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Q12

## **Discuss India's achievements in the field of Space Science and Technology. How the application of this technology has helped India in its socio-economic development?**

UPSC Civil Services Mains 2016 · GS III · 12 marks · Indian Economy

Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.

### **Core demand of the question**

- Recount India's main achievements in space science and launch technology
- Show how satellites and applications have served weather, communication, land, and security
- Link those applications to socio-economic development

### **Revision summary**

**PSLV**, growing **GSLV** capacity, **INSAT/GSAT**, and the **IRS** family are the core engineering achievements.

Chandrayaan-1, the Mars Orbiter Mission, and the **IRNSS/NavIC** constellation mark science and autonomy.

Development use is weather and disaster warning, crop and fishery advice, tele-education, and telemedicine.

Maps of water, forest, and cities improve planning if officials actually open them.

Space multiplies other public goods; it does not replace roads, credit, or local administration.

### **Introduction**

Indian space work began as a development tool, not as a race for flags. From **Aryabhata (1975)** to a working **Polar Satellite Launch Vehicle**, an operational **Indian National Satellite** communication fleet, and the **Mars Orbiter Mission (2014)**, the Indian Space Research Organisation has built both **rockets and uses**. The second half of the question is the more important one for GS-III: how those uses raise income, safety, and public services.

### **Body**

#### **Achievements in science and technology**

- **Launch vehicles:** **SLV** and **ASLV** were learning steps; **PSLV** became a reliable workhorse for polar and many foreign commercial satellites; **GSLV** with an indigenous cryogenic stage opened heavier geostationary lifts; **GSLV Mark III** is the next heavy-lift path.
- **Remote sensing:** the **Indian Remote Sensing** series, **Cartosat**, **Resourcesat**, and **Radar Imaging Satellite (RISAT)** give maps of crops, water, forests, and all-weather images.
- **Communication and meteorology:** **INSAT** and **GSAT** carry television, telecom, and weather payloads; a meteorological chain supports the India Meteorological Department.

- **Navigation:** the **Indian Regional Navigation Satellite System (NavIC / IRNSS)** reached a seven-satellite regional constellation in 2016, reducing dependence on foreign GPS for Indian users.
- **Science missions:** **Chandrayaan-1 (2008)** contributed to evidence of water molecules on the Moon; **Mars Orbiter Mission** entered Martian orbit in 2014 at a low cost and on the first attempt; astronomy payloads and forthcoming **Chandrayaan-2** keep the science line alive.
- **Human and reusable steps:** crew-module tests and a **Reusable Launch Vehicle** technology demonstrator show a longer ladder, not an already finished human-spaceflight programme.
- **Antrix** commercial launches and satellite services earn foreign exchange and prove reliability.

### Socio-economic applications

- **Weather and disaster:** cyclone track, rainfall, and drought maps give early warning for the coast and for farmers; flood and landslide mapping supports the National Disaster Management Authority and State relief.
- **Agriculture and fisheries:** crop-acreage and production estimates, drought assessment, and **Potential Fishing Zone** advisories from ocean satellites raise the chance of a catch and a planned sowing.
- **Land and water:** groundwater prospect maps, watershed planning, forest-cover change, and wasteland mapping feed rural programmes and forest departments.
- **Communication and education:** **INSAT** and **EDUSAT**-type capacity carry tele-education, telemedicine to district hospitals, and rural Direct-to-Home and radio, which matter where fibre has not arrived.
- **Governance and inclusion:** unique identity and many e-governance links ride on communication satellites; village resource centres were an early ISRO-development experiment.
- **Infrastructure and cities:** high-resolution imagery helps road, rail, and urban planning and monitors mining and coastal erosion.
- **Security and navigation:** navigation and radar satellites support the armed forces and civilian aviation and shipping; they also help in search and rescue when coupled with beacons.
- **Industry:** a domestic vendor chain in electronics, composites, and software jobs sits around the centres at Bengaluru, Sriharikota, Thiruvananthapuram, and Ahmedabad.

### Limits that still bind development gains

- Last-mile extension, language, and a working phone still decide whether a fishing advisory is used.
- Data must reach **panchayats, krishi vigyan kendras, and municipal engineers**, not only a national atlas.
- Space cannot replace roads, cold storage, or a solvent discom; it only targets and times those investments better.

### Flow diagram

ISRO launch and satellites launch and satellites -> PSLV GSLV NavIC GSLV NavIC  
 ISRO launch and satellites -> Weather farm fish telecom  
 Weather farm fish telecom -> Early warning income public services  
 Chandrayaan MOM -> ISRO launch and satellites  
 Last-mile extension -> Early warning income public services

## Conclusion

India's space record is a ladder of **PSLV** and GSLV, INSAT and IRS, Chandrayaan-1, Mangalyaan, and NavIC. Socio-economic value appears when those assets warn a cyclone coast, guide a fishing boat, map a watershed, teach a remote classroom, and time a disaster response. The achievement is real when the map and the message reach the farmer and the district officer, not only the control room.

## Facts & figures

### Aryabhata 1975

India's first satellite, launched with Soviet help, marking the start of the Indian space programme in orbit.

### PSLV

Polar Satellite Launch Vehicle: ISRO's reliable workhorse for remote-sensing and many commercial foreign satellites.

### Chandrayaan-1 2008

Lunar orbiter whose payloads contributed to detecting water-molecule signatures on the Moon.

### Mars Orbiter Mission 2014

India's first interplanetary spacecraft; entered Mars orbit on the first attempt at comparatively low cost.

### IRNSS / NavIC 2016

Seven-satellite regional navigation constellation completed in 2016 for Indian-region positioning.

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