The international journal of science / 31 August 2023

nature

India's lunar-landing success should be celebrated

When Chandrayaan-3 touched down, India pulled off a huge win for its own space programme and for international efforts to understand the Moon.

It's hard to land on the Moon and keep your spacecraft intact. Just weeks ago, Russia's Luna-25 mission crashed, dashing hopes for the country's first trip to the Moon since 1976, when it was part of the Soviet Union. In April, a private Japanese effort also crash-landed on the lunar surface. That is one of the reasons the successful landing of the Chandrayaan-3 mission by the Indian Space Research Organisation (ISRO) is so special.

Touchdown occurred just after 6 p.m. Indian time on 23 August near the Moon's south pole, making India only the fourth nation (after the United States, the Soviet Union and China) to achieve a controlled lunar landing. Furthermore, India is the first to land at high latitudes, around 600 kilometres from the pole. That's significant because the polar regions are thought to contain ice that could be a resource for future lunar exploration, for instance as a source of the components of rocket fuel.

On 24 August, the mission's landing module Vikram, named after physicist Vikram Sarabhai, considered the founder of India's space programme, deployed a small rover that will study lunar rocks and dirt. The solar-powered mission is meant to last for two weeks, until lunar night hits this part of the surface.

Like the US and Russian space agencies, ISRO has learnt from a previous failure. The Chandrayaan-2 lander crashed in September 2019, when its software could not diagnose and correct a problem with its thrusters as the craft descended to the lunar surface. ISRO engineers added many back-up systems to Chandrayaan-3, and tested more rigorously how the spacecraft could respond if things went wrong.

Lunar trailblazer

Dozens of missions to the Moon are planned in the coming years. The next attempt is likely to come in the next few weeks, when Japan aims to send a spacecraft to test pinpoint landing techniques. It's tempting to frame this flood of interest in the Moon as a new space race, with nations jockeying to be the first to reach particular milestones. But as space writer Jatan Mehta observed this month: "This is not the cold war era. Budgets are finite enough to not risk expensive hardware being blown amid pursuits of trivial firsts and a slight edge at best."

However, lunar exploration can be seen as a new proving ground for science and engineering. Previous ISRO missions have already brought about fresh lunar science. India's first Moon mission, the Chandrayaan-1 orbiter, launched in 2008 and helped to confirm the existence of water on the Moon with data gathered by a NASA instrument on board (C. M. Pieters *et al*. *Science* **326**, 568–572; 2009). Meanwhile, the orbiter component of Chandrayaan-2, which worked even though the lander crashed, continues to map and study the lunar surface. If Chandrayaan-3 continues to function well, it will collect data on the chemistry and mineralogy of the surface.

> "Lunar exploration can be seen as a new proving ground for science and engineering."

Yury Borisov, director-general of Russian space agency Roscosmos, told state media last week that Russia's Moonshot failure happened because the country's lunar programme had been interrupted for almost five decades, hollowing out the expertise needed to make it to the Moon. ISRO, by contrast, has steadily built on its achievements, including ramping up its engineering talent, although it has declined to reveal how much – or how little – it spent on Chandrayaan-3.

Indian Prime Minister Narendra Modi, who joined millions of people in watching the final descent, rightly said: "This success belongs to all of humanity." It is also undoubtedly a stellar achievement for India's scientists and engineers across many generations.

Why sustainable development is inseparable from climate action

The science is clear: sustainability cannot be achieved without climate action, and vice versa. What's needed is a fight on both fronts.

When the Sustainable Development Goals (SDGs) were adopted in September 2015, the outcome of an upcoming United Nations climate summit due to take place in Paris three months later was anything but guaranteed. Global leaders, diplomats, environmentalists and scientists were all keenly aware of the world's failure to secure an agreement on a new climate pact in Copenhagen six years earlier, and negotiations were still in flux. That is among the reasons why the 13th of the 17 SDGs – to "take urgent action to combat climate change and its impacts" – includes no numerical target for limiting global temperature rise.

The magnitude and urgency of the task has never been in any doubt, however. Several decades of science has