

POLLUTION GS PAPER-III
India's Waste Management Crisis
Context

- A global study published in *Nature* (2025) ranks **India as the world's largest plastic polluter**, generating **9.3 million tonnes annually**.
- The **Supreme Court's judgment in the Vellore tanneries case (2024)** highlights the use of '**continuing mandamus**' as a judicial tool to enforce environmental justice.

What is Waste Management?

- It involves **collection, segregation, treatment, and disposal** of various waste types (solid, liquid, plastic) to **prevent environmental harm**.
- Although India claims **95% waste collection**, actual **per capita plastic waste generation** is estimated at **0.54 kg/day** (Nature, 2025), far higher than the official figure of **0.12 kg/day**.
- This gap highlights **underreporting**, especially in **rural areas** and **informal sectors**.

Key Initiatives and Legal Framework

1. **Plastic Waste Management Rules (2016–2024)**
 - Emphasize **source segregation**, **Extended Producer Responsibility (EPR)**, and **ban on specific single-use plastics**.
2. **Jute Packaging Act, 2010**
 - Mandates **eco-friendly jute packaging** to replace plastics in commodity packaging.
3. **Extended Producer Responsibility (EPR)**
 - Obligates **Producers, Importers, and Brand Owners (PIBOs)** to collect, recycle, and reuse plastic waste with penalties for non-compliance.
4. **Decentralized Waste Governance**
 - Delegates waste management duties to **Gram Panchayats**, targeting rural inclusion and accountability.

Key Challenges in Waste Management

- **Data Deficiency**
 - Official figures **exclude rural waste, informal sector activities, and open burning**.
 - Lack of **waste audit methodology** and **third-party validation**.
- **Infrastructural Gaps**
 - Dump sites outnumber **sanitary landfills 10:1**.
 - No universal **geotagging**, or linkages to **Material Recovery Facilities (MRFs)**.
- **Urban-Rural Disparity**
 - Rural regions are not integrated into **formal collection systems**.
- **Weak EPR Implementation**
 - **Collection and segregation infrastructure** is inadequate; PIBO obligations poorly enforced.
- **Enforcement Failures**
 - Supreme Court notes **strong laws exist**, but are **poorly implemented** due to lack of accountability mechanisms.

Way Forward

1. **Judicial Oversight (Continuing Mandamus)**
 - Courts must adopt a model of **ongoing supervision**, ensuring **time-bound enforcement** with regular progress reports.
2. **Robust Data Systems**
 - Mandate **waste audits, independent verification**, and **real-time dashboards** to enhance transparency.
3. **Infrastructure Mapping**
 - Ensure all **urban and rural bodies** are connected to **MRFs** and **sanitary landfills**.
4. **Localized EPR Enforcement**
 - Establish **EPR kiosks** at the panchayat/ward level, staffed by PIBOs.
5. **Polluter Pays and State Accountability**
 - SC affirms that the **State must compensate** victims, **recover costs** from polluters, and undertake **ecological restoration**.
6. **Technology Integration**
 - Utilize **AI, GIS tracking, and geotagging** for real-time waste monitoring and enforcement.

Conclusion

India's mounting waste problem reflects a **systemic failure** in **policy execution, data integrity, and institutional equity**. Judicial interventions like **continuing mandamus** and the **polluter pays principle** are crucial for accountability. To ensure **sustainable development**, India must adopt a **people-centric, data-driven, and technologically-enabled** waste governance model.

GS PAPER 2/3: SOCIAL JUSTICE, ENVIRONMENT, RESOURCE MANAGEMENT
India's Blueprint for Clean Drinking Water
Key Objectives

- **Direct tap water access** in urban & rural areas.
- Upgrade **treatment plants and distribution infrastructure**.
- Integrate **smart water management** (IoT, sensors).
- Promote **water recycling** (10,000 MLD/day).
- Restore **water bodies** (ponds, lakes, rivers).

Current Status

- **Jal Jeevan Mission (JJM)**: 15.44 crore households, ~80% rural coverage (Feb 2025).
- **AMRUT**: 93% urban coverage; 1.73 crore connections under AMRUT (as of 2023).
- Piped water: 21.4% households (NSSO).
- Groundwater: 85% rural, 48% urban reliance.

Key Challenges

- **Water scarcity**: India has 4% of world's freshwater; per capita availability falling.
- **Urbanization pressures**: Over-extraction, pollution, poor access for the poor.
- **Governance issues**: Top-down approach; weak demand-side management.
- **Infrastructure gaps**: Old pipelines, poor treatment, funding cuts in JJM.
- **Groundwater depletion**: Linked to free electricity & water-intensive agriculture.
- **Quality concerns**: Only 6% receive drinkable municipal water; Nonylphenol contamination.
- **Behavioral issues**: Wasteful usage, low awareness.

Key Solutions

- **Best Practice**: *Puri (Odisha)* – 24/7 tap water initiative.
- **Climate Resilience**: Desalination, rainwater harvesting, drought preparedness.
- **Water body revival**: Community-led efforts, catchment protection.
- **Tech Innovation**: Solar RO plants, AI-based leak detection, smart meters.
- **Policy Reforms**:
 - User-pays pricing.
 - Promote water-efficient agriculture (drip, aquaponics).
 - Rationalize subsidies on water-guzzling crops.

Conclusion

India needs a **multi-dimensional approach—governance reforms, community participation, climate adaptation, and technological investment**—to achieve universal, clean drinking water access by 2047.

PRELIM FACTS
1. Ancient Muziris Port

Historian MGS Narayanan, a pivotal figure behind the Muziris Heritage Project (MHP), was remembered in the Kerala State Assembly.

About Ancient Muziris Port

Location: It was located on the *Malabar Coast* in present-day Kerala.

Historical Period: It was active from around the 1st century BCE to the early medieval period.

Historical references: It was also mentioned in the writings of *Pliny the Elder* and in the *Periplus of the Erythraean Sea*.

Trade significance: It served as a major international trading port in the Indian Ocean network. It connected South India with Persia, the Middle East, North Africa, and the Mediterranean (notably Greek and Roman civilizations).

Major exports: It was renowned for its spice trade, especially black pepper, often called black gold. Other items of export included semi-precious stones, ivory, pearls, etc.

2. Bhimavva Shillekyathara & Togalu Gombeyaata

1. **Togalu Gombeyaata** is a traditional form of **leather shadow puppetry** native to **Karnataka**.
2. **Bhimavva Doddabalappa Shillekyathara**, a 96-year-old puppeteer from **Moranala village, Koppal district (Karnataka)**, is a noted exponent of Togalu Gombeyaata.
3. She has been performing and preserving this art form for **over seven decades**.
4. Togalu Gombeyaata performances often depict epics such as the **Ramayana** and **Mahabharata** using **backlit cloth screens** and intricately crafted leather puppets.
5. Bhimavva belongs to a family with **more than a century-old tradition** of practicing this art.
6. Despite the decline in public interest in traditional folk arts, she has actively **mentored children and youth** to continue the practice.
7. In **2025**, Bhimavva Shillekyathara was awarded the **Padma Shri** for her contribution to the field of **art and culture**.

8. The term "**Gombeyaata**" in Kannada translates to "**puppet play**".
9. Togalu Gombeyaata is characterized by the use of **miniature puppets**, unlike other Indian shadow puppetry traditions that use life-size puppets.
10. The tradition plays a crucial role in **preserving oral narratives** and **regional storytelling techniques** in Karnataka.

3. Green Hydrogen Certification Scheme of India (GHCI) – Key Points

- **Launched by:** Ministry of New and Renewable Energy (MNRE)
- **Nodal Agency:** Bureau of Energy Efficiency (BEE)
- **Supported under:** National Green Hydrogen Mission
- **Certification Body:** Accredited Carbon Verification (ACV) Agencies

Objectives:

- Certify hydrogen produced only through **renewable energy** sources
- Ensure **traceability, transparency, and credibility** in hydrogen production
- Promote **market trust** and enable **carbon credit trading**
- Contribute to India's target of **5 MMT green hydrogen by 2030**

Key Features:

- **Scope:** Covers up to hydrogen **purification**; excludes **transport and storage**
- **Eligibility:** Includes **electrolysis** and **biomass conversion**; new technologies can be approved by BEE
- **Verification:** Requires **annual third-party audits**
- **GHG Metric:** Emissions measured in **kg CO₂ equivalent per kg of H₂**
- **Guarantee of Origin (GO):** Validates green hydrogen claims
- **Compliance:** Mandatory for **domestic producers**; **exempt for export-only units**
- **Monitoring Portal:** Data must be uploaded on the **Green Hydrogen Portal**

Significance:

- Boosts **credibility of Indian green hydrogen** in global markets
- Attracts **investments** and sets **clear standards**
- Supports India's **Carbon Credit Trading Scheme (2026)**
- Strengthens India's role as a **green energy leader**

ANSWER WRITING

Q. Discuss the key challenges and solutions for making Indian cities more resilient, inclusive, safe, and sustainable in the face of climate change and rapid urbanisation.

(Word Limit: 250)

Introduction

India is undergoing rapid urbanisation, with over 35% of the population now residing in cities. However, urban growth has been largely unplanned, making Indian cities increasingly vulnerable to climate-induced risks like floods, heatwaves, and water scarcity. Ensuring that cities are **resilient, inclusive, safe, and sustainable** is key to achieving **SDG 11** and long-term climate adaptation.

Key Challenges

1. **Unplanned Urban Sprawl:** Growth without proper land use planning has led to encroachments on wetlands and green spaces, increasing flood risks.
2. **Infrastructure Deficiency:** Urban infrastructure such as drainage, public transport, and solid waste systems remain outdated and overstressed.
3. **Housing Inequality:** A significant urban population lives in slums without access to basic services, undermining inclusivity.
4. **Climate Vulnerability:** Rising temperatures and erratic rainfall have led to frequent heatwaves, water shortages, and urban flooding.
5. **Institutional Fragmentation:** Urban governance is divided among multiple agencies, hindering coordinated action.
6. **High Carbon Footprint:** Dependence on fossil fuels and private vehicles contributes to air pollution and emissions.

Solutions

1. **Integrated Urban Planning:** Implement Transit-Oriented Development (TOD) and GIS-based Master Plans focusing on green cover and climate resilience.
2. **Affordable Housing and Slum Upgradation:** Expand schemes like PMAY-U to ensure equitable access to services.
3. **Climate-Resilient Infrastructure:** Build urban flood control systems, cool roofs, and green buildings.
4. **Strengthen Urban Local Bodies (ULBs):** Devolve funds, functions, and functionaries to empower cities under the 74th Constitutional Amendment.
5. **Smart Cities Mission:** Scale up innovations in mobility, energy, and e-governance across all cities.
6. **Disaster Preparedness:** Create city-level climate action plans with early warning systems and community training.

7. **Sustainable Mobility:** Promote public transport, cycling, and pedestrian zones to reduce emissions.

Conclusion

Building climate-resilient, inclusive, and sustainable Indian cities requires a paradigm shift in planning, governance, and citizen participation. With robust policy implementation, technological integration, and decentralised governance, Indian cities can become engines of equitable and green growth.

MCQ

- With reference to India's water management initiatives, consider the following statements:
 - Jal Jeevan Mission aims to provide piped water to every rural household by 2026.
 - AMRUT 2.0 focuses on "drink from tap" facilities in urban areas.
 - Puri city has implemented India's first 24x7 tap water supply project.
 Which of the above statements is/are correct?
 - 1 and 2 only
 - 2 and 3 only**
 - 1 and 3 only
 - 1, 2 and 3
- Which of the following factors contribute to water stress in India?
 - High dependency on groundwater.
 - Poor treatment of urban wastewater.
 - Overemphasis on engineering-based supply augmentation.
 - Widespread implementation of drip irrigation.
 Select the correct answer using the code below:
 - 1 and 2 only
 - 1, 2 and 3 only**
 - 2, 3 and 4 only
 - 1, 2, 3 and 4
- The ancient port of Muziris, recently in news, was located in:
 - Andhra Pradesh
 - Kerala**
 - Tamil Nadu
 - Karnataka
- Which of the following ancient texts mention the port of Muziris?
 - Arthashastra
 - Periplus of the Erythraean Sea
 - Sangam literature
 - Works of Pliny the Elder
 Select the correct answer using the code below:
 - 1 and 2 only
 - 2 and 4 only
 - 2, 3 and 4 only**
 - 1, 2, 3 and 4
- With reference to the ancient port of Muziris, consider the following statements:
 - It was an important center for the spice trade, especially black pepper.
 - It facilitated maritime trade between South India and the Roman Empire.
 - It was active primarily during the Gupta Empire.
 Which of the above statements is/are correct?
 - 1 and 2 only**
 - 2 and 3 only
 - 1 and 3 only
 - 1, 2 and 3
- The traditional art form Togalu Gombeyaata, recently in the news, is associated with which Indian state?
 - Tamil Nadu
 - Maharashtra
 - Karnataka**
 - Andhra Pradesh
- Consider the following statements about Togalu Gombeyaata:
 - It uses leather puppets to perform shadow theatre.
 - It is traditionally performed using backlit cloth screens.
 - It originated in Odisha.
 Which of the above statements is/are correct?
 - 1 and 2 only**
 - 2 and 3 only
 - 1 and 3 only
 - 1, 2 and 3
- The Green Hydrogen Certification Scheme of India (GHCI) has been launched by which ministry?
 - Ministry of Environment, Forest and Climate Change
 - Ministry of Power
 - Ministry of New and Renewable Energy**
 - Ministry of Science and Technology
- Under GHCI, which of the following processes are eligible for green hydrogen certification?
 - Electrolysis using renewable energy
 - Biomass conversion
 - Steam methane reforming
 - Nuclear-powered hydrogen production
 Select the correct answer using the code below:
 - 1 and 2 only**
 - 1, 2 and 3 only
 - 2 and 3 only
 - 1, 2, 3 and 4
- With reference to the Padma Awards, consider the following statements:
 - These awards are announced annually on the eve of Independence Day.
 - The government servants including those working with PSUs are not eligible for these Awards.
 - The Award can be used as a suffix or prefix to the awardees' name.
 How many of the above statements are correct?
 - Only one
 - Only two
 - All three
 - None