

India's Leachate Problem

Mains: GSIII - Environment

Why in News?

India's growing dependence on landfills has increased concerns over leachate, a toxic liquid generated when rainwater and moisture pass through decomposing waste.

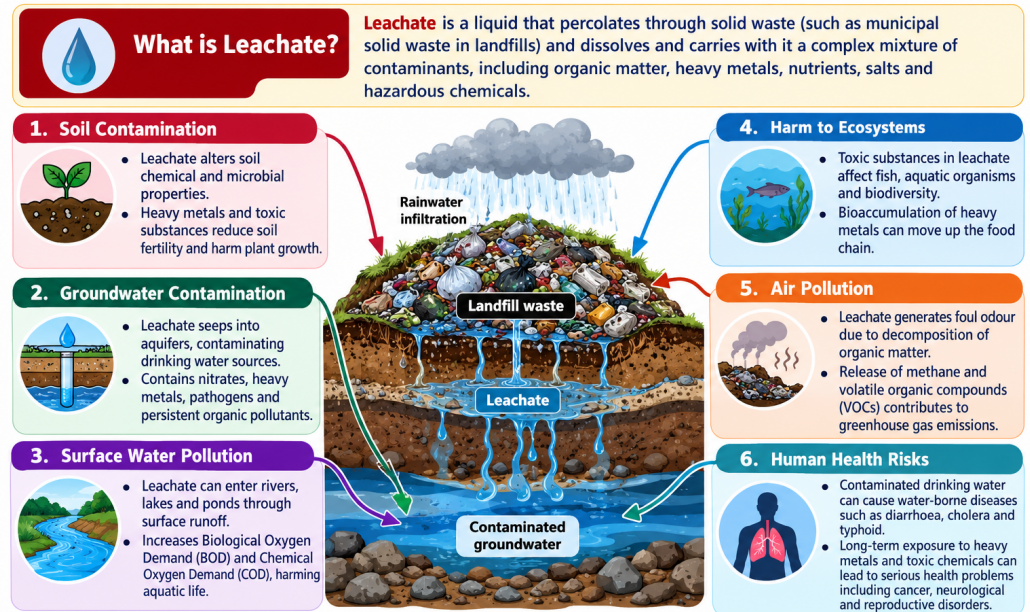
What is Leachate?

- **Leachate** - It is a contaminated liquid formed when water percolates through layers of municipal solid waste and absorbs organic and inorganic pollutants.
- **Effect** - Decomposition of biodegradable waste generates methane,
 - Volatile fatty acids and
 - Dissolved organic carbon,
 - While percolating water carries ammonia, humic substances and heavy metals.

Leachate composition changes with the age of the landfill.

- **Nature of Leachate** - Young leachate contains high levels of biodegradable organic pollutants, reflected in high BOD and COD.
- As the landfill matures, the BOD/COD ratio decreases and ammoniacal nitrogen and recalcitrant organic compounds become more significant.
- Heavy metals such as copper, zinc, lead, chromium and cadmium may persist depending on pH and local geochemical conditions.
- Globally, leachate has also been found to contain pharmaceutical residues, microplastics and PFAS.

Leachate – Definition and Effects on Environment



Why is Leachate a Serious Concern for India?

- **High Biodegradable Waste** - More than half of India's municipal waste is biodegradable, increasing the potential for leachate generation during decomposition.
- **Dependence on Landfills** - Large quantities of municipal waste continue to be disposed of in landfills and open dumping areas, increasing the risk of uncontrolled leachate movement.
- **Groundwater Contamination** - Untreated leachate can alter soil and groundwater chemistry.
 - Studies at Delhi's Ghazipur landfill have detected hazardous substances, including cadmium, in groundwater at exceeding drinking-water limits.
- **Emerging Contaminants** - Pharmaceuticals, microplastics and PFAS add new dimensions to leachate pollution.
 - Pharmaceutical and biomedical residues may also contribute to the spread of antibiotic-resistant bacteria and resistance genes.

What are the Existing Leachate Management Gaps in India?

- **Inadequate Collection and Containment** - inadequate infrastructure causing overflow of leachate into nearby ecosystems.
 - **Example**, The Bandhwari landfill experience illustrates weaknesses in basic infrastructure.
 - Temporary kutchha drains and concrete pipes were being used for movement of leachate.
- **Treatment Capacity Mismatch** - The Leachate transported to sewage treatment plant was lower for the estimated generation, indicating a gap between generation, and treatment capacity.
- **Changing Composition** - A single treatment technology is less effective throughout the landfill's life because the characteristics of leachate changes (active to the mature stage).

- **Environmental concerns** - Poorly managed leachate can
 - Contaminate groundwater and surface water.
 - Degrade soil quality and agricultural land.
 - Affect wetlands and surrounding ecosystems.
 - Introduce heavy metals and persistent pollutants into food chains.
 - Create long-term remediation challenges because some contaminants remain persistent.
- **Public Health Problem** - Contaminated groundwater can expose nearby communities to hazardous substances.
 - The presence of pharmaceutical residues and biomedical contaminants can also contribute to antimicrobial resistance, creating a wider public-health concern.
- **Governance and Institutional Gaps** - The problem reflects not merely a technological gap but also weaknesses in:
 - Monitoring of leachate quantity and quality.
 - Coordination between urban local bodies and treatment facilities.
 - Regular inspection and environmental compliance.
- **Technological mismatch** - Lack of integrated treatment systems for treating leachate as a different stream rather than just as wastewater.

What measures can be taken?

- **Adopt a Life-Cycle Approach** - Leachate management should cover the entire landfill cycle—from waste deposition and active operation to closure and post-closure monitoring.
- **Strengthen Collection Infrastructure** - Construct properly designed drainage and collection systems.
 - Use impervious liners for storage ponds. Prevent uncontrolled overflow and seepage.
- **Improve Treatment Capacity** - Treatment capacity should be based on actual and projected leachate generation, rather than merely available infrastructure.
- **Promote Source Segregation** - Better segregation and processing of biodegradable waste through composting, biomethanation and other decentralised methods can reduce the organic load entering landfills.
- **Strengthen Monitoring** - Regular testing of groundwater, surface water and leachate should be undertaken for conventional pollutants as well as emerging contaminants.
- **Improve Institutional Accountability** - Urban local bodies, landfill operators and pollution-control authorities should have clearly defined responsibilities, measurable compliance.

What lies ahead?

- Leachate represents the hidden liquid pathway through which landfill pollution can enter soil, groundwater and ecosystems.
- Therefore, India needs a shift from landfill-centric waste disposal towards scientific waste processing, lifecycle-based leachate management, and integrated treatment systems.

Reference

[Down To Earth| How India must plug its leachate problem](#)

