



Original Article

Assessing the Efficacy of Hazardous Waste Management Laws: A Critical Analysis of Environmental Protection and Regulatory Frameworks in India

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India's rapid modernization and growing economy have caused a big rise in the amount of Hazardous and Other Wastes (HOW) that is produced. This study critically evaluates the effectiveness of India's hazardous waste management regulatory system, namely the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 (HOW Rules, 2016), established under the Environment (Protection) Act, 1986. The regulatory framework is extensive and conforms to international agreements such as the Basel Convention; however, its practical effectiveness is significantly undermined by ongoing obstacles, including insufficient infrastructure, enforcement shortcomings, and the intricate relationship between federal and state authorities. This research examines the framework's intrinsic strengths and shortcomings, evaluating compliance rates, technology capabilities, and the pivotal role of the Indian Judiciary, especially the Supreme Court and the National Green Tribunal (NGT). The judiciary has aggressively reaffirmed environmental concepts like the "Polluter Pays" Principle, the Precautionary Principle, and the idea of Absolute Liability via major court judgments. This is typically done to make up for the lack of action by the administrative and regulatory bodies. The research suggests that for the HOW Rules, 2016 to be genuinely successful, a move from simple statutory existence to strict, outcome-oriented enforcement, backed by technical enhancements and enhanced institutional capacity, is needed.

India's hazardous waste management is a critical sector for the environment and public health, and the rules are changing in response to court cases and policy needs. This article critically analyzes the effectiveness of current hazardous waste management legislation, particularly in light of the 2025 changes, as well as the related environmental protection and regulatory frameworks. The research indicates significant advancements in legal rigor and digital oversight; yet, it underscores ongoing implementation difficulties, infrastructure deficiencies, and the need for integrated, technology-driven, and participatory governance to achieve sustainable hazardous waste management.

Keywords: Hazardous waste, Environmental law enforcement, Regulatory framework, Judicial declarations, NGT, Polluter Pays Principle

Introduction

India's rapid industrialization has led to a huge rise in the amount of hazardous waste (HW) produced, making environmental protection and health protection top national responsibilities. Traditionally, regulatory actions have been aimed at stopping the careless dumping of hazardous waste, making sure that it is treated safely, and making the Polluter Pays Principle a part of the law. The Hazardous Waste Management Rules, 2025, and other environmental laws, as well as important court decisions, have made India's legal system stricter, but enforcement and infrastructure problems still make it hard to follow. This article critically examines India's hazardous waste management path, looking at how laws have changed, how well they are followed, and how the courts have played a key role in upholding rights-based environmental protection. Hazardous waste management is an important problem in the world and in the United States.



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Reactivity: Waste that is unstable and may explode or react violently when it comes into contact with water or other materials.

Corrosivity: Wastes, usually strong acids or bases, that may eat through containers and let out harmful chemicals.

Managing hazardous waste is a huge problem that poses a big threat to the health of people and the environment, both throughout the world and in countries like India that are growing quickly. The issue is huge since there is so much garbage and not enough treatment capacity.

Statistics and Data

Here are some important statistics and data that show how serious the problem of hazardous waste is:

The size of hazardous waste affects throughout the world. The production of hazardous trash across the globe is a huge problem for the environment and for moving things around. Huge Amounts Made Every Year: The globe generates hundreds of millions of tons of dangerous trash every year. Statistics show that around 400 million tons of hazardous waste are generated each year, or nearly 13 tons per second.

Per Capita Burden: Every year, around 60 kg of hazardous waste is produced per person in the world. This quantity is going up as industry grows.

Chemical Overload: The output of man-made chemicals has increased by 40,000% in only one generation, reaching almost 400 million tons. Many of these chemicals end up as hazardous waste.

Environmental Persistence: Persistent organic pollutants (POPs) are substances that stay in the environment for a long time. Examples include Polychlorinated Biphenyls (PCBs) and DDT (a pesticide). Some studies show that 99% of the persons examined still had these substances in their bodies, even decades after they were prohibited. This shows how dangerous they are in the long run.

Under-Treated rubbish: In low-income nations, more than 90% of rubbish is frequently not picked up, thrown in the open, or burnt in the open. This causes serious health and environmental problems.

Problems with Hazardous Waste in India

In India, the quick growth of industry and problems with regulations make the matter much worse.

1. Generation and Infrastructure Gap

According to the Central Pollution Control Board (CPCB) National Inventory, India produced over 15.66 million metric tonnes (MMT) of hazardous waste in the year 2022-23.

Key Generator States: A few states, such as Maharashtra, Gujarat, Andhra Pradesh, and Chhattisgarh, make up a large part of the overall amount of hazardous waste. Bharuch (Gujarat) and Mumbai (Maharashtra) are two of the districts that produce the most waste, for example.

Not Enough Disposal Capacity: Treatment, Storage, and Disposal Facilities (TSDFs) with secured landfills are examples of scientifically constructed disposal facilities that frequently don't have enough space to hold all of the hazardous waste that may be disposed of on land. Because of this imbalance in capacity, a lot of the garbage is sent to illegal or non-compliant disposal locations.

2. Management and Care

Management Breakdown (2022–23): Of the 15.66 million metric tons of hazardous waste created:

Recycled/Used (including co-processing): About 8.61 MMT was handled via use.

Disposed: About 3.60 MMT was thrown away in safe landfills and incinerators.

Note: The rest of the trash is frequently kept or not tallied, which is a direct threat to the environment.

Number of Units: India has more than 83,600 industrial units that produce hazardous waste and need to be monitored and follow the rules.

Effects on the Environment and Health

Not getting rid of this hazardous burden properly has serious and measurable effects on health and the environment.

Contamination of Water and Soil: When hazardous waste is not handled correctly, it often leaks out as leachate, a poisonous liquid that pollutes both surface and groundwater sources. This puts the main supply of drinking water for a lot of people at risk.

Air Pollution: Burning hazardous and other solid trash in the open, which is widespread in cities, produces very dangerous pollutants, such as heavy metals and persistent organic pollutants (POPs) like Dioxins and Furans, which are known to cause cancer.

Public Health: Exposure to harmful compounds from hazardous waste has been associated to significant health difficulties, including cancer, neurological damage, respiratory ailments, and developmental abnormalities in children, with workers in the informal garbage industry being especially exposed.

The amount of hazardous waste produced each year, together with the fact that there is not enough scientific infrastructure for safe disposal, makes it evident that hazardous waste management is one of the most important environmental challenges.



Regulatory Structure

The **Indian Constitution**, namely Articles 48A and 51A(g), says that the State and its inhabitants must conserve the environment. The **Environment (Protection) Act of 1986** (EPA) gives the federal government the jurisdiction to make laws for managing hazardous waste and combating all types of pollution. It gives the Central Government wide-ranging authority to do everything it takes to safeguard and enhance the quality of the environment and stop, regulate, and reduce pollution. The EPA is the law that makes it possible for precise standards to be made and enforced for handling various kinds of waste, such as hazardous waste. It also explains what a "hazardous substance" is and requires safety measures for handling these kinds of items.

The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

Statutory Design and Scope: The HOW Rules, 2016, are a big step forward from earlier versions. They mostly do this by bringing India's domestic law in line with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and by bringing together the management of both hazardous waste that is made in India and hazardous waste that is moved across borders.

Main Characteristics:

Expanded Scope: The addition of "Other Wastes" widened the scope to encompass materials that are going to be recycled, co-processed, or recovered, which means that the whole life cycle of industrial waste is now regulated.

The Rules make it clear that there is a priority order for waste management: Prevention, Minimization, Reuse, Recycling, Recovery, Co-processing, and Safe Disposal. This shifts the emphasis of regulations from just getting rid of things to using resources more efficiently.

Extended Producer Responsibility (EPR): The Rules suggest the idea of EPR for certain types of trash. This means that the producer is liable for the waste until it is disposed of in an ecologically safe way.

Manifest System: A manifest system formalizes the process of tracing HW from its source to its final destination. This makes sure that all movements are recorded and can be traced.

Transboundary Movement: The Rules closely limit the import and export of HW. They don't allow waste to be imported for disposal, but they do allow it to be reused, recycled, or recovered with express government clearance.

Efficacy in Practice: Shortcomings and Constraints

Even if the HOW Rules, 2016, are very well written, their effectiveness is still in doubt because of widespread problems with putting them into practice:

Inadequate Treatment and Disposal Infrastructure: One of the biggest problems is that there aren't enough Treatment, Storage, and Disposal Facilities (TSDFs) or working Common Effluent Treatment Plants (CETPs). Some major companies may have their own TSDFs, however many small and medium-sized businesses (SMEs) that make a lot of HW don't have the space or money to use them, so they dump it illegally.

Enforcement Deficit: The State Pollution Control Boards (SPCBs), who are the main bodies that carry out the rules, sometimes don't have enough competent technical personnel, modern lab equipment, or, most importantly, political will. This leads to poor monitoring, slow authorization procedures, and a lack of capacity to properly administer and collect fines.

Statistics and Transparency Issues: There is still a lack of reliable, up-to-date statistics on how much HW is really being made, stored, and thrown away. The "black market" for hazardous trash flourishes outside of the law because people recycle and throw away rubbish in ways that aren't scientifically sound.

SME Compliance: The complicated rules for compliance and the expensive expense of scientific disposal make it harder for SMEs to follow the rules, which makes them more likely to break them. The official system has a hard time bringing together and controlling the huge informal recycling industry.

Frameworks for Rules and Administration

Central and State Pollution Control Boards (CPCB and SPCBs):

Given the job of issuing permits, checking for compliance, and enforcing rules. New standards stress the need of exchanging information across agencies and reporting on a regular basis.

Digital Compliance and Reporting:

Digital manifest systems, e-registries, and real-time monitoring are all meant to make people more accountable and make it harder for people to avoid rules.

Regulations for different sectors:

There are certain requirements for e-waste, biological waste, and cars that are no longer in use. Each one uses EPR and digital traceability.

The main guidelines for waste management in India, which were mostly put in place between 2016 and 2022, all have the same focus on source separation, scientific processing, and the idea of Extended Producer Responsibility (EPR). The Solid Garbage Management Rules, 2016 require people and businesses that generate garbage to sort it into three groups: wet, dry, and home hazardous. These rules also apply outside the city borders. The Plastic Waste Management (Amendment) Rules, 2022 require manufacturers, importers, and brand owners to collect and recycle plastic packaging.



They also restrict some single-use plastics. The E-Waste (Management) Rules, 2022 and the Battery Waste Management Rules, 2022 also use a system-based EPR. This means that producers of electronic equipment and all types of batteries, including EV batteries, must meet strict collection and recycling/refurbishment targets through a centralized online portal. They are not allowed to throw away their products in landfills or burn them. The Bio-Medical trash Management Rules, 2016 are about how to separate, treat, and get rid of trash from healthcare institutions. They say to use color-coded bags and Common Bio-Medical garbage Treatment institutions to safely get rid of the garbage. Finally, the Construction and Demolition (C&D) Waste Management Rules, 2016 say that C&D waste must be collected, processed, and reused, treating it as a resource instead of just trash. The guidelines encourage the use of recycled materials in all categories, require online registration and reporting, and follow the Polluter Pays Principle by making those who don't follow the rules pay for environmental damage.

International Agreements and Following Them

India is a signatory to the **Basel Convention**, which attempts to govern the transfer of hazardous wastes across borders and how they are disposed of. The Basel Convention is part of the country's rules, which means that exports and imports must satisfy international responsibilities and have prior informed permission and paperwork. **The Rotterdam Convention** (1998) talks about the Prior Informed Consent (PIC) Procedure for certain dangerous chemicals and pesticides that are traded throughout the world. **The Stockholm Convention (2001)** wants to get rid of or limit the production and use of Persistent Organic Pollutants (POPs).

Judicial Intervention: Strengthening Environmental Law

The Indian Judiciary has always stepped in when the government and regulators have failed, using judicial activism to improve environmental protection. These court rulings have not only upheld the legislation but also made India's environmental law more complex.

Important Supreme Court Decisions and Changing Ideas

The Supreme Court of India has changed environmental preservation from a Directive Principle to an essential aspect of the Right to Life (Article 21) by utilizing its powers under Articles 32 and 142 of the Constitution.

A. Total Responsibility and Fairness for the Environment

In the case of *M.C. Mehta v. Union of India* (Oleum Gas Leak Case, 1987), the Supreme Court built on the Strict Liability rule to come up with the idea of Absolute Liability. This historic ruling made it clear that a business that does anything harmful or risky is fully responsible for paying for any damage that happens to anybody. This notion is very important for HW governance since it makes sure that businesses can't get away with not being responsible.

B. The Polluter Pays Principle and Cleanup

Indian Council for Enviro-Legal Action v. Union of India (Bichhri Village Case, 1996): This case was very important since it showed how chemical companies in Rajasthan were polluting the groundwater very badly. The Court clearly incorporated the globally acknowledged 'Polluter Pays' Principle into Indian legislation, asserting that the polluter is responsible not just for compensating victims but also for the expenses associated with environmental restoration and repair. This ruling immediately backs up the financial system that cleans up locations where hazardous waste has been placed unlawfully.

C. Control of Waste Across Borders

Research Foundation for Science, Technology and Ecology v. Union of India (Hazardous Waste Import Case, 2005): The Supreme Court's ongoing oversight of the importation of hazardous waste has been essential. It gave detailed instructions that made it clear that importing hazardous trash for ultimate disposal is against the law. Even imports for recycling must follow strict rules for ecologically sound management, and a High Powered Committee frequently checks to make sure these rules are being followed.

What the National Green Tribunal (NGT) does

The National Green Tribunal (NGT) has a very important and unique function in India when it comes to stopping and dealing with hazardous waste. It does this mainly by making sure that environmental laws are strictly followed and that polluters are punished.

The NGT, which was set up in 2010 and has its own environmental authority, is now the main enforcer of the HOW Rules. The NGT's method includes keeping an eye on things and giving out large amounts of money for environmental damage. The NGT is a specialized and easy-to-use place for settling environmental issues around hazardous waste. It considers proceedings against businesses, importers, or people who run disposal facilities for dumping hazardous waste without permission, storing it incorrectly, treating it in an unscientific way, or bringing it in or out of the country without permission. The NGT may start proceedings suo motu (on its own volition) based on news stories, letter petitions, or allegations of environmental harm. This means that it can act quickly even if no one files a formal complaint.

Continuous Monitoring and Compliance: The NGT routinely makes suo motu (on its own motion) orders and keeps an eye on big instances of non-compliance. It typically tells SPCBs to clean up polluted areas and build enough TSDFs.



The Tribunal has been very important in holding both the polluters (via the "Polluter Pays" Principle) and the regulatory organizations (for not enforcing) responsible. For example, the NGT has given states big fines for not properly managing trash scientifically, showing that it is ready to break through the barrier of institutional inertia.

Legacy garbage and Scientific Disposal: The NGT has frequently ordered the cleanup of old hazardous garbage that was placed in open places and old landfills. They have told people to employ scientific techniques like bio-mining, which shows how important it is to fix decades of bad disposal practices.

A critical look at how enforcement and institutions respond

Agencies at the State and Central Levels :

The Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCBs) are in charge of important regulatory, monitoring, and enforcement tasks. But their efficacy is often hurt by structural problems, overlapping authorities, and a lack of resources.

Watching and Reporting- There are rules for compliance toolkits, required paperwork (Form 3 and Form 6), and site-specific monitoring, but inspections and reports at the ground level are still irregular and uneven, particularly in areas that are hard to get to or don't have many resources.

Judicial Oversight- The courts have ordered agencies to follow best practices, be more accountable, and protect the public's interest. But bureaucratic inertia and a lack of cooperation make it hard to turn court orders into long-term regulatory action.

Effects on health and the environment- Poor handling of hazardous waste has serious effects on the environment, such as pollution of air, soil, and water, loss of biodiversity, and threats to public health. People who live in cities are more affected by pollution since there are a lot of polluting companies and not enough waste separation.

Final Thoughts and Suggestions

The effectiveness of India's hazardous waste management legislation, especially the HOW Rules, 2016, is a story of two different worlds. The framework is complete and follows the best practices throughout the world as required by law. In practice, its effect is greatly lessened by a lack of key infrastructure and a poor enforcement system. The Indian Judiciary has been the most successful protector of the environment with groundbreaking ideas like "absolute liability" and "polluter pays." However, this cannot replace strong executive control. India's regulations for dealing with hazardous waste are strong and in line with international standards, but they don't operate as well as they should because of gaps in enforcement, problems with infrastructure, and a lack of coordination across institutions. To protect the environment and public health, India has to make its regulatory system stronger by expanding capacity, improving technology, and getting more people involved. The courts should also keep an eye on things and follow international rules. India can only achieve its objectives for efficient hazardous waste management by taking a comprehensive strategy that includes changing policies, enforcing them in a practical way, and getting the community involved.

Problems and What Comes Next

India has to deal with certain very important problems:

1. Lack of coordination and fragmentation in regulations between state and federal legislation.
2. Ongoing problems with infrastructure and not enough TSDF coverage.
3. Weak ways to keep an eye on things, report on them, and make sure they happen.
4. Not enough involvement from the community and public awareness.

Suggestions for making things work better:

Strengthen Institutional Capacity: Give the SPCBs/PCCs a lot more money, technical staff, and lab space so they can do proactive monitoring, gather correct data, and take quick enforcement measures.

Decentralized and Common Facilities: Actively support and fund the building of integrated Treatment, Storage, and Disposal Facilities (TSDFs), especially by grouping them together to serve industrial regions with a lot of small and medium-sized businesses.

Digitalization and Transparency: Set up a statewide, real-time digital manifest system to keep track of hazardous waste from "cradle to grave." This will make it harder for people to dump garbage illegally and make the public more accountable.

Economic Instruments: Put environmental taxes or cess on companies depending on how much garbage they make and how dangerous it is. The money should go to cleaning up the waste and building new TSDFs. At the same time, provide them clear financial reasons to use technology that reduce trash and recycle it.

Codified Judicial Enforcement: Regulatory organizations should continuously turn the rules set by the Supreme Court and the NGT into explicit, measurable enforcement criteria. This will make it less necessary to use public interest lawsuits for every incident of non-compliance.

India's main problem is no longer how to write the legislation; it's how to create a culture of environmental responsibility. The legal instruments are there; to use them well, institutions need to be willing to keep using them and put money into them.



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