Sustainable E-Waste Management Strategies

For Prelims: **E-waste**, **Heavy Metals**, **Particulate Matter**, **DNA**, **Extended Producer Responsibility**, **Central Pollution Control Board**, **Blockchain**, **Right-to-Repair**.

For Mains: E-Waste Management in India: Current Status, Challenges, Socio-Economic Impacts, Policy Initiatives, and Way Forward.

Source: TH

Why in News?

India generated **2.2 million metric tonnes (MT)** of **e-waste** in 2025, becoming the **third-largest global generator** after **China** and the **US**. However, **informal recycling** exposes **millions**, especially **marginalised communities**, to **serious health risks**, making it a major **urban challenge**.

E- Waste

- **About: E-waste**, or electronic waste, refers to discarded or end-of-life electronic devices and equipment. It includes items such as **computers, televisions, mobile phones, printers, refrigerators, and air conditioners**.
  - These products often contain **toxic substances** like lead, mercury, cadmium, and chromium.
- **Current Status of E-waste in India:**
  - **Rapid Growth:** E-waste generation recorded a **150% surge** from the **0.71 million MT** recorded in **2017–18**. At **current rates**, this **volume** is expected to nearly **double by 2030** in India.
  - **Urban Hotspots**: The **crisis** is concentrated in **cities**, with over **60% of e-waste** originating from just **65 urban centers**. **Key hotspots** include **Seelampur** and **Mustafabad** in **Delhi**, **Moradabad** in **Uttar Pradesh**, and **Bhiwandi** in **Maharashtra**.
  - **Informal Recycling: India** has **322 registered formal recycling units** with a capacity of **2.2 million MT** annually, yet over **half of e-waste** (**43% officially processed** in **2023–24**) is processed **informally or not recycled**.
- **E-waste Management Frameworks in India**
  - **E-Waste (Management) Rules, 2016:** It introduced the concept of a **Producer Responsibility Organization (PRO)**.
  - **E-Waste (Management) Rules 2022:** Under **Extended Producer Responsibility (EPR)**, **producers** must meet **annual recycling targets** through **registered recyclers**, with **EPR certificates** ensuring **accountability** for recycled products.
    - **Public institutions** must dispose of **e-waste** through **registered recyclers/refurbishers**, who handle **collection and processing**.
  - **E-Waste (Management) Second Amendment Rules, 2023:** Under **Rule 5** of the **E-Waste (Management) Rules 2022**, **Clause 4 was added** to ensure **safe and**

sustainable management of refrigerants in **refrigeration and air-conditioning manufacturing**.

- **E-Waste (Management) Amendment Rules, 2024:** The rules provide for the **creation of platforms** for trading **EPR certificates** as per **Central Pollution Control Board (CPCB) guidelines** with its approval.
  - The **CPCB** will set the **EPR certificate price range** between **30% (minimum)** and **100% (maximum)** of the **environmental compensation** for non-compliance.
- **Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2025:** It introduces a **comprehensive EPR framework** for **non-ferrous metal scrap**, making **producers** responsible for **recycling targets** rising from **10% in 2026-27** to **75% by 2032-33**.

What are the Key Challenges Associated with Managing E-waste in India?

- **Dominance of the Informal Sector: Over 50%** of **e-waste** is managed by the **informal** sector, which uses hazardous methods like **open-air burning**, and **acid leaching** causing serious **health** and **environmental impacts**.
- **Weak Implementation: EPR non-compliance**, **false reporting** (fake certificates), and **weak penalties** fail to deter large corporations.
- **Inadequate Infrastructure:** Insufficient **authorized dismantlers and recyclers**, **lack of advanced technologies** for precious metal recovery, and the **high cost of formal recycling** limit India's e-waste management capacity.
- **Lack of Consumer Awareness:** Most citizens lack **awareness** of e-waste hazards, often mixing it with **municipal waste**, while **formal collection systems** like producer take-back or drop-off points remain little known and inaccessible.
- **Complex Nature of E-Waste:** E-waste contains **valuable metals** (gold, copper), **toxic heavy metals** (lead, mercury), and **hazardous chemicals**, while modern **compact device designs** with glued or soldered parts make safe **dismantling labor-intensive** and difficult.

How Does E-Waste Impact the Environment and Human Health?

- **Health Impacts:** Informal e-waste recycling exposes workers and nearby populations to **respiratory illnesses**, **neurological damage**, **skin, and eye disorders**, and **genetic impacts** like **DNA** damage and immune alterations.
- **Impacts on the Environment:** Open burning releases **particulate matter**, **heavy metals**, and **dioxins**, creating hazardous **air pollution**; meanwhile, **toxic slurries** contaminate **groundwater**, threatening drinking and irrigation sources.
- **Impact on Agriculture:** Leaching from e-waste turns soil into a sink for **heavy metals** (cadmium, lead, chromium), which are absorbed by **crops** and **livestock**, while chemical contamination harms **soil microbiota**, reduces **organic matter**, and alters **soil pH**.
- **Socio-Economic Impacts:** Hazardous low-cost informal recycling hinders **formal green industry growth**, while improper handling of data storage devices risks **fraud** and **identity theft**.

How can India Make E-waste Management More Sustainable and Efficient?

- **Formal Integration of the Informal Sector:** Train informal **e-waste workers** as **Green Collar technicians**, provide **safe recycling zones** with **protective gear** and link **formal registration** to **healthcare, insurance**, and **pension benefits**.
  - Use a **blockchain-style digital ledger** to **track e-waste** from consumers to recyclers, **mandate annual audits**, and **streamline the EPR framework** to

ensure **accountability**.

- **Leveraging Technology & Innovation: Fund R&D** for **advanced shredding**, **bioleaching**, and **non-thermal recovery methods**; establish **decentralized recycling hubs**, and incentivize **"urban mining"** by treating **e-waste** as a **valuable resource**.
- **Fostering Consumer Responsibility:** Run **campaigns** on the **health impacts of informal recycling** and **proper e-waste disposal**; teach **e-waste** and **circular economy** in **schools**; and simplify **disposal** via **producer take-back** and **reverse vending machines** with **incentives**.
- **Circular Economy:** Promote **Right-to-Repair** laws, encourage **durable** and **easily disassembled electronics** through **incentives**, and support **green public procurement** by prioritizing **repairable** and **recycled-content products**.
- **Global Collaboration:** Strictly enforce the **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989)**, a global treaty aimed at limiting the international movement of **hazardous waste**, including **e-waste**. **India** is a signatory to this convention.

Conclusion

India's booming digital transformation has intensified its **e-waste crisis**, disproportionately affecting marginalized communities. Sustainable solutions require **formalising the informal sector, strengthening enforcement, leveraging technology, promoting consumer responsibility, and embracing circular economy principles**. Urgent multi-stakeholder action is essential to safeguard **public health, environmental integrity, and long-term economic resilience**.

Drishti Mains Question:

"India's digital leap has an unintended consequence: a silent e-waste epidemic." Critically examine this statement, analyzing the socio-economic and environmental challenges posed by informal e-waste recycling in urban India.

Frequently Asked Questions (FAQs)

1. What is India's current e-waste generation status?
India generated 2.2 million MT of e-waste in 2025, ranking third globally, with urban hotspots like Delhi, Moradabad, and Bhiwandi contributing over 60%.

2. What is the concept of 'urban mining' in the context of e-waste management?
It treats e-waste as a valuable resource by recovering precious and rare-earth metals from discarded electronics, promoting a circular economy and reducing the need for virgin material extraction.

3. What are the major health risks associated with informal e-waste recycling?
Informal recycling exposes workers to respiratory illnesses, neurological damage, skin disorders, DNA damage, and developmental delays, especially in children.

UPSC Civil Services Examination, Previous Year Questions

Prelims:

Q. Due to improper/indiscriminate disposal of old and used computers or their parts, which of the following are released into the environment as e-waste? (2013)

1. Beryllium
2. Cadmium

3. Chromium
4. Heptachlor
5. Mercury
6. Lead
7. Plutonium

Select the correct answer using the codes given below:

(a) 1, 3, 4, 6 and 7 only

(b) 1, 2, 3, 5 and 6 only

(c) 2, 4, 5 and 7 only

(d) 1, 2, 3, 4, 5, 6 and 7

Ans: (b)

Mains:

Q. What are the impediments in disposing of the huge quantities of discarded solid waste which are continuously being generated? How do we safely remove the toxic wastes that have been accumulating in our habitable environment? (2018)