

PRAGNYA BHARATHI: Detailed News Analysis (DNA)

Topic : GM Crops

Relevance : GS Paper 3 Science and Technology

Source : The Hindu

Context :

There is progress on GM food crops, says official

Remark comes amid apprehensions over the Environment Ministry's approval for commercial cultivation of GM mustard in 2022. Supreme Court is set to hear pleas on the same next month

Jacob Koshy
NEW DELHI

A head of a fresh series of hearings in the Supreme Court next month over genetically modified (GM) food crops, the Department of Biotechnology (DBT) said there was "progress" on this front.

"The matter is *sub judice* but GM mustard stories are being taken up again," DBT Secretary Rajesh Gokhale said at a biotechnology event on Friday. The DBT, which has for years funded research and development into transgenic and GM food crops, comes under the Ministry of Science and Technology.

At present, Bt cotton is the only genetically modified crop allowed to be cultivated. Though the Environment Ministry gave its conditional go-ahead for commercial cultivation of GM mustard in 2022, it has not taken off as it was challenged in the Supreme Court.

Science Minister Jitendra Singh who was also at the event, said, "There is so much dynamism in bio-



Awaiting hearing: Petitioners have challenged the Environment Ministry's approval for cultivation of GM mustard. BY MOORTHY

technology development that we cannot look at tomorrow through the prism of today."

Hearing from April 15

On March 6, a three-judge Bench of the Supreme Court said it will begin hearing from April 15 petitions challenging the Environment Ministry's approval for cultivation of GM mustard. The court has told all parties to file their written submissions within a week.

A two-judge Bench of the top court, on July 23, 2024, gave a split verdict

on the validity of the Centre's 2022 decision granting conditional approval for the environmental release of GM mustard crop. However, it also directed the Centre to formulate a "national policy" on GM crops. Mr. Gokhale told *The Hindu* that the DBT had provided "technical inputs" to the Union Environment Ministry, which was formulating the policy and was the "nodal coordinator".

Safety concerns GM mustard, developed using public funds, was the

first transgenic food crop to be approved for farmer fields by the Genetic Engineering Appraisal Committee, a scientific body. However, it wasn't approved for cultivation following safety objections by activist groups.

However, the use of biotechnology to improve food crops – as in the case of GM mustard – is a key focus of the government's BioE3 policy.

This involves manufacturing new kinds of enzymes, pharmaceuticals and agricultural products while applying techniques, including genetic engineering.

A report released by the DBT at the event on Friday on the current state of India's "bio-economy" says that bio-agriculture accounts for 8.4% – the smallest share – of the \$165.7 billion bio-economy in India.

"Valued at \$13.5 billion, this segment enhances agricultural productivity and resilience through genetically modified crops like Bt Cotton and precision agriculture technologies," the report notes.

Meanwhile, **Science Minister Jitendra Singh** emphasized the dynamic nature of biotechnology, hinting that progress should not be hindered by outdated perceptions. The **DBT has been actively involved** in providing technical support to the **Union Environment Ministry**, which is working on a **national policy on GM crops**.

A report released by the DBT revealed that **bio-agriculture** constitutes only **8.1%** of India's **\$165.7 billion bio-economy**, indicating the sector's relatively small contribution despite its potential. The government's **BioE3 policy** envisions biotechnology as a means to enhance agricultural productivity through **genetically modified crops and precision agriculture technologies**.

What are GM Crops?

Genetically Modified (GM) crops are plants whose DNA has been altered using genetic engineering techniques to achieve desired traits, such as:

GM CROPS IN INDIA A PRIMER

What is a GM crop?

A crop which has a gene artificially inserted into it from another species, even unrelated, to give it some desired properties. GM crops are mostly either pest-resistant or herbicide-tolerant

Are there other GM crops in India?

No, the government has not approved commercial cultivation of other GM crops, though efforts have been made for brinjal and mustard

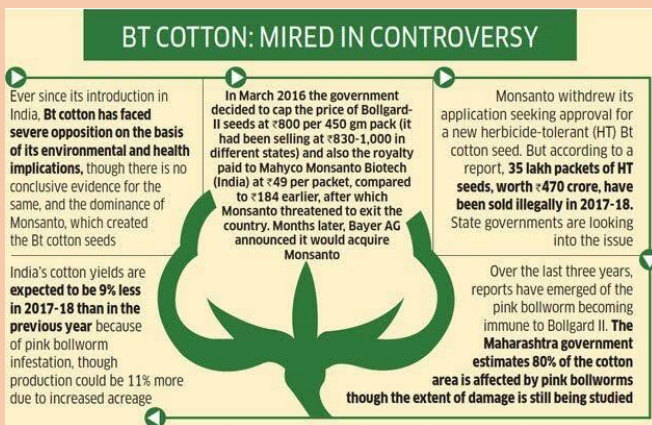
When did India get its first GM crop?

The first GM crop variety approved for commercialisation was Bt cotton. Bollgard-I, which provided immunity against the pink bollworm and developed by Monsanto, was given the go ahead in 2002. Monsanto released Bollgard-II in 2006. India has become the world's largest producer of cotton partly due to Bt cotton, which accounts for over 90% of the total cotton acreage in the country

*The Supreme Court of India is scheduled to hear petitions challenging the **Environment Ministry's approval of GM mustard** from April 15. The debate on GM crops in India has been ongoing, with **Bt cotton** being the only GM crop currently allowed for cultivation*

The **Department of Biotechnology (DBT)**, under the **Ministry of Science and Technology**, has expressed optimism regarding the progress in GM food crops, despite the issue being under judicial scrutiny. **DBT Secretary Rajesh Gokhale** remarked that discussions around GM mustard are resurfacing. The **Genetic Engineering Appraisal Committee (GEAC)** initially approved GM mustard for environmental release in 2022. However, safety concerns and resistance from activist groups halted its commercial adoption.

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- Increased resistance to pests and diseases
- Enhanced tolerance to herbicides
- Improved nutritional content
- Faster growth and higher yields

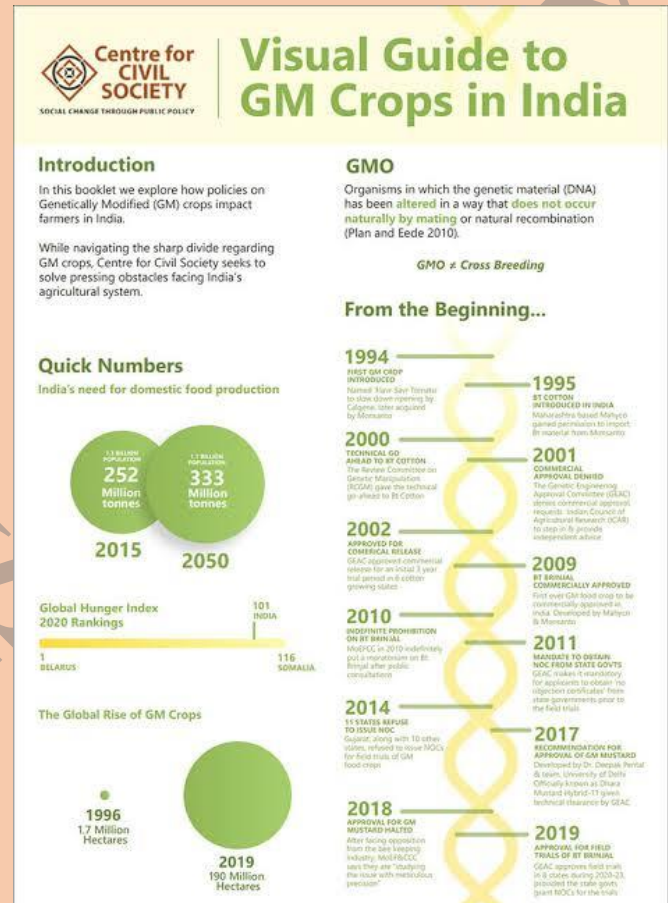
The genetic modification process involves introducing specific genes from other organisms into the plant's genome, resulting in improved characteristics that traditional breeding methods cannot achieve.

Relevance of GM Crops in India

India is primarily an **agriculture-driven economy**, with a significant portion of the population dependent on farming. As agricultural challenges intensify due to **climate change, pest attacks, and stagnant yields**, GM crops present potential solutions. Their relevance lies in:

1. **Enhanced Crop Yield:** GM crops can significantly increase production and meet the growing demand for food.
2. **Pest and Disease Resistance:** Reduces dependency on chemical pesticides, lowering costs and environmental pollution.
3. **Herbicide Tolerance:** Helps in effective weed management.

4. **Nutritional Improvement:** Biofortified crops can address nutritional deficiencies.
5. **Adaptation to Climate Change:** Tolerance to drought, salinity, and fluctuating temperatures.



Significance of GM Mustard

GM Mustard, developed by the **Centre for Genetic Manipulation of Crop Plants (CGMCP)** at the **University of Delhi**, is India's first transgenic food crop to receive conditional approval. It is engineered to:

- Increase **self-pollination efficiency**, improving yields by up to **25-30%**.
- Be resistant to herbicide **glufosinate ammonium**.

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Benefits:

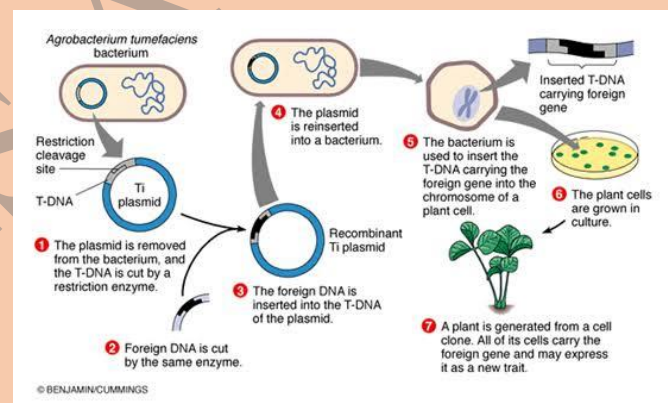
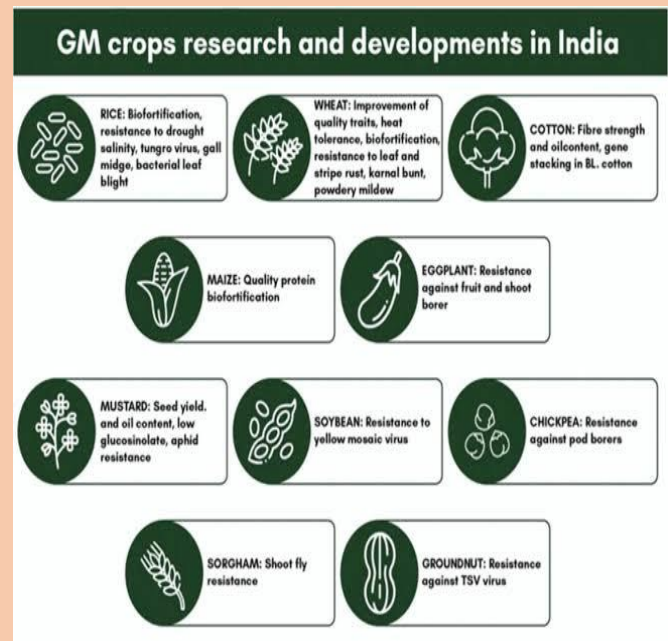
1. **Reduced Import Dependency:** India imports a substantial amount of edible oils, and higher mustard yields could reduce this burden.
2. **Economic Impact:** Boosting domestic production would benefit farmers and reduce the import bill.

Existing GM Crops in India

The only GM crop that has been **commercially cultivated in India** is **Bt Cotton**, approved in **2002**. It contains a gene from the bacterium *Bacillus thuringiensis* (*Bt*) that makes the crop resistant to bollworm pests.

Authorization and Regulatory Framework:

1. **Genetic Engineering Appraisal Committee (GEAC):** The apex body for approval and regulation of GM crops.
2. **Ministry of Environment, Forest and Climate Change (MoEFCC):** Grants environmental clearance.
3. **Department of Biotechnology (DBT):** Supports research and technical development.
4. **State Governments:** Responsible for granting permission for field trials.

**Future Prospects of GM Crops in India**

The debate on GM crops remains contentious in India, with opinions sharply divided between **scientific advancement and safety concerns**. Future prospects involve:

1. **Policy Formulation:** A clear and comprehensive **national policy** on GM crops is necessary to address concerns and lay down a robust regulatory framework.
2. **Research and Development:** Continued investment in **public sector research** can

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minimize corporate monopoly and ensure transparency.

3. **Public Awareness and Participation:** Educating farmers and stakeholders on the **safety and benefits** of GM crops is crucial.
4. **International Collaboration:** Learning from countries that have successfully adopted GM crops can offer insights into best practices.

Prelims Practice Question

With reference to **Genetically Modified (GM) crops** in India, consider the following statements:

1. Bt cotton is the only GM crop approved for commercial cultivation in India.
2. GM mustard was developed using public funds and was the first transgenic food crop approved for environmental release in India.
3. The **Genetic Engineering Appraisal Committee (GEAC)** is responsible for granting commercial cultivation approval for GM crops in India.
4. The Supreme Court of India has permanently banned the cultivation of all GM food crops in India.

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 1, 2, and 3 only
- (c) 2 and 4 only
- (d) 1, 3, and 4 only

Answer:

Correct Answer: (b) 1, 2, and 3 only

Explanation:

1. **Statement 1 is correct:** Bt cotton is currently the **only GM crop approved for commercial cultivation** in India.
2. **Statement 2 is correct:** GM mustard was developed using **public funds** and was the first **transgenic food crop** to receive approval for **environmental release** from the **Genetic Engineering Appraisal Committee (GEAC)**.
3. **Statement 3 is correct:** The GEAC is the **apex body under the Ministry of Environment, Forest and Climate Change (MoEFCC)** responsible for granting approval for **environmental release and commercial cultivation** of GM crops.
4. **Statement 4 is incorrect:** The Supreme Court has not **permanently banned all GM food crops**. The matter is **sub judice**, and the decision on GM mustard is still pending.

Therefore, the correct answer is **(b) 1, 2, and 3 only**.

Mains Model Question

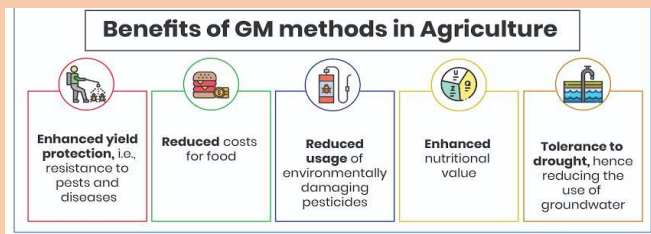
Discuss the significance of Genetically Modified (GM) crops in the context of India's agricultural sector. Critically analyze the challenges and prospects associated with the commercial cultivation of GM mustard.

Genetically Modified (GM) crops hold immense potential in addressing the challenges faced by Indian agriculture, such as low productivity, pest infestations, and vulnerability to climate change. By introducing desirable traits like pest resistance, herbicide tolerance, and enhanced nutritional content, GM crops can revolutionize agricultural

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practices and contribute to food security. India, being a predominantly agrarian economy, stands to benefit significantly from higher yields and reduced dependence on chemical pesticides. However, the adoption of GM crops in India remains contentious and limited.

The commercial cultivation of GM mustard, approved by the Genetic Engineering Appraisal Committee (GEAC) in 2022, has sparked intense debate. GM mustard, developed using public funds, promises a substantial increase in yield, which can help reduce India's dependency on imported edible oils. As India is one of the largest



importers of edible oils, domestic production through high-yield GM mustard can have a positive economic impact. Despite its potential, the crop's environmental release has been stalled due to safety concerns raised by activists and environmentalists. Critics argue that GM mustard's resistance to herbicides could lead to overuse, adversely affecting soil health and biodiversity. Additionally, the possibility of cross-pollination with non-GM varieties raises concerns about genetic contamination.

The Supreme Court of India is currently hearing petitions challenging the government's approval, reflecting the legal complexities associated with GM crops. The central issue lies in balancing scientific advancements with ecological and public health considerations. The absence of a clear national policy on GM crops has further complicated their acceptance and implementation.

To move forward, it is crucial to establish stringent safety protocols and promote transparent research. Public awareness campaigns can also help build trust and address misconceptions. Ultimately, while GM crops have the potential to transform Indian agriculture, their adoption must be rooted in robust scientific evaluation and an inclusive policy framework.

Topic : Currency Appreciation and Foreign Exchange Reserves

Relevance : GS Paper 3 Economy

Source : Indian Express

Context :

The appreciation of a currency, such as the recent rise of the Indian Rupee against the U.S. Dollar, is a multifaceted economic phenomenon influenced by both domestic and global factors. One of the most critical aspects that shape currency movements is the status and management of **foreign exchange reserves**.

Economic Significance of Foreign Exchange Reserves

Foreign exchange reserves are crucial assets held by the central bank (RBI in India) to **back liabilities, manage currency stability, and facilitate international trade and payments**. They consist primarily of foreign currencies (like USD, EUR, GBP), gold, and **Special Drawing Rights (SDRs)** issued by the **International Monetary Fund (IMF)**.

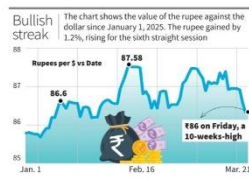
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Rupee climbs to a 10-week high

The domestic currency's gain was supported by stronger-than-expected trade data and a rise in foreign exchange reserves following the RBI's USD/INR swap intervention; rupee emerges 'top performer' among Asian currencies so far this month

Lalatu Mishra
Ashokamithran T.
MUMBAI

The rupee on Friday climbed to a 10-week high of 86 against the U.S. dollar due to a surge in foreign inflows into domestic equities and debt markets, analysts said. The domestic currency was trading at 85.89 a dollar on January 9, 2025. The rupee surged nearly 0.1% on Friday, making it the eighth consecutive day of appreciation against the dollar. It closed at 85.98 against the U.S. dollar. On a weekly basis, the



rupee surged 1.1% with the appreciation on Friday. "The rupee's gain was supported by stronger-than-expected trade data

and a rise in foreign exchange reserves following the Reserve Bank of India's (RBI) USD/INR swap intervention," said Dilip Par-

mar, Research Analyst, HDFC Securities.

"The central bank's efforts have paid off, with the rupee emerging as the top performer among Asian currencies so far this month," he said, adding that in the short term, the rupee is expected to receive support at 85.70 and resistance at 86.45.

Jatendra Trivedi, Vice President, Research Analyst - Commodity and Currency, LKP Securities said, "Rupee strengthened as FII inflows surged with strong buying figures in recent days." "The Fed's decision to hold rates steady and its

forecast for lower interest rates ahead pulled the dollar down, providing significant support to the rupee but major capital market strengthening gives rupee the strong push higher," he added. Equity markets also reported gains on Friday, with frontline indices rising by 0.7%.

The NSE Nifty extended its bullish run for a fifth consecutive session, closing higher by 159 points, or 0.69%, at 23,350. NSE cash market volumes surged dramatically by 53% from the previous day, reaching their highest level since November 25, 2024.

From an economic perspective, reserves serve several vital functions:

- 1. Currency Stabilization:** They enable the central bank to intervene in the foreign exchange market to **control volatility** and maintain confidence in the domestic currency.
- 2. Debt Servicing and Crisis Management:** High reserves provide a buffer against **external shocks**, like sudden capital outflows or a balance of payments crisis.
- 3. Enhancing Investor Confidence:** Countries with **ample reserves** are seen as **financially stable**, attracting **Foreign Direct Investment (FDI)** and **Foreign Institutional Investor (FII)** inflows.
- 4. Maintaining Export Competitiveness:** Although a strong currency might reduce export competitiveness, reserves help moderate excessive appreciation to **preserve trade balance**.

The Dynamics of Currency Appreciation: How Reserves Play a Role

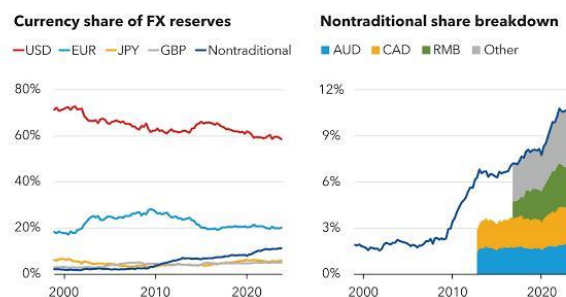
Currency appreciation occurs when the **demand for the domestic currency exceeds its supply**. In the Indian context, the recent appreciation of the rupee can be attributed to:

- 1. Foreign Inflows into Equity and Debt Markets:** As foreign investors purchase Indian assets, they exchange dollars for rupees, increasing **demand for the rupee**. This surge in FII and FDI inflows raises foreign exchange reserves.
- 2. RBI's Forex Market Intervention:** To stabilize the rupee and manage excessive volatility, the RBI conducts **USD/INR swaps** or direct interventions by selling dollars and buying rupees. This intervention:
 - **Absorbs dollar liquidity**, reducing its supply, thereby appreciating the rupee.
 - **Builds reserves** when dollars are purchased, reflecting stronger **external sector fundamentals**.
- 3. Global Economic Environment:** A dovish stance by the **U.S. Federal Reserve**, holding interest rates steady or projecting lower future rates, weakens the dollar. This indirectly strengthens emerging market currencies like the rupee, especially when paired with rising capital inflows.

Interplay Between Forex Reserves and Currency Strength

Nontraditional currencies rise

Falling share of "big four" currencies mirrored by increasing holdings of nontraditional reserve currencies.



Sources: IMF COFER; Arslanalp, Eichengreen, and Simpson-Bell (2022, updated). Note: The "big four" currencies are the US dollar, euro, Japanese yen, and British pound. Nontraditional are all other currencies. AUD = Australian dollar, CAD = Canadian dollar, RMB = Chinese renminbi. China became a COFER reporter between 2015 and 2018.

IMF

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A rise in foreign exchange reserves does not automatically lead to currency appreciation. Instead, it depends on **how reserves are accumulated** and managed. For instance:

- **Active Accumulation through RBI Purchases:** When the RBI buys dollars to increase reserves, it can **depreciate the rupee** by increasing dollar demand.
- **Passive Accumulation through Inflows:** When reserves increase due to **natural capital inflows** (like FDI or FII), it reflects **strengthening economic fundamentals** and boosts currency appreciation.

The current scenario in India represents the latter, where stronger-than-expected **trade data**, improved economic sentiment, and robust FII inflows have naturally raised reserves, leading to rupee appreciation.

Economic Implications of Currency Appreciation

While currency appreciation might signal **economic strength**, it also brings challenges:

1. **Impact on Exports:** A stronger rupee makes Indian goods costlier in the global market, potentially hurting exports.
2. **Inflation Control:** A stronger currency makes **imported goods cheaper**, which helps **tame inflation**, especially for commodities like crude oil.
3. **Capital Flow Volatility:** High foreign inflows leading to rapid appreciation can quickly reverse if global sentiments change, leading to a **sudden depreciation**.

Therefore, the RBI often **sterilizes inflows** by conducting open market operations or

increasing the **Cash Reserve Ratio (CRR)** to **neutralize the inflationary impact** of excess liquidity.

The recent appreciation of the Indian Rupee is rooted in a complex interplay of **foreign inflows, strategic central bank interventions, and favorable global economic conditions**. While rising foreign



exchange reserves bolster investor confidence and economic stability, they must be judiciously managed to avoid excessive currency strength that could harm exports. The RBI's strategic interventions have balanced these dynamics effectively, positioning the rupee as a **top-performing Asian currency** in recent weeks. To sustain this positive trend, it is crucial to maintain prudent economic policies, manage reserves efficiently, and remain vigilant against potential external shocks.

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Prelims Practice Question

With reference to the relationship between **foreign exchange reserves and currency appreciation**, consider the following statements:

1. An increase in foreign exchange reserves always leads to the appreciation of the domestic currency.
2. The Reserve Bank of India (RBI) can influence the value of the rupee by conducting USD/INR swap interventions.
3. A stronger rupee generally makes Indian exports more competitive in the global market.
4. High foreign exchange reserves improve investor confidence and reduce the risk of a balance of payments crisis.

Which of the statements given above are correct?

- (a) 1 and 3 only
 (b) 2 and 4 only
 (c) 1, 2, and 3 only
 (d) 2, 3, and 4 only

Answer:

Correct Answer: (b) 2 and 4 only

Explanation:

1. **Statement 1 is incorrect:** An increase in foreign exchange reserves does not always lead to currency appreciation. It depends on how the reserves are accumulated and managed. If the RBI buys dollars to build reserves, it may actually depreciate the rupee.
2. **Statement 2 is correct:** The RBI can influence the value of the rupee by conducting **USD/INR swap interventions**,

where it buys or sells dollars to stabilize or adjust the currency's value.

3. **Statement 3 is incorrect:** A stronger rupee makes Indian exports **less competitive** in the global market as they become more expensive for foreign buyers.
4. **Statement 4 is correct:** High foreign exchange reserves enhance **investor confidence** and act as a **buffer against external shocks**, reducing the risk of a **balance of payments crisis**.

Therefore, the correct answer is **(b) 2 and 4 only**.

Mains Model Question

Discuss the impact of rising foreign exchange reserves on the Indian economy. How does it influence currency appreciation and what are the associated economic challenges?

Rising foreign exchange reserves have a significant impact on the Indian economy, reflecting economic stability and boosting investor confidence. These reserves, primarily composed of foreign currencies, gold, and Special Drawing Rights (SDRs), act as a buffer against external shocks and balance of payments crises. An increase in reserves generally indicates strong foreign capital inflows through Foreign Direct Investment (FDI), Foreign Institutional Investment (FII), and positive trade balances.



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This accumulation bolsters the Reserve Bank of India's ability to intervene in the forex market, stabilizing the rupee during periods of volatility.

One of the most direct effects of rising reserves is currency appreciation. As foreign capital inflows increase, the demand for the domestic currency rises, strengthening the rupee. Additionally, when the RBI conducts USD/INR swaps or sells dollars to absorb rupee liquidity, the currency appreciates further. A stronger rupee reduces the cost of imports, particularly essential commodities like crude oil, thereby helping to control inflation. It also enhances the purchasing power of the rupee in the global market, reducing the burden of external debt repayment.

However, currency appreciation poses economic challenges, particularly for the export sector. A stronger rupee makes Indian goods more expensive in international markets, adversely impacting export competitiveness and reducing earnings from sectors like textiles, IT services, and agriculture. This can widen the trade deficit if imports rise disproportionately due to cheaper foreign goods. Moreover, rapid and unchecked appreciation may encourage speculative inflows, increasing the risk of sudden capital flight if global conditions change.

Managing rising reserves thus requires a balanced approach. While they strengthen macroeconomic fundamentals, the RBI must carefully intervene to prevent excessive currency appreciation. Implementing prudent reserve management strategies and maintaining export competitiveness are crucial to sustaining long-term economic growth and stability.

Topic : Influenza Vaccination and Flu Trends in India

Relevance : GS Paper 3
Science and Technology

Source : The Hindu

Context :

Influenza, commonly known as the flu, remains a major public health challenge worldwide, including in India. Despite advancements in vaccine development and recommendations from global health organizations like the World Health Organization (WHO), influenza vaccine uptake in India remains significantly low. Recently, reports of a surge in flu cases in the Delhi-NCR region have sparked renewed discussions on vaccination efficacy and public health strategies.

Current Scenario and Data Trends

The recent surge in influenza cases in the Delhi-NCR region, with some sources indicating a spike of over 54%, lacks precise clinical validation as it is based on local surveys rather than laboratory-

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confirmed data. According to the National Centre for Disease Control's (NCDC) Integrated Disease Surveillance Programme (IDSP), India recorded:

- **516 influenza cases and six deaths in January 2025.**
- **20,414 cases and 347 deaths for the entire year of 2024.**



'FLU VIRUS CHANGING PATTERNS'
Vaccines previously considered essential only in high-risk populations

- Influenza & pneumonia vaccines recommended for all by Health associations
- Decision taken during 'Indian consensus guideline on adult immunisation'
- Pneumococcal vaccine essential for most populations
- Influenza vaccine essential in immunocompromised people & pregnant women
- These were previously considered essential only in high-risk populations
- Experts said influenza virus has been changing patterns rapidly in recent years

Although, Indian population in general has been resistant to such viruses, due to large population once a person is infected the spread will be quick —**Dr Kiran Madhala** | CONVENER
SCIENTIFIC COMMITTEE, IMA

LIST OF VACCINES DISCUSSED IN CONCENSUS
Anthrax | Chickenpox | Chikungunya | Cholera | Covid | Diphtheria | Pertussis (Whooping Cough) | Tetanus | Haemophilus influenzae type B | Hepatitis A | Hepatitis B | Human Papilloma Virus | Influenza | Japanese encephalitis | Meningococcal | Pneumococcal | Poliomyelitis

However, the absence of consistent monthly data makes it difficult to assess whether the current surge is unusual or part of a seasonal pattern. Influenza typically peaks twice a year in India:

1. **Monsoon Season**
2. **Winter Season**

Studies indicate that approximately **15.4% of acute respiratory infections (ARI)** and **12.7% of**

severe acute respiratory infections (SARI) are attributable to influenza. However, routine influenza testing is uncommon in clinical settings, leading to potential underreporting.

Influenza-Associated Mortality and Demographic Vulnerability

Estimating influenza-related mortality in India is challenging due to the lack of widespread influenza testing and the rarity of flu being certified as the cause of death. A modeling study from 2020 estimated about:

- **1,27,092 influenza-associated respiratory and circulatory deaths per year.**
- Higher mortality rates were observed among **adults over 65 years and children under five years.**

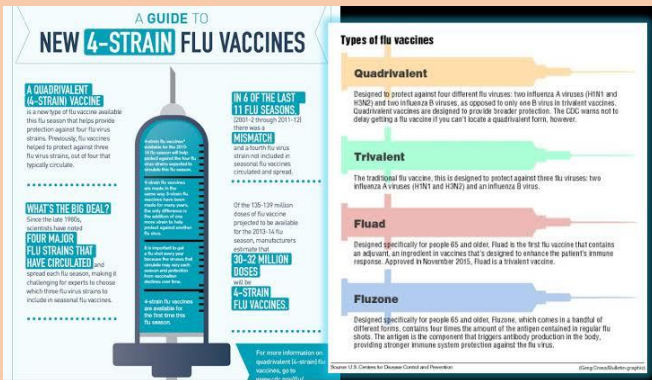
Despite these alarming figures, influenza vaccination is only considered "desirable" for these vulnerable groups, as per Health Ministry guidelines. This lack of prioritization further hampers the uptake of vaccines.

Vaccine Composition and Production

WHO periodically updates influenza vaccine compositions to ensure alignment with circulating strains. For the **2025-2026 northern hemisphere flu season**, WHO recommended the vaccine composition well in advance to facilitate timely production. Key aspects include:

- **Chicken egg-based production** (most common and takes several months).
- **Serum Institute's egg-based vaccine and Sanofi's egg-based and recombinant vaccines.**

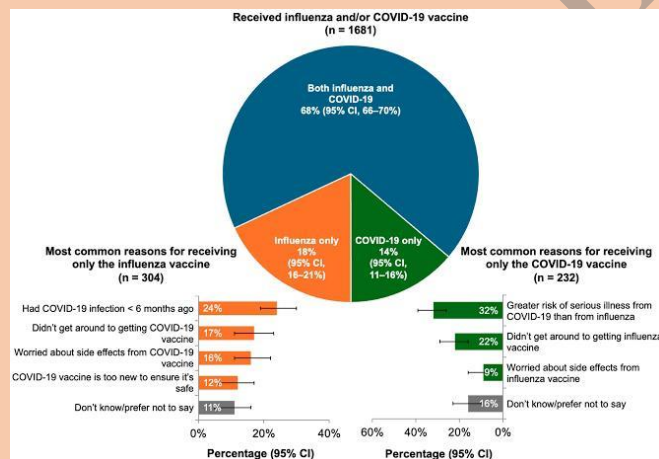
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While mismatches between vaccine strains and circulating strains can reduce efficacy, there is currently no reported mismatch for the upcoming season in North India. This suggests that the vaccines available should offer adequate protection against circulating strains.

Vaccination Uptake and Public Health Challenges

Despite the availability of vaccines and occasional awareness campaigns, influenza vaccine uptake in India remains exceptionally low:



- Less than **5%** of the adult population has been vaccinated.
- Only **1.5%** of adults aged **45 or older** have ever received a flu vaccine.

- Even among healthcare workers and those with chronic conditions, vaccination rates remain inadequate.

Barriers to higher vaccine uptake include:

1. **Low public awareness and misconceptions about flu vaccination.**
2. **Lack of integration into the universal immunization program.**
3. **Perception of the vaccine as “desirable” rather than essential.**

In contrast, countries like the United States have a much higher vaccination rate, with **47% of children and millions of adults being vaccinated annually.**

Economic and Public Health Implications

The low influenza vaccine coverage in India has serious economic and public health consequences:

- **Frequent flu outbreaks strain healthcare systems** and reduce productivity.
- Vulnerable groups, such as the elderly and children, face increased morbidity and mortality.
- Scaling up vaccination efforts could reduce healthcare costs associated with severe flu cases.

Increasing vaccine coverage requires:

- **Integrating flu vaccination into national immunization programs.**
- **Enhancing public awareness through mass campaigns.**
- **Strengthening surveillance and data collection to assess flu trends accurately.**

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Prelims Practice Question

Q. Consider the following statements regarding Influenza and its vaccination in India:

1. Influenza vaccination is a part of India's Universal Immunization Programme.
2. WHO recommends the composition of influenza vaccines months in advance based on circulating strains.
3. The most common method of influenza vaccine production involves the use of chicken eggs.
4. Influenza peaks in India primarily during the monsoon and winter seasons.

Which of the statements given above are correct?

- A) 1 and 2 only
- B) 2, 3 and 4 only
- C) 1, 3 and 4 only
- D) 1, 2, 3 and 4

Answer: B) 2, 3 and 4 only

Explanation:

1. **Statement 1 is incorrect:** Influenza vaccination is not part of India's Universal Immunization Programme. It is recommended only for high-risk groups, such as healthcare workers, pregnant women, and people with chronic illnesses.
2. **Statement 2 is correct:** The World Health Organization (WHO) recommends influenza vaccine compositions months in advance based on the analysis of currently circulating strains.
3. **Statement 3 is correct:** The most common method for influenza vaccine production involves using chicken eggs to grow the virus strains.

4. **Statement 4 is correct:** In India, influenza typically peaks during the monsoon and winter seasons.

Therefore, the correct answer is **B) 2, 3 and 4 only**.

Mains Model Question:

Discuss the challenges associated with influenza vaccination in India and suggest measures to improve vaccine uptake, especially among vulnerable groups.



Influenza remains a significant public health concern in India, causing substantial morbidity and mortality every year. Despite the availability of vaccines and recommendations from global health bodies like the World Health Organization (WHO), the vaccination rate in India remains exceptionally low, with less than 5% of the population receiving the flu shot. One of the primary challenges is the lack of awareness among the general public regarding the severity of influenza and the benefits of vaccination. Additionally, influenza vaccination is not part of India's Universal Immunization Programme, making it less accessible to the broader population.

Cultural perceptions and misconceptions further hinder vaccine acceptance, as many people view the flu as a mild, self-limiting illness rather than a

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potentially life-threatening disease. Another challenge lies in the healthcare system itself, where routine influenza testing is not common practice, leading to underreporting of cases and misattribution of respiratory deaths. Consequently, influenza is rarely certified as the cause of death, which undermines the perceived importance of vaccination. Moreover, the current guidelines classify vaccination for the elderly and young children as merely “desirable,” despite evidence indicating that these groups are at higher risk of severe outcomes.

To address these challenges, it is imperative to integrate influenza vaccination into the national immunization schedule, prioritizing high-risk groups such as healthcare workers, the elderly, pregnant women, and those with chronic conditions. Public awareness campaigns should be conducted to dispel myths and emphasize the importance of vaccination in preventing severe disease and mortality. Strengthening surveillance systems to accurately record influenza cases and outcomes will also support more informed policy decisions. By fostering a culture of preventive healthcare and enhancing access to vaccines, India can significantly reduce the burden of influenza and protect its most vulnerable populations.

Topic : Issue and Challenges with Disclosure of Voting Data in India

Relevance : GS Paper 2 Polity and Governance

Source : The Hindu

Context :

Why is uploading voting data a challenge?

Why does the Election Commission of India find it difficult to disclose absolute numbers of booth-wise votes cast in elections? What do the Opposition and activists want? What are the two parts of Form 17C? What are some of the discrepancies that have been pointed out?

Priscilla Jehara

The story so far:
In May 2024, in the middle of the Lok Sabha elections, the Supreme Court of India considered a petition by the Association for Democratic Reforms (ADR), seeking the publication of the first part of Form 17C, which includes booth-wise voter turnout data, on the Election Commission of India's ECI website, within 48 hours of polling.

What was the EC's stand?
The EC flatly refused, saying that it was only legally mandated to share this form with polling agents representing electoral candidates, and not with the general public or the media. A year later, after Opposition outrage at alleged discrepancies in voter turnout and vote counts in multiple Assembly elections, the EC has told the top court it is prepared to meet with the ADR and fellow petitioners, Trinamool Congress MP Malina Mohita, signalling that the new Chief Election Commissioner Gyanesh Kumar is “ready and willing” to hear their demand.

What is Form 17C?
The Conduct of Election Rules, 1961 mandates that a two-part form, recording voter turnout and vote count, is filled for every polling station; in the 2024 parliamentary poll, there were more than 10.5 lakh polling stations across the country. Part 1 of Form 17C is the Account of Votes Recorded, and is filled in by the presiding officer of each polling station, with a true copy to be furnished to every polling agent present at the close of the poll. It includes the identification number of the Electronic Voting Machine (EVM) used in that polling station, the

“We believe that every vote matters, and should be accounted for”

total number of electors assigned to that polling booth, the number of votes cast as per the EVM, as well as the numbers deciding not to record their votes or who were not allowed to vote, and whether there are any mismatches between these numbers. It also includes the number of tendered ballot papers and paper seals. The presiding officer, as well as every polling agent present are required to sign and validate this form, before it is placed in a sealed cover and transported to the returning officer, along with the EVM, to be held until the day of counting.

On counting day, Part 2 of Form 17C, titled the Result of Counting, is filled in by the returning officer. It includes the names of each candidate and the number of votes recorded in favour of each of them, as seen when the “result” button is pressed on the EVM. The returning officer must also state “whether the total number of votes shown above tallies with the total number of votes shown against item 5 of Part 1 (which is the number of votes cast as per the EVM on the day of polling) or any discrepancy noticed between the two totals.” Part 2 is signed by the returning officer, the counting supervisor, and each candidate or their counting agents.

Who do Opposition parties want this data to be published online immediately?

In July 2024, after the conclusion of the Lok Sabha elections, ADR conducted an analysis of voter data issued by the EC and arrived at the shocking conclusion that the number of votes polled tallied exactly with the number of votes counted in only five parliamentary constituencies across the country. In the remaining 538 constituencies, there were discrepancies seen. In 362 seats, the number of votes counted was cumulatively 5.5 lakh fewer than votes polled, while in 176 seats, there was a total of 35,000 extra votes counted in comparison to the votes polled.

This is a minuscule fraction of the 64.64 crore votes polled across the country, and the EC dismissed them as occasional manual errors made by presiding officers or a failure to remove the votes cast when the mock poll was conducted. The majority of these discrepancies were lower than the winning margin in constituencies. “The margin of victory does not matter because winning or losing is not the important point. We believe that every vote matters, and should be accounted for,” says ADR founder and trustee Jagdeep Chhokar. The booth-wise information available in Form 17C will allow discrepancies to be pinpointed and accountability to be fixed, so that corrective action can be taken at the booth level, says Mr. Chhokar. Aggregating this data will show if there

is any pattern of discrepancies in an election.

Opposition parties have raised a hue and cry about the significant differences in voter turnout as released provisionally through the EC's mobile app or its press statements on the day of polling, and the final turnout figures declared days later; in the first phase of the parliamentary election, the final voter turnout was published 11 days late, and was up to 5% higher than initially announced. The EC's published voter turnout data is also in percentage terms, not in absolute figures as recorded in Form 17C. The demand for Form 17C to be published immediately is meant to spotlight and prevent such discrepancies, though the EC says the issue of hard copies of Form 17C to polling agents on the day of the election ensures transparency. “In theory, Form 17C is supposed to be given to polling agents. In practice, every party and every candidate does not have the wherewithal to have a polling agent for each polling station. What the EC's rule book says does not actually happen. Form 17C can be incorrect and there may be no polling agents, or only polling agents for the ruling party, or polling agents can be bought,” says Mr. Chhokar. “It is not just political parties that have a right to this information, but also the voter.”

What difficulties does the EC face?

The EC told the court that “indiscriminate disclosure” of the data could create chaos, warning that images of Form 17C, published online could be misread and lead to “widespread discomfort”. It noted that postal ballots are not included in Form 17C. The poll body also argued that it was not obligated to hand over the form to anyone but polling agents.

Former election officials also point to practical difficulties on the ground, admitting that some errors are inevitable. “There are about one crore poll workers involved in conducting a national election in India. Many are not well educated, and they are under extreme stress with all kinds of pressure being put on them at the polling station so they may commit blunders,” explained former Chief Election Commissioner G.P. Rawat. He said that the copies of Form 17C are sent overnight to the returning officer (RO) and the next day, the election observer camps out and verifies the data recorded in Part 1 with the presiding officer's diary and other documents as well as video recordings at the polling station. He then “recalls” the data on Form 17C with “corroborating evidence”, a process that may take several days. It is not clear if polling agents are then asked to sign off on the “recalled” data. Mr. Rawat notes that political parties can collect Form 17Cs from their polling agents and publish them if they wish. “Mistakes will lead to disciplinary action against poll workers who are under stress and do not deserve it (polling agents) will take flak from them next time. That's why they want to put the ball in the EC's court,” he said.



Change in role: Gyanesh Kumar takes charge as Chief Election Commissioner in New Delhi on February 13, 2025

The debate over disclosing booth-wise voting data has been ongoing in India, primarily revolving around the publication of **Form 17C**, a two-part document mandated under the **Conduct of Election Rules, 1961**. This form records voter turnout and vote count at every polling station. The **Election Commission of India (EC)** has been resistant to publishing this data online, citing legal and practical challenges. However, the issue has gained momentum due to increasing demands from opposition parties and civil society organizations.

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What is Form 17C?

Form 17C comprises two parts:

1. **Part 1 (Account of Votes Recorded):**

Filled by the **presiding officer** at the polling station, it records:

- Identification number of the **Electronic Voting Machine (EVM)**.
- Total number of electors assigned and the number of votes cast.
- Details of tendered ballot papers and paper seals.
- Any discrepancies between the recorded and counted votes.
- Signatures of polling agents to validate the data.

2. **Part 2 (Result of Counting):** Filled by the **returning officer** on counting day, it includes:

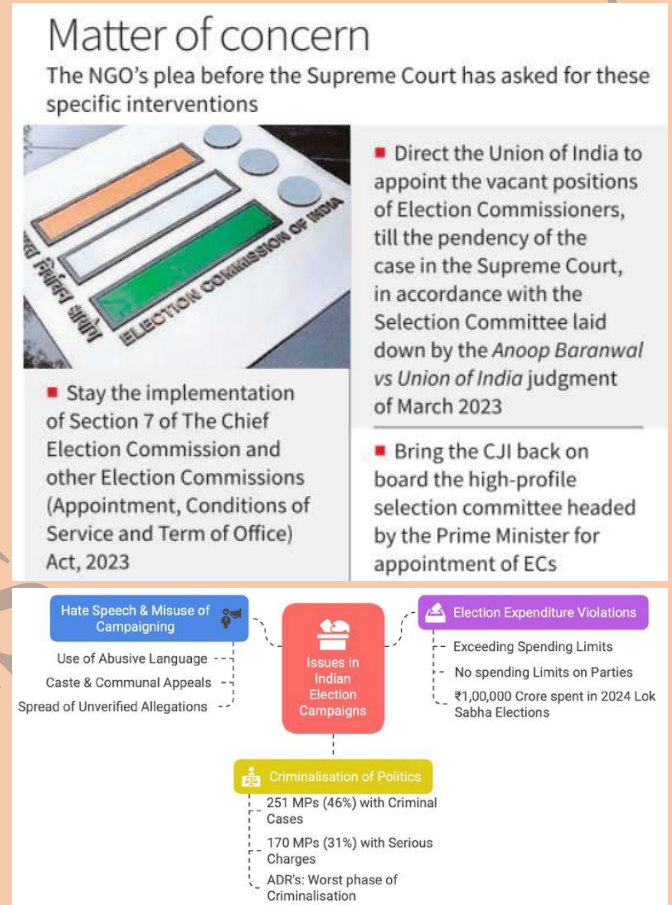
- Names of candidates and votes recorded for each.
- Verification of whether the counted votes match the recorded votes.

Issue at Hand

The **Association for Democratic Reforms (ADR)** filed a petition seeking immediate online publication of **Part 1 of Form 17C** within 48 hours of polling. The demand stems from the need for **greater transparency and accountability**, as discrepancies between the **votes polled and votes counted** have been observed in recent elections. In the **2024 Lok Sabha elections**, data analysis revealed that only **5 parliamentary constituencies** showed a perfect match between votes polled and votes

counted, while **538 constituencies** had discrepancies, including a cumulative shortfall of **5.5 lakh votes** and an excess of **35,000 votes** in different seats.

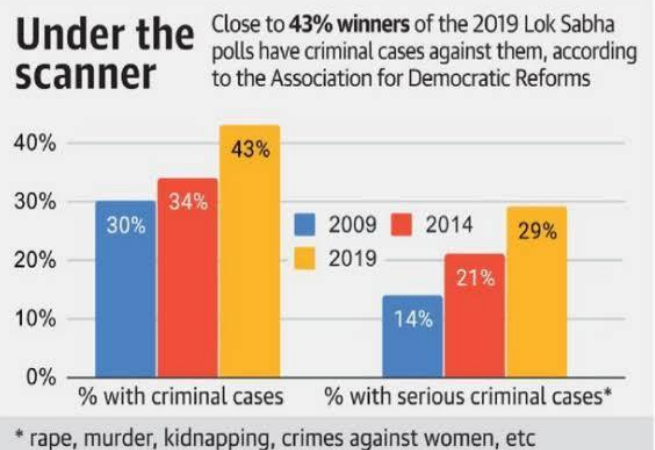
Matter of concern
The NGO's plea before the Supreme Court has asked for these specific interventions



- Direct the Union of India to appoint the vacant positions of Election Commissioners, till the pendency of the case in the Supreme Court, in accordance with the Selection Committee laid down by the *Anoop Baranwal vs Union of India* judgment of March 2023
- Stay the implementation of Section 7 of The Chief Election Commission and other Election Commissions (Appointment, Conditions of Service and Term of Office) Act, 2023
- Bring the CJI back on board the high-profile selection committee headed by the Prime Minister for appointment of ECs

Issues in Indian Election Campaigns

- Hate Speech & Misuse of Campaigning
 - Use of Abusive Language
 - Caste & Communal Appeals
 - Spread of Unverified Allegations
- Election Expenditure Violations
 - Exceeding Spending Limits
 - No spending Limits on Parties
 - ₹1,00,000 Crore spent in 2024 Lok Sabha Elections
- Criminalisation of Politics
 - 251 MPs (46%) with Criminal Cases
 - 170 MPs (31%) with Serious Charges
 - ADR's: Worst phase of Criminalisation



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Concerns Raised by Opposition Parties

Opposition parties have raised significant concerns regarding:

- **Accuracy and Transparency:** The difference between **provisional voter turnout** and final figures, often revealed days later, raises suspicions. For instance, in the **first phase of the 2024 parliamentary elections**, the final voter turnout published after 11 days was **5% higher** than the initial figure.
- **Public Right to Information:** Activists argue that every vote must be counted accurately, as **democratic accountability** demands it.



- **Discrepancies in Booth-wise Data:** Publishing data online would allow

discrepancies to be pinpointed and **accountability fixed** at the booth level.

Challenges Faced by the Election Commission

The EC has cited several challenges in publishing Form 17C data online:

- **Legal Constraints:** The rules only mandate sharing Form 17C with **polling agents** and not the public.
- **Potential for Misuse:** Concerns that **online images of Form 17C could be morphed** or manipulated, causing public unrest.
- **Practical Difficulties:** With around **one crore poll workers**, many of whom are under stress and may lack adequate training, errors are inevitable.
- **Verification Process:** Post-polling verification is conducted by **election observers** to reconcile data discrepancies, which may take several days.

Way Forward

There is a strong need to **strike a balance between transparency and practicality**. Some potential measures include:

- **Strengthening Training for Poll Workers:** This will minimize human errors during data recording.
- **Automated Verification Mechanisms:** Leveraging **technology to cross-verify data** can enhance accuracy.
- **Public Awareness and Political Consensus:** Educating voters and gaining consensus among political parties can reduce opposition to transparent data publication.

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- **Periodic Audits:** Independent auditing of voting data may increase public trust.

While ensuring voting transparency is crucial to upholding democratic values, practical challenges must be carefully addressed to avoid creating chaos and mistrust. Balancing public interest with logistical feasibility is key to maintaining electoral integrity.

Prelims Practice Question:

Q. With reference to the Conduct of Election Rules, 1961, consider the following statements:

1. Form 17C is a two-part form used during elections to record voter turnout and vote count at each polling station.
2. Part 1 of Form 17C records the number of votes counted for each candidate after the counting process.
3. The Election Commission of India is legally mandated to publish Form 17C on its website within 48 hours of polling.

Which of the above statements is/are correct?

- (a) 1 only
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1, 2, and 3

Answer: (a) 1 only

Explanation:

1. **Statement 1 is correct:** Form 17C is a two-part form mandated by the Conduct of Election Rules, 1961. It records voter turnout and vote count at each polling station.
2. **Statement 2 is incorrect:** Part 1 of Form 17C records the **Account of Votes**

Recorded, including the number of votes cast as per the EVM, and not the vote count for each candidate. **Part 2 of Form 17C** contains the **Result of Counting**, which records votes counted for each candidate.

3. **Statement 3 is incorrect:** The Election Commission of India is not legally mandated to publish Form 17C online. It is required to share the form only with polling agents present during the election process.

Mains Model Question:

Discuss the challenges and concerns associated with the publication of Form 17C during elections in India. How do these challenges impact electoral transparency and accountability?

The publication of Form 17C during elections in India has sparked debates on transparency and accountability. Form 17C, mandated by the Conduct of Election Rules, 1961, is a two-part form that records voter turnout and vote count at each polling station. While Part 1 documents the number of votes cast as per the Electronic Voting Machine (EVM), Part 2 contains the actual vote count for each candidate after pressing the result button on the EVM.

One of the primary challenges associated with publishing Form 17C is the potential for data manipulation and misinformation. The Election Commission (EC) has expressed concerns that indiscriminate disclosure could lead to morphing or alteration of the data, causing confusion among voters and stakeholders. Additionally, practical

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challenges arise from the sheer scale of elections in India, involving over one crore poll workers who may commit errors under stress. These errors, if publicly disclosed without verification, may erode public trust in the electoral process.

NRI VOTERS & PROXY VOTING	
<ul style="list-style-type: none"> ➤ For 66 yrs, India has held that NRIs need to be present physically to cast votes ➤ Former Prime Minister Manmohan Singh 1st promised to change laws & consider other options ➤ On August 3, 2017 even as Cong & other parties opposed, EC, Centre held proxy voting as viable ➤ 2 other options discarded: postal ballot system (for logistical reasons) & e-voting (for technical issues) ➤ On December 18, bill to allow proxy voting introduced in Lok Sabha 	<ul style="list-style-type: none"> ➤ As of December 2016, there were more than 1.3 crore NRIs ➤ As of December 2017, only 24,348 of them registered to vote in India <ul style="list-style-type: none"> ➤ 96% or 23,556 of the 24.3k voters registered are from Kerala ➤ Punjab a far 2nd with 364 NRI voters, followed by Puducherry (137); TN (49) & Delhi (37) ➤ Only 14 in Gujarat, and 15 in Andhra Pradesh, while Chandigarh has 11

— Source: Election Commission of India & Government of India

Topic : Successful Return of NASA Astronauts from the ISS

Relevance : GS paper 3

Science and Technology

Source : India Express

Context :

The successful return of astronauts **Sunita Williams** and **Barry Wilmore** aboard **Dragon Freedom** marks a milestone in space exploration and technological advancement. Their nine-month mission at the **International Space Station (ISS)** was pivotal in conducting **scientific research**, maintaining ISS operations, and studying **human adaptation to microgravity**. The **SpaceX Dragon Freedom spacecraft**, with its advanced safety features and autonomous capabilities, played a crucial role in ensuring a safe return. The strategic landing in the **Gulf of Mexico** underscores the region's importance in facilitating safe recoveries, contributing to the ongoing success of NASA's space missions.

Furthermore, discrepancies between voter turnout and vote count have raised questions about the accuracy of election results. Opposition parties and activists have demanded immediate publication of Form 17C to identify inconsistencies and enhance accountability. However, the EC argues that providing hard copies of Form 17C to polling agents already ensures transparency, although not all parties can deploy agents at every polling station.

The lack of public access to Form 17C data also raises concerns about democratic accountability. Activists argue that every vote must be accounted for to maintain the integrity of the electoral process. However, balancing transparency with data security and accuracy remains a significant challenge. Ensuring accurate data verification and minimizing human errors are essential to uphold the credibility of India's electoral system while addressing demands for greater openness.

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Overview:

SPACE
NASA astronauts head back to Earth
After nine months in space, NASA astronauts Butch Wilmore and Sunita Williams are finally on their way home with splashdown estimated at 21:57 GMT on Tuesday.

- June 5**
After several delays, Boeing's Starliner launches. Wilmore and Williams are scheduled to return to Earth on June 14.
- June 6**
Starliner docks at the International Space Station (ISS).
- June 11**
NASA says Starliner has five small helium leaks and the astronauts' mission will be extended to June 18.
- August 24**
NASA confirms the astronauts will have to return home on a different spacecraft in 2025 and Starliner will return uncrewed.
- September 7**
Starliner lands uncrewed at White Sands Space Harbor in New Mexico.
- September 29**
A SpaceX spacecraft arrives at the ISS on a planned six-month mission with two spare seats for Wilmore and Williams.
- March 14**
An ISS replacement crew launches on SpaceX's Crew-10 mission from the Kennedy Space Center.
- March 16**
Crew-10 docks at the ISS.
- March 17**
Wilmore and Williams ready for their departure back to Earth.
- March 18**
05:05 GMT: Spacecraft undocks from the ISS
21:31 GMT (approx): Deorbit burn
21:57 GMT (5:57pm local time approx): Splashdown off Florida.

Source: NASA, news agencies | March 18, 2025 | @A2Labs ALJAZEERA

- On **March 18, 2025**, NASA astronauts **Sunita Williams** and **Barry "Butch" Wilmore**, along with two other crew members, successfully returned to Earth after a **nine-month mission** aboard the **International Space Station (ISS)**.
- They traveled back onboard **SpaceX's Dragon Freedom spacecraft**, which splashed down safely in the **Gulf of Mexico**, near **Tallahassee, Florida**, around **6:30 p.m. EDT**.
- The mission marked another successful collaboration between **NASA and SpaceX**, demonstrating advancements in **space transportation and human spaceflight capabilities**.

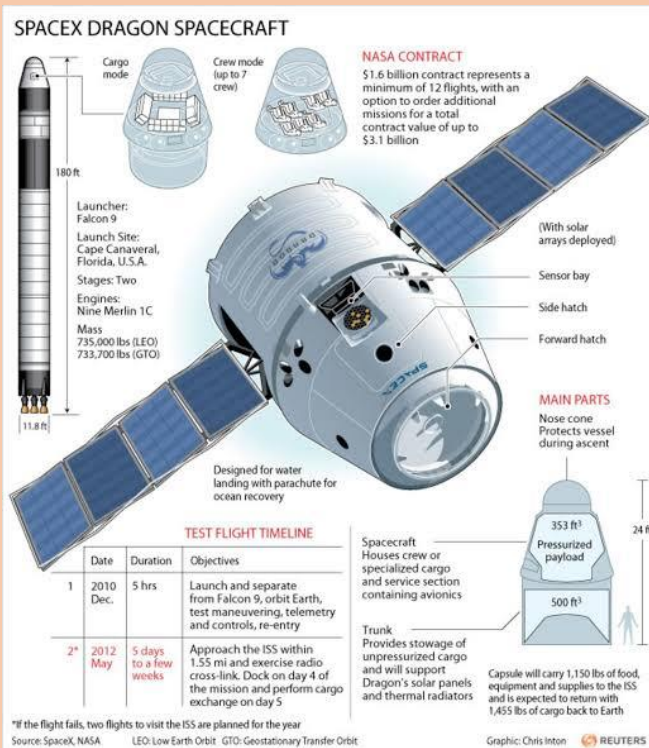
Purpose and Significance of the Mission:

- The astronauts' mission to the ISS aimed to:
 - **Conduct advanced scientific research** in microgravity, particularly in areas like **human physiology, genetics, materials science, and space medicine**.
 - **Maintain and upgrade the ISS infrastructure**, ensuring continued functionality and safety for future missions.
 - **Enhance space technology and perform spacewalks** to repair and install critical equipment.
 - **Study the effects of long-duration spaceflight on the human body**, helping prepare for **future missions to the Moon and Mars**.
- Their contributions are vital for understanding:
 - How the **human body adapts to microgravity** over extended periods.
 - The **impact of space environments** on mental and physical health.
 - Strategies for **long-duration space exploration and interplanetary missions**.

SpaceX Dragon Freedom Spacecraft:

- Part of SpaceX's **Crew Dragon spacecraft series**, developed under NASA's **Commercial Crew Program**.
- Designed to transport up to **7 astronauts** or a mix of crew and cargo to and from the ISS.

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- **Life Support Systems:** Maintains cabin pressure and temperature.
- **Waste Management and Sleeping Facilities:** Supports long-duration space travel.

- **Recovery and Reusability:**
 - Designed to be **reused up to five times** with refurbishments between missions.
 - Can splash down in the **Atlantic Ocean or Gulf of Mexico**, allowing flexibility in recovery operations.
- The successful return underscores SpaceX's role in supporting **human space exploration** and NASA's **space objectives**.

International Space Station (ISS):

- **Notable Features:**
 - **Advanced Avionics:** Ensures precise navigation and flight control.
 - **Autonomous Docking Capability:** Can autonomously dock with the ISS, reducing the need for manual intervention.
 - **Enhanced Safety Systems:**
 - **Abort System:** Provides rapid escape in case of emergency during launch.
 - **Reinforced Heat Shield:** Ensures safe re-entry into Earth's atmosphere.
 - **Crew Comfort:**
 - **Touchscreen Controls:** Streamlined interface for easy control.
- A modular space laboratory orbiting the Earth, operated by **NASA, Roscosmos, JAXA, ESA, and CSA**.
- Serves as a **critical platform for space research and technological advancements**.
- Enables the study of **human adaptation to microgravity and long-duration space missions**.
- The mission contributes to ongoing efforts to develop **sustainable human presence beyond Earth**.

Sunita Williams' Journey:

- A veteran astronaut with **over 322 days in space** and **seven spacewalks** before this mission.
- During the nine-month ISS stay, she:

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- Performed **scientific experiments and maintenance tasks**.
- Participated in **educational outreach** to inspire future generations.
- Worked on enhancing **space technology and mission readiness**.
- Williams' extensive experience makes her a key figure in advancing **human spaceflight research and international cooperation**.

Significance of the Gulf of Mexico Landing:

- The **Gulf of Mexico** is a strategic location for **spacecraft splashdowns** due to:
 - **Expansive water area and calm sea conditions**.
 - Proximity to **recovery facilities in Florida**, ensuring efficient crew and spacecraft retrieval.
- The recent landing near **Tallahassee** highlights the Gulf's role in **NASA and SpaceX operations**, offering a safe and accessible landing site for space missions.

Prelims Practice Question:

Q. Consider the following statements regarding SpaceX's Dragon Freedom spacecraft:

1. Dragon Freedom is a part of SpaceX's Crew Dragon series and is designed to transport astronauts to and from the International Space Station (ISS).
2. The spacecraft is capable of autonomous docking with the ISS and is equipped with an emergency abort system.
3. The spacecraft is designed to splash down only in the Atlantic Ocean.

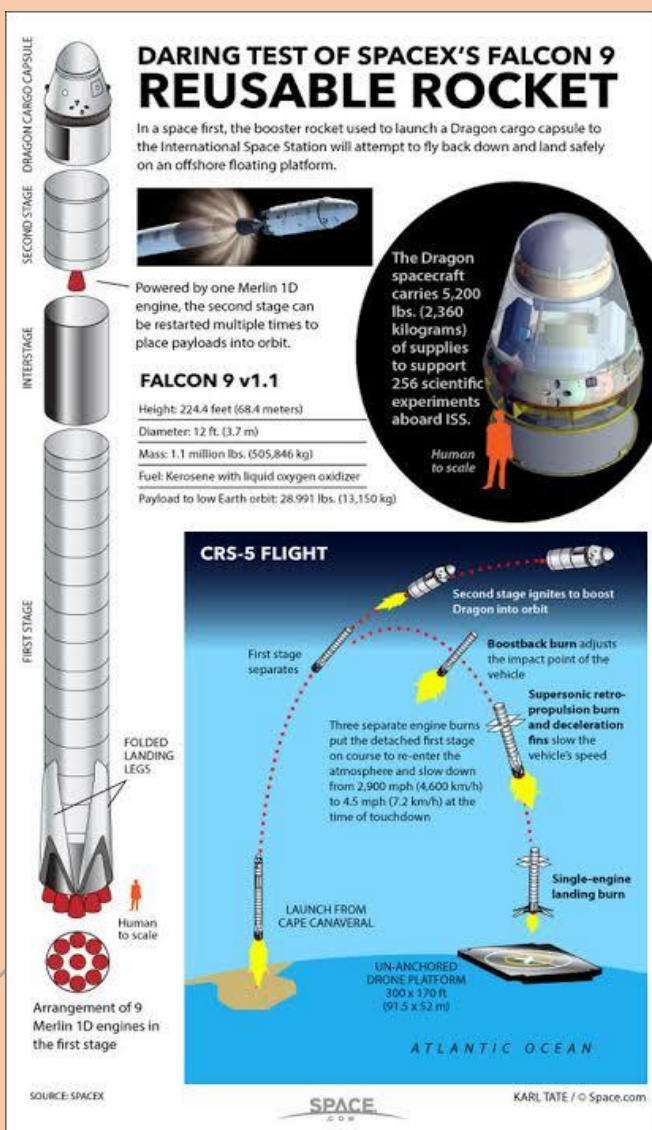
Which of the statements given above is/are correct?

- A) 1 and 2 only
 B) 2 and 3 only
 C) 1 only
 D) 1, 2, and 3

Answer: A) 1 and 2 only

Explanation:

1. **Statement 1 is correct:** Dragon Freedom is indeed a part of SpaceX's Crew Dragon series and is designed to transport astronauts to and from the International Space Station (ISS).



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series and is designed to transport astronauts to and from the ISS.

- Statement 2 is correct:** The spacecraft is capable of autonomous docking with the ISS and has an advanced emergency abort system to ensure crew safety.
- Statement 3 is incorrect:** The spacecraft is capable of splashing down both in the **Atlantic Ocean and the Gulf of Mexico**, not just the Atlantic Ocean.

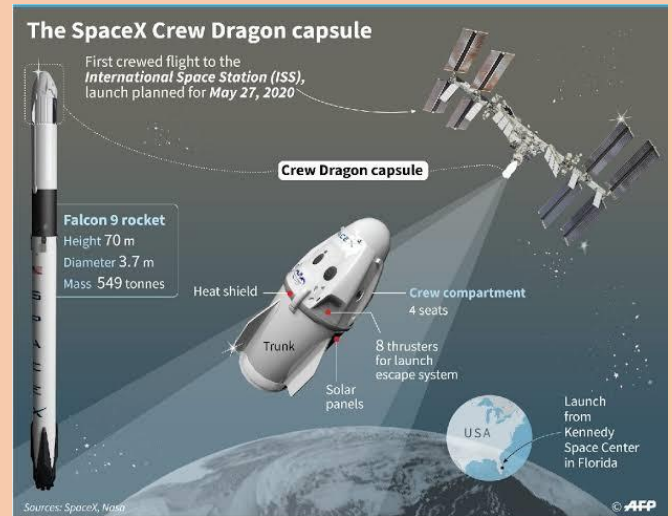
Therefore, the correct answer is **A) 1 and 2 only**.

Mains Model Question:

Discuss the significance of SpaceX's Dragon Freedom spacecraft in space exploration and its role in astronaut recovery. What are the challenges faced by astronauts during re-adaptation to Earth's gravity after prolonged space missions?

SpaceX's Dragon Freedom spacecraft, part of the Crew Dragon series, marks a significant advancement in human spaceflight and astronaut recovery. Developed under NASA's Commercial Crew Program, it serves as a reliable transportation system to and from the International Space Station (ISS). The spacecraft is designed for autonomous docking and undocking, featuring advanced safety systems such as an emergency abort mechanism to protect astronauts during critical phases. Its ability to splash down in both the Atlantic Ocean and the Gulf of Mexico enhances recovery flexibility, reducing turnaround time and increasing mission efficiency.

On March 19, 2025, the Dragon Freedom successfully returned from the ISS, carrying astronauts Sunita Williams, Barry Wilmore, Aleksandr Gorbunov, and Nick Hague.



After a nine month mission, the capsule safely landed in the Gulf of Mexico, near Tallahassee, Florida. This strategic location was chosen for its calm waters and proximity to support teams, enabling prompt recovery and medical assistance. The astronauts' mission aimed to conduct experiments on human physiology, microgravity effects, and other scientific research crucial for long-duration space exploration.

Returning to Earth after prolonged space missions poses significant challenges for astronauts. Microgravity leads to muscle atrophy, bone density loss, and fluid redistribution, causing physical discomfort and health risks. NASA's post-flight reconditioning program addresses these challenges through tailored physical therapy, cardiovascular exercises, and medical evaluations. Rehabilitation focuses on restoring muscle strength, balance, coordination, and cardiovascular endurance, as well as monitoring psychological well-being.

The significance of Dragon Freedom extends beyond transportation; it symbolizes a step towards sustainable human space exploration. By providing safe, reliable, and reusable space

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vehicles, SpaceX has enabled longer and more frequent missions to the ISS and beyond. As humanity ventures further into space, addressing the physical and psychological challenges of re-adaptation will remain a crucial aspect of mission planning.

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