Mission Chandrayaan

Why in News?

- On 22 July 2019, India launched Chandrayaan-2, its second lunar exploration mission after Chandrayaan-1 from Satish Dhawan Space Centre, Sriharikota.
- It is a Lunar orbiter, lander, rover type mission. It is expected to do soft-landing on the Moon on 7 September, 2019.
- Chandrayaan-2 is ISRO's first attempt to land on any extraterrestrial surface.
- **Core Objective:** To map the location, and abundance of lunar water.

Background

- The project began in 2007 with an agreement between India's space agency ISRO and Russia's ROSCOSMOS for mutual cooperation.
    - However, the mission was postponed in January 2013 and rescheduled to 2016 as Russia was unable to develop the lander on time.
- Later, after Russia's withdrawal, India decided to develop the lunar mission independently. Finally, on 22 July 2019, GSLV MK III M1 on its first operational flight successfully launched Chandrayaan-2.
- Once successful, **India will become the fourth country to soft-land a spacecraft on the Moon** after the USSR, the USA and China. Chandrayaan-2 will make a landing at a site where no earlier mission has gone, near the south pole of the Moon.
- Chandrayaan-2 is a natural sequel to Chandrayaan-1, an Orbiter mission launched in October 2008.
    - Chandrayaan-1, ISRO's first exploratory mission to moon, was designed to just orbit the Moon and make observations with instruments on board.
    - Chandrayaan-1 operated for 312 days as opposed to the intended two years but the mission achieved 95% of its planned objectives.

Key Findings of Chandrayaan-1

- **Confirmed presence of lunar water**
- **Evidence of lunar caves** formed by an ancient lunar lava flow
- Past tectonic activity were found on the lunar surface.
    - The faults and fractures discovered could be features of past interior tectonic activity coupled with meteorite impacts.

Chandrayaan-2: Design and Mission Profile

- Chandrayaan-2 is an integrated 3-in-1 spacecraft of around 3,877 kg comprising of an Orbiter of the Moon, Vikram (after Vikram Sarabhai) the lander and Pragyan (wisdom) the rover, all equipped with scientific instruments to study the moon.
- The Orbiter will orbit from 100 km away, while the Lander and Rover modules will separate and make a soft-landing on the surface.
- **Lander (Vikram)** will remain stationary after touching down, will mainly study the moon's

atmosphere. It will also look out for seismic activity.

- **Rover (Pragyan):** Once on the Moon, the Rover, a six-wheeled solar-powered vehicle, will detach itself and slowly crawl on the surface, making observations and collecting data.
    - It **will study the composition of the surface near the lunar landing site,** and determine the abundance of various elements.
- Orbiter: While the Lander and Rover are designed to work for only 14 days (1 lunar day), the Orbiter, a 2,379-kg spacecraft with seven instruments on board, would remain in orbit for a year.
    - It is equipped with different kinds of cameras to **create high-resolution three-dimensional maps of the surface**.
    - It will **study the mineral composition on the moon** and the lunar atmosphere, and also to **assess the abundance of water**.
- The mission sequence involves meticulous planning of series of Earthbound manoeuvres, trans-lunar injections, series of lunar burns, lander separation, lander descent, and touchdown and subsequent rover rolling out of the lander on the Moon surface.

Mission Objectives

- Try and build on the evidence of water molecules shown by Chandrayaan-I and study the extent and distribution of water on the Moon
- Study topography, seismography, composition of lunar surface and the lunar atmosphere
    - The study of ancient rocks and craters can offer indications of origin and evolution of the Moon.
    - The South Pole region of the Moon also contains clues to the fossil records of early solar system. Thus, it will improve our understanding of the early solar system as well.
- Map the lunar surface and prepare 3D maps of it.

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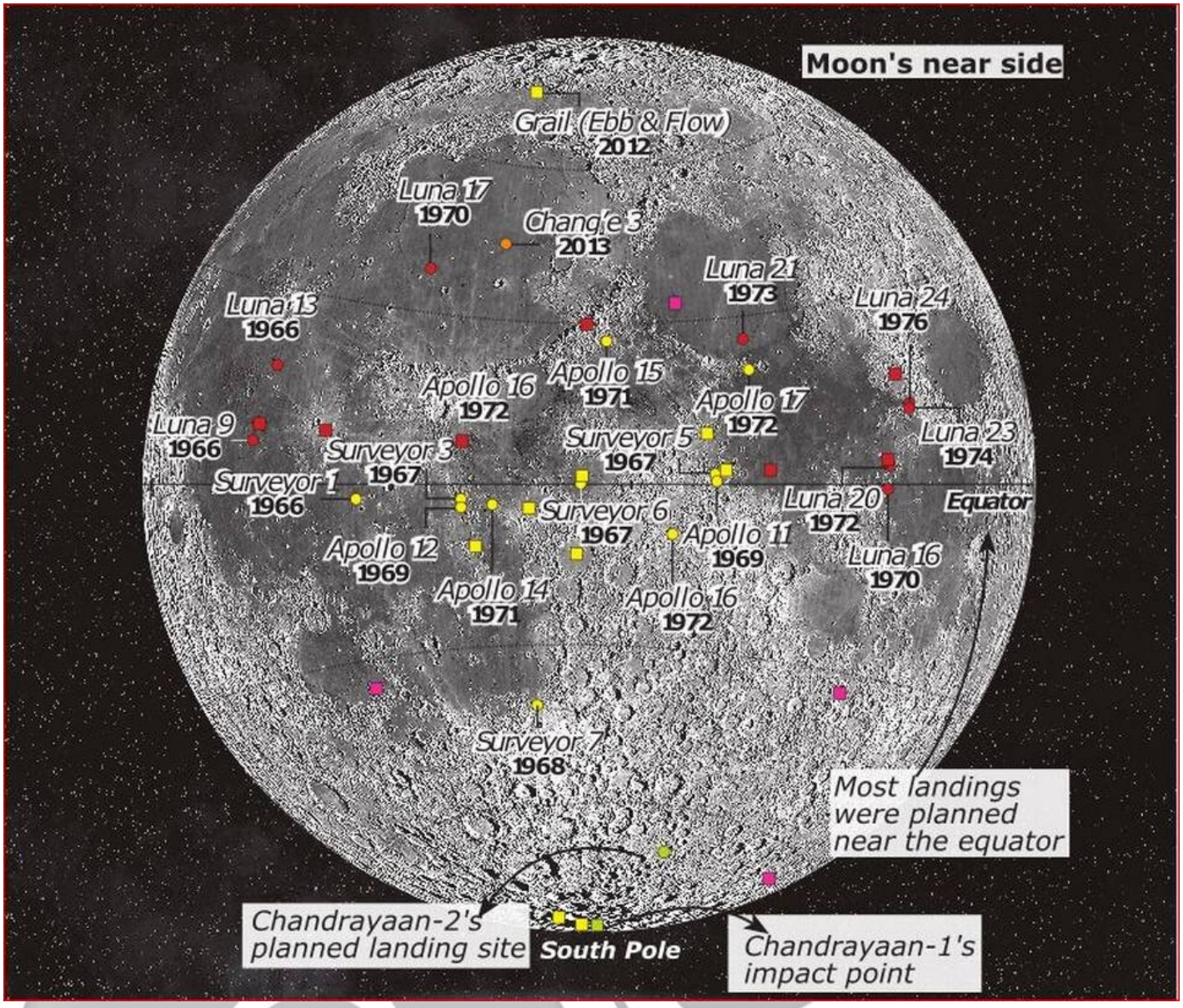

Chandrayaan 2 and every other moon mission mapped

Mission Challenges

Chandrayaan 2, being a technologically challenging mission, requires multifaceted developments of various new systems for the first time with a very high level of perfection. Major challenges in the complete mission involve:

- Successfully performing the launch of its heaviest rocket GSLV-Mark III.
- Ensuring trajectory accuracy while travelling such a long distance. It will perform successive orbital manoeuvres to raise the module into higher orbits until it reaches the “Earth to Moon” transfer orbit.
- Landing on safe hazard free zone: ISRO had never performed soft landing on any space object. The lunar surface is covered with craters, rocks, dust, hot gases and faces extreme surface temperature variations. Thus, it is an extremely hostile environment for lander and rover operations.
- Further, the South Pole region of the Moon receives less sunlight compared to equatorial region, which is required by solar-powered instruments.

Thus, the margin of error is extremely narrow. The recent failure of Israel’s Moon landing mission indicates the difficulty in soft and precise moon landing.

Importance and Benefits of the Mission

- The moon **offers a pristine environment to study**. It is also **closer than other celestial bodies**. Understanding how it formed and evolved can **help us better understand the solar system and even earth itself**.
- With space travel taking shape and exoplanets being discovered everyday, learning more about earth's celestial neighbour **can help in advanced missions**.
- India would be the 4th nation to reach the Moon. It **boosts national pride** in the citizens of India.
- It will **boost the morale of scientists** and research academicians. Also, it can **motivate the youth to develop scientific temper** and undertake real-life applications of science and technology.
- High precision components used in the mission require high standards of manufacturing procedures. It is critical for **imbibing the spirit of innovation in Indian manufacturing industry**.
- ISRO initially partnered with a startup-TeamIndus for the launch, which however could not materialize. Still, it gave a boost to the Indian startup industry in space sector thereby promoting entrepreneurship. Chandrayaan-2 offers similar possibilities.
- For Chandrayaan-2 mission, two women - Ritu Kridhal and M Vanitha are leading as project and mission directors respectively. Thus, it is a **symbol of women empowerment** and an icon of women taking leadership roles in the country's biggest projects.

Way Forward

- The Chandrayaan-2 mission is a precursor to other ambitious missions like:
    - The Gaganyaan project, which aims to place three Indians in space by 2022,
    - Interplanetary probes and a solar spacecraft mission (Aditya-L1),
    - Permanent space station in line with the ISS.
- India is already in talks with Japan's JAXA (Japan Aerospace Exploration Agency) for a future mission **Chandrayaan-3** in 2024, to bring back soil and rock samples from the South Pole of the Moon.
- ISRO's previous missions had several applications in different domains like **telecommunication, military, remote-sensing,** etc.
    - Its future missions are expected to further **explore new areas in deep space technology**. Moon is the perfect test-bed for proving technologies required for future space exploration.
- If the future missions are successful in extracting water from the Moon, it will **pave the way for colonization of the Moon**. Water will not only help in sustaining life on Moon but can also provide **Hydrogen and Oxygen to be used as fuel for interplanetary missions,** particularly to Mars.

Humanity is currently facing challenges like global warming, population explosion and shrinking of resources. Thus, mission programmes like Chandrayaan show the capability of Indian scientists to protect the interest of mankind and future generations by providing viable alternatives to life.

For Mind Map