

Why food inflation is softening

Agriculture production recovery and forecast of 'above normal' monsoon should further cool food prices. Together with easing global crude prices and a stable rupee, this can provide a boost to consumption



HARISH DAMODARAN

THE LAST El Niño — from around April 2023 to May 2024 — was not only a long, but also strong event.

Sea surface temperatures (SST) in the Pacific Ocean waters off the coasts of Ecuador and Peru rose up to 2 degree Celsius above the 30-year average for this region in some months. That was way higher than the minimum threshold, of 0.5 degree Celsius or more positive SST departure from normal, for classification as an El Niño event.

The long and strong El Niño was responsible for large parts of India not getting adequate rainfall during the 2023-24 monsoon (June-September), post-monsoon (October-December) and winter (January-February) seasons. It was accompanied by the winter's delayed onset and warmer-than-usual temperatures, culminating in the heat waves from the second half of March through mid-June 2024.

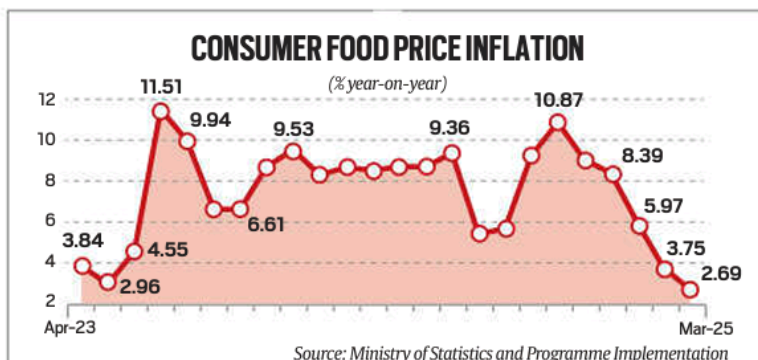
Food inflation impact

The end-result was 2023-24 turning out to be a not-so-great agricultural year, with subpar kharif (June-August sown and October-December harvested) as well as rabi (October-December sown and March-May harvested) crops.

Its effects were also felt in food prices. The annual rise in the official consumer food price index averaged over 8.5% between July 2023 and December 2024. That made it one of the country's longest episodes of food inflation in recent times.

High food prices, in turn, impacted consumer spending. With households having to allocate a larger portion of their incomes to food, they were left with less money to spend on other things. Hindustan Unilever, India's largest fast-moving consumer goods company, reported annual sales volume growth of 2% each in the July-September 2023, October-December 2023 and January-March 2024 quarters, 4% in April-June 2024, 3% in July-September 2024 and 0% in October-December 2024.

Simply put, El Niño — an abnormal warming of the central and eastern equatorial Pacific Ocean waters, leading to en-



CENTRAL POOL STOCKS AS ON APRIL 1

	Wheat	Rice*	Total
2013	242.07	354.68	596.75
2014	178.34	305.52	483.86
2015	172.21	238.2	410.41
2016	145.38	288.11	433.49
2017	80.59	297.84	378.43
2018	132.31	300.43	432.74
2019	169.92	398.16	568.08
2020	247	491.49	738.49

	Wheat	Rice*	Total
2021	273.04	499.29	772.33
2022	189.9	550.37	740.27
2023	83.45	433.81	517.26
2024	75.02	531.54	606.56
2025	117.94	631	748.94

*Includes rice equivalent of un-milled paddy.
Distribution, in lakh tonnes
Source: Dept of Food and Public Distribution

hanced evaporation and cloud-formation activity in western Latin America, the Caribbean and the US Gulf Coast, and correspondingly depriving Southeast Asia, Australia and India of convective currents — wreaked havoc on the country's farm output, pushing up food prices and crimping household spending.

Easing pressure

Those pressures have subsided since the start of this calendar year. Retail food inflation was at 2.7% year-on-year in March (see chart), the lowest since November 2021.

The reason: An agriculture production recovery in 2024-25 on the back of a good monsoon, sans El Niño or other weather shocks. If anything, there was a mild La Niña or a cooling of SSTs in the central and eastern tropical Pacific Ocean. La Niña does the opposite of El Niño: As the trade winds blowing west along the equator carry warm water from South America towards northern Australia and Indonesia, they cause increased cloudiness and rainfall over this region — whose effects may percolate to India too.

The SST departures from the average were not significant enough this time (minus 0.5-0.6 degrees during November-February 2024-25) to qualify as a full-fledged

La Niña event.

But it ensured a more or less normal winter — and a decent rabi crop, on top of the monsoon-aided kharif harvest. The softening of food inflation has coincided with their arrivals in the market.

Wheat relief

The real relief would be in wheat, the stocks of which in government godowns — at 7.5 million tonnes (mt) on April 1, 2024 — were the lowest for this date since 2008.

The 2023-24 crop, harvested and marketed in April-June 2024, wasn't good in central India, because of the winter's late arrival followed by foggy weather and lack of sunshine in January. While yields in north and northwest India were above par, the poor harvests in Madhya Pradesh (MP), Gujarat, and Maharashtra dragged down overall production.

As a result, wheat prices remained elevated all through last year and beyond, even as the new marketing season from April has opened with not-too-comfortable government stocks.

The good news is that the crop in central India has been bumper this time, thanks to no major temperature anomalies or fog/smog conditions. Yields in north and northwest India have been reported marginally lower

than last year, but should still add up to higher overall national production figure.

"When temperatures spiked briefly in February, it seemed that the crop would mature early for harvesting by early-April. But March was relatively cool, which allowed normal grain-filling and harvesting to happen from the second week of April. Last year, my yields were the best ever, at 27-28 quintals per acre. This year, it is 24-25 quintals," said Pritam Singh, a progressive farmer from Urlana Khurd village of Haryana's Panipat district.

The bumper wheat harvests of 2024 and 2025, especially in Punjab and Haryana, have been attributed to moderate weather and also the cultivation of new high-yielding varieties such as HD-3386, DW-327, PBW-826 and PBW-872. "These varieties have bolder grains. The average weight of thousand grains from them is 50-54 grams, as against 40-44 grams for the older varieties," Singh claimed.

One indicator of a good crop is prices. Fair average quality wheat is trading in MP's Dewas and Ujjain markets at Rs2,400-2,500 per quintal, as against Rs 3,000-3,100 three months ago and the government's minimum support price of Rs 2,425. Higher government procurement in the current marketing season should help bolster its wheat stocks, over and above the already-record levels of rice (see table).

Future outlook

Last week, the India Meteorological Department (IMD) forecast an "above normal" southwest monsoon, with rainfall during the upcoming season (June-September) likely at 105% of the long period average for this four-month period.

If the forecast materialises — the IMD expects ENSO-neutral conditions (i.e. neither El Niño nor La Niña) — that should enable a further cooling of food inflationary pressures.

Viewed along with falling global oil prices (Brent crude is ruling at below \$68 per barrel, compared to \$80 three months ago) and a weakening dollar (from 87.5 levels in February to Rs 85.4 now), it translates into a "positive terms of trade shock" for Indian households, firms and the government. All three can retain a larger part of their incomes/revenues that were previously being expended on costlier food and imported inputs or subsidy. The immediate boost could be to household consumption.

That may, to some extent, compensate for the shocks to exports and general economic uncertainty from US President Donald Trump's tariff wars.

Why first confirmed image of the colossal squid in deep sea is significant

ALIND CHAUHAN

NEW DELHI, APRIL 20

IN THE Age of Sail, when much of the world's oceans were still uncharted, the mythical Kraken, a gigantic tentacled sea monster with a taste for human flesh, was a sailor's worst nightmare.

"Below the thunders of the upper deep; Far, far beneath in the abysmal sea; His ancient, dreamless, uninvaded sleep; The Kraken sleepeth: faintest sunlights flee..." wrote Lord Alfred Tennyson in his 1830 poem, *The Kraken*.

But the Kraken was not just a product of superstition. Today, it is well-known that its descriptions were probably based on sightings of real animals, namely the giant squid (*Architeuthis dux*) and colossal squid (*Mesonychoteuthis hamiltoni*), the largest

cephalopods (class of marine animals including octopii and cuttlefish), and possibly the largest invertebrates, in the world.

Despite their size, these deep-sea creatures remain elusive. Until very recently, a century after it was first identified and named, there was still no image of the colossal squid in its natural environment.

This changed last month when scientists on board a research vessel in the South Atlantic recorded a juvenile colossal squid, only a foot long, 2,000 feet under the ocean's surface. The footage taken near the South Sandwich Islands was released on April 15.

EXPLAINED SCIENCE

Underwater enigmas

Colossal squid have been nearly impossible to spot, especially on camera. This is probably because their large, sensitive eyes make them stay away from research equipment that can be bright and loud, Dr Kat



A juvenile colossal squid in the South Atlantic Ocean. AP

Bolstad, an associate professor at the Auckland University of Technology, told NPR.

As a result, researchers have very little idea about the diet, lifespan or reproductive traits of the colossal squid. Most of our un-

derstanding of the creature comes from dead or dying specimens found within the stomachs of whales and seabirds, or when younger ones turn up in trawl nets.

The cephalopod was first discovered in 1925 when scientists found arm fragments from two squid in the belly of a sperm whale.

Although also elusive, more is known about the giant squid, identified in 1857. A live specimen was captured on camera only in 2004, and on video in 2016. Giant squid too live in the frigid depths of the ocean, between 600 to 3,000 feet, in tropical and temperate waters. They are known to eat deep-sea fish and other squid species.

Secret to size

Beyond their habitat, the two massive squid differ in shape and size. However, reports have often exaggerated just how big they are.

Experts believe that colossal squid can

be as long as seven metres or 23 feet, and weigh up to 500 kg. The giant squid are thought to grow up to 13 metres or 43 feet, and typically weigh up to 275 kg.

"Colossal squid have a huge body but relatively short arms and tentacles, which means their body plan is in some ways opposite to giant squid," said Jon Ablett, a curator at the Natural History Museum, London, according to a report on the museum's website.

Researchers suggest their massive size increases the number of animals they can prey on, and reduces the number of species who can prey on them. Once fully grown, the only animal that can eat them is the sperm whale, the largest toothed predator in the world. Their eyes — roughly the size of basketballs — help them spot their primary adversary, according to some experts.

But unlike many other squid species, giant and colossal squid likely take years to mature. "Most squid live fast and die young," Ablett said. Researchers believe gi-

ant squid live anywhere between two and 12 years. There is no clear agreement on the average lifespan of the colossal squid.

A significant sighting

The high-resolution video footage of the colossal squid can help resolve several mysteries around the animal — from how they spend their time to where they travel to mate or spawn, and how long they live.

Speaking about the observed juvenile colossal squid, Dr Aaron Evans, an independent researcher who was not part of the expedition, told CNN: "For us to see this kind of midrange size in between a hatchling and an adult is really exciting because it gives us the opportunity to fill in some of those missing puzzle pieces to the life history of this very mysterious animal."

Researchers highlighted that the sighting can also inform decisions about human activities such as deep-sea mining, known to harm marine life.

Diving into SC's verdict on Governors

The Supreme Court's recent judgment in the Tamil Nadu Government's suit against its Governor has done more than clear some Bills for the one State — it has set the tone for governments and Governors in a similar position in several other States

EXPLAINER

Gautam Bhatia

In April 8, 2025, the Supreme Court decided a long-simmering dispute between the Governor of the State of Tamil Nadu, and the State's government and Legislative Assembly. For a period spanning years, the Governor had refused to act upon the Bills that had been passed by the State's Legislative Assembly — neither assenting to them, nor returning them to the Assembly nor referring them to the President. Effectively, the Governor had been exercising a "pocket veto" over the Bills.

Upon the Supreme Court's nudging, the Governor eventually returned the Bills to the Legislative Assembly for reconsideration; when, upon reconsideration, the Legislative Assembly sent the Bills back to the Governor's office for a second time, the Governor then referred them to the President. At the time of the court's judgment, the President had assented to one of the ten Bills before her, withheld assent to seven, and had yet to act on two.

Tamil Nadu is not the only State where such events have taken place: clashes between the centrally-appointed Governor and the Legislative Assemblies of States have been increasingly commonplace in recent years, in States where an Opposition party, or a combination of Opposition parties, are in power. The dispute before the Supreme Court, thus, was important not only for its own sake; more than that, it was representative of a broader set of tensions within India's federal structure.

Going above and beyond

In a lengthy judgment, spanning 415 pages, the Supreme Court found that there was no justification for the Governor's actions. Under the Constitution, Governors were entitled neither to exercise a veto nor a pocket veto over the State Legislative Assembly's Bills. Nor could Governors first return a Bill to the State Legislature, and then refer it to the President; it had to be one or the other (and the second, only under certain specific conditions).

The President, as well, when considering State Bills, could not withhold their assent unless there was a constitutionally-sanctioned reason for doing so (such as, for example, inconsistency between the State Bill and an existing central law). Indeed, this was the only position that adequately respected the will of the people of the States, as articulated through their elected representatives in the State's Legislative Assembly, and the only position that adequately respected India's federal structure.

The Supreme Court, however, did not stop at simply laying down the law. In a move that has raised eyebrows and generated some amount of controversy, it went further: first, it laid down specific and categorical timelines within which the Governor and the President were required to consider, and take action, on State Bills (these timelines depended on the nature of the action — assent, referral, or return). It is important to note that the Constitution itself prescribed no such timelines.

And secondly, in this specific case, having found that the Governor had acted without *bona fides*, and that years had passed since the Bills were first sent to his



Questioning court's ambit: Critics argue that in prescribing timelines where none existed in the Constitution, and by taking it upon itself to "enact" the pending Bills, the Court overstepped its remit. PTI

office, the Supreme Court invoked its power to do "complete justice" under Article 142 of the Constitution, and held that these Bills were deemed to have been passed, and were now law. Indeed, a day after the court's judgment, the government of Tamil Nadu promptly notified the Acts, and brought them into force.

Critics argue that in prescribing timelines where none existed in the Constitution, and by taking it upon itself to "enact" the pending Bills, the court overstepped its remit, and engaged in functions that, constitutionally, are within the remit of other branches of government. Defenders of the court, on the other hand, point to the fact that the Governor's years-long, unjustified delay had backed the court into a corner, where there was no other realistic option before it. What, then, are we to make of what the court did?

To answer this question, it is important to move beyond the specific actions of the specific actors in this drama, and consider the constitutional design itself.

Problem of constitutional design

The Indian Constitution contains a set of tensions that are the product of the historical moment in which it was written. On the one hand, the framers of the Constitution were committed to creating a federal and parliamentary structure of governance for the new nation-state that was coming into being.

On the other hand, however, prominent members of the Constituent Assembly — Jawaharlal Nehru, B.R. Ambedkar, and Vallabhbhai Patel, among others — were, at heart, centralists. For a number of distinct reasons — which did not always overlap — they wanted to ensure that even as the Constitution devolved power both horizontally (that is, away from the executive and to representative bodies) and vertically (away from the Centre, and to the States), ultimate control would be exercised by a

strong, unitary executive.

To achieve this, the framers turned to what they knew best: colonial constitutional instruments, whose core governing principle had always been the principle of executive supremacy. From the beginning of the 20th century, under serious pressure from the Indian national movement, the British had grudgingly, and incrementally, allowed for the existence of representative institutions and proto-legislatures. At all times, however, they made sure to ensure that the ultimate control lay with the British-appointed executive, who could override representative institutions in the larger interests of maintaining the British Empire.

One crucial part of this arsenal was the colonial governors, who were appointed to keep nationalist aspirations within the provinces, as expressed through provincial legislatures, in check.

The framers did not, of course, borrow the colonial institution of the Governor wholesale; what they did was to carry over the form into the new Constitution. However, the moment the Constitution created two poles of authority — the Centrally-appointed Governor, and the elected State Legislature — at the federal level, tensions and conflicts were bound to arise.

One way of resolving these tensions would have been to adopt a strategy that we see elsewhere in the Constitution: extensive codification and detailed rules setting out how power would be exercised, and how it would be limited. However, when it came to the structures of government — the legislature, the executive, and the Governor — the framers did not codify; instead, they left the issue to be decided through unwritten constitutional conventions.

This choice was not neutral: the refusal to expressly limit the exercise of power meant that the Constitution contained silences where it mattered the most — silences that could, and were, exploited

by actors who had no respect for constitutional conventions.

The problem before the Supreme Court, thus, was a problem of constitutional design. By design, the Constitution placed no express check on Governors engaging in pocket-vetoes. At the same time, without such a check, the system was entirely reliant on good faith: the moment a Governor chose to exploit constitutional silences, the entire federal structure could — and would — be undermined.

Time for course correction

The Supreme Court's decision, therefore, is best understood as a judicial attempt to correct defective constitutional design. The choices made at the time of the framing were playing out in a way that would reduce the principles of federalism and representative democracy to a farce — unless there was external intervention. In our system, the only body capable of such intervention is the court.

Of course, the court's judgment is not free of problems. In doing what it did, the court granted itself further and greater powers: to enforce timelines (as well as decide exceptions to those timelines), and judge intra-State organ conflicts. This should tell us that, ultimately, such intervention is not sustainable in the long-term, as piecemeal attempts to correct defective constitutional design will lead to lop-sided results elsewhere.

What is needed, then, is an urgent conversation about the Constitution's centralising drift, and whether the centralising choices made in 1949 still hold today. A starting point for this could be questioning why it is, in 2025, that we need the office of the Governor in the first place.

In the meantime, however, the court's judgment, thus, is not gratuitous overreach; it is best understood as a temporary salve — a band-aid — on a wound that needs deeper, and more longer-term treatment.

THE GIST

► In a lengthy judgment, the top court found that the Governor had no locus standi in refusing to act on the Bills passed by elected representatives of the State Legislature Assembly.

► Laying down the law, the court laid down timelines for Governors and Presidents to act on Bills, and in this specific case, invoked its power to do "complete justice" and held that these Bills were deemed to have been passed.

► The court's decision can be understood as an attempt to correct defective constitutional design, which left several aspects of the Governor's powers to unwritten conventions.



CURRENT SCENARIO
NEWS THAT MATTERS, TO YOU

Scientists find green way to recycle toxic perovskite solar cells

Scientists have developed a way to process perovskite solar cells — which are more efficient but have shorter lifespans — such that the efficiency is almost the same as using fresh materials, even after being recycled up to five times; they were also able to re-obtain about 99% of the cells' layers after multiple rounds

Rohini Subrahmanyam
BENGALURU

Using solar energy may be better for the environment than burning through fossil fuels, but the process still isn't exactly perfect. Making silicon-based solar panels is energetically expensive and we still don't know what to do with the silicon once the panels are done being used.

There is a cheaper way to make solar panels, also called photovoltaics (PVs), using crystal structures called perovskites. However, perovskite crystals contain toxic elements like lead, which needs to be processed carefully once these solar panels reach the end of their lifespan. And so far, researchers have had to use toxic organic solvents like dimethylformamide to recycle such solar panels.

A yummy sandwich

Now, in a paper published in *Nature*, scientists have described another, potentially greener way of dealing with the problem. Using a water-based recycling solution, they have reported a way to degrade and recycle used perovskite. They were also able to get back high-quality perovskite crystals, which can potentially be used again for making new solar cells.

"It's kind of a complex chemistry to make the water solution usable and very stable for perovskite recycling, to fully remove the [the use of] organic solvents," Xun Xiao, a postdoctoral researcher at Linköping University in Sweden and lead author of the paper, said.

Perovskite solar cells are made up of multiple layers. The perovskite layer is sandwiched between materials that can conduct and transport charges, in this case metal electrodes and glass sheets.

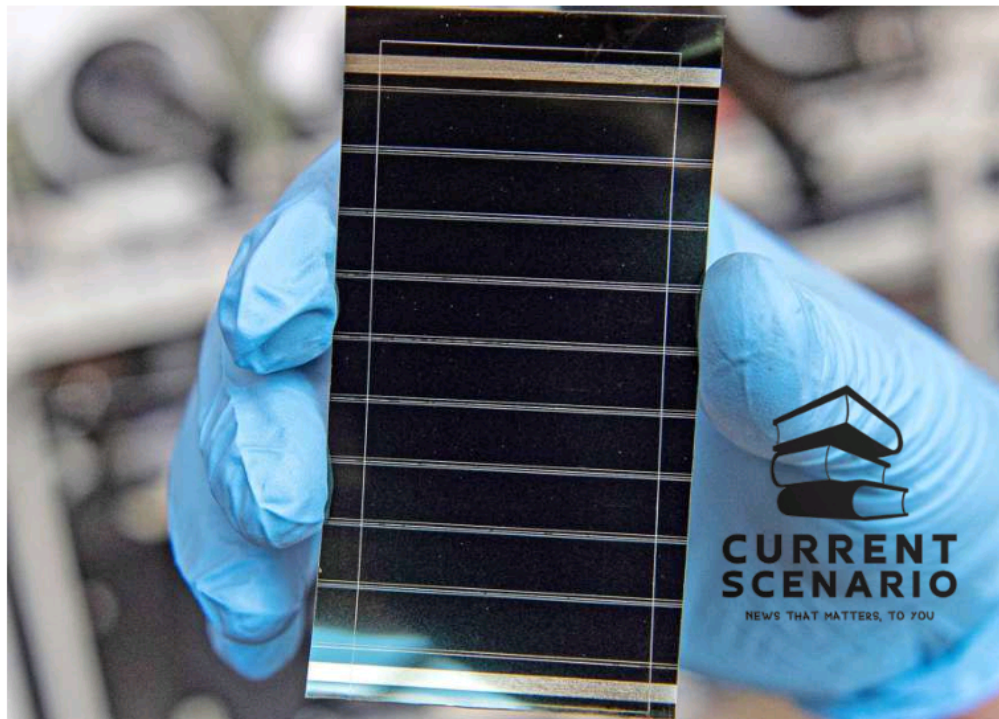
"People have been very excited about [perovskite PVs] for a decade or more now because very quickly they have been able to achieve very high power conversion efficiencies," Rhys Charles, a researcher in the chemical engineering department at Swansea University in the U.K. explained. "So you could deliver an extremely cheap solar energy technology, but there are some things that have been holding the field back."

Stability is one of them: perovskite solar cells have a shorter lifespan.

Improving solar energy

"Early attempts to recycle these devices have all focused on capturing lead. Now, people are taking a little bit more of a holistic view of it," Charles continued. "From a circular economy point of view, recycling is also important because they want to capture the major impact materials [that] they use again."

For a circular economy, the aim is to keep the product — in this case the components of a perovskite solar cell — in use for as long as possible, to minimise



A researcher holds up a PET perovskite solar module. DENNIS SCHROEDER / NREL

waste. This way, if the cells are made again with recycled components, they would have a much lower environmental impact, which means lower emissions and lower cost associated with solar energy generation.

Thus far, the only way to recycle these important materials has been to use toxic organic solvents.

Acids and salts

Dissolving and recycling the lead-containing perovskite layer in water was a major challenge to overcome. For this, the scientists added three key salts to help in the recycling process.

The first salt they added was sodium acetate. The acetate ions bound with the lead ions in the perovskite, making a highly soluble lead acetate that dissolved well in water.

They then added sodium iodide and hypophosphorous acid to help regenerate pure perovskite crystals in their water solution. Sodium iodide contains iodide ions that help repair and restore the degraded perovskite, such that when the solution is cooled, high-quality, pure perovskite crystals re-emerge from the solution.

The acid acts as a long-term stabiliser, ensuring the water solution can be reused and that the quality of the recycled crystals remains high.

"I'm pleased to see this focus on



Early attempts to recycle these devices have all focused on capturing lead.

Now, people are taking a little bit more of a holistic view of it

RHYS CHARLES

Researcher at chemical engineering department, Swansea University

recycling, remanufacturing, and green chemistry," said Matthew Davies, a professor of chemical engineering at Swansea University. "It lays the foundation for perovskite PVs to deliver on their promise as a low-cost, high-efficiency solar technology within a circular economy, avoiding the large-scale waste challenges faced by earlier PV technologies."

The scientists also developed solutions made of ethanol and ethyl acetate to dissolve other components of the perovskite solar cell, after which they were able to recycle each component to reuse along with the perovskite crystals. Then they reassembled the solar cell layer by layer and found that the efficiency was almost the same as using fresh materials, even after being recycled up to five times. They were also able to re-obtain about 99% of the different layers even after multiple rounds of recycling.

THE GIST

Perovskite crystals used in making solar panels contain toxic elements like lead. And so far, researchers have had to use toxic organic solvents like dimethylformamide to recycle such solar panels

Dissolving and recycling the lead-containing perovskite layer in water was a major challenge to overcome. Now, using a water-based recycling solution, scientists have reported a way to degrade and recycle used perovskite. They were also able to get back high-quality perovskite crystals, which can potentially be used again for making new solar cells.

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"These guys seem to have solved the problem; they seem to be able to use this aqueous system to recycle the cells and make them again with high efficiency," Charles said. "If it can be scaled [up] and if it works as well as the paper claims, it could potentially overcome some of the most significant barriers to commercialising perovskites and solve some of the key environmental concerns about the technologies as well."

Charles also stressed the need to underpin scientific and industrial progress, especially when it came to environmental technologies, with life cycle assessments. Life cycle assessment, he explained, is an approach to quantify all the impacts of a technology across its entire life cycle, from the start to when one has the final product. "But you can go further," he said. "Then you can look at the use phase of the technology and the end-of-life phase as well."

"I always enjoy it when I see these things underpinned by life cycle assessment, to make sure there aren't unintended consequences and to make sure the research really is targeting the key environmental problems for the technology," Charles added. "I'd like to see more of that as well, as just standard practice."

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Two cheetahs move to new home in Madhya Pradesh

Chief Minister Mohan Yadav releases Prabhas and Pawak into Gandhi Sagar Wildlife Sanctuary; the six-year-old males are from the batch of cheetahs brought from South Africa in February 2023

Mehul Malpani
BHOPAL

Two cheetahs, Prabhas and Pawak, moved to their new home as Madhya Pradesh Chief Minister Mohan Yadav released them into the Gandhi Sagar Wildlife Sanctuary on Sunday.

The six-year-old males are from the batch of cheetahs brought to the Kuno National Park from South Africa in February 2023.

They will now sprint in their 64-sq. km enclosure at Gandhi Sagar that is spread between Mandsaur and Neemuch districts, with the Chambal river cutting the sanctuary into almost two equal halves.

Calling the Cheetah Project an ambitious initiative by Madhya Pradesh, Mr. Yadav said the goal was to increase the number of cheetahs in India and preserve the species. Cheetahs were first introduced at Kuno in September 2022.

“Encouragingly, the project is achieving success. Gandhi Sagar Sanctuary has become the second site in the State, after Kuno National Park, where chee-



New territory: Chief Minister Mohan Yadav releases a cheetah into the Gandhi Sagar Wildlife Sanctuary in Madhya Pradesh on Sunday. PTI

“Cheetahs are being reintroduced,” he said. Mr. Yadav said efforts were on to bring more cheetahs from South Africa, Kenya, and Botswana.

Four to arrive

Four cheetahs are scheduled to be translocated to Gandhi Sagar from Botswana in May, while four will arrive later in the second phase, the State government had said in a state-

ment on April 18.

Mr. Yadav claimed that following the intercontinental translocation, Kuno had recorded the highest number of cheetah births in the world.

Earlier in the day, a 20-member team, led by Kuno's Chief Conservator of Forest (CCF), Uttam Kumar Sharma, transported the two cheetahs by road to Gandhi Sagar, located over 250 km away from Kuno.

The team will spend seven days at the sanctuary, during which the Gandhi Sagar staff, who have received extensive training at Kuno, will get accustomed to handling the big cats.

With the movement of two of its cats, Kuno now has 24 cheetahs – 14 in the wild and 10 in enclosures.

Over the past year, the State wildlife authorities have increased the prey base of the sanctuary.

ISRO satellites forecast wheat production, assess crop condition

The Hindu Bureau
BENGALURU

The Indian Space Research Organisation (ISRO) in a study using its satellites has estimated that the total wheat production from eight major wheat-growing States will be 122.724 million tonnes as on March 31, 2025.

According to the space agency, the Comprehensive Remote Sensing Observation on Crop Progress (CROP), a semi-automated and scalable framework, developed by the ISRO's National Remote Sensing Centre (NRSC), enables the near real-time monitoring of crop sowing and harvesting during the Rabi season across India.

Systematic assessment

The ISRO said that using this approach, the progress of wheat sown areas and the overall crop condi-



A woman harvesting wheat in a field in Lucknow, Uttar Pradesh, one of the major wheat-growing States in India. SANDEEP SAXENA

tion across the States were systematically assessed, using Optical and Synthetic Aperture Radar (SAR) remote sensing datasets from EOS-04 (RISAT-1A), EOS-06 (Oceansat-3), and Resourcesat-2A, for the Rabi season, 2024-25.

The eight major wheat-growing States are Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, Harya-

na, Bihar, Gujarat and Maharashtra.

It added that the spatial distribution of the wheat crop as of March 31 across the country is 330.8 lakh hectares.

“The wheat sown area derived from satellite data by March 31 stands at 330.8 lakh hectares, which is close to the statistics generated by the Ministry of

Agriculture and Farmers Welfare (324.38 lakh hectares) as on February 4, 2025,” it added.

Parameters

The ISRO said that experimental assessment of wheat production, at the national scale, is done by assimilating satellite-derived parameters such as crop area, sowing date information, and in-season crop condition in a process-based crop growth simulation model at 5×5 km spatial resolution.

“The multi-source data integration is expected to enhance the accuracy of production estimation at a finer spatial level, supporting precise and scalable estimation of wheat production. The total wheat production from eight major wheat-growing states of India as on March 31 is estimated to be 122.724 million tonnes,” the ISRO said.