Science & Technology · GS - III

The rapid expansion of commercial satellite constellations is creating a new governance challenge at the intersection of technological innovation, environmental protection and the global commons. Analyse.

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 26/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
15	~250 words

Answer Hint

Space commercialisation, orbital congestion, light pollution, radio astronomy, space debris, Outer Space Treaty, international coordination, sustainable space governance

Model Answer

The expanding commercial use of outer space

Satellite constellations support broadband connectivity, navigation, disaster management and scientific applications. However, proposals for extremely large orbital data-centre networks raise concerns about the environmental and institutional sustainability of space activities.

Emerging areas of concern

1. **Astronomical interference:** Reflected sunlight from satellites can brighten the night sky, affecting optical observations. Radio transmissions may also disrupt radio astronomy.

2. **Orbital congestion:** Increasing satellite density raises collision risks and the possibility of cascading debris generation, threatening operational spacecraft.

3. **Environmental externalities:** Rocket launches consume resources and generate emissions. Satellite re-entry and manufacturing also require assessment of their atmospheric and material impacts.

4. **Unequal access:** Commercial constellations may occupy valuable orbital and radio-frequency resources, creating concerns about equitable access for developing countries and scientific institutions.

Governance gaps

The Outer Space Treaty, 1967 establishes principles of peaceful use, state responsibility and avoidance of harmful contamination. The Liability Convention, 1972 addresses international liability for damage caused by space objects. However, existing frameworks face difficulties in regulating rapidly expanding private commercial activities, cumulative environmental impacts and emerging technologies.

Towards sustainable space utilisation

1. Strengthen international coordination through the United Nations Committee on the Peaceful Uses of Outer Space.
2. Improve satellite brightness standards, orbital tracking, collision avoidance and end-of-life disposal.
3. Require transparent environmental assessments for exceptionally large satellite constellations.
4. Encourage consultation between commercial operators and astronomical research institutions.

Conclusion: Outer space must remain accessible for scientific discovery and peaceful development. Technological expansion therefore needs to be guided by shared responsibility and long-term orbital sustainability.