
MCF	1182 Nos	1272 Nos
Mini MCF	9357 Nos	19156 Nos
Godown facility	16 Nos	67 Nos
Godown Area	85250 sqft	481548 sqft
Container storage facility		198 Nos

Source: Compliance Report submitted before NGT by Gov ernment of Kerala, October 2024.

Streamlining Waste: The state government introduced the Haritha Mithram App to improve door-to-door coverage, streamline user fee collection, manage segregated material transport, and ensure timely waste collection from households to disposal sites. The report further states that 80 percent of households now actively segregate their waste, significantly boosting the state's total bio-waste treatment capacity. For managing biodegradable waste, facilities have been established across the state with a total capacity of 7659.48 tonnes per day, surpassing the estimated generation of 7398.64 TPD. Similarly, the capacities for collection. storage, sorting and transportation of non-biodegradable waste have been improved to cover 2797.83 TPD against an estimated generation of 2173.72 TPD of dry waste, claims the government. in its October 2024 report.

Clearing Legacy Waste: While the long-overdue process of clearing legacy waste across the state is progressing, the government has come up with new figures for the number of dump sites and the quantity of legacy waste to be cleared. As per the Compliance Report of October 2024 submitted to NGT, the state has 59 legacy waste sites with a total quantity of 18,91,358 tonnes. This includes the 44 sites identified earlier (and presented in the Compliance

Reports of January and April 2024), and 15 new ones. Curiously, the quantity of waste in the old sites has been revised as 17,61,871.98 tonnes, up from 7,51,000 tonnes. No explanation has been provided for this revision. The 15 new sites hold an additional 1,29,486 tonnes of waste. Bio-remediation has been completed at 24 sites (3,58,279 tonnes–19%), leaving 81 percent of the accumulated waste to be cleared.

The plan is to declare Kerala as litter-free on March 30, 2025

Strengthening Laws: In order to give teeth to the laws, the state amended the Kerala Municipality Act and the Kerala Panchayat Raj Act significantly increasing the fines charged for waste management violations and environmental damage. Under the revised legislation, all citizens must submit their segregated waste to local authorities or an authorized agency for proper scientific processing. The spot fine for infractions has been raised from Rs 250 to Rs 5,000 in both rural and urban areas, while the fine for illegal dumping has been increased from Rs 25,000 to Rs 50,000, reflecting the actual environmental harm caused by such offences. Local bodies also could incur fines for non-compliance with state directives.

Ensuring People's Participation: To enhance public awareness and participation in waste management, comprehensive Information, Education, and Communication (IEC) campaigns are being conducted with renewed vigour. These campaigns involve a wide range of stakeholders, including students, youth organisations, businesses, government and non-governmental organisations, residents' associations, and neighbourhood groups. Initiatives such as pledges, posters, theme songs, engaging videos, flash mobs, street plays, and media campaigns are promoting the message: My Waste is My Responsibility.

People's Campaign: Malinya Muktham Nava Keralam, the campaign launched by the Local Self Government Department (LSGD) to achieve litter-free status for the state, entered its second year in June 2024. The renewed campaign aimed at achieving 100 percent door-to-door collection of waste.

On October 2, 2024 the chief minister of Kerala inaugurated the Malinya Muktham Nava Keralam Janakeeya Padhathi, People's Campaign for Zero-Waste New Kerala, aimed at declaring the state as litter-free on March 30, 2025, the Global Zero Waste Day. The action plans for the campaign are jointly prepared by Haritha Keralam Mission, Sanitation Mission, Pollution Control Board, Clean Kerala Company, Kudumbashree Mission and the Kerala Solid Waste Management Project. The campaign focuses on promoting the habit of reusing, recycling and adopting nature-friendly alternatives among the people.

As part of the campaign, on November 1, the Kerala Formation Day, the state government awarded Green Status to 13,353 institutions and offices, 68 tourist centres, 810 towns, 6048 schools, 315 public places, 298 colleges and 24713 neighbourhood groups.

3 Bigger Challenges

While the Kerala government is making efforts to declare the state waste-free by March 30, 2025, some glaring issues remain unresolved, adversely impacting Kerala's waste management. These challenges include lack of reliable data, the inability to independently manage non-biodegradable waste — particularly plastics and e-waste, a bias towards waste-to-energy solutions, and the failure to recognize waste management as a critical sector within the state's climate action plan.

Photo: **Surendranath C**

Chapter 7

Unreliable Data

Accurate estimates of waste generation and composition are crucial for formulating and implementing both current and future waste management strategies. The methods and capacity for waste storage, the types, sizes, and numbers of collection vehicles required, the optimal manpower needs, and the frequency of waste collection all depend heavily on reliable data regarding the quantity of waste generated. Additionally, the choice of disposal methods is influenced by the composition and characteristics of the waste. However, in the case of Kerala, data on crucial aspects of municipal solid waste are inconsistent and unreliable.[51]

Given the rapid urbanisation in Kerala, MSW generation is anticipated to rise, mirroring the global and national trends However, official data from 2018 to 2024 show the state's MSW generation remaining nearly static at around 3.7 million tonnes a year or slightly above 10,000 tonnes per day. The SWM policy (2018), the implementation manual of KSWM, the annual report of Suchitwa Mission (2021) and the latest Compliance Report submitted before NGT in October 2024 all quote figures reflecting the same trend.

Urban-Rural Twist

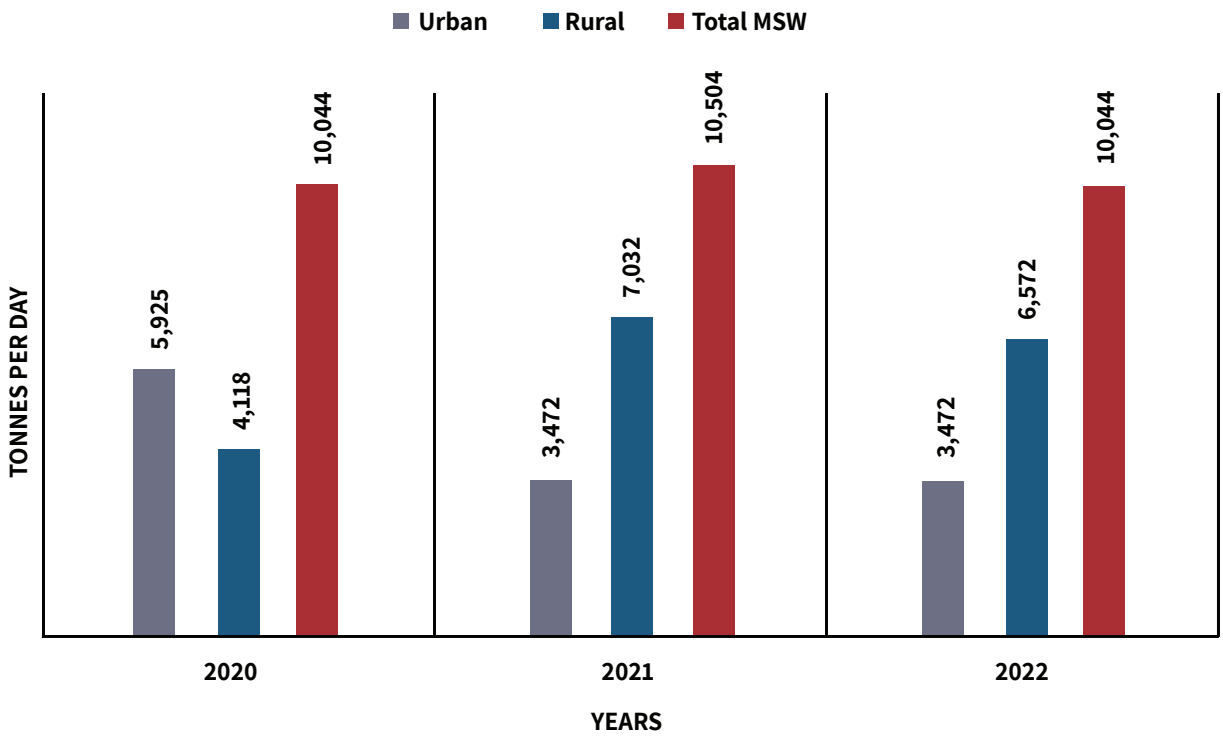
Another issue related to the MSW data is regarding the urban and rural share of it. Relying on figures based on per-capita waste generation estimations and population, the Economic Reviews prepared by the State Planning board have been reporting a greater proportion (59%) of generation of MSW in the urban local bodies compared to the rural local bodies (41%). This ratio was followed till Suchitwa Mission came up with new figures in its 2020-21 annual report: 33 percent for urban and 67 percent for panchayats. This change is reflected in the Economic Review figures for MSW from 2021 onwards. Thus, the Economic Reviews show a significant 41.4 percent drop in urban waste and a drastic 70.7 percent increase in rural waste during 2020-2021 (See the chart).

Data on crucial aspects of MSW are inconsistent and unreliable

The CAG report 2022 sheds further light on this critical issue. The report reveals that none of the ULBs conducted proper surveys to assess the quantity of waste generated or its composition and physical and chemical characteristics. Further, the volume of different types of waste such as plastic waste, e-waste, biomedical waste, construction and demolition debris, and domestic hazardous waste has not been separately quantified.

The Municipal Solid Waste Management (MSWM) Manual clearly says that for making long-term waste management plans, the average amount of waste

MSW GENERATED AS PER ECONOMIC REVIEW REPORTS



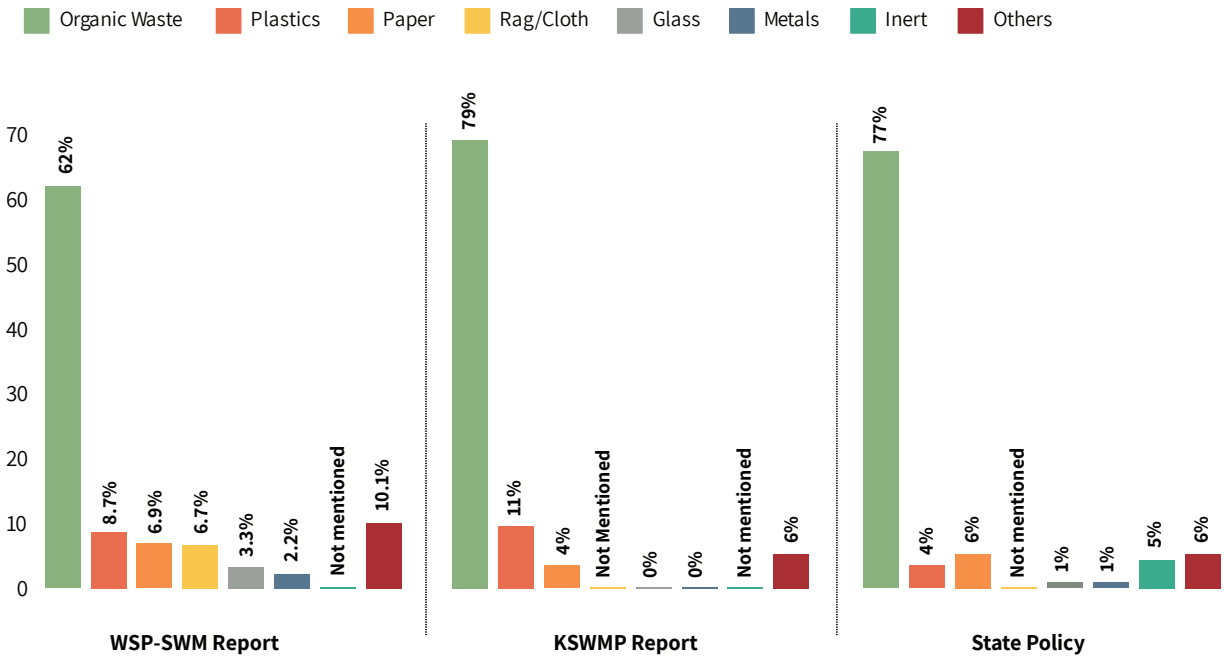
disposed by a specific class of generators may be estimated by averaging data from several samples to be collected continuously over seven days at multiple representative locations, in summer, winter and rainy seasons. Instead, the ULBs adopted a per capita generation-population estimation method for assessing the extent of waste generated. "This method has a low level of reliability," observes CAG.

The per capita, per day generation of waste taken as the basis for total waste estimation by the LSGIs was 300-400 grams/day for corporations and 240-350 grams/day for municipalities, says the CAG report. The CPCB's estimation of per capita MSW generation in 2018-19 was 500 gm for cities with a population of one million and above and 400 gm in Class I towns. The State Planning Board's Economic Review in 2017 had adopted the per capita MSW generation figures of 470 grams, 350 grams and 235 grams in the corporations, municipalities and grama panchayats respectively. However, the 2020 Report on Strategic Environmental Assessment of Waste Management in Kerala prepared by Suchitwa Mission for the World Bank-aided KSWMP estimated higher per capita waste generation in corporations and municipalities as 545 gm/day and 419 gm/day respectively. The study, however, did not cover the grama panchayats, which generated the bulk of MSW in Kerala.

"In the absence of a scientific estimation of waste generation as prescribed in MSWM Manual, the current planning in SWM is not adequate," observes the CAG report. Further, wrong estimations of the quantity of waste generated at different tiers of LSGIs may lead to disproportionate fund allocation for waste management and construction of facilities with inappropriate capacities.

Wrong estimation of waste leads to improper fund allocation

Composition of Waste



Source: CAG Audit Report on Waste Management in Urban Local Bodies, 20226

Composition of Waste

The composition of MSW is another key information which should form the basis of selection of waste processing technology. None of the CAG audited ULBs assessed the composition of solid waste generated. The World Bank's Water & Sanitation Programme-SWM Sector Assessment Report (2007), the State Policy on SWM (2018) and the KSWMP Report (2020) give different data for the composition of solid waste.[52]

Physical and Chemical Characteristics

Critical parameters for selecting the appropriate processing technology are quantity and characteristics such as density, moisture, calorific value and toxicity of waste. Bio-chemical characteristics of waste determine the suitability of specific treatment processes. The calorific value of garbage will help to select the treatment technologies like Waste-to-Energy and other thermal processes.

Proper assessment of characteristics and composition of MSW has not been done

However, all the 22 local bodies which were audited have not assessed the physical and chemical characteristics of waste generated, says the CAG report. "Even Suchitwa Mission, the state nodal agency for SWM, vested with the responsibility to extend technical and financial assistance to local bodies for handling solid/special waste, has not conducted any study so far to assess the quantity as well as physical and chemical characteristics of waste generated in the State," observes the report.

Plastic Data Anomalies

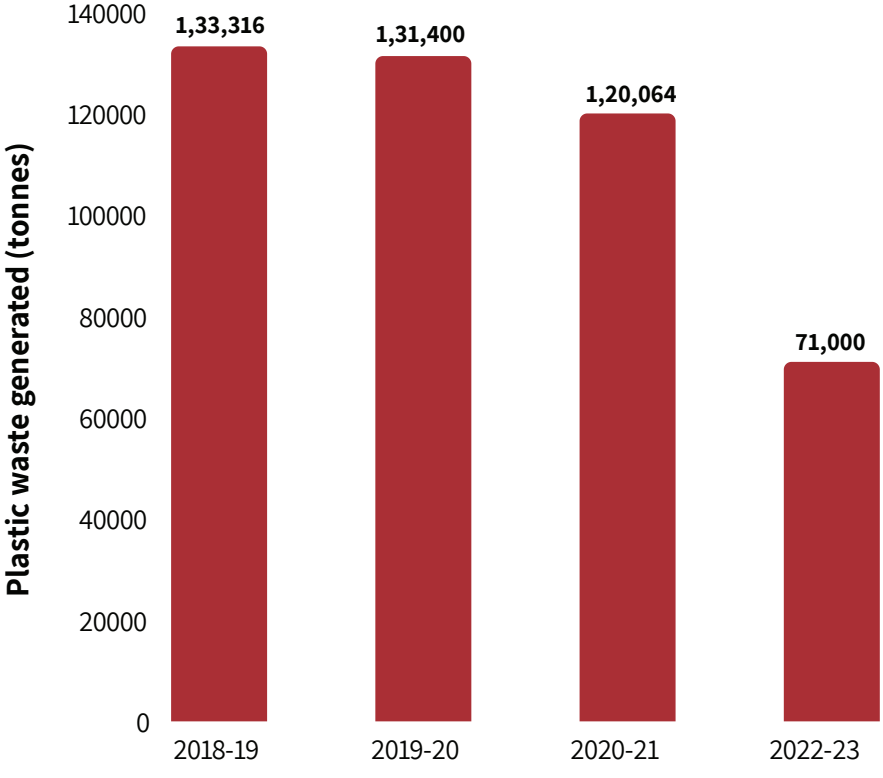
Kerala's plastic waste generation has been shown as reducing by KSPCB

Official statistics for plastic waste generation and recycling are inconsistent for Kerala and India as well. For instance, CPCB reported plastic waste generation in the country as 3.3 million TPA in 2018-19, while the Ministry of Housing and Urban Affairs (MoHUA) presented a conflicting figure of 9.49 million tonnes for the same period. MoHUA's assertion that India is recycling 60 percent of its plastic waste has also been challenged. A 2023 report brought out jointly by experts from India and Australia - National Circular Economy Roadmap for Reducing Plastic Waste in India - puts India's actual plastic recycling rate in 2019 as a mere eight percent.

Interestingly, while plastic waste generation is growing in the world and in India, Kerala's plastic waste generation has been shown as reducing in the annual reports on Plastic Waste Management Rules 2016 submitted by KSPCB to CPCB.

Kerala generated close to 330 tonnes of plastic waste everyday, says the Project Appraisal Document for the KSWMP project (2021), adding that only three percent of this is collected and recycled. The remaining plastic leaks into the environment. However, if we go by KSPCB's claim that the state recycles 200 tonnes of plastic per day[53], the plastic recycling rate of Kerala has improved to 66 percent–a tall claim compared with the plastic waste recycling rate of less than 50 percent that even the European Union could achieve!

Misleading Figures: Plastic Waste Generation in Kerala



Sources: CPCB Annual Reports, Compliance report submitted to NGT

CPCB and MoEF&CC do not have a complete picture of plastic waste generation –PAC

PAC's Observations

Such discrepancies in data at the state and the national level have recently come under the scanner of the Public Accounts Committee (PAC) of Parliament. The PAC Report on "Pollution Caused by Plastic" presented to the Lok Sabha in February 2024 has noted that "there were data gaps due to which CPCB as well as MoEF&CC did not have a complete and comprehensive picture of plastic waste generation in the entire country during the period 2015-20."

The deficiencies start with delays, gaps and inconsistency in data being collected from the LSGIs and absence of cross-checking by SPCBs and CPCB. PAC observes that the data collected did not include plastic waste generated by rural local bodies. Even when reported, the data was not uniform and was "based on assumptions without any sound rationale." Neither MoEF&CC nor CPCB has made any realistic projection for the future regarding plastic waste generation based on population, geographical area, economic growth, changes in consumption and manufacturing, notes the report. The committee also observes that MoEF&CC does not have any action plan for reduction, reuse or recycling (3Rs) of plastic waste. The PAC has urged the ministry and the board to set national and local targets for achieving.

Chapter 8

Plastic Peril

Photo: Adobe Stock

The tragic incident of a sanitation worker being swept away while cleaning the Aamayizhanchan Canal clogged with plastic debris near Thiruvananthapuram Central Railway Station in July 2024 exposes the dark underbelly of Kerala's struggle with non-biodegradable waste. His body was found after 46 hours of search. The search was arduous due to the plastic waste accumulated in the canal.

This gruesome incident happened despite the warning by the Comptroller and Auditor General of India (CAG) in its 2022 report on waste management calling for urgent action for cleaning the canal. Throwing plastics in the canal might lead to urban flooding apart from pollution, the report had cautioned.

After the Brahmapuram disaster, this unfortunate mishap once again forced the Kerala High Court to intervene in the state's MSW management. The court ordered the Thiruvananthapuram Municipal Corporation, the Railways and the district collector to submit reports regarding the reasons for the flow of plastic waste into the canal, the manner in which it is to be removed and who was responsible for removing it.

Plastic wastes pose a pervasive challenge to ecosystems in the state

The state government had banned the manufacture, sale, storage and transportation of single-use plastic (SUP) in January 2020 even before the central government brought the nationwide ban on 19 SUP items, including plates, cups, straws, trays, and polystyrene on July 1, 2022.

Nevertheless, plastic discards pose a pervasive environmental challenge in the state, necessitating urgent attention and effective mitigation strategies to address its far-reaching consequences on the ecosystem, human and wildlife health. The state's canals, streams, rivers, tourist and pilgrimage centres, and even reserved forests are polluted with plastic litter, mainly carrying bags, bottles and food packages.

Photo: Nithin Krishnan

Drowning in Plastics

Many common fish varieties are contaminated with microplastics

A 2019 study on plastic litter along the Kerala coast done by Thanal,[54] a Thiruvanathapuram-based environmental research and campaign organisation, found that the average plastic litter index for the Kerala coast was 1,660 pieces per km, nearly three times higher than the global average of 573 pieces per km. The study estimated the number of plastic litter along the state's shoreline at a whopping 17,00,32,429 pieces with a total weight of 1057.45 tonnes.

The condition of water bodies in the state is alarmingly grim due to the scourge of plastic pollution, which not only chokes aquatic life but also contaminates the water table, posing a significant threat to ecosystem and human health.

A 2023 study by the Kerala University of Fisheries and Ocean Studies (KUFOS) found plastic pollution in Vembanad lake to be much higher than reported from most estuaries the world over. The study estimated the quantity of plastic waste was to the tune of 3,005 tonne dry weight of macroplastics in the surface one-metre sediment of the lake.[55]

The case of Ashtamudi Lake in Kollam District, another Ramsar site, is not different. A 2024 study by the Department of Aquatic Biology and Fisheries, University of Kerala,[56] found micro plastics in the macrofauna, with fish accounting for 19.6 percent and shellfish 40.9 percent.

Kerala's commonly consumed fish varieties such as Thirutha (grey mullet), Kanambu (Blue spot mullet), Neichala (Indian oil sardine), Kozhuva (Indian anchovy) as well as Kadukka and Kallumakka (green and brown mussels)

Photo: Nithin Krishnan

Pervasive Microplastics

When plastics break down over time, they can form smaller particles called microplastics. They are with a diameter of less than five millimetre. Microplastics, in turn, can further break down to even smaller pieces called nanoplastics (1 millimetre = 10,00,000 nanometre). Most of the microplastic waste in the environment is made up of fragments from large pieces of litter such as plastic bags, bottles or packaging materials.

These tiny particles can travel vast distances, infiltrating marine and terrestrial ecosystems and even lofted into the atmosphere, where they may seed clouds and influence temperature and rainfall patterns. They are discovered in a variety of ecological settings, including beaches, shorelines, oceans, intertidal zones, mangroves, estuaries, lakes, rivers, and agricultural soil.

have also been found to be contaminated with microplastics at several locations in the state.[57]

A 2018-19 study done by KUFOS and the National Institute of Technology Calicut (NITC)[58] on the impacts of floods on microplastic distribution in the marine environment of Kochi found a three-fold increase of microplastic concentration in the surface water and 1.5-fold increase in beach sediments.

A large amount of plastic waste has accumulated in the sea mainly by runoffs through rivers and other human activities including fisheries. The Department of Fisheries had initiated the Suchitwa Sagaram project in 2017 in Kollam district to collect plastic waste from sea and to shred and dispose of the waste. Suchitwa Mission, Clean Kerala Company, Harbour Engineering Department and the Society for Assistance for Fisherwomen (SAF) had joined hands in the project. The state budget for 2024-25 has now allocated Rs 2 crore for continuing the project.

Planet vs Plastic

Plastics are synthetic materials produced mainly from fossil fuels which are on a fast path to exhaustion. Global plastic production has surged dramatically, increasing from 2 million tonnes (Mt) in 1950 to 460 Mt in 2019–an alarming growth of 230-fold. According to the *Global Plastics Outlook* published by the Organisation for Economic Co-operation and Development (OECD), this trend is expected to continue, with production projected to nearly triple, reaching 1,231 Mt by 2060.

Along with production of plastics, plastic waste is also mounting–nearly doubling from 156 million tonnes (Mt) in 2000 to 353 Mt in 2019. Close to 63 percent of this waste consists of short-lived packaging materials and consumer products.

A staggering 79 percent of the plastics ever produced in the world has accumulated in landfills or nature and another 12 percent has been incinerated; only less than 10 percent has been recycled. Mismanaged plastic waste contributes to environmental pollution and climate change.

Chemical Danger

Over 86,770 different chemicals have been introduced in the market in the United States, according to the 2024 TSCA Inventory (Toxic Substances Control Act Chemical Substance Inventory) prepared by the US Environmental Protection Agency (EPA). This number is substantially higher in the European Union, totaling around 1,40,000 chemicals.[59] Despite this vast array of chemicals in circulation, only a fraction are being regularly tested to assess contamination of groundwater, as highlighted in a 2019 report by the Center for Health, Environment & Justice.[60]

A 2023 UNEP report provides more data on toxic chemicals in plastics and their impacts.[61] The report calls for urgent action to address this issue.

- More than 13,000 chemicals have been identified as associated with plastics and plastic production across a wide range of applications.
- Ten groups of chemicals (based on chemistry, uses, or sources) are identified as being of major concern due to their high toxicity and potential to migrate or be released from plastics, including specific flame retardants, certain UV stabilisers, per- and polyfluoroalkyl substances (PFASs), phthalates, bisphenols, alkylphenols and alkylphenol ethoxylates, biocides, certain metals and metalloids, polycyclic aromatic hydrocarbons, and many other non-intentionally added substances (NIAS).
- 'Chemicals of Concern' have been found in plastics across a wide range of sectors and product value chains, including toys and other children's products, packaging (including food contact materials), electrical and electronic equipment, vehicles, synthetic textiles and related materials, furniture, building materials, medical devices, personal care and household products, and agriculture, aquaculture and fisheries.
- Chemicals of concern in plastics can impact our health and our environment: Extensive scientific data on the potential adverse impacts of about 7,000 substances associated with plastics show that more than 3,200 of them have one or more hazardous properties of concern.
- Women and children are particularly susceptible to these toxic chemicals. Exposures can have severe or long-lasting adverse effects on several key periods of a woman's life and may impact the next generations. Exposures during foetal development and in children can cause, for example, neurodevelopmental or neurobehavioral disorders. Men are not spared either, with latest research documenting substantial detrimental effects on male fertility due to current combined exposures to hazardous chemicals, many of which are associated with plastics.
- Chemicals of concern can be released from plastic along its entire life cycle, during not only the extraction of raw materials, production of polymers and manufacture of plastic products, but also the use of plastic products and at the end of their life, particularly when waste is not properly managed, finding their way to the air, water and soils.

Global Plastic Treaty: Still Pending

In March 2022, at the fifth session of the UN Environment Assembly , a historic resolution was adopted to develop an international legally binding treaty on plastic pollution.

The treaty, envisioned to cover the full life cycle of plastic, including its production, design, and disposal, was expected to be a major turning point in the fight against plastic pollution and its impact on the environment. The ambition was to complete the negotiations by the end of 2024. However, the fifth round of negotiations held in December 2024 in Busan, South Korea, ended in failure to adopt the final legally binding treaty.

One of the most contentious issues was whether the treaty should include specific targets for reducing global plastic production. Many countries argued that curbing plastic production is essential to effectively tackle pollution at its source. Conversely, a coalition of oil-producing nations opposed any language in the treaty that would impose restrictions on production. The group argued that the focus should be on waste management and recycling rather than limiting production itself.

Another major point of disagreement revolved around the regulation of hazardous chemicals used in plastic products.

Ban Lacks Bite

Despite entering its second year, the intense Malinya Muktham Nava Keralam Campaign could not make significant achievements in dealing with plastic waste. The ban on single-use plastics is not working as intended. Inadequate monitoring and enforcement have resulted in unhindered flow of banned plastics into the state from other parts of the country.

The Plastic Waste Management Rules (PWM Rules, 2016) stipulates that every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of plastic waste either on its own or by engaging authorised agencies. According to the rules, plastic waste which can be recycled shall be channelised to registered plastic waste recyclers. Similarly, as per the Kerala government's SWM Strategy, the non-recyclable plastic waste shall either be shredded and used for road construction or be bailed and sent to cement plants for burning.

Inadequate monitoring has resulted in unhindered flow of banned plastics into Kerala

In the decentralised waste management system of the state, it is the responsibility of Haritha Karma Sena (HKS) to collect, store and sort the non-biodegradable waste in MCFs and RRFs and hand over the sorted waste to CKCL or other authorised agencies for disposal. "However, in the absence of proper segregation by HKS, 25 to 100 percent of plastic waste collected from urban local bodies in the state was mixed up with other waste and was being disposed of as rejects," noted the CAG report.

Banned single-use plastic (SUP) carry bags formed the largest component (46%) of plastic litter among 324 garbage hotspots surveyed during a 2023 study by Socio Economic Unit Foundation (SEUF),[62] indicating the failure of

Photo: Surendranath C

the SUP ban in the State. Banned cups made up another 21.2 percent of the plastic litter.

One reason for the continuous flow of banned plastic into the state is the central government's conflicting policies on plastic. For instance, the omission of multi-layer packages (MLP) from the SUP ban despite scientific studies and citizen groups pointing out the health hazards caused by them.

Multi-Layered Hazard

Multi Layered Plastic (MLP) is any material with at least one layer of plastic laminated together with thin sheets of aluminium or paper. They are widely used by global and local brands in packaging consumer goods and food products.

As per the PWM Rules 2016, manufacture and use of non-recyclable MLP should have been phased out in two years. But In 2018, when the PWM Rules were amended, the term 'non-recyclable MLP' was replaced with this definition: "MLP which is non-recyclable or non-energy recoverable or with no alternative use."

The addition of the term 'non-energy recoverable' impeded the phasing out of MLPs from the market. It gives the packaging industry the leeway for continuing with their production. As a result, nearly 11.6 million tonnes of MLP waste is generated in India each year of which only 3.6 percent is collected, according to Wuppertal Institute,[63] a German research institution.

In Kerala, multi-layer plastics (MLP) which are not covered in the SUP ban formed nine percent of plastic litter and 10.7 percent of plastic waste collected in the MCFs, according to the SEUF study.

Misleading Chasing Arrows

Key:

1- PET: Polyethylene terephthalate

2- HDPE: High-density polyethylene

3- PVC: Polyvinyl chloride

4- LDPE: Low-density polyethylene

5- PP: Polypropylene

6- PS: Polystyrene

7- Others

There are different ways of classifying plastic and divergent views on its recyclability.

'Plastic" is an umbrella term used to refer to materials that come in various types with various features, which bring along unique complexities for its safe use, handling and disposal.

Plastic is broadly classified as Thermoplastic Plastics and Thermoset Plastics. In theory all thermoplastics are recyclable, because they can be melted when heated and hardened when cooled. They can be reheated, reshaped and frozen repeatedly. But Thermosets cannot be re-melted and reformed. Most official reports go by this classification of plastics.

The Resin Identification Codes (RIC) with the chasing arrows logo classifying plastics from 1 to 7, is another way of classifying plastics. The RICs are supposed to indicate their recyclability, but they are, in fact, misguiding as several plastics are not recyclable or recycled in practice due to technical and economic reasons and difficulties in collection, cleaning and segregation.

Many manufacturers -and most consumers - misinterpret the label as an indicator of the package's recyclability or recycled content. That's because the symbol is often placed prominently on the packaging or accompanied by text such as "Please recycle."

Code 1 and Code 2 are the most commonly recycled types. In contrast, Code 3 and Code 5 are often not recycled due to their chemical properties. Code 4 has seen technical failures in recycling processes. Code 6 recycling is difficult and costly, while Code 7, designated for "other" plastics, is typically non-recyclable due to the diversity of materials and the composite nature of this category.

"The problem lies not with the concept or process of recycling, but with the plastic material itself-it is plastic recycling that does not work," says a Greenpeace USA report.[64]

NOTE: THE "CHASING ARROWS" LOGO IS MISLEADING FOR MOST TYPES OF PLASTIC, AS THEY ARE RARELY RECYCLABLE.

Photo: Nithin Krishnan

Pathways to Pollution

In Kerala's decentralised Solid Waste Management System, plastic waste is either despatched to recyclers, utilised in road construction, or co-processed in cement kilns. All of these three 'convenient' options, however, have significant impacts on the environment.

Using plastic waste in road construction is being highlighted as a quick-fix to manage plastic wastes by the central and the state governments.

In November 2016, in accordance with the recommendation of the Coordination Committee of the LSGD, the state government issued an order for using the shredded plastic in polymerised road construction. It allowed the local bodies to procure, install and operate plastic shredding machines. The shredded plastic is collected and sold by the Clean Kerala Company to the contractors involved in the road construction works of the National Highways Authority of India (NHAI), the state's Public Works Department (PWD) and LSGIs.

From 2016 till November 2023, close to 3,550 tonnes of shredded plastics were produced in the state and 3,114 tonnes were used for constructing 5,598.83 km of polymerised roads.

Though approved by CPCB and aggressively promoted by governments, "making roads using plastics should not be seen as a silver bullet for our mammoth problem," argues the Centre for Science and Environment in its 2022 report *The Plastic Recycle*. The report says CPCB itself had pointed out in 2004 that road construction activities are contributing to emissions of dioxins and other toxins during the melting and mixing processes.

"There are known health risks associated with heated plastic, chemical additives, and microplastic, in using plastic waste for road-building," says the *Plastic and Health Report*, produced by a coalition of community-based organisations, including the Center for International Environmental Law (CIEL).[65]

Making roads using plastics should not be seen as a silver bullet - CSE

Chapter 9

E-Waste Emergency

In January 2022, a fire broke out in an unauthorised scrap shop at Killipalam in Thiruvananthapuram Municipal Corporation. Hazardous e-waste was kept exposed here without the mandated safeguards.

Implementation Guidelines for e-waste (Management) Rules, 2016 state that loading, transportation, unloading and storage of e-waste should be done without causing any damage to the environment and health. However, e-waste requiring careful handling such as computer monitors, television sets, refrigerators, electricity cable and wire lie scattered in the open in scrap shops and the local bodies' MCFs without any environmental or health safeguards.

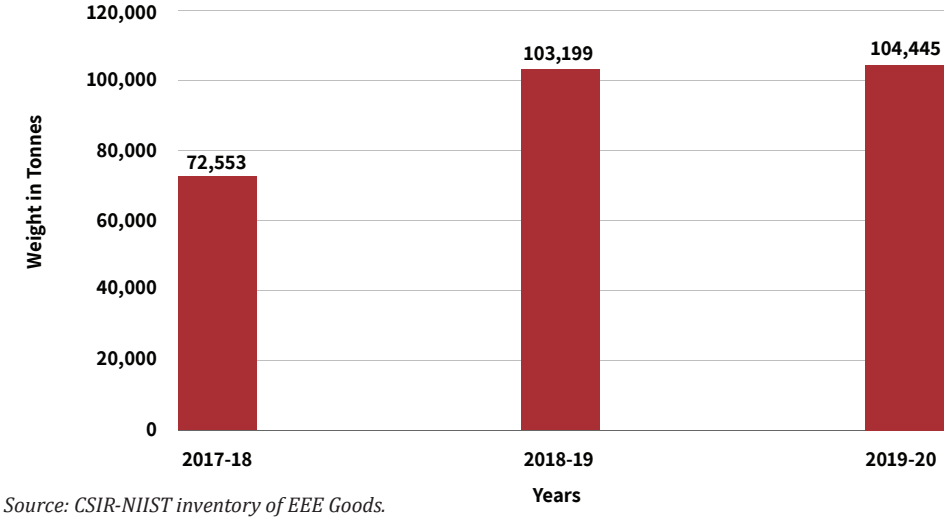
E-waste recycling and disposal issues are going to be more acute

Though there is no registered e-waste recycling centre in the state, a significant number of unregistered recyclers and refurbishers operate in the informal sector, according to the inventory prepared by CSIR - NIIST in 2022.[66]

The e-waste recycling and disposal issues are going to be more acute in the coming years considering the significant increase in the sale of electrical and electronic items in Kerala as shown by the CSIR-NIIST inventory.

Photo: Surendranath C

Sale of EEE goods in Kerala

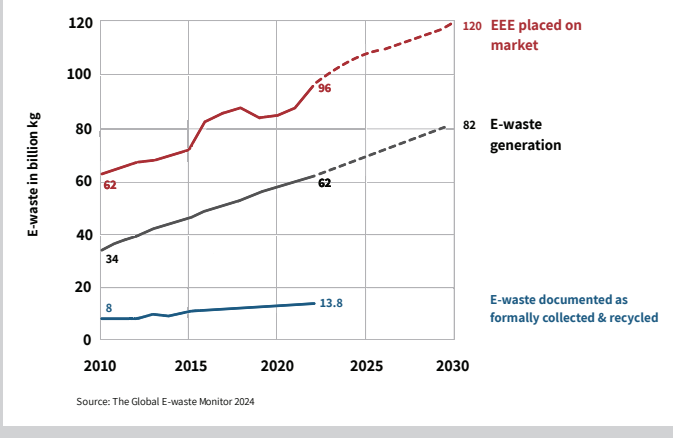


Source: CSIR-NIIST inventory of EEE Goods.

E-Waste: Fastest, Borderless

Electronic waste is the fastest growing stream of waste. Globally, 62 million metric tonnes of e-waste was produced in 2022, an increase of 82 percent from 2010, according to the *Global E-waste Monitor 2024*.[67] Driven by progress in technologies, increased consumption, limited repair options, short lifecycles and inadequate e-waste management infrastructure, e-waste is growing five times faster than rates of its recycling.

Out of this 62 million tonnes (Mt), only 13.8 Mt (22.3%) was documented as collected and recycled in an environmentally safe manner. 16 Mt (25.8 %) was recycled in the informal sector and 18 Mt (29%) was shipped by the richer nations to the poorer countries, often under the guise of promoting Reuse. 14 Mt (22.5%) was just landfilled/incinerated.



E-waste contains toxic and persistent substances such as flame retardants that are used in appliances and in Electrical and Electronic Equipment (EEE) containing plastics. Out of the 62 million tonnes of e-waste generated in 2022, plastic waste amounted to 17 million tonnes (24%) comprising 59,000 tonnes of plastic waste with toxic flame retardants. On account of poor global capacity for recycling such plastics, it is estimated that 45,000 tonnes of them were released into the environment.

Mercury is one dangerous substance found in e-waste, and its release into the environment from the e-waste in 2022 alone amounted to 58 tonnes. E-waste contains numerous other toxic substances including metals such as lead, cadmium, and nickel, and organic compounds such as dioxins and furans.

These items will inevitably become e-waste at the end of their life cycle, expected within the next 5-10 years, adding to the e-waste burden from products purchased prior to the assessment years. Among these, household appliances like washing machines, with an average lifespan of nine years, are projected to generate the largest volume of e-waste in Kerala.

It is important to note that the inventory does not include electrical and electronic equipment (EEE) sold through online platforms or imported from abroad.

E-Waste in India

India is the third largest generator of e-waste, after China and the United States.[68] With India's growing population and emerging economy, the usage of Telecom, IT, and consumer electronics, as well as home appliances has grown rapidly, especially during the last decade. Generation of e-waste in India amounted to 1.6 million tonnes in 2022, double the quantity from 2018. Though import of e-waste is banned in India, the country does allow the import of used e-waste for reuse, recycling, and refurbishment. In 2022, India imported 2,40,800 tonnes of used EEE and scrap.

Out of the 1.6 million metric tonnes of e-waste generated in 2022, India could collect and process only 5,27,000 metric tonnes–mere 32.93%.

The majority of e-waste is collected and handled in the informal sector where it is just crudely dismantled to extract metals such as iron, steel, copper and aluminium, and precious metals like gold, silver, and platinum. But the highly toxic materials contained in e-waste, including lead, mercury, and cadmium are not properly disposed of.

Chemicals in E-waste Leachate and Health Risks

Chemicals	Health risks	Waste source
Cadmium	Kidney disease, lung damage, fragile bones	Plastics in computers
Chromium (VI)	Allergic reactions, bronchitis, respiratory problems, DNA damage	Anti-corrosion agent in steel computer parts
Lead	Severe brain and kidney damage, miscarriage, high blood pressure, anaemia	Glass panels in screens and monitors
Mercury	Brain and nervous system damage, kidney problems, ulcers, high blood pressure	Circuit breakers, switches, other electronic equipment
Polybrominated Diphenyl Ether (PBDE)	Liver and thyroid problems	Flame retardant additive in plastics and textiles
Polychlorinated Biphenyls (PCBs)	Negative effects on the liver and endocrine system; skin and eye problems; impaired immune system; neurological effects in children; low birth weight; reproductive organ damage; cancer	Electrical equipment

Extended Producer Responsibility (EPR)

EPR is a powerful regulation but it is under-implemented

Extended Producer Responsibility (EPR) is a powerful, and for the same reason, often under-implemented regulation designed to shift the responsibility of waste management from consumers to the primary creators of global consumer waste: producers, importers, and brand owners.

Implementing EPR principles is crucial for effective waste management, as they encourage sustainable product design, promote recycling and reuse, minimise waste generation, and enhance accountability among waste producers. EPR also contributes to pollution prevention, stimulates innovation in waste management practices, improves waste collection and sorting, and raises consumer awareness and education. This framework acknowledges that producers of waste must take responsibility for the waste generated throughout a product's lifecycle, given their significant influence on product design, packaging, and material choices.

Under EPR, producers, importers, and brand owners (PIBOs) are primarily responsible for managing waste produced throughout the lifecycle of consumer goods.

EPR is mandated under the Plastic Waste Management (PWM) Rules and the E-Waste Management Rules. While some awareness and capacity-building programmes have been initiated and a registration process for plastic processors, brand owners, importers, and local bodies have been established, various EPR instruments-such as take-back schemes.

The Kerala Government's feeble first steps in implementing the EPR principles show the inability of governments to address the real issue in tackling plastic waste: curbing multinational corporates as well as local consumer goods companies that generate the bulk of plastic waste. Along with efforts to bring all stakeholders in the plastic waste sector under an online registration system, the Kerala government has been prodding its three public sector brands, Supplyco (Kerala State Civil Supplies Corporation), Bevco (Kerala State Beverages Corporation) and Milma (Kerala Co-operative Milk Marketing Federation) to set the precedence in EPR compliance. As per media reports, Milma currently uses nearly 25 lakh non-recyclable plastic pouches every day to supply milk. Rather than reducing the usage of non-recyclable plastic pouches or collecting them back for safe disposal, Milma intends to offset its plastic footprint and fulfill its EPR compliance targets through the purchase of EPR/plastic credit certificates from registered Plastic Waste Processors (PWPs).

Ageing Challenge

Kerala is undergoing a significant demographic shift toward an ageing population, which presents new challenges for the waste management sector, especially as healthcare services for seniors and palliative care patients expand.

According to the Kerala State Planning Board, the state is rapidly ageing in terms of population transformation. Compared to other states in India, Kerala has made significant progress in terms of demographics. Many factors including lower birth and death rates have contributed to this.

Kerala's population is ageing and this poses new challenges to waste management

In 1961, as per the Census of India, the proportion of elderly (aged 60 and above) in Kerala was 5.1 per cent, which was slightly below the national average of 5.6 percent. In 2001, the state's figure rose to 10.5 percent surpassing the all-India figure of 7.5 percent. In 2011, the state's elderly population ratio further increased to 12.6 percent and is expected to grow to 23 percent by 2036.

The rising use of adult diapers, along with baby nappies and sanitary napkins, poses considerable challenges for Local Self-Government Institutions. Although classified as biomedical waste and excluded from municipal solid waste (MSW), these items often get mixed with plastic waste, complicating the efforts of the Haritha Karma Sena, LSGIs, and agencies that provide doorstep waste collection services.

Soiled biomedical waste must be transported for processing at Kerala Enviro Infrastructure Limited (KEIL) in Kochi or at IMAGE, a large biomedical waste treatment facility operated by the Indian Medical Association in Kanjikode, Palakkad. Despite the availability of these services, some transporters resort to dumping or burning waste in remote areas. Currently, the state lacks a well-monitored plan for effectively managing this type of waste.

Scrap Dealers Unrecognised

Scrap dealers play a pivotal role in the management of non-biodegradable waste in Kerala, contributing significantly in its collection and processing. There are more than 10,000 scrap collection centres in Kerala, employing around 3.5 lakh people.[69] The scrap shops collect, sort and process diverse materials such as electronics goods, plastics, paper and metal. But they are mostly unauthorised; the CAG audit had found 31 out of 42 scrap shops (73%) operating without necessary licences.

As per the State SWM Policy 2018, LSGIs are required to identify and recognize organisations of informal waste collectors and promote and establish a system for integrating them into the waste management including door to door collection.

While issuing Dangerous and Offensive (D&O) trade licences to scrap dealers, many urban local bodies do not specify the nature of waste the dealers are authorised to collect, nor ensure that they have a formal agreement with an authorised recycler or dismantler. This has led to these dealers collecting, storing and transporting e-waste without authorisation from KSPCB and in violation of EWM Rules, 2016. There are incidents of the unauthorised dealers transporting plastic and e-waste far beyond the borders of the state and handing over to unauthorised recyclers or dumping it in the open in the neighbouring states.

Integrating the huge number of informal waste collectors and unregistered recyclers and refurbishers into the system remains a big challenge for the state. There is no efficient system in place to monitor the quantity and type of waste handled by scrap dealers or to ensure their proper storage and disposal.

Photo: Surendranath C

Chapter 10

Shifting the Burden

Even as Kerala has been pushing forward the *Malinya Muktham Nava Keralam* Campaign with fervour since May 2023, a suo motu case was registered by the National Green Tribunal (O.A.NO.164/2023/SZ) against Kerala for dumping solid waste in Tamil Nadu villages.

The investigations carried out by the Central Pollution Control Board in December 2023 on the directions from NGT has revealed a sordid picture of Kerala's management of non-biodegradable waste.[70] CPCB took up the inquiry based on the case on dumping waste at Anamalai in Erode district in Tamil Nadu. But it found that Kerala's waste spread much farther, across several districts in Tamil Nadu and even to Pune, Malad and Delhi, through scrap merchants and recyclers who are mostly unauthorised.

CPCB found that neither the LSGIs in Kerala that allowed unauthorised scrap merchants to buy recyclable waste from the households, MCFs run by the Haritha Karma Sena and the Haritha Keralam Mission, nor the Clean Kerala

Photo: Surendranath C

Company, which engaged private agencies for the disposal of non-recyclable waste in cement plants in Tamil Nadu, did any follow up on the fate of the waste they got rid of from their hands. “It is to be pointed out that lack of accountability was observed at almost all levels," the CPCB report submitted before NGT observed.

Plastic Jaggery

Even as the enquiry on the Anamalai waste dumping case was progressing, a fresh case reported by the Tamil Nadu Pollution Control Board (TNPCB) led the CPCB team to unearth another end-of-life point for plastic wastes from Kerala: a jaggery manufacturing unit at Kavindapadi in Erode district. Here, wastes from Kerala are mixed with sugarcane waste and burned in the open for the production of jaggery.

In this case, CPCB observed a murky deal involving several players–an individual in Namakkal district who bought the waste for the jaggery unit in Erode, a transporter in Kozhikode who brought in goods that Kerala needed from Tamil Nadu and refilled the return trucks with municipal solid waste, and a waste handler who had rented out part of his godown to the government-owned Clean Kerala Company. The transporter used a bogus bill of a waste management agency whose contract with the Kozhikode Corporation had lapsed four months back.

While awaiting an action taken report from KSPCB on the matter, CPCB has advised TNPCB to direct the LSGIs in Tamil Nadu to educate the villagers to stop using plastic waste as fuel in the production of jaggery.

Too Many Players

The generation and management of non-biodegradable waste, encompassing both recyclable and non-recyclable materials, are driven by the open market. Investigations by CPCB identified at least five entities involved in the handling of plastic waste in the Chittur-Thathamangalam municipality of Palakkad district. The five included the Local Self Government Institution (LSGI) at one end and the cement factory in Tamil Nadu that incinerated the waste at the other end. Three firms–the Clean Kerala Company; a subcontractor engaged by CKCL for the storage and transportation of waste; and a Chennai-based EPR consultancy–operated in between. The role of the consultant was to secure 'alternative fuel' for the cement companies and collect, in return, Extended Producer Responsibility Certificates for the big plastic waste generators in the country for the fulfilment of their EPR targets.

Observing that "roles of such waste management agencies are redundant or irrelevant," CPCB has recommended that "the number of waste management agencies be kept at a minimum." The LSGIs or agencies entrusted by them should directly enter into agreements with entities having waste disposal facilities. Also, all agencies should mandatorily obtain consent and authorizations for proper verification and scrutinization of records, CPCB has suggested.

Agencies handling waste should have authorisation –CPCB

CKCL: A Middleman?

Observing that the Clean Kerala Company (CKCL) has no authorisation under the SWM Rules 2016, CPCB has come down heavily upon the "ambiguous role" of the company. It lacks even the basic infrastructures such as storage area, baling machine, shredders etc. and does not have its own fleet of GPS fitted vehicles. CKCL is engaging private waste management agencies to handle its responsibility of disposing of rejects and its role is limited to that of a commission agent or a middleman, CPCB observed.

Many local bodies engage private agencies for waste management due to the exorbitant fee of Rs. 10 per kg charged by CKCL, compared to the Rs. 4 to Rs. 6 per kg charged by private agencies. "Another important grievance is that CKCL is irregular in lifting, transporting and disposing waste from MCFs or collection centres of local bodies."

The CPCB report has recommended to the Kerala government to ensure that CKCL functions as a full-fledged waste management entity with all necessary authorisations and consents mandated under relevant waste management rules. Further, all infrastructure for collection, storage, segregation, transportation, processing and disposal must be available with CKCL for management of non-biodegradable fractions of MSW.

Bleak Future

Apart from exposing the unauthorised, practically unmonitored and often illegal pathways of Kerala's disposal of dry waste, CPCB's investigations have also underlined the urgent need for Kerala to find its own means for managing its waste. "The inadequate treatment system to handle non-biodegradable wastes are often downplayed, highlighting certain successful Kerala models for managing compostable waste," observes CPCB.

Kerala gives more thrust on "the monitoring part rather than augmenting the treatment facilities and infrastructure," the report says. And as for the efficacy of monitoring, the report says it is non-existent in the border checkposts the CPCB team inspected. There are 14 interstate entry points between Kerala and Coimbatore alone and there are several others in Thiruvananthapuram, Kollam, Idukki, Malappuram and Wayanad districts.

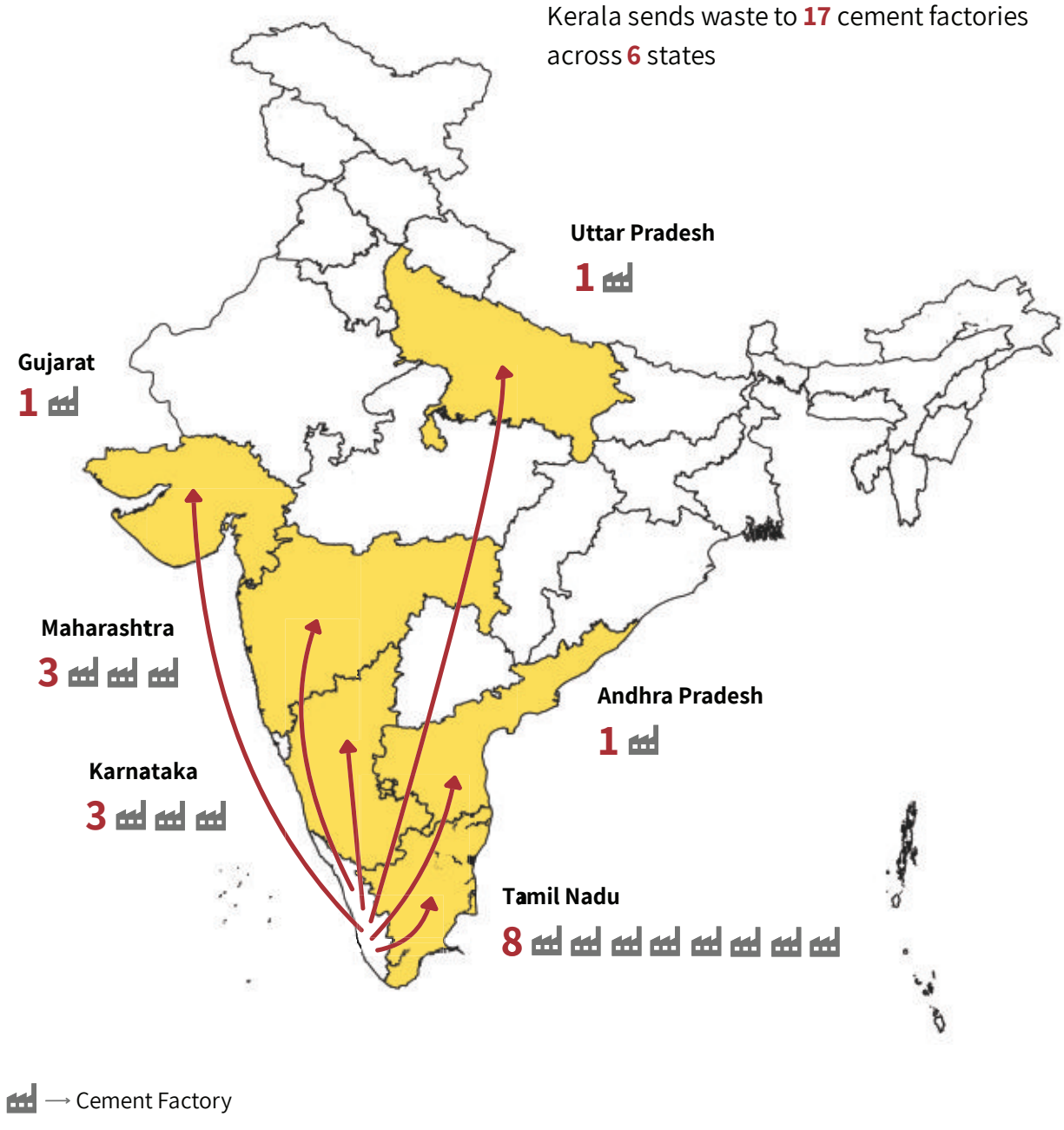
The task force for surveillance constituted with key officials from various departments in Tamil Nadu and Kerala is activated only in case of emergencies. Among the agencies that do regular monitoring of goods at the checkposts, the RTO has no mandate to check the type of goods transported and the police lack technical knowledge in identifying whether the waste is recyclable or not.

The October 2024 Compliance Report submitted by the Kerala government before NGT has stated that more than 800 tonnes of Refuse Derived Fuel (RDF) are being transported daily to 17 cement factories in six states,

including Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu. Notably, eight of these factories are situated in Tamil Nadu.

Given the increase in generation, collection and volumes of waste to be disposed of, it will not be possible for Kerala to continue with its practice of burning plastic waste in the cement plants in other states.

Dry Waste: Beyond Borders



Source: Compliance Report submitted before NGT by Gov ernment of Kerala, October 2024

Cementing Plastics Wastes

As plastic recycling rates stagnate and no viable solutions emerge for the global plastic crisis, governments across the world increasingly promote plastic waste as 'alternative' fuel in cement kilns. The arguments used to justify this practice are that co-incineration helps reduce waste as well as emission of greenhouse gases from the cement plants: a win-win situation for the planet and the industry.

In India, the Central Pollution Control Board (CPCB) in its guidelines on co-processing of plastics in cement kilns prepared for implementing the PWM Rules 2016 says that co-processing (burning plastic waste at high temperature) is a more environment-friendly and sustainable method of waste disposal compared to landfilling and conventional incineration as the process reduces emissions and generates no residues to be disposed of.

However, "a closer look at so-called alternative fuels, such as Refuse-Derived Fuel (RDF), shows that these fuels are not green or sustainable," says Zero Waste Europe, a network of communities and scientists working for sustainable waste management. A 2020 advisory report of the network highlights that typical Refuse Derived Fuel (RDF) made from mixed waste contains around 31 percent plastic, a product derived from fossil fuels, and thus cannot be counted as a sustainable or alternative fuel.[71]

The report says emission of pollutants including highly toxic heavy metals, dioxins and polychlorinated biphenyls (PCBs) increases with higher proportions of plastic and other wastes in the fuel used in cement plants. It cites instances from European cities where replacing petroleum coke with waste-based fuels have led to significant increases in pollutant emissions, provoking public protests and even plant shut-downs.

Promoting co-incineration as a solution for the plastic waste crisis also hinders efforts towards circular economy, waste prevention, reuse and recycling.

Co-processing could be especially harmful in countries where emission monitoring systems are lax.

CPCB's Suggestions

Based on the investigation, CPCB submitted an action plan for Kerala, to be implemented within specific time limits. Key suggestions:

- Development of adequate facilities for management of non-recyclable plastics
- Registering all agencies sending out and receiving waste
- Empanelling all waste management agencies afresh, adopting revised criteria
- Setting up an online tracking mechanism for vehicles transporting waste
- Preparing a detailed inventory of solid waste management system at the LSGI level
- Setting up Waste-to-Energy plants within the state by 2025.

Concrete Collusion

A powerful global alliance has emerged between consumer goods giants responsible for much of plastic packaging waste and the cement industry, points out a Reuters special report.[72]

The report named Coca-Cola, Unilever, Nestlé S.A., and Colgate-Palmolive among the prominent partners in the alliance. Notably, these brands are among the top ten worst plastic polluters, identified in brand audits in India and abroad by the non-profit #Break Free from Plastic.

This global alliance is being shaped at a time when both the consumer goods and cement industries are grappling with increasing scrutiny due to their pollution. The cement sector, responsible for approximately seven percent of the world's carbon dioxide emissions, faces mounting pressure to cut its greenhouse gases. Likewise, consumer brands are under pressure as countries are being forced to ban or put a tax on single-use plastics and make the polluting producers pay the clean-up costs through Extended Producer Responsibility (EPR) regimes.

Linear and Circular Economies

Managing the leakage of waste including plastics into the environment is one of the critical challenges of the 21st century.

The root cause of this crisis, unabated global production of plastics, however, remains uncontrolled under the capitalist linear economy path that the world follows.

Linear Economy is the traditional economic model where raw materials are extracted from the earth and transformed into products, which are thrown away when they reach the end of their useful life. This model is characterised by a "take, make, waste" pattern that doesn't consider recycling or reuse, and it leads to severe resource depletion, environmental, climate and health issues.

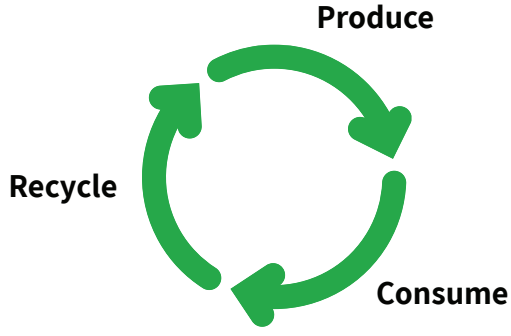
Circular Economy: The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum.

For many of its critics, however, 'Circular Economy' is just the new 'buzzword' of capitalism, after 'Sustainable Development'.

Global Circularity Status: "Global circularity is still in decline," says the 2024 *Circularity Gap Report*, published by Circle Economy Foundation.[73] The vast majority of extracted materials entering the economy are still virgin, with the share of recycled materials declining steadily from 9.1 percent in 2018 to 7.2 percent in 2023, according to the report.

Linear Economy

Circular Economy



Circular Economy is Limited

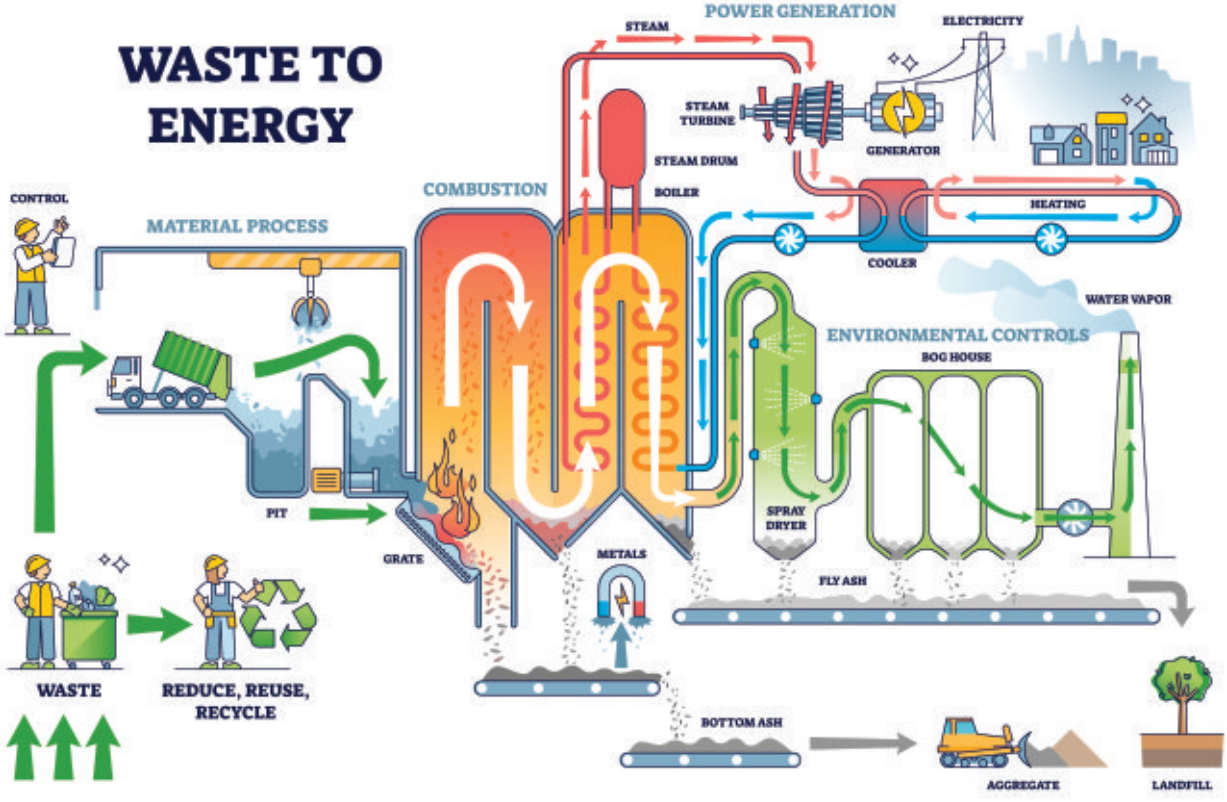
7.2% of the global economy is circular

Chapter 11

Burning Waste: What a Waste!

In his first speech on the Brahmapuram fire in the state assembly on 15 March 2023, Pinarayi Vijayan, chief minister of Kerala, announced a series of measures the government intended to take, which included conducting a health study, a scientific study on air-water-soil pollution, a police investigation of the incident, and a vigilance as well as an anti-corruption bureau investigation. The chief minister also categorically spoke about the state government's plan to set up a multi-crore plant at Brahmapuram that would convert waste to energy (WTE) through the process of gasification. The chief minister expressed his confidence that the plant would come up in two years.

This was not something new. Since 2011 the Kochi Municipal Corporation authorities and the state government have been considering a WTE plant at Brahmapuram to roll over the mounting garbage crisis in Kochi. In 2012, there was a move to set up a WTE plant at Chala in Thiruvananthapuram after the closure of the city's one and only centralised plant at Vilappilsala after strong protests from the local residents against dumping of waste in their



Kerala government announced 7 WTE plants at one go in 2018

village. The project was aborted later when media reports revealed that the private company which was to set up the plant was fictitious.

Even while emphasising on the importance of decentralised and sustainable waste management, the state MSW policy 2018 has incorporated a clause that whenever and wherever it's necessary, new technologies could be utilised to find solutions to the growing garbage issues. Centralised WTE plants are often highlighted by the authorities as the ultimate solution for the burgeoning waste crisis, and thermal processes such as incineration, gasification and pyrolysis are described as "environmental-friendly, world-class, modern technologies'' that will make garbage disappear forever with energy recovery as a bonus.

What is Waste to Energy?

Waste to energy (WTE) are technologies of energy recovery from waste that cannot be recycled or composted. It is the generation of energy from high-calorific value rejects such as plastic, paper, textiles and other materials. Energy can be harnessed from MSW either by directly burning it (thermal) or by converting it into fuel (thermochemical or biochemical). WTE plants that use thermal technologies such as incineration, pyrolysis and gasification are essentially incinerators that burn waste to produce heat, which in turn would power a turbine to produce electricity.

- **Incineration** is the process of burning waste material. This process, often described as thermal treatment in the industry,involves using special incinerators to convert waste into o ash, heat, and flue gas (gas emitting to the surrounding air).
- **Pyrolysis** is the thermal decomposition of waste into gas and solid particles in the absence of oxygen. This process typically occurs at temperatures around 500-600°C. During pyrolysis, materials like plastic and tires break down into smaller molecules, producing pyrolysis oil, pyrolysis gas, and carbon black.
- **Gasification** is a process that converts carbon-based materials into gases. The process takes place in a high-pressure, high-temperature vessel called a gasifier. The gasifier uses a controlled amount of oxygen and/or steam to convert the material into carbon monoxide, hydrogen, and carbon dioxide. The fuel gas produced by gasification is also known as syngas. Gasification is generally carried out in the temperature range of 600°C-1000°C.

In 2018, the state government announced seven WTE plants at one go, besides the already proposed plant at Brahmapuram. The proposal was to build 5 MW plants in Thiruvananthapuram, Kollam, Thrissur, Kozhikode, Kannur, Palakkad and Malappuram to convert waste to electricity through the thermal process of gasification.

Interestingly, the state took this decision even as there were only 11 WTE plants in the country at that time (now 14), and half of them were closed due to various issues including the poor quality of waste. The Thiruvananthapuram plant was first proposed at Peringammala, a part of the biodiversity-rich forest ecosystem of Ponmudi and in the Ecologically

Photo: M. Suchitra

Sensitive Zone One (ESZ-I) of the Western Ghats. The residents of Peringammala staged a year-long protests in 2018 pressuring the government to go back on its decision.

Subsequently, the Local Self Government Department issued an order[74] whereby the state government accorded sanction for the development of Integrated Solid Waste Management projects with WTE plants. The government also directed the Kerala State Industrial Development Corporation (KSIDC) to act as the nodal agency for the coordination and implementation of WTE plants, in effect infringing on the rights and responsibilities of the LSGIs.

Proportion of high calorific value materials is low in city waste in India

This strategy was in line with India's Solid Waste Management (SWM) Rules, 2016, which classifies waste into three categories–biodegradable, non-biodegradable and domestic hazardous. As per the Rules, biodegradable waste has to be treated by means of aerobic and anaerobic technologies as close to the source of generation as possible; non-biodegradable recyclables have to be streamlined for recycling; and non-recyclables with calorific value of 1,500 kcal/kg or more should be used to generate energy either through WTE or co-processing in cement kilns instead of disposing of in landfills.

The Ministry of New and Renewable Energy (MNRE) supports the WTE sector through several programmes which focus on waste management and the promotion of Renewable Energy production. Launched in 2014, Swachh Bharat Abhiyan or Clean India Mission promotes WTE as a component of

Kerala's MSW has high moisture content and low calorific value

waste management plans.

Thermal treatment technologies rely on the energy released from high calorific waste such as plastics, cardboard, paper and textiles to generate electricity. The amount of energy that can be derived from WTE depends on the nature, composition, volume, calorific value and moisture content of the waste. Calorific value is the measure of heat produced by the complete combustion of a specified quantity of a product. Moisture content is usually calculated as the percentage of water in solid waste.

Calorific Value is Crucial

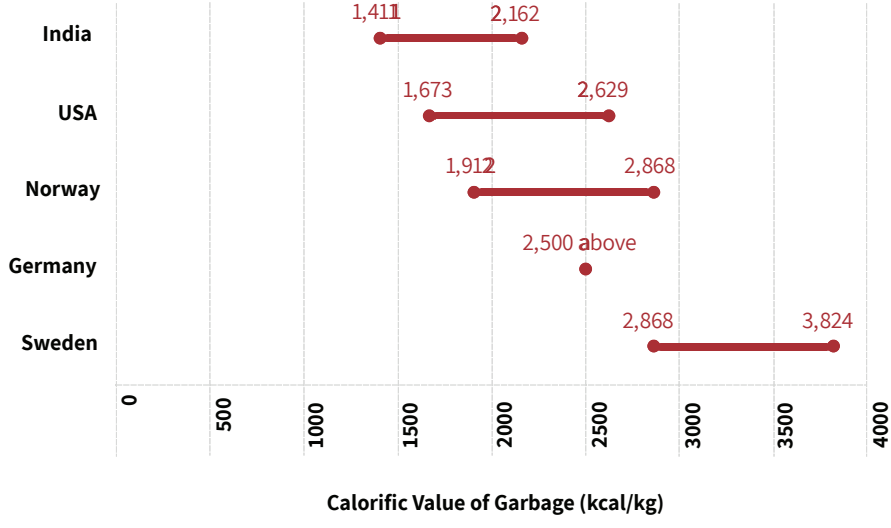
Studies on waste have repeatedly shown that the content proportion of high-calorific-value materials in city waste is low in India–most of the MSW fraction is biodegradable in nature, with low calorific value and with high moisture content–whereas countries that are heavily dependent on WTE have waste with high calorific value.

A 2018 urban waste study[75] by the Centre for Science and Environment (CSE), New Delhi, found that organic waste fraction was around 40-70 percent of the total waste, paper and cardboard contribute about 6-7 percent, and recyclable plastic (6-10 percent), and non-recyclable plastic (5-10 percent). Metal, glass and domestic hazardous waste contribute around 1- 3 percent.Calorific value and moisture content of waste in India varies widely from city to city.

According to a 2004-05 study[76] by the Central Pollution Control Board (CPCB) with assistance of the National Environmental Engineering Research Institute (NEERI) in 59 cities (35 metro cities and 24 state capitals), the average calorific value of waste was in the range of 1,411-2,162 kcal/kg. The average moisture content in the waste of cities assessed ranged from 41 to 52 per cent.

The first WTE plant in India was set up in Timarpur-Okhla in Delhi in 1987 with a cost of Rs 20 crores. Built by a company from Denmark, the plant was supposed to incinerate 300 tonnes of municipal solid waste per day to generate 3.75 MW of electricity. However, the plant had a breakdown within

Calorific Value of Garbage



Source: To Burn or Not to Burn, Centre for Science & Environment

20 days. The reason is said to be the poor quality of waste, says a 2019 report published by Down to Earth magazine.[77]

WTE projects require Viability Gap Funding

According to the Economic Review 2018, 81.6 percent of the MSW generated by major urban centres and 71.6 percent generated by smaller urban centres are compostable. The document also says the moisture content of the state's MSW is 55-70 percent and the calorific value is 1700 kcal/kg. Waste management experts in Kerala and organisations such as the Sastra Sahitya Parishad (KSSP) have repeatedly pointed out the incompatibility of thermal incineration technologies with the high moisture content of the bulk of municipal waste generated in Kerala experiencing six months of rain with an annual average precipitation of 3000 mm.

Since the thermal WTE projects are capital intensive, the state's plan was to go for a Public Private Partnership (PPP) model. A private firm would be chosen as the partner to design, build, finance, operate, maintain and transfer the project to the government. The state government would provide the firm with land, mandatory clearances and financial concessions; local bodies would supply a particular quantity of municipal solid waste as per the agreement. The private company would be allowed to mortgage the land to get funds from formal financial institutions; since the cost of the electricity produced would be high, agencies such as the Kerala State Electricity Board (KSEB) would buy it with the help of viability gap funding from the state government. The company would run the plant for 20-30 years as per the agreement, take the profit and then transfer the plant to the government.

Proponents of WTE, a section of technocrats, bureaucrats and political leaders, offer arguments such as that energy harnessed from waste is cheap, WTE plants address the issues of growing waste generation, provide scientific and effective management, divert discards from landfills and reduce the stress on limited space, reduce reliance on fossil fuels, offer a diversified energy mix and an enhanced energy security, create job opportunities and support the local livelihoods and local economies, contribute to climate change mitigation by reducing greenhouse gas (GHG) emissions by harnessing untapped waste resources, alleviate health risks, and that they align with the Sustainable Development Goals and circular economy principles. They also describe WTE as Clean Energy, Green Energy or Renewable Energy.

But how far are these arguments true?

The Global Alliance for Incinerator Alternatives (GAIA) debunks these claims in its reports on facts about Waste-to-Energy incinerators[78,79,80,81].

FACT 1: WTE is Prohibitively Expensive

WTE remains an extremely costly option for waste disposal and energy generation, in comparison with other established power generation sources and for waste management including landfills. It is costlier than thermal, solar and wind energy. Incineration is highly polluting, expensive and carbon-intensive, with large capital costs and high operational costs incurring from covering pollution control, air quality monitoring, wastewater management and ash disposal.

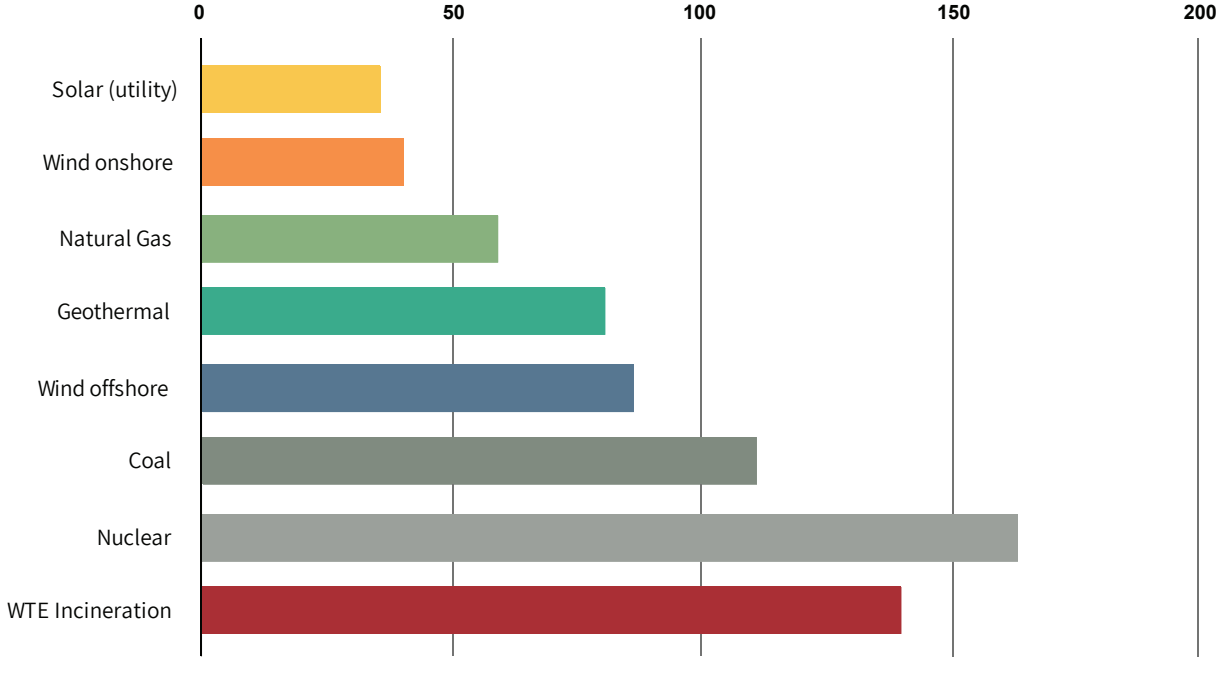
A 2021 study published by GAIA estimated the costs at USD 190 million to USD 1.2 billion to build an incinerator with a capacity of processing 1 million tonnes of waste per year. The report says both capital expenditure and operational expenditure are among the highest for WTE incineration compared to other waste management options such as composting, anaerobic digestion, and landfills.

A big chunk of the municipal waste is biodegradables. To make the feedstock less wet and transform the waste stream into one that is compatible with thermal technologies, WTE infrastructure requires complex drying technologies. These extra measures require extra maintenance, extra energy and extra costs.

The GAIA report also points out that WTE incineration requires hefty upgrades. Incinerator operators need to keep improving pollution control equipment in order to comply with emission regulations. Costly upgrades often become a major factor in facility shutdown, as the revenues are not sufficient to cover the additional expenditure. In the U.S., at least 31 municipal solid waste incinerators closed between 2000 and 2020, largely due to the financial burden caused by necessary pollution control requirements. "In many Southeast and South Asian countries, the capital expenditures for incinerators are significantly lower as the facilities are often built without air emission control equipment," notes the report.

Globally, many governments are increasingly prioritising waste reduction, reuse and recycling as more cost-effective and more environmentally sound than the use of WTE technology .

Global levelized cost of energy generation (USD/megawatt hour)



Source: GAIA, The High Cost of Waste Incineration, based on:Lazard.(2020).Levelized Cost of Energy and Levelized Cost of Storage–20209;U.S. Department of Energy.(2019, August).Waste-to -Energy from Municipal Solid Wastes.

FACT 2: Dirty and Harmful

Whatever be the technology used to convert waste to energy through thermal processes, waste is burned. A 2016 World Energy Council's report on WTE has stated that emissions from incineration facilities were contaminated by toxic heavy metals (mercury, lead and cadmium), Persistent Organic Pollutants (dioxins and furans), acid gases (sulphur dioxide and hydrogen chloride), nitrogen oxides, carbon monoxide and particulate matters.[82]

Dioxins and furans are Persistent Organic Pollutants known as the forever chemicals, and they are the most toxic human-made chemicals known to science. They have been linked to cancer and several types of auto-immune disorders. Dioxins accumulate in animal fat. Even those who are not living near an incinerator can suffer some of the grave effects. Eating the meat of the animals that have been grazing on nearby land, or consuming their milk, is

More Polluting than Coal

Dioxins: Trash incinerators release 28 times as much dioxin than coal power plants do to produce the same amount of energy.

Mercury: a potent neurotoxin that accumulates in the fatty tissue of fish once in the environment. A state-wide analysis by the New York State Department of Environmental Conservation found that, in 2009, the state's 10 trash incinerators released 14 times as much mercury per unit of energy than the state's 8 coal power plants–high enough that the total amount of mercury coming from the incinerators was higher than the emissions from coal plants

Lead: A toxic chemical that diminishes intelligence and–by lowering dopamine levels in the brain–may even be tied to increases in violent behaviour and cocaine addiction. Trash incineration releases more than six times as much lead as coal to produce the same amount of energy.

Nitrogen oxide (NOx): Primarily contributes to eye, nose, throat, and lung irritation and respiratory problems like shortness of breath that can trigger asthma. Trash incineration releases 3.3 times as much NOx as coal does to produce the same amount of energy.

Carbon monoxide (CO): Is released from trash incinerators at rates comparable to coal power plants per 1 MWh of energy produced. Both NOx (directly) and CO (indirectly) contribute to the formation of ground-level ozone pollution, aggravating asthma.

Hydrochloric Acid (HCl): HCl is linked to acute bronchitis and lung cancer. Trash incineration releases a whopping 27 times more HCl than coal plants to produce the same amount of energy.

Sulphur dioxide (SO_2): Bad for lungs, with even short exposures to ambient levels causing bronchoconstriction and increased asthma symptoms. It's one of the rare pollutants where coal plants are worse. Coal plants release two times more SO_2 as trash incinerators to produce the same amount of energy.

Carbon dioxide (CO_2): The prime global warming pollutant - is released at a rate 1.65 times that of coal power plants. *(Global Waste Management Outlook 2024)*

enough to ingest dioxins. Once the dioxins enter into animal bodies, it will remain there and magnify. Dioxins can go into babies through breast milk.

According to the US-based Energy Justice Network, trash incinerators are the dirtiest way to make electricity, going by most air pollution measures. Even with air pollution control equipment, trash incinerators emit more pollution than (less controlled) coal power plants per unit of energy produced. Coal power plants are widely understood as the most air-polluting energy source, but few realise how much worse trash incinerators are for air quality.

FACT 3: WTE is Waste of Energy

Any object that may end up as waste embodies more energy than the heat released when it is burned. Any basic life-cycle assessment will show that the calorific value of most items is a small fraction of their "embodied energy," the energy used to extract and process raw materials, turn them into products, and transport those products to markets worldwide. The embodied energy is all lost when an item is burned in an incinerator. Besides, since incinerators have limited thermal efficiency, only a portion of the fuel value of the material burned can be recovered. In a standard waste-to-energy incinerator, at most only 35 percent of the calorific value of the waste is generated as electric power.

FACT 4: WTE is Non-Renewable

Even as the global municipal waste generation is projected to grow rapidly, waste cannot be considered as a renewable fuel from the point of sustainable resource and waste management, sustainable development and climate change. MSW has been recognised as something that needs to be reduced drastically. However, more than 20 countries in the world, including India, consider waste as a renewable energy resource and promote WTE plants and make subsidies available for such mega projects.

MSW consists of discards such as plastic, paper and glass that are produced from finite natural resources such as fossil fuels, forests and minerals. A large portion of the materials currently burned in incinerators can be reused, recycled and composted. Burning these materials for generating electricity discourages much needed efforts to conserve resources and undermines energy-conserving practices such as recycling and composting. Moreover, using waste as fuel creates a never-ending demand for waste, and waste reduction, which is the most crucial part of waste management, becomes impossible.

Reduction in waste generation will adversely affect the quantity of feedstock and the viability of the project. Countries such as Germany, Sweden, the Netherlands, the United Kingdom, Denmark and Spain are facing issues of not having enough municipal solid waste to convert into energy as hundreds of municipalities within the European Union have set Zero Waste as their new goal. Due to better waste management strategies in the European Union, there are more incinerators than the waste available for burning. This has led to importing trash from elsewhere.

Incinerators require huge capital investments

FACT 5 : WTE Does Not Support Local Livelihood

Incinerators require huge capital investments, but they offer relatively few jobs when compared to recycling. There are also no green jobs in "waste-to-

energy" incineration, and they take away jobs from people who need them most. It adversely affects the livelihoods of local waste collectors. Thermal treatment technologies rely mainly on the energy released from high calorific waste such as plastics, cardboard, paper and textiles to generate electricity. Since these are the materials most likely to be collected by informal waste collectors for recycling, destroying them using thermal treatment threatens their already vulnerable livelihoods.

For that reason, waste picker associations in Asia, Africa and Latin America have protested against WTE plants and incineration, pointing out that it would be preferable to develop an integrated MSW management plan based on material flow analysis that integrates concepts such as the waste hierarchy, the circular economy and the creation of green jobs.

WTE plants emit more CO_2/MWh than power plants based on coal

FACT 6: WTE Contributes to Climate Change

Incineration fares very poorly from a climate perspective. They emit more CO_2 per megawatt-hour than power plants based on coal, natural-gas or oil. This is because waste often contains plastics and other synthetic materials derived from fossil fuels, which release CO_2 when burned. However, the specific CO_2 emissions from incineration can vary greatly depending on the composition of the waste.

According to the US Environmental Protection Agency (EPA), waste-to-energy incinerators and landfills contribute far higher levels of greenhouse gas emissions throughout their life cycles than source reduction, reuse and recycling of the same materials. Incineration also drives a climate changing cycle of new resources extracted, processed in factories, transported around the world, and then burned in incinerators and dumped in landfills. WTE is a part of the linear economy and burning of discards leads to more fossil fuel use, resource extraction, biodiversity loss, adding to climate change challenges.

GHGs and other airborne pollutants emitted from combustion processes may also hinder countries' abilities to meet obligations related to their Nationally Determined Contributions (NDCs) and emission trading scheme allowance (Source : Methane Matters).[63]

FACT 7: WTE Does Not Do Away with Landfills

For every 4 tonnes of waste burned in an incinerator, one tonne of toxic ash is produced. That means, incinerators still need landfills. Managing this toxic ash is very difficult and requires stringent pollution control measures and continuous monitoring. The ash produced from incineration often contains hazardous substances, making it difficult and costly to manage. It requires specialised landfills with stringent environmental controls to prevent contamination of soil and water.

FACT 8: WTE Does Not Make Waste Disappear

According to waste management experts, only 10-15 percent of total municipal waste is incinerable. Despite all these facts, the authorities seem bent upon promoting WTE plants as an ultimate answer to the question of

Many nations are moving away from incineration to Zero Waste solutions

how to deal with ever-growing waste. It could be so because other solutions require structural, systemic and behavioural changes in the pattern of production, consumption and generation of waste. It also requires hardworking and concerted efforts from governments, policymakers and communities to build up awareness on sustainable waste management and move towards a zero waste scenario.

"As the most expensive mechanism for waste management and generating energy, so-called "waste-to-energy (WTE)" incinerators are a waste of money and resources that could otherwise be directed at more cost-effective and sustainable zero waste solutions," notes GAIA.

FACT 9: WTE Leads to Centralised Ownership

High-cost WTE plants lead to concentrated ownership and control of energy generation into the hands of a single firm. Whereas waste is produced by society as a whole, the electricity generated by the incinerator is owned by the operator and sold back to society. In this manner, the larger society is forced to invest increased energy in production to replace those materials destroyed in the incinerator and pay the WTE operator for the privilege of getting back a small fraction of the energy in their own waste.

FACT 10: The World is Moving Away from Burning Waste

A 2018 report of the GAIA states that the trend of moving away from incineration towards Zero Waste Solutions is gaining momentum globally. In the United States, no new incinerators have been built since 1997 due to resistance from the public, health risks and high costs.

Europe, home to some of the most advanced waste-burning facilities in the world, has taken the first step to phase out incinerators. The European Union adopted a Circular Economy Action Plan (CEAP) in March 2020. It was one of the main building blocks for sustainable growth that would reduce pressure on natural resources and reduce the generation of waste. A 2017 communication of the European Commission urged the member states to issue a moratorium on new incinerators, decommission old facilities, and phase out public support and subsidies for incineration. Higher targets for sustainable waste management with emphasis on the waste disposal hierarchy–reduction, recycling and reusing–have caused incineration overcapacity, meaning there are more incinerators than waste available for burning. This overcapacity has led to waste importation in Germany, the Netherlands, United Kingdom, Sweden, Denmark and Spain.

“Incinerator companies are now approaching cities and municipalities in developing countries, particularly in Asia, to peddle the waste burning facilities. Incinerators are sold as "high-tech solutions" that "have worked" in developed countries. But many developments today reveal that the world is waking up and realising the failures of incineration. Developed countries that have previously relied on incineration are now shifting away from it," notes the report.

WTE:
10 Questions For Policymakers

The United Nations Global Outlook on Waste 2024 poses a few helpful questions for policymakers to consider regarding thermal treatment technologies :

1	Is the technology the best available, and can it meet stringent emission and discharge limits, including for any hazardous waste residues?
2	Can a guaranteed quantity of feedstock be supplied within the required window of calorific value and moisture content for the entire lifespan of the facility? If not, will contractual penalties be affordable?
3	Is a suitable system in place to divert the majority of food waste from the feedstock?
4	If recyclables such as plastic, paper and cardboard are to be used as feedstock, how will livelihoods within the recycling value chain and sustainability/zero waste/ circular economy ambitions be impacted?
5	Can the facility be operated by local people or will employment opportunities mainly be available to those from elsewhere?
6	Do appropriate national regulations exist, and does the environmental regulator have sufficient capacity to monitor emissions and enforce these regulations?
7	Will a hazardous waste landfill cell (a waste-holding unit within the landfill) be required for any of the outputs, and is this feasible?
8	Can the technology be developed at an appropriate scale for the population it is designed to serve, and are transport networks suitable for a centralised facility?
9	Will it be possible to utilise the heat and electricity generated in order to achieve minimum efficiency standards?
10	Will airborne emissions meet air quality targets, climate change goals and countries' pledges in their NDCs?

(Source: *Global Waste Management Outlook 2024)*

Climate Change Causes Extreme Events

Photo courtesy: **Madhuraj, Mathrubhumi**

Chapter 12

Waste Changes Climate

2024 is the warmest year in the 175-year observational record.[83]

A report on the state of the global climate released by the World Meteorological Organisation (WMO) in December 2024 has officially confirmed that 2024 with a global average temperature of at least 1.55°C above pre-industrial levels (1850-1900) has surpassed the global warming record of 2023 (1.45°C).

Heatwaves, floods, droughts, wildfires and rapidly intensifying tropical cyclones are causing misery and mayhem, substantially altering everyday life in a number of ways for millions of people and inflicting many billions of dollars in economic losses, observed the WMO report.

“Today I can officially report that we have just endured a decade of deadly heat. The ten hottest years on record have occurred in the last decade, including 2024," said United Nations Secretary-General António Guterres in his New Year's message issued on 30 December 2024. "We are facing a climate breakdown in real time. We must get off this road to ruin, and we have no time to lose."

All the regions across the globe are facing the severe impacts of the altered climate patterns in one way or another. Kerala is no exception. Impacts of climate change are already being felt in the state, as evident in the recent events of extreme rains, floods, droughts and an increased number of cyclones. The state prepared its first Action Plan on Climate Change (SAPCC 1.0) in 2014 and revised it in 2022 (SAPACC 2.0) for the period 2023-2030. The revised plan portends increased impacts in the coming years. The proximity of the warming Arabian Sea in the west and the Western Ghats, an

Warming Arabian Sea

IPCC has pointed out[85] that 93 percent of the excess heat due to global warming is absorbed by oceans, and the Indian Ocean takes a quarter of this. The Arabian Sea, the northern part of the Indian Ocean, is warming fast, leading to an increase in the number and intensity of cyclones along the western coast of India. The warming of the Arabian Sea has also led to changes in the patterns of monsoons. Kerala has about 590 kilometres of shoreline, and many low-lying areas have been experiencing coastal and tidal flooding of increased frequency and intensity.

extensively altered mountain range, in the east, both playing crucial roles in determining Kerala's climate patterns, would make the impacts more intense, says SAPCC 2.0.[84]

GHGs Alter Climate

Climate change research has established that a steady increase in the temperature results from the increased emissions of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), fluorinated gases and water vapour which absorb and retain heat. This has resulted from prolonged human activities like the burning of fossil fuels, deforestation, chemically intensive agriculture and poor waste management.

Carbon dioxide constitutes a substantial portion of the increased atmospheric concentration of greenhouse gases since the Industrial Revolution. Methane, the second most important GHG after CO_2, a short-lived but extremely potent gas, has 82.5 times more warming potential than CO_2 over a 20-year timespan and it is responsible for about 0.5°C of warming, according to the Intergovernmental Panel on Climate Change (IPCC).[86]

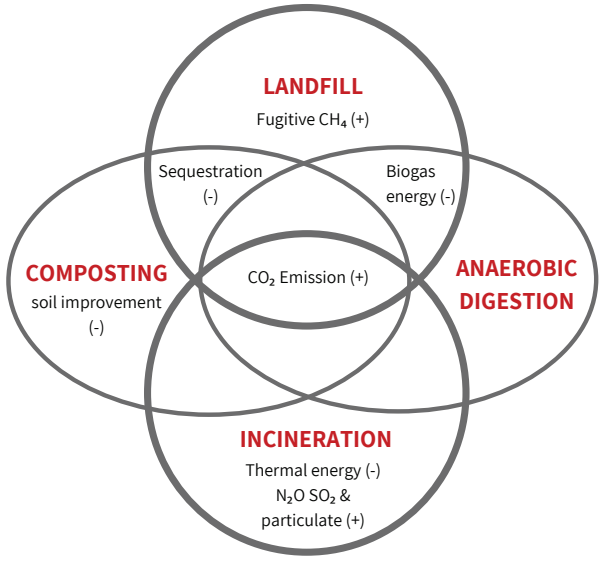
Waste Enhances GHGs

The solid waste sector is a significant source of GHG emissions, particularly methane, which it emits at rates comparable to the oil and gas sectors. IPCC identifies waste management as one of the three sectors with the greatest potential to reduce surface temperature rise.

The extraction of raw material, manufacture, distribution, and use of products, as well as management of the resulting waste, all result in emissions of GHGs that adversely affect the Earth's climate. Municipal solid waste (MSW) is of particular concern as for GHG emission, particularly methane.

The waste sector is the third-largest source of anthropogenic methane emissions worldwide. The UNEP's Global Waste Management Outlook 2024

Waste Management Options & Global Warming



Source: ResearchGate, 2021.Climate Change and Waste Management: A Balanced Assessment

Methane emissions from human activities have increased by 20% in the past two decades

has pointed out that the impact of waste on climate change has been underestimated historically and this has led to underinvestment in waste reduction and waste management as effective climate change mitigation measures.[87]

For example, the Outlook points out that the Fifth Assessment Report of IPCC previously estimated the contribution of the waste sector to GHG emissions at around three percent, meaning countries may have previously underestimated the potential of municipal waste management interventions in fulfilling their commitments in climate change mitigation. "However, recent calculations by the International Solid Waste Association [ISWA] suggest that better waste and resource management could mitigate 15-25 percent of global GHG emissions, and therefore must be included in every country's NDCs," says the report.

Methane Matters

According to UNEP and Climate and Clean Air Coalition 2021, 20 percent of anthropogenic methane emissions are caused by the anaerobic decomposition of food and other organic materials left in landfills, open dumps and wastewater. Breaking down of biodegradable material, including food, human waste, wood and paper in the absence of oxygen in dump sites and landfills (anaerobic decomposition) leads to production of methane. Open dumpsites and landfills constantly leak methane into the atmosphere. Methane is highly inflammable and causes landfill fires resulting in emission of CO_2 and other toxic gases.

The Global Methane Budget 2024 highlights that methane emissions from human activities have increased by 20 per cent in the past two decades. The budget is produced by international research partners, including CSIRO, Australia's national science agency, as part of the Global Carbon Project. It covers 17 natural and anthropogenic (human-induced) sources and shows that methane has increased by 61 million metric tonnes per year. Human activities are responsible for at least two-thirds of global methane emissions, adding about 0.5°C to global warming that has occurred to date, notes the report.

The report found that agriculture contributes 40 percent of global methane emissions from human activities. This is followed by the fossil fuel sector (34%), solid waste and wastewater (19%), and biomass and biofuel burning (7%).

Global Methane Pledge

Anthropogenic methane emissions are expected to continue to increase by more than 15 percent by 2030, reaching nearly 380 million tonnes per year, an eight percent increase from 2020 levels. In this context, more than 110 countries committed to the 'Global Methane Pledge' - an initiative launched at the 2021 United Nations Climate Conference (COP26) in Glasgow. The Pledge has the collective goal of reducing global methane emissions by 30 percent by 2030, compared with a 2020 baseline. India has not participated in this pledge.

Incineration is Not Green

Similarly, incineration technologies including mass-burn, pyrolysis, plasma, gasification, and other systems that generate electricity or fuels are contributors to climate change. Incinerators are significant sources of CO_2 and also emit nitrogen oxides (NOx) including nitrous oxide (N_2O), a potent greenhouse gas that is approximately 300 times more powerful than CO_2 at trapping heat in the atmosphere.

A 2009 report published by GAIA points out that by destroying resources rather than conserving them, all incinerators cause significant and unnecessary GHG emissions. Pyrolysis, plasma, and gasification incinerators may have an even larger climate footprint than conventional mass-burn incinerators because they require inputs of additional fossil fuels or electricity to operate.[88]

Ground-level Ozone

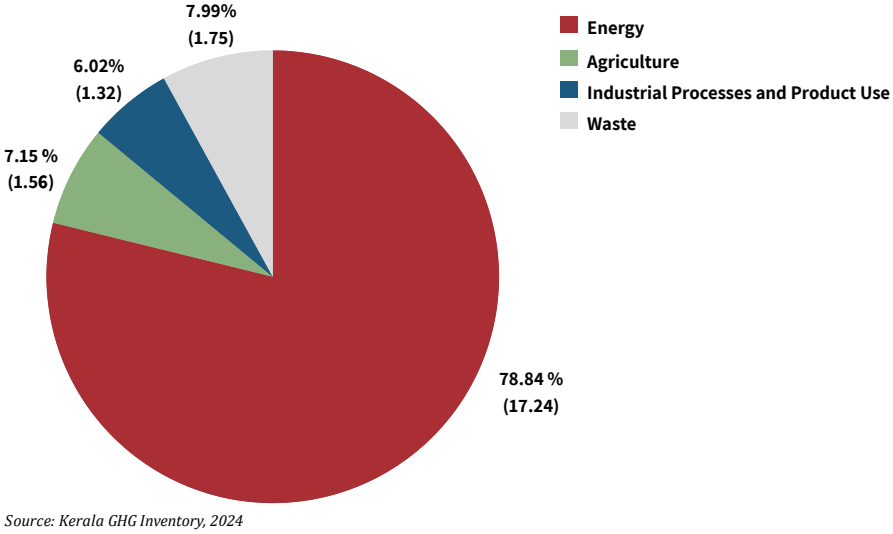
Ground-level or tropospheric ozone, which is produced by the interaction of sunlight with emissions of methane, nitrogen oxides, carbon monoxide and volatile organic compounds, is not only a potent greenhouse gas but causes severe health impacts. According to the Climate and Clean Air Coalition, ground-level ozone affects human health by impairing respiratory and cardiovascular function and causing even premature mortality.[89]

Kerala : Waste and GHG Emission

In Kerala, the waste sector constitutes the second largest emitter of greenhouse gases after the energy sector, according to the Kerala GHG Inventory released in June 2024 by the State Department of Environment. The waste sector accounted for 1.75 $MtCO_2$-e (the unit CO_2-e represents an amount of a GHG whose atmospheric impact has been standardised to that of one unit mass of carbon dioxide (CO_2), based on the global warming potential of the gas.) emissions which was approximately eight percent of the gross emissions in the state in 2021. Solid waste disposal, domestic wastewater and industrial wastewater are the key categories of GHG emissions in the waste sector.[90]

In Kerala, the waste sector is the second largest emitter of GHGs

Sector-based GHG emission - Percentage share and $MtCO_2$-e 2021



Source: Kerala GHG Inventory, 2024

The state lacks adequate and updated data for assessing GHG emissions

The inventory, however, claims the emissions from solid waste disposal in Kerala declined at a rate of 7.9 percent from 0.10 $MtCO_2e$ in 2005, to 0.03 $MtCO_2e$ in 2021, based on the Kerala Government's claim (in the Economic Review 2023) that the municipal solid waste treatment in the state has improved in the state from 52 percent in 2019-20 to 93 percent in 2022-23.

Inadequate Data and Research

This claim needs to be examined in the global context where agencies such as UNEP highlight the lack of data and research on emissions from waste is lacking in many countries. For instance, modelling of methane emissions from waste disposal sites had previously assumed that emissions are generated gradually and over a long period after site closure, whereas recent data suggests that a larger fraction of methane is produced during a landfill's operating life. Since methane is a short-lived climate forcer, this means that biodegradable waste being disposed of to landfills and dump sites today will have a more near-time impact on climate change than previously understood.[91]

There has been inadequate research into the scale of emissions from the open burning of waste, but whatever studies are available to indicate the gravity of the issues of GHG emission from waste. For instance, the CUSAT study 2024 observed that the total amount of CH_4 and CO_2 emitted during the waste fires (2019, 2020, 2023) at the Brahmapuram dump site was on par with the emissions from 159 days of waste storage for CH_4 and 51.8 years of waste storage for CO_2, with a cumulative global warming potential of 147.9 Kg CO_2e.[92]

International and national policies have to rely on estimates, but since open burning is an informal activity that often takes place in backyards or at

Plastic Fuels Climate Crisis

- The fastest-rising constituent of waste streams is plastic
- It's a derivative of fossil fuels that has no good disposal options
- Plastic production is currently growing at 3.5-4% per year
- At this rate, plastic will consume 13% of the 1.5°C carbon budget by 2050
- If plastic were a country, it would already be the fifth-largest emitter in the world
- In 2019 alone, plastic production and incineration resulted in greenhouse gas emissions equal to the emissions from 189 coal power plants
- The 1.5-degree target outlined in the Paris Agreement will not be achievable without significant reductions in plastic production
- Plastic in the oceans interferes with the oceans' capacity to absorb and sequester CO_2, thus contributing to accelerating climate change.

Source: GAIA, 2021.[94]

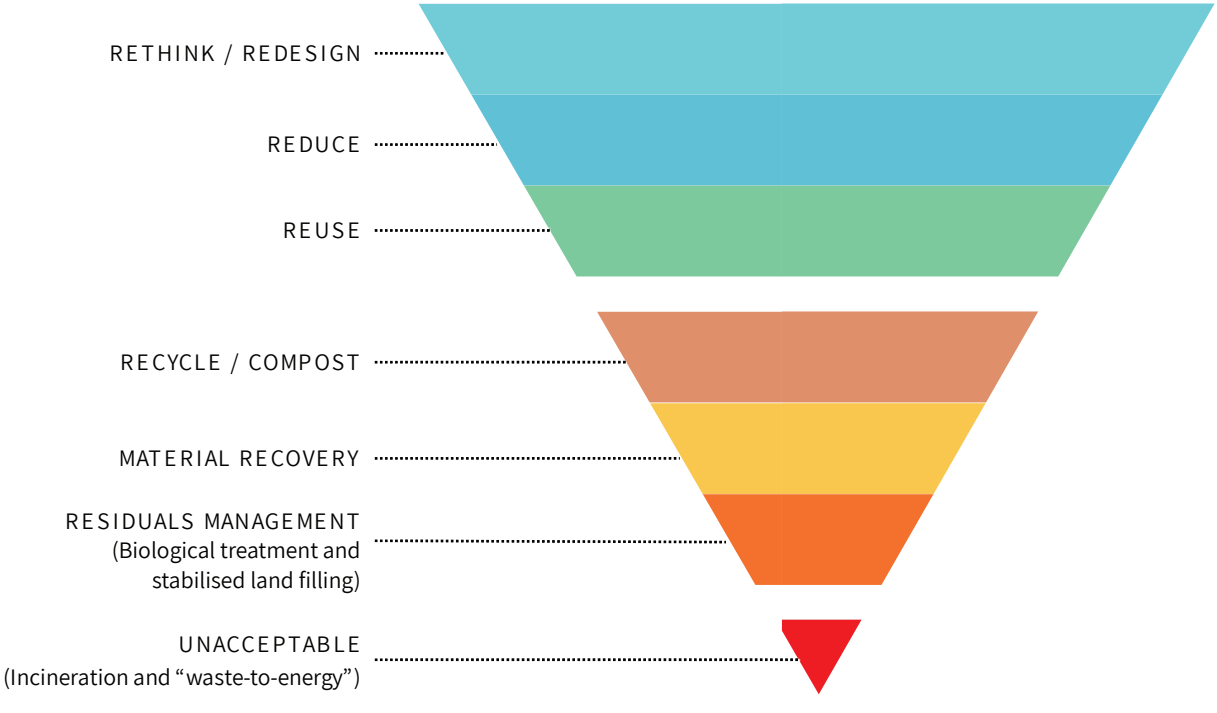
uncontrolled disposal sites, its scale is often underestimated and under-reported.

Even when Kerala has fixed a target of achieving Net Zero status by 2050, the state lacks adequate and updated data for assessing greenhouse gas emissions. The inventory itself points out that the assessment of GHG emissions from different sectors was based on available data from state-owned entities which "may not be the latest or the most accurate data suitable for higher-tier assessment." . Emphasising the fact that lack of data will hinder policy change and investment, the inventory has called for generating new data since these assessments will be the basis for prioritising the sectors and actions for reducing GHG emissions in Kerala.[93]

Zero Waste Strategy

Aiming for Zero Waste is one of the fastest, cheapest, and most effective strategies available for combating climate change. According to UNEP and other agencies working on Zero Waste , the most important strategies for mitigating methane emissions from waste are organic waste reduction, segregation at source and proper treatment of biodegradable discards. These strategies are low cost and easy to implement anywhere in the world.

The waste hierarchy principles in which waste prevention, reduction, recycling and reusing, and minimising the discards to be disposed of in landfills or incinerators, could be used as an effective tool to achieve this. The waste hierarchy helps the transition towards a zero waste circular economy.



Source: Zero Waste International Alliance

Photo Collage: Sabeer

“A threatened community is a strengthened one if people work together.”

– Dr. Paul Connett, Waste management expert and author of the book *The Zero Waste Solution: Untrashing the Planet: One Community at a Time*

Chapter 13

The Way Ahead

The world is largely driven by the dominant, profit-oriented, neoliberal capitalist economy that prioritises quantitative growth through the exponential production and consumption of consumer goods. However, the rampant extraction of natural resources, coupled with unsustainable production and consumption practices and significant lifestyle changes, has resulted in an alarming increase in waste generation. Poor waste management poses serious threats to our climate, ecosystems and environment, particularly impacting the health of vulnerable populations, including the poor and marginalised communities.

The management of municipal solid waste is fundamental to effective governance and one of the most critical responsibilities of local governments. The fire disaster at Brahmapuram, Kochi, in March 2023, serves as a vital wake-up call for Kerala to reassess and enhance its waste management systems. This incident underscores significant institutional failures in achieving effective environmental governance and ensuring social justice. Moreover, it highlights the insufficient engagement of the community in both the planning and implementation of waste management initiatives. It is essential to thoroughly evaluate and address the long-term repercussions of the Brahmapuram disaster and similar incidents.

Since the 1990s, Kerala has implemented numerous initiatives to enhance sanitation and waste management. Despite these efforts, sustainable management of municipal solid waste continues to pose a significant challenge for the state. To effectively tackle this pressing issue, Kerala must concentrate on several key factors:

1. Understanding Larger Picture

Management of MSW is fundamental to effective governance

It is essential to recognize the interconnectedness of municipal solid waste, pollution, public health, ecosystem integrity, climate change, and social and economic inequalities. Sustainable waste management must be a central element of environmental governance and strategic action plans aimed at addressing climate change, restoring ecosystems, conserving biodiversity and managing disasters. The state must integrate waste management strategies with broader development goals, land-use planning, community health initiatives, and efforts to promote social and gender justice. Making waste management a top priority in the state's environmental budget is crucial. By

adopting such a holistic approach, the state can ensure that its development plans effectively align with the Sustainable Development Goals.

2. Generating Reliable Data

A significant limitation in Kerala's waste management efforts is the absence of reliable data concerning the quantity, composition and characteristics of the municipal solid waste generated, collected, treated, and disposed of. Addressing this data gap is essential for developing effective infrastructure and selecting suitable technologies for waste treatment. Therefore, all urban and rural local bodies in the state must undertake immediate initiatives to conduct comprehensive solid waste surveys, as specified in the Solid Waste Management (SWM) Manual. These surveys should be carried out at micro levels, such as neighbourhoods, clusters, or wards.

3. Creating Solid Waste Inventories

Immediate action is required to create a comprehensive inventory of municipal solid waste for each Local Self Government Institution (LSGI) in the state. This inventory should encompass all waste streams and accurately record the quantities of various types of solid waste. Such data is crucial for developing effective waste management and reduction strategies, as well as for establishing the necessary infrastructure. Many local bodies in the state currently lack even basic facilities for waste storage and quantification, highlighting the need for urgent improvements.

4. Preparing Master Plans by LSGIs

The Solid Waste Management (SWM) Rules of 2016 mandate that every Local Self Government Institution (LSGI) develop a master plan and bylaws for effective and scientifically sound municipal solid waste management. However, many local bodies in the state have not yet completed these essential plans and legal instruments. It is important to review this process and the resulting plans to ensure that all critical factors, including climate change and disaster management, are adequately incorporated.

5. Strengthening Decentralised Systems

Kerala's waste management policy is grounded in the principles of 'Zero Waste,' focussing on waste reduction, reuse, and recycling. The state has developed an extensive decentralised waste management system based on these principles. To improve the efficiency of this system, the state should prioritise the following measures:

Source Segregation: Implementing effective waste segregation at the source, as this is essential for all waste treatment technologies.

Comprehensive Door-to-Door Collection: Ensuring that door-to-door waste collection services reach all waste generators.

Local Processing of Biodegradable Waste: Processing biodegradable waste at the source or community level using region-specific, environmentally sustainable technologies, such as composting or biogas production.

LSGIs must prepare master plans for effective waste management

Proper Management of Non-Biodegradable Waste: Accurately quantifying and effectively managing non-biodegradable waste within the state.

6. Effectively Managing Plastic and E-Waste

While the state has made significant progress in managing biodegradable waste, its capacity to handle plastics and e-waste remains insufficient. Plastic waste presents a pervasive challenge in Kerala, requiring urgent attention and effective mitigation strategies to address its widespread impacts on ecosystems and human and wildlife health. The following actions are needed:

Plastic Waste

- **Data Generation:** Develop reliable inventories at the LSGI level in the state to gather data on the sources, quantities and types of plastic waste generated and disposed of. Given the alarmingly low global recycling rates, these inventories should provide realistic estimates of recyclable and non-recyclable plastics, factoring in technological, economic and practical viability. This information is critical for formulating diverse strategies to combat plastic waste effectively.
- **Brand Audits:** Conduct brand audits on plastic waste to raise community awareness about plastic waste generators and encourage practices such as refusing and reducing consumption.
- **Enforcement of Single-Use Plastic Ban:** Strictly enforce the ban on the manufacture, sale, storage, and transportation of single-use plastics (SUPs). The state government should actively monitor and prevent the import of banned SUPs from outside the state.
- **Restrict Unsustainable Packaging:** Restrict unmanageable and environmentally harmful plastic packaging, such as multi-layered plastic (MLP) while promoting and incentivising safe, eco-friendly packaging alternatives.
- **Advocacy for Consistent Policies:** The state government should advocate against conflicting central government policies on plastics, which contribute to the ongoing influx of banned plastics into Kerala.
- **Separation of Plastics:** Prevent the mixing of plastics with other waste streams and ensure proper separation of recyclable plastics from non-recyclables to avoid disposal as rejects.
- **Plastic-Free Action Plans:** Develop separate action plans for eliminating plastic waste in canals, streams, rivers, backwaters, coastal areas, and at tourist and pilgrimage centres. Sufficient funding should be allocated to support sustainable plastic waste management programs and campaigns.
- **Mandatory Green Protocol:** Make the Green Protocol mandatory for all functions and events to minimise plastic use.
- **Open Burning Prohibition:** Enforce a strict ban on burning plastics in open areas.

Conduct brand audits to raise awareness about waste generators

E-Waste

Update e-waste inventory to include online trade and import

A comprehensive plan for managing e-waste is essential, especially given the significant rise in the sale of electrical and electronic devices. Key components of this plan should include:

- **Inventory Development:** Update the inventory of e-waste to include electronic goods bought through online platforms and those imported from abroad.
- **Careful Handling:** Ensure that e-waste requiring specialised handling-such as computer monitors, television sets, refrigerators, and electric cables-is not left exposed in scrap shops or local collection facilities without proper environmental and health safeguards.
- **Safe Practices:** Regulate the loading, transportation, unloading, and storage of e-waste to prevent environmental damage and health risks.

7. Managing Soiled Diapers and Sanitary Napkins

Kerala's population is ageing and this poses new challenges to waste management. Care should be taken that biomedical waste is not mixed with plastic. The state must encourage the manufacturing and use of compostable diapers and sanitary napkins as well as reusable menstrual cups.

8. Implementing EPR

Implementing Extended Producer Responsibility (EPR) is essential for effective waste management, as it fosters sustainable product design, and promotes 'recycling, reuse, and reduce' of waste generation. Top brands that contribute the most to trash output need to be identified and made accountable.

9. Integrating Scrap Dealers

Scrap dealers play a crucial role in managing non-biodegradable waste in Kerala, significantly contributing to its collection and processing. With over 10,000 scrap collection centres across the state and approximately 3,50,000 individuals employed in this sector, it is vital to recognise that more than 70 percent of these workers operate without the necessary licences. LSGIs must identify and acknowledge informal waste collectors and promote systems that integrate them into the decentralised waste management framework.

10. Upgrading HKS

The waste management system in Kerala is closely linked to the poverty alleviation efforts for women, relying heavily on the Haritha Karma Sena. This organisation comprises women primarily from low-income groups and oppressed castes and communities who often find themselves at the bottom of the waste management hierarchy, with no decision-making power.

These women face numerous challenges, including low wages due to inadequate user fee collection, and frequently encounter disrespectful and

It is crucial to enhance income and status of HKS

demeaning treatment from waste generators. To improve their social standing, it is crucial to raise their incomes and provide them with technical training and capacity-building opportunities. Enhancing their skills and financial stability will empower these women, enabling them to become key stakeholders in the waste management process and contributing to a more equitable and effective system.

11. Augmenting Livelihood Opportunities

Several Local Self Government Institutions (LSGIs), such as Vatakara Municipality, have implemented innovative initiatives aimed at generating local employment and income by promoting microenterprises focused on the reuse, repair, and recycling of waste products. These successful livelihood generation schemes should be replicated and scaled up across LSGIs to maximise their impact and foster sustainable economic development. By supporting these microenterprises, LSGIs can contribute to both waste management and community empowerment, creating a more resilient and environmentally conscious local economy.

12. Refining CKCL

The Clean Kerala Company Limited (CKCL) plays a crucial role in managing non-biodegradable waste in the state, acting as both a waste collection agency and a facilitator for private partnerships in the disposal of plastic and e-waste. However, CKCL faces significant challenges due to a lack of essential facilities, such as adequate storage areas and GPS-enabled transport fleet.

As emphasised by the Central Pollution Control Board, CKCL should not limit its functions to that of a mere "middleman." Instead, it should adopt a more proactive approach by regularly collecting, transporting, and streamlining solid waste for treatment from Material Collection Facilities (MCFs). Furthermore, CKCL should strive to offer lower service fees compared to private companies, thereby enhancing its efficiency and effectiveness in waste management while providing cost savings for local bodies.

13. Removing Legacy Waste

The process of clearing legacy waste through biomining and bioremediation must be expedited and continuously monitored. The Kerala State Pollution Control Board should make sure that the biomined plastics and other materials are managed exclusively by authorised agencies. Since most of the old dump sites are located near water bodies, strict monitoring should be there to prevent contamination by leachate. Landfills to dispose of residual, non-biodegradable, non-recyclable, non-combustible waste should be scientifically designed to ensure environmental safety.

14. Rejecting Incineration

Both the state government and the local self-governments often lean towards promoting centralised, high-cost, energy-intensive Waste to Energy (WTE) plants as the ultimate solution to the growing solid waste crisis. When

considering such plants, authorities should carefully evaluate several critical factors: Are these technologies the best available options? Can a reliable and guaranteed supply of feedstock be ensured for the entire lifespan of the facility? Will WTE plants create a persistent demand for waste, which undermines efforts for waste reduction and sustainable management? Will the plants comply with stringent emission and discharge limits, particularly regarding hazardous waste residues? Furthermore, is there an efficient and rigorous pollution monitoring system in place? Addressing these questions is vital to ensure that waste management solutions align with the principles of sustainability and environmental protection.

Sustainable waste management requires significant cultural changes

15. Creating Behavioural Changes

Achieving sustainable waste management requires significant behavioural and cultural changes among the public, which remains a major challenge for the state. To enhance public awareness and engagement in waste management efforts, comprehensive Information, Education, and Communication (IEC) campaigns must be implemented with renewed vigour.

In this initiative, non-governmental organisations, advocacy groups, residents' associations, political parties and the media can play an active role. By collaborating on these campaigns, we can foster a greater sense of responsibility and participation among citizens, ultimately driving the necessary changes in attitudes and behaviours to support effective waste management practices.

16. Strengthening KSPCB

State Pollution Control Boards are the statutory authorities responsible for implementation of all environmental legislations and rules. They have a critical role in setting standards for waste collection, treatment and disposal, monitoring compliance among waste generators, issuing necessary authorisations for waste handling facilities and advising governments on effective solid waste management policies. The fact that the waste handling facility at Brahmapuram could operate for more than a decade without the authorisation from KSPCB highlights the urgent need for enhancing the board's capacities and accountability.

17. Eliminating Corruption

The waste management sector presents numerous profit-making opportunities, with various groups offering solutions and technologies to address the growing garbage crisis. However, this often leads to political patronage and corruption, creating obstacles to sustainable waste management. In many local bodies contractors hold significant influence over authorities and peoples' representatives. This situation places greater responsibility on authorities to identify appropriate and credible technologies, service providers, and partners and free the waste management system from profit-driven motives and corruption.

Kerala should abstain from transporting waste to other states

18. Understanding Lifestyle Changes

Kerala has been urbanising rapidly, resulting in significant changes in lifestyle, consumption patterns, and waste generation. To manage waste effectively, it is crucial to study and understand the evolving characteristics and composition of waste generated in the state.

19. Prioritising Climate-Resilience

Kerala is facing severe impacts of altered climate such as extreme rains, frequent floods, acute drought and severe cyclones. The vulnerability of Kerala to climate change is predicted to increase in the coming years, posing new challenges to its waste management systems. Disasters such as floods generate increased volumes of waste while rising temperatures leads to frequent fire breakouts at waste dump sites. Changes in climate may also alter the characteristics of municipal solid waste. Notably, the municipal solid waste sector is the second-largest contributor to greenhouse gas emissions in the state, further exacerbating climate change. Therefore, it is imperative for the state to develop plans for climate-resilient waste management.

20. Stopping Externalising Waste

Kerala has been shifting the burden of its non-biodegradable waste disposal to other states, primarily Tamil Nadu, by exporting plastic and e-waste for recycling and incineration in cement plants. However, this approach does not equate to sustainable waste treatment, as crude recycling and incineration methods contribute to pollution and environmental degradation. Kerala should find internal solutions for sustainable management of non-biodegradables rather than externalising the burden.

Photo: Surendranath C

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