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DAILY NEWS

ANALYSIS

16 July

Explained

1. Services Exports Cut Trade Deficit
2. Linguistic Diversity
3. Recovery after Space Journey
4. Extraterrestrial Life and Black Hole Merger
5. GM Maize Trials

Decoded

5. Contesting Future of Forest Governance

Playlist Link:

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SERVICES EXPORTS CUTS TRADE DEFICIT

Services exports cut India's trade deficit by 9.4% in Q1

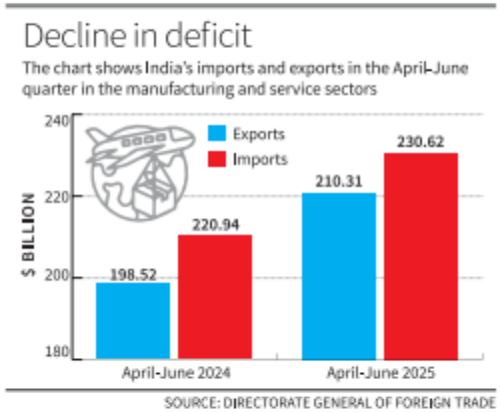
Around 11% growth in services exports helps overall trade deficit contract to $20.3 billion; current export growth on track to beat last year's record figures of $825 billion, says Commerce Secretary

The Hindu Bureau
NEW DELHI

India's overall trade deficit contracted 9.4% to $20.3 billion in the first quarter (Q1) of the current financial year, driven by a nearly 11% growth in services exports during this period, according to official data.

Data released by the Ministry of Commerce and Industry on Tuesday showed that India's overall exports grew to $210.3 billion in the April-June quarter, up from $198.5 billion in the corresponding period of the previous financial year, rising about 6%.

"If exports grow the way they have grown in Quarter One of this financial year, then we are going to beat last year's record exports," Commerce Secretary Sunil Barthwal said at a press briefing.



SOURCE: DIRECTORATE GENERAL OF FOREIGN TRADE

Positive territory

"In fact, if you look at this quarter, both merchandise as well as services are in the positive territory and better than what was expected by the WTO [World Trade Organisation] in terms of world trade," Mr. Barthwal added.

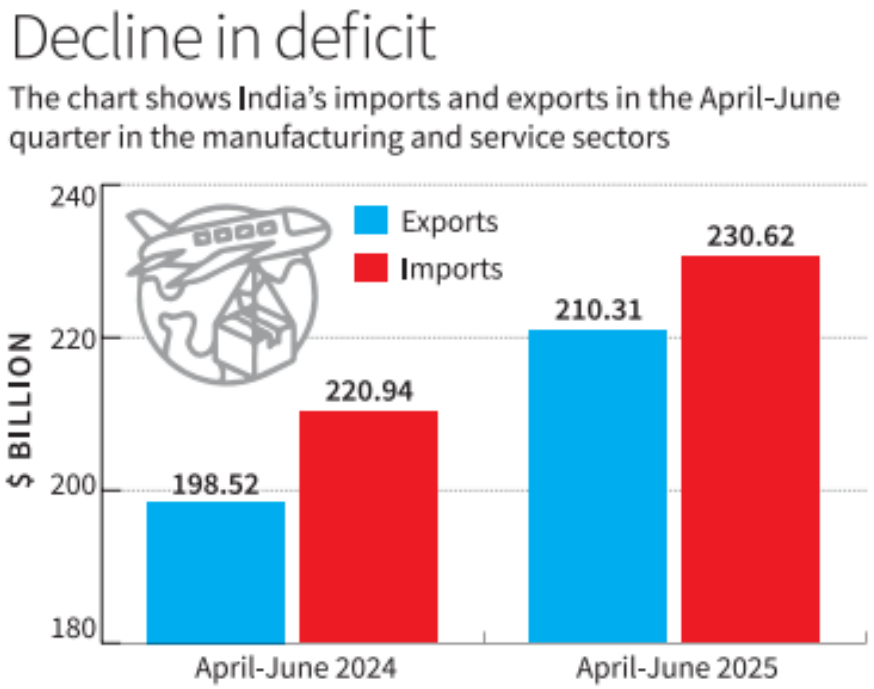
India's total exports stood at an all-time high of $825 billion in the financial year 2024-25.

Within India's total exports, it was services that drove the growth. Services exports rose to $98.1 billion this Q1, up nearly 11% from the $88.5 billion seen in the corresponding quarter of last year.

Merchandise exports in Q1 of this financial year grew just 2% to $112.2 billion. However, Mr. Barthwal emphasised that a large part of this slowdown was due to falling petroleum prices, since India's non-petroleum exports grew 6% during this period.

India's total imports grew 4.4% in Q1 of this financial year to $230.6 billion, with merchandise imports growing 4.2% and services imports growing 4.9% during this period.

CONTINUED ON » PAGE 10



Backdrop: Around 11% growth in services exports helps overall trade deficit contract to $20.3 billion.
Relevance: GS 3/Economy

About the news

- **Overall trade deficit** narrowed by **9.4%**, reaching **$20.3 billion**.
- **Total exports** rose by **6%**, from **$198.5 billion** (Q1 2024-25) to **$210.3 billion** (Q1 2025-26).
- **Total imports** increased by **4.4%**, reaching **$230.6 billion**.

Breakdown

Exports

- **Merchandise exports**:
  - Grew **2%** to **$112.2 billion**.
  - Growth slowed mainly due to **falling petroleum prices**.
  - **Non-petroleum exports** rose by **6%**.
- **Services exports**:
  - Jumped **nearly 11%**, from **$88.5 billion** to **$98.1 billion**.
  - Services were the **main driver** of export growth.

Imports

- **Merchandise imports**:
  - Increased by **4.2%**.
- **Services imports**:
  - Rose by **4.9%**.

High-Growth Sectors

Export Items

- **Electronics**:
  - Grew **47.1%** to **$12.4 billion** (highest among sectors).
- **Marine products**:
  - Up by **over 19%** to **$1.9 billion**.
- **Tobacco and tea**:
  - Increased by **~19%** and **16%**, respectively.

Import Items

- **Sulphur & unroasted iron pyrites**: ↑ **284%**
- **Silver**: ↑ **216%**
- **Chemical materials & products**: ↑ **142%**
- **Raw and waste cotton**: ↑ **73%**

Top Export Destinations (Q1 2025-26)

1 **United States** – $25.5 billion (↑ **22.1%**)

2 **United Arab Emirates (UAE)** – $9.04 billion

3 **Netherlands** – $5.65 billion

4 **China** – $4.4 billion

5 **United Kingdom (UK)** – $3.3 billion

Top Import Sources

1 **China** – $29.7 billion (↑ **16%**)

2 **UAE** – $16.8 billion

3 **Russia** – $16.77 billion

4 **United States** – $12.86 billion

5 **Iraq** – $7.26 billion

What is Balance of Payments (BoP)?

- BoP records **all economic transactions** between a country and the rest of the world during a specific period.
- It tracks **money inflows and outflows** from trade, investments, and financial transfers.

Components of BoP

Current Account

- Covers **day-to-day transactions** related to consumption.
- Divided into:
  - **Trade Balance**: Exports minus imports of **physical goods**.
  - **Invisibles Trade**: Includes **services** (IT, banking, tourism), **remittances**, etc.
- If imports exceed exports (including services), it leads to a **Current Account Deficit (CAD)**.

Capital Account

- Records **investment-related transactions**.
- Includes:
  - **FDI and FPI**
  - **Loans and financial transfers**
- Reflects the country's ability to **attract foreign investment or borrowings**.

Balance of Trade

- It is a statement that records a country's **imports and exports of goods** with the rest of the world.
- It includes **transactions of goods only** and is a **component of the Current Account** in the Balance of Payments (BoP).

Current status of India’s service sector

Contribution to Economy

- Contributes **55% to India’s Gross Value Added (GVA)** at current prices in **FY24**.
- Out of **8.12 million jobs created in FY23**, service sector firms (IT, banking, finance) generated **nearly half**.
- The **gig economy** is growing at **17% CAGR**, projected to create **90 million jobs by FY30**.

Competitive Advantage

- **Ranked 39th** in the **Global Innovation Index (GII) 2024**.
- Has a **large skilled workforce**, especially in IT & BPM, available at **low cost**.
- **Demographic shift** from agriculture to services is ongoing.

PRACTICE QUESTION

Q1. With reference to the Current Account of the Balance of Payments (BoP), which of the following statements is/are correct?

1. It includes trade in both goods and services.
2. A surplus in the Current Account means more imports than exports.
3. Remittances are part of the Current Account.

Select the correct answer using the code below:

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

LINGUISTIC DIVERSITY

The need to protect India's linguistic secularism

According to the 2011 Census, India has 121 languages and 270 mother tongues

LETTER & SPIRIT

C.B.P. Srivastava

India's diversity in religion and language is one of the primary factors which protects the secular character of the nation, ensuring its unity and integrity. But while religion and language are the two most crucial aspects of any culture, these are also the predominant cross-cultural barriers. This is clearly visible in recent communal tensions and the violence in Maharashtra.

Secularism in India is different from what the West practises. When the concept originated in England in the mid-19th century, it was explained that there should be complete separation between the state and religion without criticising any of the prevalent religious beliefs. India too accepted this notion and incorporated the concept in the Constitution in the form of rights to religious freedom. These rights are based on the principles of religious tolerance and equality. Every person has the equal right to freedom of conscience and to profess, practise and propagate his religion. This makes India truly secular as the state does not have its own religion. However, the unique aspect of Indian secularism is not only related to religion but it is also concerned with language. Indian secularism is neither pro-religion or language, nor against. Yet it is not neutral either. It is incorporated in the Constitution as a state policy and it empowers the state to take steps against communalism, be it religious or linguistic.

Official vs national language

This is the reason why we do not and cannot have a national language. In order to protect linguistic diversity, the Eighth Schedule of the Constitution includes 22 languages. As India is a unitary federation, that is, a Union of States, Article 343 enshrines that the official language of the Union shall be Hindi in Devanagari script. The States are free to choose their own official language. This arrangement is due to the fact that in India, States are culturally integrated and no State is permitted to go out of it in the name of distinct language or culture.

Article 29 incorporates that any section of citizens of India including minority groups shall have the right to protect their language, script or culture, and that language cannot be the ground for discrimination. According to the 2011 Census, India has 121 languages and 270 mother tongues. About 96.71% population of the country have one of the 22 scheduled languages as their mother tongue. Finally, the Census says that the 121 languages are presented in two parts, languages included in the Eighth Schedule, and languages not included (99) in the Eighth Schedule.

Respecting diversity

Such diversity needs to be protected; each and every language irrespective of region or State must be shown respect. This is the only way to protect India's linguistic secularism. Many southern and northeastern States have resisted the imposition of Hindi, citing fears of cultural domination. Dravidian movements in Tamil Nadu historically opposed Hindi imposition, favouring Tamil and English. Maharashtra, however, has emerged as the most sensitive State so far as the language debate is concerned. The recent violence against the non-Marathi population is the manifestation of identity politics. Definitely, it is not to protect its cultural identity. Had it been related to the protection of culture, the "protectors" of Marathi language would have considered that 'tolerance' and 'liberality' are the two pillars of India's unity in diversity.

India has always accepted different religions, ideas, lifestyles, food habits etc., mainly because of its liberal and tolerant attitude. In a globalising world, a conservative leaning towards religion or language will lead to a fragmentation of society and tear apart the secular fabric.

Political parties have the onus to ensure the protection of India's diversity which has been well shielded by the Constitution.

C.B.P. Srivastava is President, Centre for Applied Research in Governance, Delhi

Background: According to the 2011 Census, India has 121 languages and 270 mother tongues.
Relevance: GS 1/Regionalism

About the news

- Religion and language can also become sources of conflict, as seen in **recent linguistic tensions and violence in Maharashtra**.
- Resisting the three-language policy proposed in the National Education Policy (NEP), 2020.
    - Government is viewing the three-language policy as a way to ‘impose Hindi’ on the state,

Importance of Diversity in India

- India’s religious and linguistic diversity safeguards its **secular character**, ensuring **unity and integrity**.
- **Religion and language**, though core elements of culture, are often **cross-cultural barriers** — recent violence in Maharashtra illustrates this.

Indian vs Western Secularism

- Western secularism advocates **complete separation** of religion and state without criticism of any belief.
- Indian secularism:
    - It is based on **tolerance and equality**.
    - Grants every citizen **freedom of conscience and religion**.

- Does **not endorse or oppose** any religion or language.
- It is a **positive state policy**, allowing the state to act against both **religious and linguistic communalism**.

National vs Official Language

- India does **not have a national language** — to preserve linguistic diversity.
- **Article 343**: Hindi in Devanagari script is the **official language of the Union**.
- **States can choose** their own official languages.
- This is in line with India's nature as a **Union of States**, which are culturally integrated but **not sovereign**.

Constitutional Safeguards

- **Eighth Schedule** of the Constitution lists **22 scheduled languages**.
- **Article 29**: Citizens, including minorities, have the **right to conserve their language, script, or culture**.
- Language cannot be used as a basis for **discrimination**.

Census Data on Linguistic Diversity

- **2011 Census**:
  - Reports **121 languages** and **270 mother tongues**.

- **96.71%** of Indians speak one of the 22 scheduled languages as their **mother tongue**.
- Out of 121, **99 languages are not part** of the Eighth Schedule.

Resistance to Linguistic Imposition

- **Southern and northeastern States** have **resisted Hindi imposition** fearing **cultural dominance**.
- **Dravidian movements** in Tamil Nadu emphasized Tamil and English over Hindi.
- **Maharashtra** has seen identity politics manifest in **violence against non-Marathi speakers**.
- Such acts contradict India's ideals of **tolerance and liberalism**.

Broader Cultural Tolerance and Role of Political Leadership

- India's unity is built on **historical acceptance of diverse religions, lifestyles, and food habits**.
- **Tolerance and liberalism** are foundational to India's **"unity in diversity"**.
- In a **globalised world**, rigid attachment to **religion or language** can **fragment society** and threaten **secularism**.

- **Political parties** have the responsibility to **protect and promote India's cultural and linguistic pluralism**.
- The **Indian Constitution** provides the **legal and policy framework** for safeguarding this diversity.
- This framework must be **actively implemented**, not just symbolically upheld.

Special Officer/Commissioner for Linguistic Minorities:

- The **Special Officer for Linguistic Minorities** safeguards the rights and welfare of linguistic minority communities in India.
- Focuses on **protecting linguistic diversity**, ensuring **equal access** to education, jobs, and services.
- Upholds India's ideals of **pluralism and inclusivity**.
- Constitutional Provision – Article 350B (Part XVII)
    - **Not in original Constitution**; recommended by **States Reorganisation Commission (1953-55)**.
    - Inserted through **7th Constitutional Amendment Act, 1956**.
    - **Appointed by the President**.
    - The Constitution does **not specify** qualifications, tenure, salary, or removal procedures.

Commissioner for Linguistic Minorities (CLM)

- Office established in **1957**.
- Headquartered in **New Delhi** with **regional offices** in:
  - **Belgaum (Karnataka)**
  - **Chennai (Tamil Nadu)**
  - **Kolkata (West Bengal)**
- Functions under the **Ministry of Minority Affairs**.
- Submits **annual reports** to the **President** via the **Union Minister for Minority Affairs**.

PRACTICE QUESTION

Q2. Article 350B of the Indian Constitution is related to:

(a) The right to education in one's mother tongue

(b) The appointment of Special Officer for Linguistic Minorities

(c) Prohibition of discrimination on the grounds of language

(d) Official language of the Union

RECOVERY AFTER SPACE JOURNEY

Recovery after space journey

Shubhanshu Shukla, the first Indian on the ISS, is back to Earth, but it will be a few days before he can be his normal self. The body is impacted by microgravity, and needs to readjust to conditions on Earth

ANONNA DUTT

HOW SHUKLA RETURNED FROM THE ISS

SpaceX's Crew Dragon spacecraft transported Shubhanshu Shukla and others to the International Space Station and also brought them back. It remained docked to the ISS for the period the astronauts were on board.

1 Crew Dragon autonomously undocks from the ISS, and uses its thrusters to move away from the space laboratory.

2 Before re-entering the Earth's atmosphere, Dragon detaches its trunk to reduce mass and save fuel.

3 Dragon's two drag parachutes are deployed at an altitude of 18,000 feet, followed by four main parachutes at 6,500 feet (right).

4 The four main parachutes conduct Dragon's speed drastically as it glides down at an angle for a safe splashdown.

Dragon undocked from the ISS at 6:05 pm IST on Monday to begin its 20-hour journey to Earth. The spacecraft orbited Earth seven times as it lowered itself to the re-entry level. It made a splashdown in the Pacific Ocean at 3 pm IST on Tuesday.

The Axiom-4 crew were assisted out of the Dragon spacecraft onto the recovery vehicle, after their return from the ISS on Tuesday.

Space environment

The human body is under stress in space due to microgravity conditions and exposure to certain radiations that are absent or benign on Earth. The impact of these stressors depends on the length of the astronaut's stay in space.

During one of the interactions from the ISS, Shukla had said he did not feel his usual self in the first few days.

"It's the first time for me, so I don't know what to expect [upon return]... I did have some symptoms coming up, so I am hoping that I will not have it going down," he said.

Missions astronaut Peggy Whitson, who was on her fifth trip to space, said, "Some people get space motion sickness coming up[side] and some people get it going down[side]. I am a downhill person so here I don't really adjust... [as] well to gravity or adjust to microgravity."

Getting back to normal

The first thing that the four astronauts, back to Earth's air after almost three weeks, did after walking out of the Grace spacecraft was to undergo a health check. They were then taken by helicopter to the NASA Space Centre in Houston, where they will rest for the next few days.

The astronauts' health parameters will be monitored closely — and based on the readings, personalised rehabilitation plans will be worked out for each. The recovery plan will focus on regaining mobility, balance, flexibility, aerobic conditioning, strength, endurance, and the body's ability to sense its position and movement.

Detailed post-flight medical checks usually continue for a week or longer after return. Impact on the functioning of the heart, bones, eyes, and immune systems are watched. Apart from things like sleep disorders and headaches.

Astronauts experience space sickness in their initial days as the brain is confused by the gravity and acceleration information it receives from the inner ear — information that is essential for maintaining balance on Earth. Living in microgravity teaches the brain to not listen to the inner ear, which becomes a challenge when the astronauts return to Earth, as they face difficulty in standing up and walking.

Also, bodily fluids tend to shift because of microgravity conditions, and usually move to the upper part of the body in space — as a result, astronauts experience light-headedness or dizziness after they return.

All these symptoms are likely to be less severe in Shukla and his crew-mates who spent just 18 days on the ISS. Astronauts on previous missions have been able to resume normal lives a week or two after their return.

Need for reconditioning

Astronauts need reconditioning after coming back to Earth to deal with their symptoms such as problems with balance, losing their gaze, and difficulty standing up.

The rehabilitation process includes training the astronauts to start listening to their inner ear again, helping with motion control, and taking care of conditions they face while standing. It also deals with their perception of movements of their own bodies, strength, and endurance.

According to NASA, around 9.2% of astronauts experience post-flight injuries. They may suffer muscle injuries, tendon-related injuries, and fractures.

Simpler, safer: Why spacecraft prefer splashdowns over landing on ground

ALIND CHAUHAN

THE SPACECRAFT carrying Indian astronaut Shubhanshu Shukla and his three colleagues on the Axiom-4 mission splashed down in the Pacific Ocean on Tuesday, after a 20-hour journey from the International Space Station.

Landing in the ocean is the preferred way to bring back astronauts from space, though some spacecraft also make a landing on a runway like an aircraft. But the latter has special requirements, needs more sophisticated systems, and is usually costlier.

For its Gaganyaan programme, Indian Space Research Organisation (ISRO) has designed a crew module that will land on sea.

Why water is preferred

Splashdown is generally a simpler and safer option. When a spacecraft begins to re-enter the Earth's atmosphere, at an altitude of 120-120 km, it is usually travelling at speeds up to 27,359 km per hour. There isn't enough time for it to decelerate to speeds that are suitable for a vertical landing on the ground. Additional braking systems, and structures like landing legs would be required.

It is safer to land a spacecraft in water even when it is travelling at 25-30 km per hour — the speed of the Axiom-4 spacecraft at the time of splashdown. The low viscosity and high density of water provides much greater cushion. While it does not ensure a completely smooth landing, it absorbs enough shock from the impact to avoid damage to the spacecraft's structure, payload, or the crew inside.

The other reason is the scalability of vast open spaces. On the ground, the landing location has to be precisely defined, in the sense, there is no danger of hitting something else even if the spacecraft is dragged a bit off-course by air or water currents.

The capsules are designed to float on water. They are conical in shape, and either have legs or buffers (depending on how they land) to ensure it remains upright, like the hull of a ship, and keeps them from falling on the surface.

How landing is executed

When a spacecraft re-enters the Earth's atmosphere, it experiences deceleration due to friction. But additional measures are required to slow it to safe speeds.

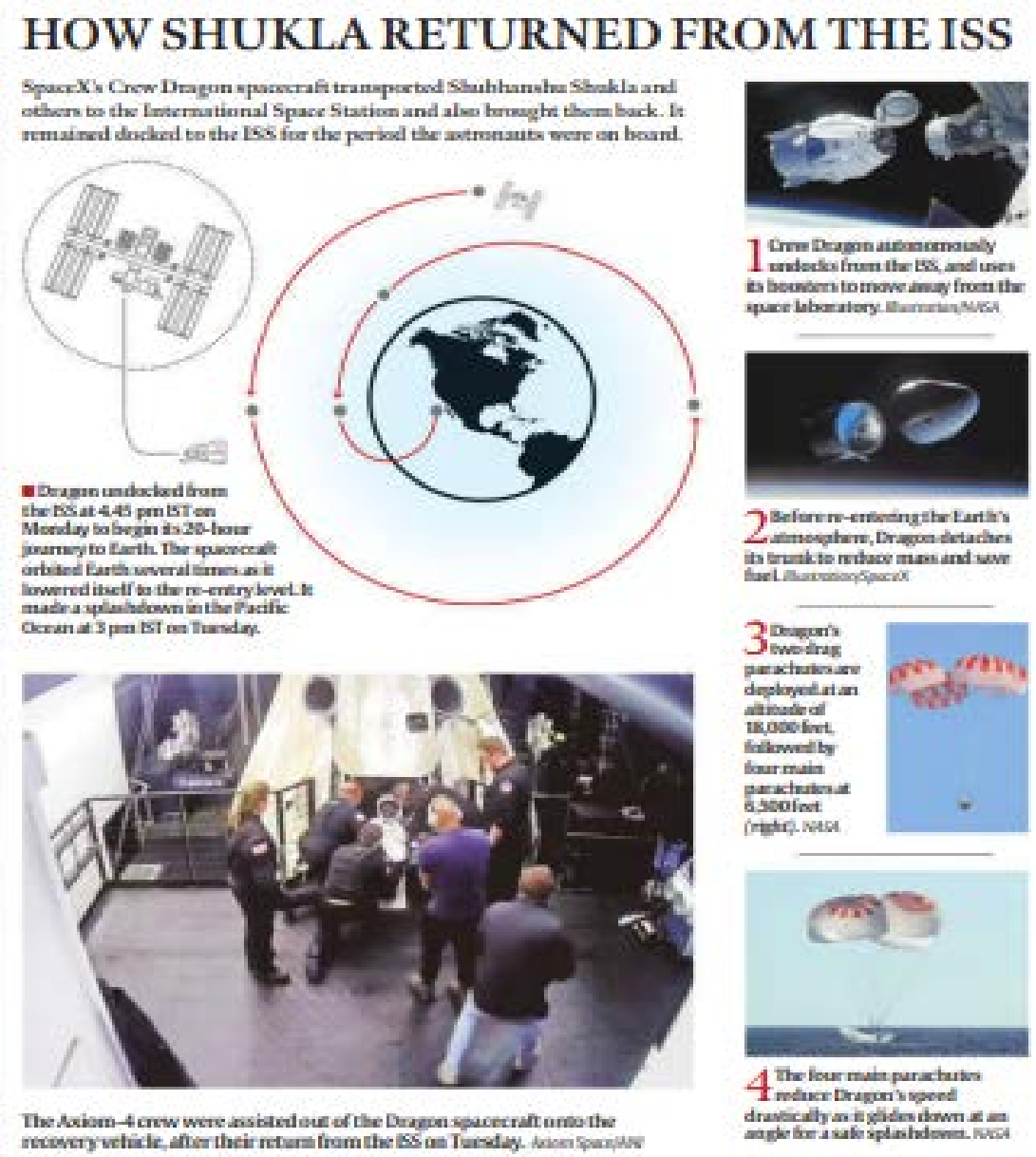
One such method is the use of parachutes. Spacecraft usually deploy two drag (or drogue) parachutes first, which stabilise the vehicle following re-entry, and reduce speed. The Dragon spacecraft deploys these parachutes at around 18,000 feet.

At about 6,500 feet, the drogue parachutes are detached, and the four main parachutes are released, which continue to slow the spacecraft further.

The spacecraft does not 'crash' vertically to Earth, but glides down at an angle. From the point of re-entry to touchdown, it traverses a distance of 1,000-2,000 km. During this time, its speed comes down to about 25-30 km per hour, which is safe for a splashdown in the ocean.

Backdrop: Shubhanshu Shukla's return from the ISS and recovery process.
Relevance: GS 3/ Achievements of Indians in Space.

About the news



HOW SHUKLA RETURNED FROM THE ISS

SpaceX's Crew Dragon spacecraft transported Shubhanshu Shukla and others to the International Space Station and also brought them back. It remained docked to the ISS for the period the astronauts were on board.

Dragon undocked from the ISS at 4.45 pm IST on Monday to begin its 28-hour journey to Earth. The spacecraft orbited Earth several times as it lowered itself to the re-entry level. It made a splashdown in the Pacific Ocean at 3 pm IST on Tuesday.

The Axiom-4 crew were assisted out of the Dragon spacecraft onto the recovery vehicle, after their return from the ISS on Tuesday. Axiom Space/AFP

1 Crew Dragon autonomously undocks from the ISS, and uses its boosters to move away from the space laboratory. Illustration/NASA

2 Before re-entering the Earth's atmosphere, Dragon detaches its trunk to reduce mass and save fuel. Illustration/SpaceX

3 Dragon's two drag parachutes are deployed at an altitude of 18,000 feet, followed by four main parachutes at 6,500 feet (right). NASA

4 The four main parachutes reduce Dragon's speed drastically as it glides down at an angle for a safe splashdown. NASA

- Shubhanshu Shukla, first Indian aboard the ISS, returned after **20 days in space** (18 days on ISS).
- Returned aboard **SpaceX's Crew Dragon**; splashdown occurred in the **Pacific Ocean**.
- Initial assistance was required while exiting the capsule due to **microgravity effects**.

Recovery After Return from Space

Health Check and Monitoring

- After landing, astronauts undergo immediate **medical check-ups**.
- They are then flown to **NASA's Space Centre, Houston** for rest and observation.
- **Health parameters** are monitored closely to design **individual reconditioning plans**.

Reconditioning Focus Areas

- **Mobility, balance, flexibility, strength, endurance**, aerobic capacity.
- Helps retrain the **inner ear-brain coordination** affected by microgravity.
- Addresses **motion control**, posture, and body perception issues.
- Detailed medical checks for:
  - Heart, bones, eyes, immune system.
  - Sleep disorders, headaches, dizziness.

Common Post-Flight Symptoms

- **Space motion sickness** due to brain confusion from altered gravity signals.
- **Light-headedness** from fluid redistribution to upper body.
- **Balance and gaze fixation problems**.
- NASA estimates **92% of astronauts face post-flight injuries**, including:
  - Muscle sprains
  - Tendon injuries
  - Fractures

Recovery Duration

- Symptoms are usually **less severe** for short missions like Shukla's (18 days).
- Astronauts typically **resume normal life within 1–2 weeks** after return.

Why Spacecraft Prefer Ocean Splashdowns

Advantages of Splashdown

- **Simpler, safer**, and more cost-effective than runway landings.
- Water's **low viscosity and high density** provides natural cushioning.
- Reduces risk of damage to:
  - **Spacecraft structure**
  - **Payload**
  - **Crew**

Technical Reasons

- Re-entry starts at ~110–120 km altitude at **27,359 km/hr** speed.
- Too little time to decelerate safely for **ground landing**.
- The ocean eliminates the need for complex landing gear and braking systems.
- Vast sea areas reduce risk of collision or misalignment.

Descent Procedure

- **Two drogue parachutes** deployed at ~18,000 ft to stabilize and slow.
- **Four main parachutes** open at ~6,500 ft to reduce speed further.
- Spacecraft **glides at an angle**, not vertically, covering 5,000–7,000 km.
- Final speed at splashdown: ~**25–30 km/hr**.

India’s Gaganyaan Mission

- ISRO’s crew module will also **splashdown at sea**.
- Water landings avoid risks of terrain impact and require **fewer onboard systems**.

PRACTICE QUESTION

Q3. Consider the following physiological changes experienced by astronauts during and after space missions:

1. Redistribution of bodily fluids to the upper body
2. Strengthening of bones due to reduced physical activity
3. Space motion sickness due to inner ear confusion
4. Enhanced immune system response in microgravity

Which of the above statements is/are ***correct?***

(a) 1 and 3 only

(b) 2 and 4 only

(c) 1, 2 and 3 only

(d) 1, 3 and 4 only

EXTRATERRESTRIAL LIFE AND BLACK HOLE MERGER

Searching for extraterrestrial life means asking the right questions first

Has the quest for alien life failed? Researchers at the Institute for Particle Physics and Astrophysics at ETH Zurich recently offered a more nuanced answer to this question — one reminiscent of an important attitude to have when doing research at the cutting edge, recognising that every observation carries with it a degree of uncertainty

Shreejaya Karantha

Since the 1990s, scientists have discovered hordes of planets outside the solar system together with tantalising hints of life – or more accurately, hints of hints of life. So far, however, there exists no proof that there's life anywhere in the universe except on the earth.

Does that mean our quest for alien life has failed?

A team led by researchers at the Institute for Particle Physics and Astrophysics at ETH Zurich, in Switzerland, recently offered a more nuanced answer to this question – one reminiscent of an important attitude to have when doing research at the cutting edge.

Writing in a recent paper in *The Astronomical Journal*, the team contended that a "no signs of life detected" conclusion can also offer valuable information to guide and refine future exoplanet studies. More broadly, the team emphasised the importance of recognising that every observation carries with it a degree of uncertainty and that it is important to ask the right questions.

A view of the Tarantula Nebula. The number of planets observed so far may suffice to establish an upper limit on the number of potentially habitable worlds. NASA HUBBLE SPACE TELESCOPE

Nothing is something

With the ultimate goal of assessing the habitability of exoplanets and finding potential signs of life, researchers have used a statistical method called Bayesian analysis. "It's a way of updating our understanding or beliefs based on new evidence," Daniel Angerhausen, a scientist in the Department of Physics at ETH Zurich and lead author of the new paper, said.

This is like making a first guess based on what one already believes, then fine-tuning it. For example, you could start by assuming life is very common in the universe. When you observe a hundred exoplanets without finding signs of life, you adjust your guess to accommodate factors that might explain how life can be common yet not found on these worlds. As you continue this process over time, your answer to "How common is life?" acquires a more informed shape.

In the new paper, the team explored how different starting assumptions affect final estimates of how common life might be.

The researchers simulated observations of 100 exoplanets, ranging from 1 to 100, to determine the minimum number of exoplanets that must be examined to conclude how many worlds are possibly habitable.

Their work suggested that if scientists examine between 40 and 80 exoplanets and find no evidence of life, they can confidently conclude that fewer than 10% to 20% of similar planets are likely to support life. That is, life would be relatively rare.

If the prevalence of life is indeed low, around 10-20%, it would be understandable for no signs of life to be found in a sample of 40-80 planets. But if life were more common, scientists should expect to observe some indications of it in that same sample. At least, this is the team's argument.

Need for better questions

This key finding suggests the number of planets observed so far may suffice to establish an upper limit on the number of potentially habitable worlds. However, the authors were careful to note that "ideal" results are likely impossible because every observation has some uncertainty.

This uncertainty can manifest in many ways (e.g., a false negative occurs when a significant sign of life is overlooked) and is related to the challenges in the questions researchers ask when they set out to find life signs.

Angerhausen explained that the question "Does this planet have life?" itself carries a significant risk of false positives. For example, a planet may have a small biosphere that doesn't alter its atmosphere in a way that can be detected from a distance. In contrast, stipulating whether "this planet has a temperature within a specific range and concentrations of certain molecules above a defined threshold" could provide more informative data.

The new paper asserts that the absence of evidence is not evidence of absence – as long as we allow the right questions to lead us

When selecting which planets to investigate, the paper emphasises the importance of asking clear and specific questions. For example, instead of posing a vague question, one might ask, "Of all the rocky planets in the habitable zone, how many show signs of water vapour, oxygen, and methane?" This would help create clear selection criteria for exoplanets as well as help experts avoid misinterpreting data from an alien world.

When observations are filled with uncertainty, the conclusion "no life detected" can be meaningless. But if the questions are thoughtfully designed, even null results can serve as powerful tools in the search for extraterrestrial life.

In sum, the effectiveness of a search depends on asking the right questions and not (solely) on the number of exoplanets observed. If scientists lack clarity on what specific indicators of life they should focus on, even the best telescopes could yield misleading results.

Significance

Angerhausen also stressed that in addition to the technological sophistication in upcoming projects like the Large Interferometer for Exoplanets (LIFE) and the Habitable Worlds Observatory (HWO) – which aim to observe dozens of earth-like planets – "our study shows that there is still a lot of work to be done on the theoretical side" and on the foundations of their knowledge. That is, how do we know a certain signal is truly a sign of life? Or what counts as dispositive evidence of a habitable planet?

The LIFE and HWO projects plan to study exoplanets for signs of water, oxygen, and other molecules that may indicate the presence of life. Angerhausen himself expressed optimism about the potential to discover habitable worlds. He said that for the first time in human history, humans will soon have the technology to systematically search for life in our cosmic neighbourhood.

In the final analysis, the new paper asserts that the absence of evidence is not evidence of absence – as long as we allow the right questions to lead us.

(Shreejaya Karantha is a freelance science writer. shreejayakaranth@gmail.com)

THE GIST

Researchers use Bayesian analysis to assess habitability. When you observe a hundred exoplanets without finding life, you accommodate factors that might explain how life can be common yet not found. As you continue this process, your answer to 'How common is life?' acquires a more informed shape

Researchers simulated observations of 100 exoplanets to determine the minimum that must be examined. They suggested that if the prevalence of life is low, around 10-20%, it would be understandable for no signs of life to be found in a sample of 40-80. But if life were more common, there should be indications of it in that same sample

When observations are filled with uncertainty, the conclusion 'no life detected' can be meaningless. But if the questions are thoughtfully designed, even null results can serve as powerful tools. The effectiveness of a search depends on the right questions and not on the number of exoplanets observed

Backdrop: Search for Extraterrestrial Life
Relevance: GS 3/Science & Technology

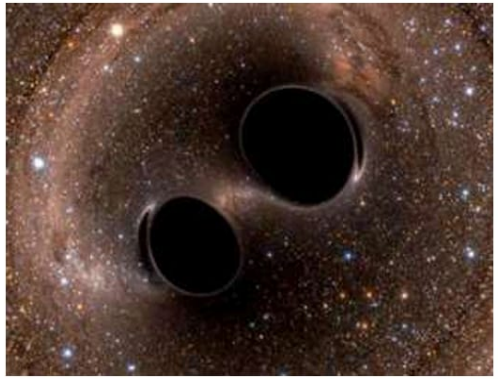
Dance of darkness

Q: What is a black hole merger?
A: A black hole merger happens when two black holes — extremely dense objects with gravity so strong that not even light can escape — get close and start orbiting each other. Over time, they lose energy by sending out invisible ripples in spacetime called gravitational waves. As they spiral closer together, their orbit shrinks until they finally crash and combine into a single, bigger black hole.

This moment releases a huge burst of gravitational waves, which can be detected on the earth by special observatories like LIGO in the US, Virgo in Italy, and KAGRA in Japan. Think of the phenomenon like two figure skaters spinning toward each other and then grabbing hands to spin faster as one, except in extreme physical conditions.

Catching these events allows scientists to learn new things about black holes and the universe.

In fact, on July 10, an international collaboration of scientists reported discovering an especially massive black hole merger, named GW231123. LIGO, Virgo, and KAGRA had detected gravitational waves from the merger on November 23, 2023. In this event, two black holes, about 137x and 103x the mass of the sun, crashed together, forming an even bigger black hole. This was unusual because black holes in this mass range are thought to be rare.



The impending collision of two black holes is seen in this still image from a computer simulation released by the LIGO collaboration in 2016. REUTERS

The discovery suggests large black holes might form when smaller ones merge, not just from dying stars. GW231123 also showed both original black holes spinning really fast, which challenges existing theories of their existence.

For feedback and suggestions
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science@thehindu.co.in
with the subject 'Daily page'

About the news

Since the 1990s, scientists have found thousands of exoplanets (planets outside our solar system), but no definitive signs of life. While this may seem like a failure, researchers at ETH Zurich argue otherwise in a recent paper.

Using **Bayesian analysis**, they emphasize that **"no life detected"** is still valuable data. Their simulations show that if scientists examine 40–80 Earth-like exoplanets and find no signs of life, they can estimate that fewer than 10–20% of such planets likely support life, suggesting life may be rare, not absent.

Bayesian analysis: It's a way of updating our understanding or beliefs based on new evidence. It is statistical inference method that updates the probability of a hypothesis as more evidence becomes available.

Large Interferometer for Exoplanets (LIFE) Project

- It is a proposed **space-based infrared interferometer** mission led by the European Space Agency (ESA).
- **Main Objectives**
    - **Search for signs of life (biosignatures)** such as water vapour, carbon dioxide, methane, and ozone.

- **Assess planetary habitability** by examining atmospheric composition, temperature, and surface conditions.
- Focus on **terrestrial (rocky) exoplanets**, especially those in the **habitable zone**.

- **How it Works**
  - Uses **infrared interferometry**, a technique where light from multiple telescopes is combined to simulate a much larger telescope.
  - This enables LIFE to detect faint infrared signals from planets that are typically obscured by their host star's brightness.

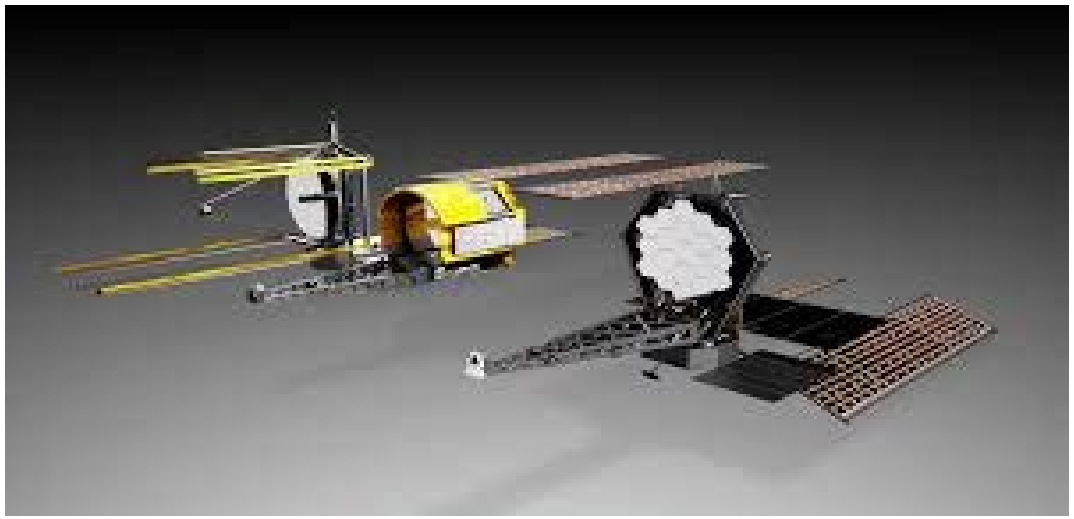
- **Why Infrared?**
  - Many important biosignatures are emitted in the **infrared spectrum**.
  - Infrared helps detect **thermal emissions** from planets and probe their atmospheric composition, even when they are not directly visible.
- **Current Status**
  - LIFE is still in the **concept and development phase**, with **feasibility studies and simulations** ongoing.

Habitable Worlds Observatory (HWO)

It is a **NASA flagship space telescope mission** that aims to be the **first mission capable of directly detecting Earth-like planets** and assessing them for signs of life.

- **Primary Objectives**
  - **Search for biosignatures** such as oxygen, water vapor, and methane on Earth-sized exoplanets.
  - **Directly image and characterize** planets in the habitable zones of Sun-like stars.
  - **Study the atmospheres and surfaces** of exoplanets to assess their potential for supporting life.
  - Advance broader astrophysics goals (e.g. star formation, galaxy evolution).

- **Key Features and Technologies**
  - Will operate primarily in **optical and ultraviolet wavelengths**, with some **near-infrared capability**.
  - **Will include:**
    - A **large segmented mirror** (likely 6+ meters in diameter).
    - An advanced **coronagraph** to block starlight and directly image exoplanets.
    - Possibly **starshades** in later developments for improved imaging.



- **Timeline and Development**
  - Currently in the **planning and pre-design phase** (as of 2024–2025).
  - Anticipated **launch in the 2040s**.

Fermi's Paradox: It explores the contradiction between the high probability of extraterrestrial civilizations and the lack of evidence for them.

Black hole merger

A black hole merger occurs when **two black holes** (incredibly dense regions with gravity so intense that even light cannot escape) approach each other and **begin to orbit.** As they circle closer, they gradually lose energy by emitting **gravitational waves**—invisible ripples in spacetime. This energy loss causes their orbits to shrink until they eventually collide and merge into one larger black hole.

- This process releases a massive burst of **gravitational waves**, which can be detected on Earth by observatories like **LIGO (USA)**, **Virgo (Italy)**, and **KAGRA (Japan)**.
- **Recent notable Discovery**
    - On **July 10**, scientists announced the detection of a **rare and massive merger** named **GW231123**, recorded on **November 23, 2023**.
    - Two black holes, **137 and 103 times** the mass of the sun, merged, forming one of the **most massive black holes ever observed** through such a method.

- **Significance of Discovery**
  - Detecting black hole mergers helps scientists understand the **nature of black holes**, gravity, and the evolution of the universe.
  - The discovery suggests large black holes might form **when smaller ones merge,** not just from dying stars.
  - GW231123 also showed both original black holes spinning really fast, which challenges existing theories of their existence.

PRACTICE QUESTION

Q4. Recently, Scientists observed the merger of giant blackholes billions of light-years away from Earth. What is the significance of this observation? [UPSC CSE 2019]

(a) 'Higgs boson particles' were detected.

(b) 'Gravitational waves' were detected.

(c) Possibility of inter-galactic space travel through 'wormhole' was confirmed.

(d) It enabled the scientists to understand 'singularity'.

FIELD TRIALS OF GM MAIZE

Backdrop: Confined field trials of GM maize to begin at Punjab University
Relevance: GS 3/Agriculture

Confined field trials of GM maize to begin at Punjab university

Vikas Vasudeva
CHANDIGARH

Trials will study weed-control efficacy in herbicide-tolerant maize hybrids.

The field trials of two kinds of genetically modified (GM) maize are expected to begin this kharif (summer) season at the Punjab Agricultural University, weeks after the Genetic Engineering Appraisal Committee, the country's top regulator for the sector, gave the nod for the trials after receiving consent from the Punjab government.

In its meeting in June, the committee recommended a proposal by Bayer Crop Science Ltd. for the conduct of confined field trials of herbicide-tolerant transgenic maize and insect-resistant transgenic maize at the Ludhiana-based university. The trials will study weed-control efficacy in herbicide-tolerant maize hybrids with the application of glyphosate-K salt, and the efficacy of insect-protected maize hybrids against targeted lepidopteran pests.

"The trials are for research purposes only, and we are not going to recommend that it (GM maize) should be grown commercially or not. It's for the Central government to take a call," Punjab Agricultural University Vice-Chancellor Satbir Singh Gosal told *The Hindu*.

The Coalition for a GM-Free India, a platform advocating safe and sustainable agriculture, has urged the Punjab government to withdraw its no-objection certificate for the trials.

In a letter to the Punjab Agriculture Minister, Kavitha Kuruganti, co-convener of the coalition, said that the State government had an issued order prohibiting the usage of glyphosate, a deadly herbicide, with a large body of scientific literature pointing to its negative impacts on human health and the environment.

"How can the university experiment with herbicide-tolerant maize that has been modified to withstand the application of glyphosate, which is in itself against the legally-approved label claim for glyphosate in India's pesticides regulatory regime?" Ms. Kuruganti said.

About the news

The field trials of two kinds of genetically modified (GM) maize are expected to begin in the ongoing kharif (summer) season at the Punjab Agricultural University, days after the Genetic Engineering Appraisal Committee gave the nod for the trials.

The field trials will include an **herbicide-tolerant transgenic maize** and an **insect-resistant transgenic maize**.

Focus of Trials

The trials will study

- **Weed-control efficacy** in herbicide-tolerant maize hybrids with the application of **Glyphosate-K salt,** and the
- Efficacy of insect-protected maize hybrids against targeted **lepidopteran pests.**
- The trials are for research purposes only.

Current Status of GM Crops in India

GM Crops Approved for Commercial Cultivation

- **Bt Cotton** is the **only GM crop approved** for commercial cultivation in India.
- Approved in **2002** to combat the **bollworm pest**.

- Over **90% of cotton** grown in India is genetically modified.
- Developed by companies like **Monsanto-Mahyco** and **Rasi Seeds**.

GM Crops Approved for Confined Field Trials

These are conducted under **controlled conditions** for research purposes only.

- **GM Maize**
  - **Traits**: Herbicide tolerance and insect resistance.
  - **Developer**: **Bayer Crop Science**.
  - **Trial site**: Punjab Agricultural University, Ludhiana.
- **GM Mustard (DMH-11)**
  - Developed by **Delhi University** using **barnase-barstar** technology for hybrid vigour.
  - **Approved for environmental release** in 2022 by GEAC.
  - **Commercial release is pending** due to legal and political opposition.
- **GM Rice**
  - Traits include **insect resistance**, **drought tolerance**, and **nutrient-use efficiency**.
  - Trials are ongoing by **ICAR** and public research institutions.

- **GM Pulses (e.g., Chickpea, Pigeon Pea)**
  - Developed by **ICRISAT** and **IARI** for **insect resistance** and **yield enhancement**.
  - Currently in **preliminary or greenhouse trial stages**.

GM Crops on Hold or Under Moratorium

- **Bt Brinjal**
  - Developed for **fruit and shoot borer resistance**.
  - **Commercial release was blocked** in **2010** due to public opposition and environmental concerns.
- **GM Mustard (DMH-11)**
  - Despite GEAC approval, **commercial cultivation is stalled** due to **ongoing Supreme Court litigation**, farmer protests, and activist concerns.

Maize Production in India

Maize production in India was estimated to be around 35.67 million metric tons in 2023-2024. Among maize-growing countries, India ranks **4th in area and 7th in production.**

Major States: Karnataka is a leading maize-producing state, often referred to as the "Maize Bowl of India", followed by Madhya Pradesh, Maharashtra, Bihar, and Uttar Pradesh.

PRACTICE QUESTION

Q5. Among the following, which of the GM crops is/are allowed for Commercial Cultivation in India?

1. Bt Cotton
2. GM Mustard (DMH-11)
3. Bt Brinjal

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) All of the above

CONTESTING THE FUTURE OF FOREST GOVERNANCE

Contesting the future of forest governance

Gautam Aredath

Policy analyst at the Ashoka Trust for Research in Ecology and the Environment. Views are personal

Sharachchandra Lele

Distinguished fellow at the Ashoka Trust for Research in Ecology and the Environment Views are personal

Recently, the Chhattisgarh forest department issued a letter designating itself as the nodal agency for implementing community forest resource rights (CFRR) under the Forest Rights Act (FRA), 2006. CFRR, a transformative provision of the FRA, recognises the right of gram sabhas to manage their customary forests. It seeks to rectify the injustices of colonial forest consolidation which dispossessed local communities and supplanted their traditional management institutions with centralised state control.

Not only was this usurpation of the nodal role contrary to the FRA, but the letter violated gram sabhas' statutory authority to implement locally developed management plans in their community forest resource (CFR) areas by insisting on a model plan from the Ministry of Tribal Affairs (MoTA). This is not required by law. It also prohibited other departments or NGOs from supporting gram sabhas in CFRR management planning.

The letter was withdrawn after a spirited grassroots mobilisation by gram sabhas, local elected representatives, and Adivasi rights groups. Still, the persistent attack on gram sabhas' autonomy in managing their forests demands a closer look at how forests should be managed under the FRA.

Forest management

Historically, forests under government control (excluding wildlife sanctuaries or national parks) have been managed through forest departments' working plans. These plans are rooted in the colonial misnomer of "scientific forestry", i.e., planning and harvesting to maximise timber production. Ecologists, starting with Madhav Gadgil, questioned this approach, especially since early working plans even included clearfelling natural forests and replacing them with single-species plantations. The decline in India's forests, evidenced by the spread of invasive species and the increase in degraded forest areas, has fuelled doubts about the appropriateness of working plans. But for forest departments, they remain an article of faith to structure their operations and mobilise financial resources.

In forest-rich central India, the continuing emphasis of working plans on timber extraction, which restricts communities' access and alters the composition of forests, was met with resistance even before Independence. While working plans have begun to consider restoration and wildlife conservation objectives, they remain products of bureaucratic writ, largely detached from local livelihoods and closed to independent scientific scrutiny.

The FRA's radically different vision recognises the integral role of local communities in the "very survival and sustainability" of forests. CFR management plans are to be developed by gram sabhas to prioritise local needs and address current problems. These plans shall be "integrated" with working plans by the gram sabha. In other words, working plans will no longer apply in CFR areas, because communities will manage forests with a different objective and at much finer scales.

Over 10,000 gram sabhas have received CFRR titles in India, but perhaps less than 1,000 have prepared their CFR management plans. Even their implementation is constrained by the refusal of forest departments to recognise their legitimacy and support gram sabhas. Instead, they have pursued a strategy of attrition, delaying or rejecting CFRR claims, attempting to revoke CFRR titles, and denying funds to CFRR-holding gram sabhas. Their aim to retain colonial power is concealed under arguments that communities lack the ability to manage forests scientifically.

MoTA's vacillating responses have not helped. In 2015, it issued guidelines that gram sabhas can use simple formats for their plans, but later came under pressure to alter its stand. A 2024 joint letter with the Environment Ministry required CFR management plans to conform to the National Working Plan Code (NWPC) and even suggested the involvement of foresters in their preparation. This violates the FRA's letter and spirit.

Community forest resource rights demands shedding historical baggage and embracing new possibilities

Addressing the bogeyman

Even according to the NWPC, a working plan should outline "the purpose with which a forest should be managed so as to best meet the interests and wishes of the owner, and indicate the means by which the purpose may be accomplished." Yet, the lengthy processes and data-intensive formats that the NWPC prescribes carry the hangover of maximising timber yield. In contrast, forest management by gram sabhas will likely pursue multiple livelihood needs, for which the NWPC provides little guidance.

Significant portions of working plans are devoted to cataloguing local conditions, but they abstract their complexities to focus on the forest crop (not ecosystem). A gram sabha's plan need not do the same because these insights are part of their lived experience. The variable impacts of climate change also challenge the linear trajectories of working plans, which need more adaptive responses that gram sabhas offer. CFRR demands shedding historical baggage and embracing new possibilities.

The path forward is evident. The Dharti Aaba Janjatiya Gram Utkarsh Abhiyan, launched by the Central government last year, introduced an indicative framework for CFR management plans. While the framework can be improved, it can be achieved through flexible and iterative practice by gram sabhas. MoTA must reject any attempt to derail CFR management through the red herring of NWPC compliance. And forest departments must provide funds and protection when required and discard a timber-oriented science in favour of a different science of a people-friendly forest management.

Backdrop: Issues with the Community Forest Resource Rights in India

Relevance: GS 3/Environment

About the news

The **Chhattisgarh Forest Department** recently issued a letter **declaring itself as the nodal agency** for implementing **Community Forest Resource Rights (CFRR)** under the **Forest Rights Act (FRA), 2006**.

- The department's move was **contrary to the FRA**, which vests implementation authority in **Gram Sabhas**, not the forest department.
- The letter also **imposed a centralised model plan** from the **Ministry of Tribal Affairs (MoTA)** for forest management, **undermining locally developed plans**, which are legally valid under the FRA.
- The letter was withdrawn after a grassroots mobilisation by gram sabhas, local elected representatives, and Adivasi rights groups

What is Forest Governance?

- Forest governance refers to the **policies, institutions, laws, and practices** that determine how forests are **used, protected, and managed**.
- It includes decision-making by **governments, communities, and other stakeholders** (NGOs, corporations, etc.).
- The key principle is balancing **ecological sustainability**, **community rights**, and **economic development**.

Current Issues with Forest Governance in India

- **Legacy of Colonial Forest Management**
  - **Forest departments** still rely heavily on **working plans** rooted in **colonial-era "scientific forestry"**, which prioritised **timber extraction** over ecological sustainability and community needs.
  - These plans continue to **marginalise traditional forest management practices** and reinforce top-down control.
- **Exclusion of Local Communities**
  - Despite the **Forest Rights Act (FRA), 2006**, which empowers **Gram Sabhas** to manage community forest resources, forest governance remains **bureaucratically driven**.
  - **Local communities are rarely involved** in decision-making processes related to forest use, conservation, and planning.
- **Resistance to Decentralisation**
  - The **state forest machinery resists transferring power** to local institutions like **Panchayats and Gram Sabhas**.
  - **Top-down governance structures** remain dominant, undermining **democratic forest governance** and **decentralised planning**.

- **Focus on Timber and Revenue**
  - Even in biodiversity-rich regions like central India, working plans still **prioritise timber harvesting**, leading to:
    - Alteration of natural forest composition.
    - Reduced access for local communities.
    - Ecological degradation including the spread of invasive species and forest fragmentation.
- **Lack of Transparency and Accountability**
  - Forest working plans are **not subject to independent ecological review**.
  - Decisions are often made **without consultation with scientists, ecologists, or local communities**, weakening ecological outcomes.
- **Conflict with Climate and Conservation Goals**
  - Forest policies increasingly tie in with **carbon markets and afforestation programs**, but often **exclude community voices**.
  - Efforts like **compensatory afforestation** may divert community land and **intensify dispossession**, under the guise of climate action.

Suggestive measures

- **Empower Gram Sabhas**
  - Encourage **flexible, iterative, and locally contextualised planning** by Gram Sabhas rather than enforcing rigid, uniform models.
  - Promote the **Dharti Aaba Janjatiya Gram Utkarsh Abhiyan** as a national model, which offers an **indicative framework** for CFR governance.
- **Reject misuse of NWPC Standards**
  - The **Ministry of Tribal Affairs (MoTA)** must **oppose any attempt** to undermine CFR rights in the name of compliance with the **National Working Plan Code (NWPC)**.
  - **Community-driven planning** must be given primacy under the FRA provisions.
- **Transform the Forest Department's Role**
  - Forest departments should **transition from controllers to facilitators**:
    - Provide **technical support** and **funds** to Gram Sabhas.
    - Promote **livelihoods**, **biodiversity**, and **climate resilience**

- **Capacity Building at the Grassroots**
  - Invest in **training and empowering tribal communities** to:
    - Prepare and implement CFR plans.
    - Understand their **legal rights** under the FRA.
- **Ensure Democratic and Transparent Forest Policy**
  - Open forest governance to **independent ecological and social scrutiny**.
  - Institutionalise **public participation**, especially from **Adivasi and forest-dwelling communities**, in drafting forest laws and policies.

Conclusion

The path forward lies in **realising the transformative intent of the FRA**- decentralising forest governance and restoring **tribal self-rule** over forests. This requires dismantling colonial legacies, resisting bureaucratic overreach, and embracing **community-driven, ecologically sound forest management** rooted in **local knowledge and democratic values**.

PRACTICE QUESTION

Q. "Democratic decentralisation in forest governance remains more rhetorical than real." In light of recent developments, how can India transition to a more people-centric and ecologically just forest governance model? (15 marks, 250 words)