



Space Debris Crisis

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Why in News?

A **500-kg metal object** crashed in **Kenya**, sparking concerns over [space debris](#) and highlighting the increasing global issues of **accountability and safety measures** for debris reentries.

What is Space Debris?

- **About:** According to the [UN Committee on the Peaceful Uses of Outer Space \(COPUOS\)](#) 'Space debris is **all man-made objects**, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are **non-functional**'.
 - It includes **defunct satellites, rocket stages, and fragments** from explosions or collisions.
- **Origin:** Most space debris comes from **on-orbit breakups** i.e., satellites or rocket stages explode, collide, or fragment in space.
 - NASA estimates **23,000 debris pieces** larger than a baseball, **500,000 marble-sized scraps**, and **100 million fragments** over one millimeter orbiting Earth.
- **Space Debris Destruction:** Debris loses altitude and **burns up on re-entry** due to atmospheric drag. It is **intensified by the 11-year solar activity cycle** that expands the atmosphere, **accelerating the decay** of low-orbit debris.
- **Associated Risks:**
 - **On-Orbit Risks:** Large debris can **destroy satellites**, while even **1 cm fragments** can disable spacecraft. **Millimeter-sized particles erode surfaces** and damage solar panels.
 - **Re-entry Risks:** Most debris burns up, but some large fragments may **reach Earth**, though the risk of injury is very low.
 - **Kessler Syndrome:** [Kessler Syndrome](#) is a **chain reaction** of debris collisions creating even more debris, potentially **making orbits unusable** for future space missions.
- **International Regulations:**
 - **Outer Space Treaty (1967): Article VI** of the treaty makes states **responsible for all national space activities**, including private ones, but **lacks enforcement mechanisms**.
 - **Convention on International Liability for Damage Caused by Space Objects (1972):** It imposes **absolute liability** for space object damage on Earth, requiring **no proof of negligence**, but enforcement is **weak**.
 - **Voluntary UN Guidelines on Deorbiting:** The UN recommends **deorbiting satellites within 25 years**, but compliance rate is only around **30%**.
- **Initiatives to Remove Space Debris:**
 - **Global:** ClearSpace-1 and Remove DeBRIS (by ESA), OSAM-1 (NASA).
 - **India:** **Debris Free Space Mission (DFSM)**, [Network for Space object TRacking and Analysis \(NETRA\)](#).

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