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Topic : **Atmanirbhar Bharat: Transforming India's Global Pharmaceutical**

Relevance : GS Paper 3 Science and Technology

Source : Indian Express

Context :

India's pharmaceutical sector is globally recognized for its ability to deliver **high-quality, affordable medicines** to both domestic and international markets. As part of the *Make in India* and *Atmanirbhar Bharat* initiatives, the **Department of Pharmaceuticals** under the **Ministry of Chemicals and Fertilizers** is driving efforts to strengthen India's self-reliance in drug manufacturing, medical devices, and innovation. The country is already a **global leader in generic drug manufacturing**, and its contribution to global vaccine supply chains — especially to UNICEF and WHO — highlights its strategic importance in global health security.**Understanding Atmanirbhar Bharat in the Pharmaceutical Context**

The term **Atmanirbhar Bharat**, meaning *Self-Reliant India*, goes beyond protectionism. It aims to **empower domestic capabilities**, reduce dependence on critical imports, and create a resilient and competitive industrial base. In the pharmaceutical sector, this vision aligns with:

- Reducing import reliance on critical APIs and medical equipment,
- Encouraging indigenous innovation and high-value drug production,
- Enhancing manufacturing capacities through strategic schemes.

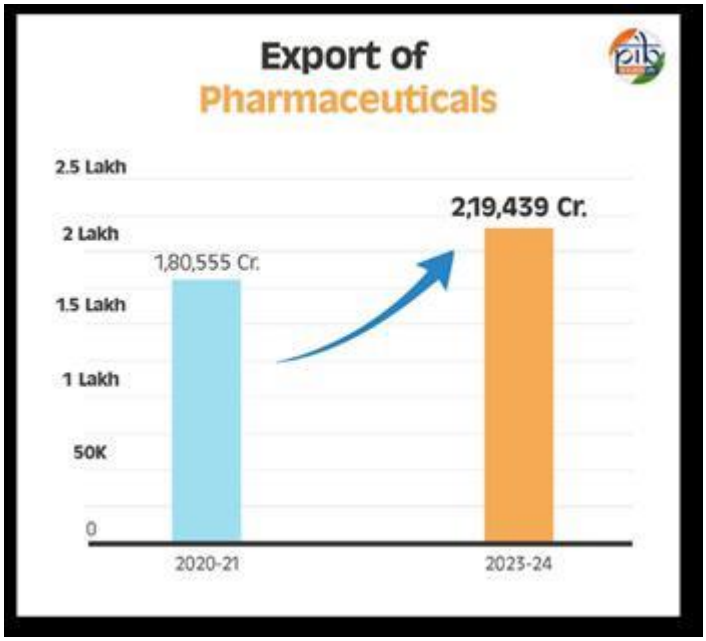
Atmanirbhar Bharat in pharma thus reflects the government's push toward creating a **globally competitive, innovation-driven and supply-chain-resilient pharmaceutical ecosystem**.

The Role of Make in India in Pharmaceuticals

The **Make in India** initiative underpins the transformation of India's pharma industry. By fostering an ecosystem that supports **investment, infrastructure, and innovation**, the initiative aims to establish India not only as the "pharmacy of the world" but also a hub for **cutting-edge drug discovery, biopharmaceuticals, and medical device production**.

This transformation includes:

- Expanding production capacity,
- Integrating global quality standards,
- Incentivizing domestic and foreign investment into manufacturing facilities,
- Focusing on backward integration to localize supply chains.



Strengthening Manufacturing through PLI Schemes

A pivotal tool to realize self-reliance in pharma is the **Production Linked Incentive (PLI) Scheme**, launched in 2020. It aims to **boost domestic production, attract global investments**, and **enhance export competitiveness**. Three key PLI schemes operate under the Department of Pharmaceuticals:

i. **PLI Scheme for Pharmaceuticals**

Approved in February 2021, this scheme has a financial outlay of ₹15,000 crore and spans FY 2022–28. It targets 55 companies to manufacture:

- High-value drugs,
- Complex generics,
- Biopharmaceuticals,
- Anti-cancer and autoimmune drugs,
- Orphan and repurposed drugs.

This scheme boosts India's ability to **innovate and lead in high-tech, high-impact medicines**, and is aligned with global quality and regulatory standards.

ii. **PLI Scheme for KSMs, DIs, and APIs**

Launched in March 2020 with a budget of ₹6,940 crore, this scheme targets **41 critical bulk drugs** to reduce import dependence, especially from China. Projects like Penicillin G in Andhra Pradesh and Clavulanic Acid in Himachal Pradesh are examples of efforts to **substitute imports with indigenous production**.

As of December 2024, 34 out of 48 approved projects have been commissioned, with total investments surpassing targets.

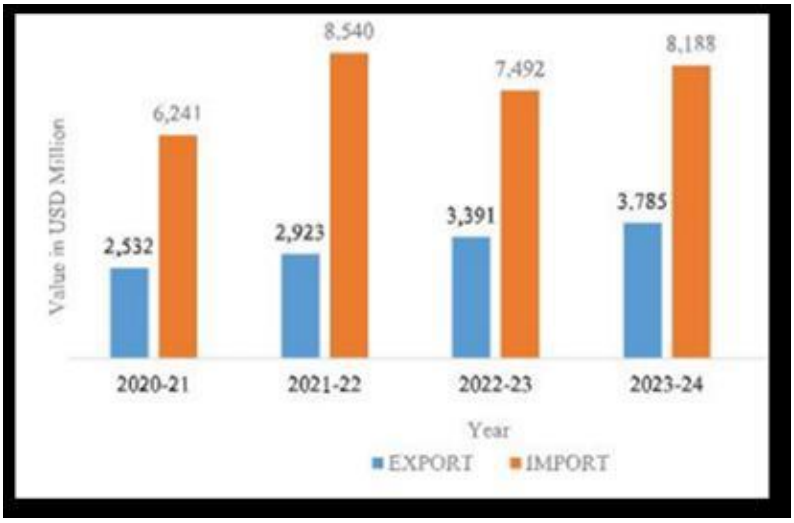
iii. **PLI Scheme for Medical Devices**

To reduce import reliance in high-tech devices, this scheme supports manufacturing in segments like radiology, imaging, cancer care, and implants. It offers a 5% incentive on incremental sales and runs from FY 2020–21 to FY 2027–28. It encourages the development of **critical healthcare infrastructure** with financial backing.

Promotion of Bulk Drug Parks

Launched in 2020 with a ₹3,000 crore budget, the **Promotion of Bulk Drug Parks Scheme** seeks to establish **world-class common infrastructure facilities** to cut production costs. Three states — Gujarat, Himachal Pradesh, and Andhra Pradesh — were selected for financial support. The objective is to ensure **scale economies, quality standardization, and cost-effective manufacturing**.

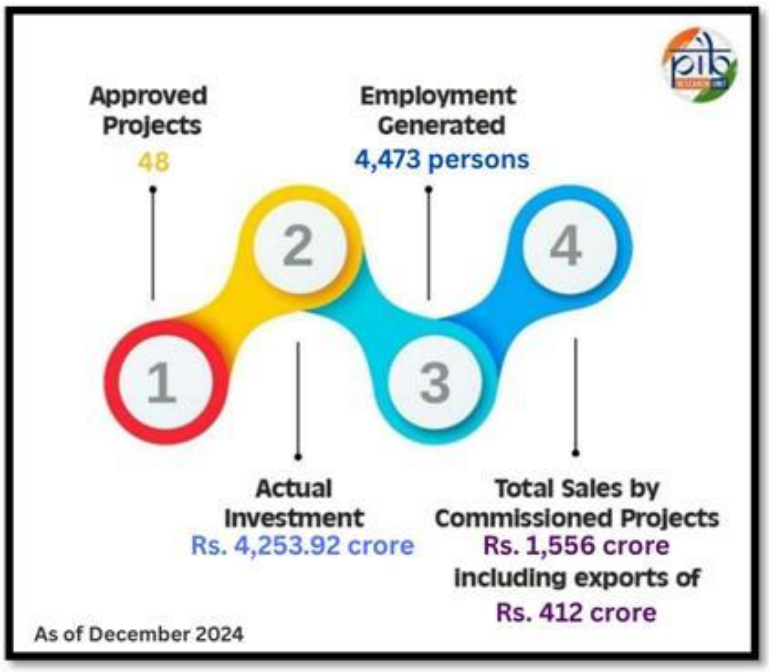
Growth of the Medical Devices Sector



The medical devices sector in India is rapidly evolving but remains **capital-intensive and technology-driven**. It includes products ranging from electro-medical equipment to surgical tools. Government schemes are aimed at:

- Supporting indigenous design and production,
- Training professionals in new technologies,
- Building ecosystem linkages between hospitals, startups, and manufacturers.

India's dependence on medical device imports is being steadily addressed through domestic capacity creation, infrastructure support, and investment facilitation.

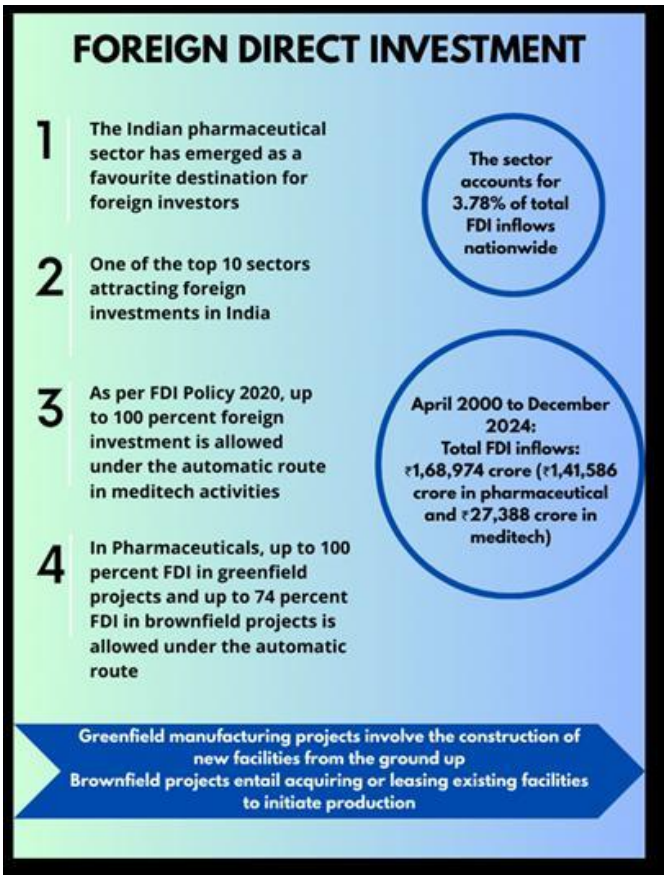


Promoting Affordable Medicines through PMBJP

The **Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP)** plays a crucial social role by ensuring **availability of quality generic medicines** at affordable prices. Key features of this scheme include:

- **Public awareness campaigns** to counter the misconception that higher cost means higher quality,
- Promoting **generic prescriptions**, especially in government hospitals,
- Strengthening last-mile accessibility through **15,479 Jan Aushadhi Kendras** across the country (as of April 2025).

This initiative contributes significantly to **universal health coverage and financial protection**, especially for economically vulnerable populations.



Strengthening the Industry through the SPI Scheme

The **Strengthening of Pharmaceuticals Industry (SPI)** is a Central Sector Scheme with a budget of ₹500 crore for FY 2021–26. It supports:

- Upgradation of existing pharmaceutical clusters,
- Quality compliance by SMEs,
- Common infrastructure development.

This scheme enhances the global competitiveness of Indian pharma, particularly in **small and medium enterprises (SMEs)** which form the backbone of generic medicine production.

Foreign Direct Investment and International Partnerships

India has seen growing **FDI inflows** in pharmaceuticals and medical devices, reaching ₹11,888 crore between April–December 2024. The government approved 13 FDI proposals worth ₹7,246.40 crore for brownfield

projects, reinforcing the country's attractiveness as a **pharmaceutical manufacturing and innovation destination**.

The government's liberalized FDI policies are encouraging joint ventures, technology transfer, and global integration, all while maintaining regulatory safeguards.

Prelims Practice Question:

Q. With reference to the initiatives taken by the Government of India to promote self-reliance in the pharmaceutical sector, consider the following statements:

1. The PLI scheme for pharmaceuticals provides financial incentives for the domestic manufacturing of high-value and complex generic drugs.
2. The Promotion of Bulk Drug Parks Scheme aims to establish individual R&D labs in each pharmaceutical unit to promote innovation.
3. The Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP) aims to promote generic medicine availability through a nationwide network of dedicated stores.
4. The medical devices sector in India is entirely self-reliant and does not depend on imports.

Which of the statements given above 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

Answer: A. 1 and 3 only

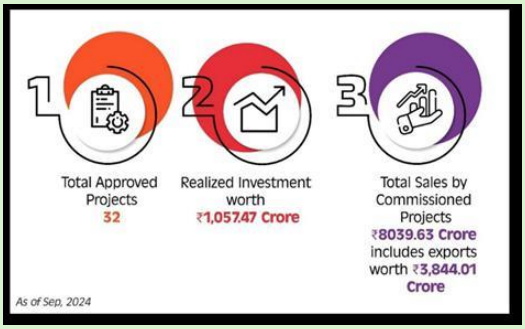
Explanation:

- **Statement 1: Correct.** The **PLI scheme for pharmaceuticals** indeed provides financial incentives to promote **domestic manufacturing of high-value and complex generics**, biosimilars, and critical drugs.
- **Statement 2: Incorrect.** The **Promotion of Bulk Drug Parks Scheme** is aimed at creating **common infrastructure facilities** (like CETPs, testing labs, warehousing, etc.) **not individual R&D labs** in every unit.
- **Statement 3: Correct.** The **PMBJP** ensures the **availability of affordable generic medicines** via **Jan Aushadhi Kendras** across the country.
- **Statement 4: Incorrect.** The **medical devices sector is not fully self-reliant**. India **still imports a significant proportion** of high-end devices, though domestic production is being ramped up under the PLI scheme.

Mains Model Question:

Q. Discuss the significance of the Atmanirbhar Bharat initiative in transforming India's pharmaceutical and medical devices sector. Examine the key government schemes introduced to achieve self-reliance in this domain.

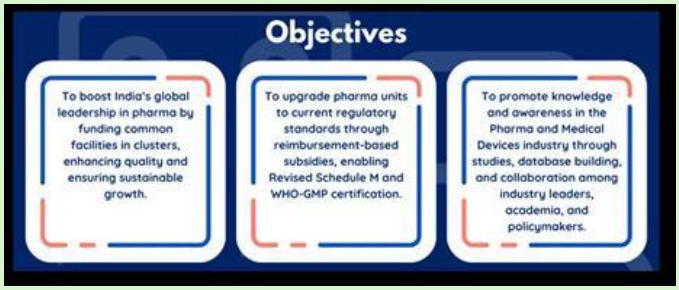
The Atmanirbhar Bharat initiative has emerged as a cornerstone of India's strategy to enhance self-reliance across critical sectors, with the pharmaceutical and medical devices industries receiving focused attention. India, already known as the "Pharmacy of the World," has further solidified its global standing through targeted policy interventions that aim to reduce import dependence, boost domestic manufacturing, and promote innovation.



One of the flagship interventions has been the Production Linked Incentive (PLI) Scheme, launched to incentivize companies to scale up production of complex generics, biopharmaceuticals, and high-value drugs. The scheme encourages investments in advanced technology and infrastructure, fostering both quantity and quality in drug manufacturing. Under its pharmaceutical component, 55 firms were selected to manufacture products across three broad categories, including biopharmaceuticals, patented/off-patented drugs, and Active Pharmaceutical Ingredients (APIs).

To further reduce reliance on imports, particularly for raw materials like APIs and Key Starting Materials (KSMs), the government launched a dedicated PLI scheme for bulk drugs. Complementing this, the Promotion of Bulk Drug Parks scheme seeks to provide world-class infrastructure and reduce production costs through shared facilities. These efforts are instrumental in achieving import substitution and securing the pharmaceutical supply chain.

In the medical devices segment, which is often import-driven, the PLI scheme aims to foster domestic manufacturing of high-end products, including cancer diagnostics, imaging systems, and implants. By offering financial incentives based on incremental sales, the scheme encourages scale and competitiveness.



Additionally, the Pradhan Mantri Bhartiya Janaushadhi Pariyojana plays a vital role in ensuring access to affordable generic medicines, particularly in underserved regions. These combined efforts under Atmanirbhar Bharat not only aim for self-sufficiency but also position India as a responsible and reliable global supplier, contributing to global health security.

Topic : **Rainfall in India**

Relevance : GS Paper 1 Geography

Source : The Hindu

Context :

Rainfall plays a **crucial role in India's agriculture, economy, ecology, and water resources**. The country's rainfall distribution is marked by stark regional and temporal variation. This pattern is primarily governed by the **monsoon system**, which is increasingly being influenced by **anthropogenic factors such as climate change, aerosol loading, and land-use changes**. A recent study using satellite-based GSMaP-ISRO data has revealed notable changes in rainfall patterns across India in the past decade (2011–2020), particularly in terms of **rainfall intensity and timing**.

Study finds a shift in peak time of maximum rainfall

The peak time of maximum rainfall in the Indo-Gangetic Plain has advanced by two-four hours during 2011-2020, the peak time of maximum rainfall has delayed by one-two hours in the west-central Indian region

R. Prasad

A study that examined the spatial rainfall trends across India has found that the amount of rainfall per day in certain parts of India has increased during the last decade, 2011-20, compared with the previous decade (2001-2010), while certain other parts have witnessed a reduction in the rainfall amount. The study has used the GSMaP-ISRO data to arrive at this conclusion. The study has also found that the timing of peak rainfall has shifted in different ways across certain Indian regions during the last decade (2011-2020) compared with the earlier decade (2001-2010).

The study, which has been published in the *Geophysical Research Letters* on March 17, 2025, used the GSMaP-ISRO data; GSMaP stands for Global Satellite Mapping of Precipitation. "The GSMaP-ISRO is a precipitation product specifically for the Indian subcontinent, which was developed through an agreement between ISRO and the Japan Aerospace Exploration Agency (JAXA)". Precipitation data from GSMaP-ISRO are available from March 2000 onwards and are available at a very fine resolution of 0.1 x 0.1 degree latitude/longitude grid with a temporal resolution of one hour.

The study found that west-central India experienced a slight increase in rainfall during the last decade (2011-2020) compared to the previous decade (2001-2010). The increase in rainfall in the west-central region during the period 2011-2020 was around 2 mm per day. Besides the west-central region, the Indo-Gangetic Plain and the southernmost parts of the country had also experienced slightly increased rainfall per day. In contrast, the eastern region received slightly less rainfall of about 1 mm per day during the period 2011-2020. The scenario was different during the previous decade. From 2001 to 2010, the northeastern and eastern parts experienced 1-2 mm more rainfall per day, while southern and central regions faced a decline. "Though the Indo-Gangetic Plain and the southernmost parts of the country experienced slightly more rainfall per day, it was less than what the west-central region had received," says Dr. Kandula V. Subrahmanyam from the National Remote Sensing Center (NRSC), ISRO, Hyderabad, and the corresponding author of the paper.

The slight increase in daily rainfall over the west-central region appears to be linked to increased vegetation. The study found an increase in spatial vegetation cover over west-central India during the last decade compared with the previous decade. The increase in vegetation cover over west-central India is reflected in the increase in the average normalised difference vegetation index (NDVI) value from around 0.2 to 0.4. NDVI is used for quantifying vegetation greenness and is useful in understanding vegetation density. "The time series of NDVI in west-central India, where the rainfall is increasing, shows a significant increase in vegetation growth over time," he says. "Increased vegetation leads to increased transpiration by plants, which releases water vapour into the atmosphere. During the summer monsoon period, the evapotranspiration process occurring because of vegetation plays a crucial role."

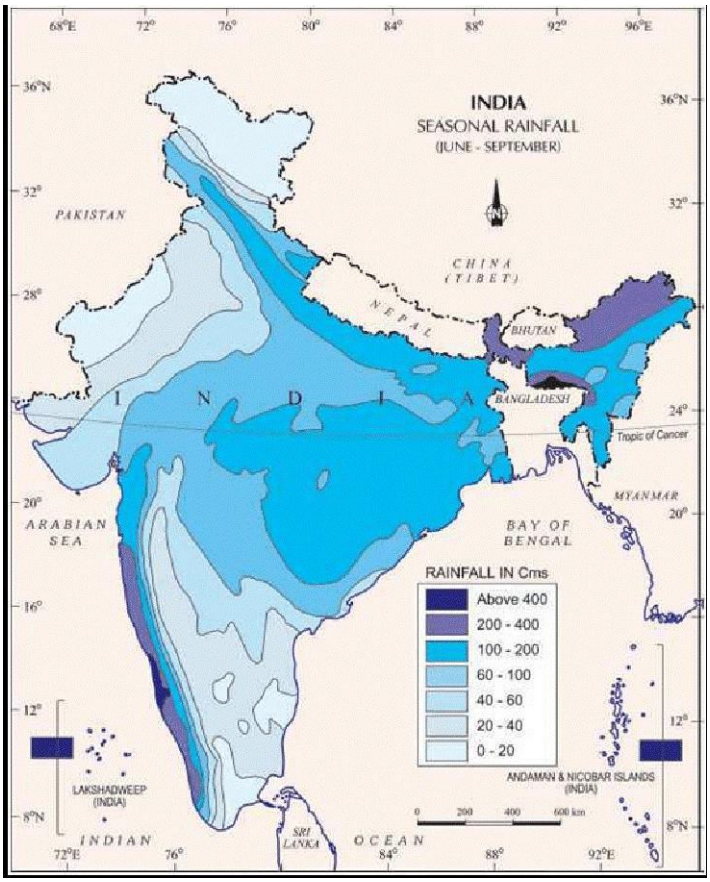
Along with an increase in vegetation cover, there has been a significant increase in soil moisture content over west-central India in the recent decade (2011-2020) compared with the previous period (2001-2010), while the eastern region showed a notable decrease during the same period. Like increased vegetation, an increase in soil moisture content is also strongly and positively correlated with rainfall.

"Another important aspect uncovered by our study is the shift in the timing of maximum precipitation or peak time of maximum rainfall during a 24-hour period," Dr. Subrahmanyam says. "In general, the peak time of maximum rainfall in the Arabian Sea and the Bay of Bengal is in the morning, while in the case of inland, the peak time of maximum rainfall is in the afternoon." The study found that compared with the previous decade, the peak time of maximum rainfall in the Indo-Gangetic Plain has advanced by two-four hours, while in the west-central region, the peak time of maximum rainfall has been delayed by one-two hours.

The occurrence and timing of maximum rainfall is influenced by the changes in the amount of aerosols or aerosol loading. "In the case of the Indo-Gangetic Plain, aerosol loading is high compared with the west-central region. More aerosol loading leads to early peaking of rainfall," says Dr. Subrahmanyam.

Previous studies have shown that in polluted conditions, heavy rainfall peaks earlier, and the maximum rainfall peaks approximately six hours earlier compared to clean days in Beijing. "Higher aerosol loading may be responsible for the early peak rainfall over the Indo-Gangetic Plain, while the relatively lower aerosol causing late peak rainfall over west-central India during the last decade (2011-2020)," he says.

Types of Monsoon in India



India's rainfall is predominantly driven by two major monsoon systems and associated weather phenomena. These are seasonal winds that change direction due to differential heating of land and sea.

1. **Southwest Monsoon (June–September)**

- This is the **primary monsoon** season in India, contributing **over 75% of the country's annual rainfall**.
- The winds blow from the **southwest to northeast**, carrying moisture-laden air from the Indian Ocean and Arabian Sea.
- It has two major branches:
  - **Arabian Sea Branch**: Strikes the Western Ghats, causing heavy rainfall on the windward side (e.g., Kerala, Karnataka, Maharashtra).
  - **Bay of Bengal Branch**: Moves northeastward toward West Bengal and the northeastern states, curving to cover northern India.
- Crucial for **Kharif agriculture**.

2. **Northeast Monsoon (October–December)**

- Predominantly affects **southeastern India**, particularly **Tamil Nadu, parts of Andhra Pradesh, and southern Karnataka**.
- Winds blow from **northeast to southwest**, picking up moisture from the Bay of Bengal.
- Provides a **secondary rainfall peak** for some regions, especially Tamil Nadu.

3. **Pre-Monsoon Showers (March–May)**

- Known as **mango showers** in the south and **Kalbaisakhis** (Nor'westers) in the northeast.
- Caused by local convectional currents and occasional cyclonic activity.
- Important for **preparing the soil** before sowing Kharif crops.

4. **Post-Monsoon and Winter Rainfall (December–February)**

- Caused by **Western Disturbances**, extra-tropical storms originating from the Mediterranean.
- Affects **Northwest India** and parts of the Indo-Gangetic Plain.
- Significant for **Rabi crops** like wheat.

Key Findings from the Study: 2011–2020 vs 2001–2010

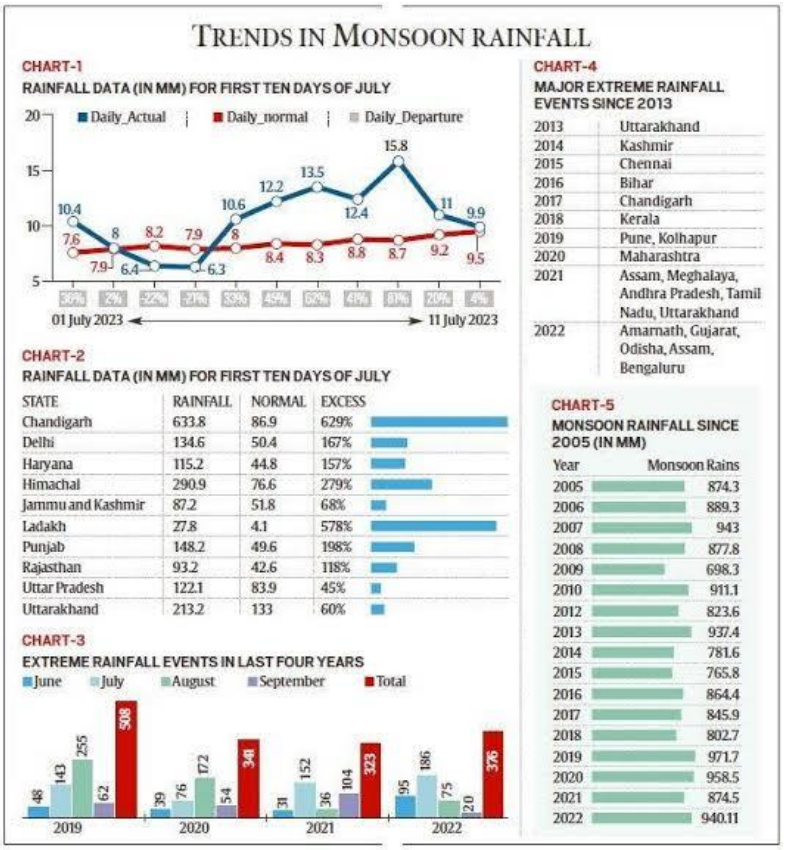
A study published in *Geophysical Research Letters* on March 17, 2025, analyzed **spatial and temporal rainfall variations** using the **GSMaP-ISRO dataset**, a high-resolution precipitation product for the Indian subcontinent developed by ISRO and JAXA.

Changes in Daily Rainfall Intensity

- **West-Central India** experienced a **notable increase (~2 mm/day)** in average daily rainfall during 2011–2020 compared to 2001–2010.
- The **Indo-Gangetic Plain** and **southernmost regions** also saw **slightly increased daily rainfall**, though less than in the west-central region.
- **Eastern India**, including parts of Odisha, Jharkhand, and Bihar, **witnessed a decline** in daily rainfall (~1 mm/day).
- In contrast, during 2001–2010, the **northeastern and eastern regions** received **1–2 mm more rainfall per day**, whereas the southern and central areas were relatively drier.

Shift in Peak Time of Maximum Rainfall

- The **timing of peak rainfall during the day** has shifted in contrasting directions:
  - **Indo-Gangetic Plain**: Peak rainfall time has **advanced by 2–4 hours** (now occurring earlier in the day).
  - **West-Central India**: Peak rainfall time has **delayed by 1–2 hours** (occurring later in the day).
- Over **coastal areas** such as the Arabian Sea and Bay of Bengal, the **morning remains the peak period**, while **inland areas** generally see peak rainfall in the **afternoon**.



Influencing Factors Behind the Changes

Vegetation Cover and Soil Moisture

- An important correlation was found between **increased vegetation** and **higher rainfall** in the west-central region.
- The **Normalized Difference Vegetation Index (NDVI)** rose from **0.2 to 0.4**, indicating a **significant increase in greenery**.

- More vegetation means **increased transpiration**, which releases moisture into the atmosphere and **enhances local rainfall** through the **evapotranspiration cycle**.
- This region also saw a **rise in soil moisture content**, which further supports **local rainfall formation**, reinforcing a **positive feedback loop**.

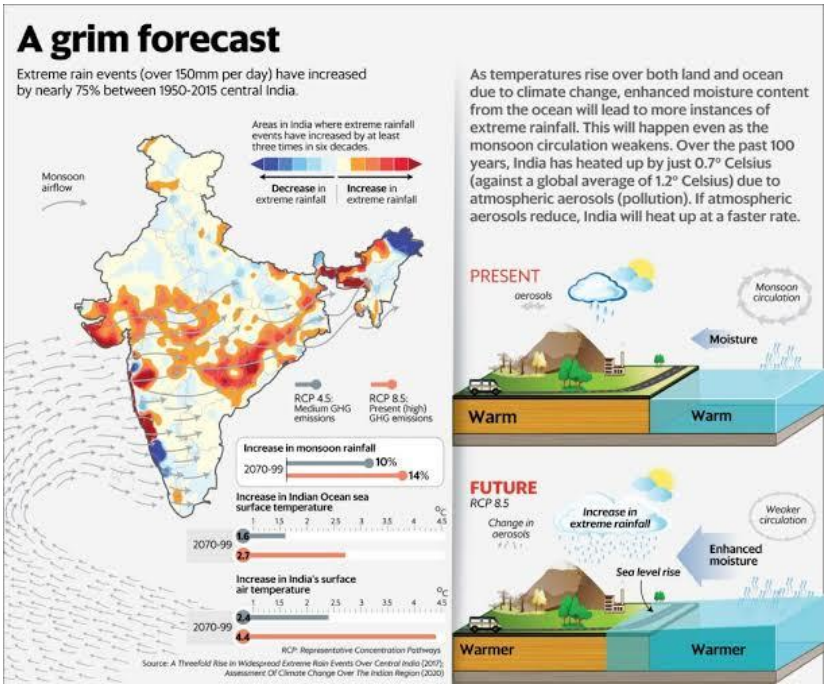
Aerosol Loading and Pollution

- **Aerosol particles** (such as dust, soot, and pollutants) influence cloud formation and rainfall timing.
- The **Indo-Gangetic Plain** has **higher aerosol concentrations**, which leads to **earlier condensation and rainfall peaking**.
- In contrast, **lower aerosol loading** in the west-central region **delays cloud development and rainfall**.
- Past research in cities like Beijing has shown that under **polluted conditions**, peak rainfall can **occur up to six hours earlier** compared to cleaner environments.

Geographical Impacts and Implications

Agricultural Patterns

- Changes in **rainfall intensity and timing** directly affect **sowing and harvesting cycles**, especially in **rainfed areas**.
- **Early or late peak rainfall** can damage crops if it doesn't align with **agricultural calendars**.
- **Crop failure risk** increases with unpredictable rainfall, threatening **food security**.

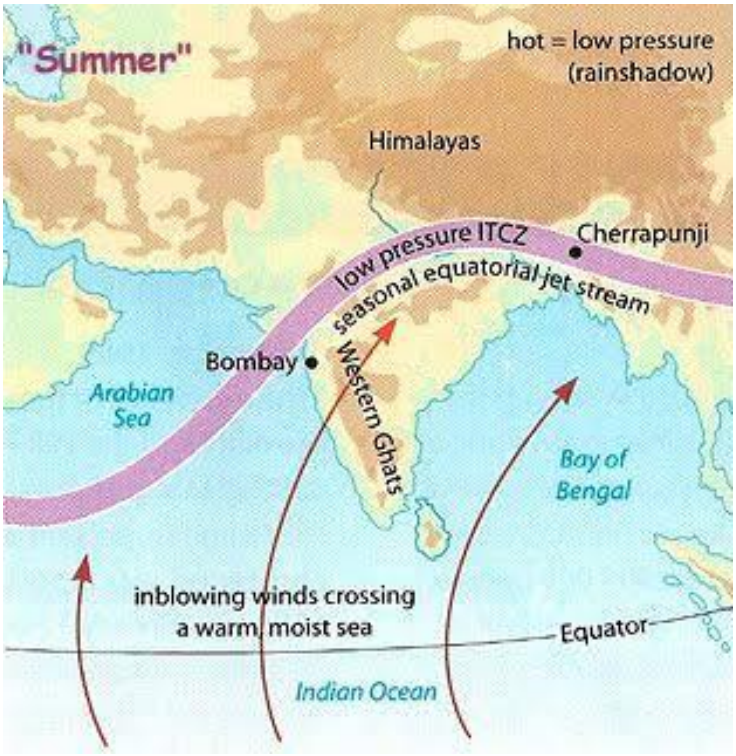


Hydrological Consequences

- Regions experiencing **increased daily rainfall** may face **flash floods, soil erosion, and dam overflows**.
- Areas witnessing a **decline in rainfall** could see **groundwater depletion, dry spells, and desertification** risks.

Urban Flooding and Infrastructure Stress

- The **temporal concentration of rainfall** (more rain in less time) in urban areas like Mumbai or Delhi can cause **drainage failures**, **traffic paralysis**, and **property damage**.
- A **shift in peak rainfall time** also affects urban preparedness, which is often based on past climatological norms.



Climate Adaptation and Policy Planning

- These findings highlight the **need to revise regional climate models and early warning systems**.
- Policymakers must focus on **land use regulation, afforestation, water conservation**, and **climate-resilient infrastructure**.
- Encouraging **sustainable agriculture** and **monitoring aerosol emissions** is critical.

Prelims Practice Question

Q. With reference to recent findings on rainfall patterns in India during the decade 2011–2020, consider the following statements:

1. The west-central region of India experienced a decrease in daily rainfall compared to the previous decade (2001–2010).
2. The peak time of maximum rainfall advanced by 2–4 hours in the Indo-Gangetic Plain during 2011–2020.
3. Increased vegetation and soil moisture are positively correlated with increased rainfall.
4. High aerosol loading causes a delay in the peak time of rainfall.

Which of the statements given above are correct?

A. 2 and 3 only
B. 1, 2 and 4 only
C. 2, 3 and 4 only
D. 1 and 4 only

Answer: A. 2 and 3 only

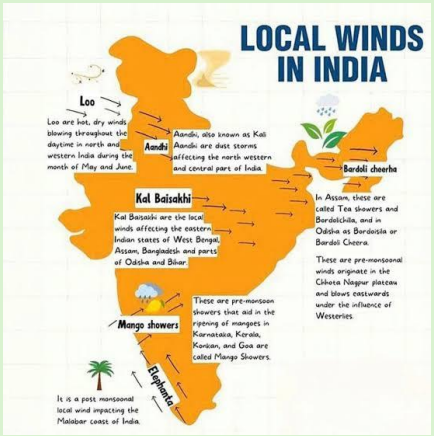
Explanation:

- **Statement 1 – Incorrect**: The west-central region **experienced an increase**, not a decrease, in daily rainfall (~2 mm/day more in 2011–2020).
- **Statement 2 – Correct**: The **peak time of maximum rainfall advanced by 2–4 hours** in the Indo-Gangetic Plain.
- **Statement 3 – Correct**: The study found a **positive correlation** between increased vegetation/soil moisture and increased rainfall.
- **Statement 4 – Incorrect**: **High aerosol loading leads to early peaking**, not a delay, in rainfall. It causes **earlier condensation and precipitation**.

Mains Model Question

Q. Discuss the recent changes in spatial and temporal rainfall patterns in India as observed during the decade 2011–2020. What are the possible causes and implications of such changes on agriculture and water resource management?

Recent satellite-based studies, particularly using the GSMaP-ISRO dataset, have revealed significant spatial and temporal shifts in rainfall patterns across India during the decade 2011–2020. One of the most notable findings is the variation in daily rainfall intensity across regions. The west-central region, including parts of Madhya Pradesh and Maharashtra, experienced a rise in daily rainfall by approximately 2 mm, while the Indo-Gangetic Plain and southernmost parts of India saw marginal increases. Conversely, the eastern region, particularly areas like Odisha and Bihar, witnessed a decline in average rainfall.



Temporal changes in rainfall have also been observed, especially in the timing of peak rainfall within a 24-hour cycle. In the Indo-Gangetic Plain, the peak time advanced by 2–4 hours, while in the west-central region, it was delayed by 1–2 hours. These shifts are influenced by various climatic and anthropogenic factors. Increased vegetation cover and higher soil moisture in the west-central region have led to enhanced local evapotranspiration, promoting more rainfall. In contrast, higher aerosol concentrations in the Indo-Gangetic region contribute to earlier rainfall peaking due to increased cloud condensation nuclei.

These changes have critical implications. In agriculture, altered rainfall timing and intensity can disrupt sowing and harvesting cycles, especially in rainfed areas. Premature or delayed rainfall can also result in crop failure, affecting food security. In water resource management, regions receiving concentrated rainfall may face flooding and soil erosion, while those with declining rainfall risk groundwater depletion and prolonged dry spells. Overall, these findings underscore the urgency to adapt agricultural practices, update irrigation infrastructure, and implement climate-resilient planning to address the evolving monsoon behavior and its cascading impacts on India's ecology and economy.

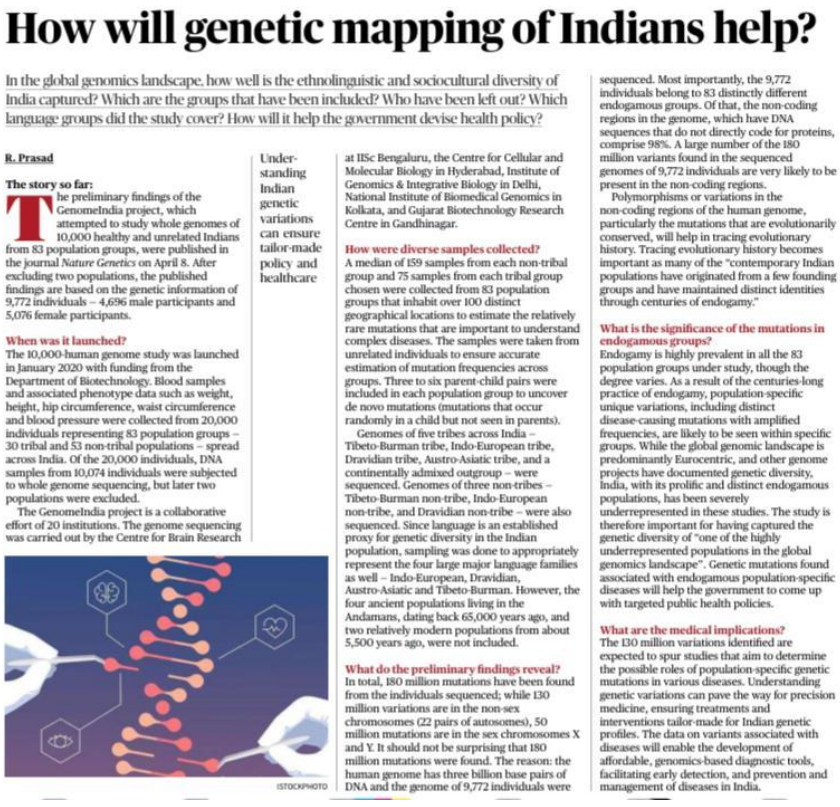
Topic : **DNA Mapping and Genome Sequencing in India**

Relevance : GS Paper 3 Science and Technology

Source : The Hindu

Context :

DNA mapping, or genome sequencing, refers to the process of determining the complete DNA sequence of an organism's genome at a single time. In humans, this involves identifying the sequence of all the nucleotide bases — adenine (A), cytosine (C), guanine (G), and thymine (T) — across the three billion base pairs that make up human DNA.



How will genetic mapping of Indians help?

In the global genomics landscape, how well is the ethnolinguistic and sociocultural diversity of India captured? Which are the groups that have been included? Who have been left out? Which language groups did the study cover? How will it help the government devise health policy?

R. Prasad

Understanding Indian genetic variations can ensure tailor-made policy and healthcare

The story so far:

The preliminary findings of the GenomeIndia project, which attempted to study whole genomes of 10,000 healthy and unrelated Indians from 83 population groups, were published in the journal *Nature Genetics* on April 8. After excluding two populations, the published findings are based on the genetic information of 9,772 individuals – 4,696 male participants and 5,076 female participants.

When was it launched?

The 10,000-human genome study was launched in January 2020 with funding from the Department of Biotechnology. Blood samples and associated phenotype data such as weight, height, hip circumference, waist circumference and blood pressure were collected from 20,000 individuals representing 83 population groups – 30 tribal and 53 non-tribal populations – spread across India. Of the 20,000 individuals, DNA samples from 10,074 individuals were subjected to whole genome sequencing, but later two populations were excluded.

The GenomeIndia project is a collaborative effort of 20 institutions. The genome sequencing was carried out by the Centre for Brain Research at IISc Bengaluru, the Centre for Cellular and Molecular Biology in Hyderabad, Institute of Genomics & Integrative Biology in Delhi, National Institute of Biomedical Genomics in Kolkata, and Gujarat Biotechnology Research Centre in Gandhinagar.

How were diverse samples collected?

A median of 159 samples from each non-tribal group and 75 samples from each tribal group chosen were collected from 83 population groups that inhabit over 100 distinct geographical locations to estimate the relatively rare mutations that are important to understand complex diseases. The samples were taken from unrelated individuals to ensure accurate estimation of mutation frequencies across groups. Three to six parent-child pairs were included in each population group to uncover de novo mutations (mutations that occur randomly in a child but not seen in parents).

Genomes of five tribes across India – Tibeto-Burman tribe, Indo-European tribe, Dravidian tribe, Austro-Asiatic tribe, and a continentally admixed outgroup – were sequenced. Genomes of three non-tribes – Tibeto-Burman non-tribe, Indo-European non-tribe, and Dravidian non-tribe – were also sequenced. Since language is an established proxy for genetic diversity in the Indian population, sampling was done to appropriately represent the four large major language families as well – Indo-European, Dravidian, Austro-Asiatic and Tibeto-Burman. However, the four ancient populations living in the Andamans, dating back 65,000 years ago, and two relatively modern populations from about 5,500 years ago, were not included.

What do the preliminary findings reveal?

In total, 180 million mutations have been found from the individuals sequenced; while 130 million variations are in the non-sex chromosomes (22 pairs of autosomes), 50 million mutations are in the sex chromosomes X and Y. It should not be surprising that 180 million mutations were found. The reason: the human genome has three billion base pairs of DNA and the genome of 9,772 individuals were sequenced. Most importantly, the 9,772 individuals belong to 83 distinctly different endogamous groups. Of that, the non-coding regions in the genome, which have DNA sequences that do not directly code for proteins, comprise 98%. A large number of the 180 million variants found in the sequenced genomes of 9,772 individuals are very likely to be present in the non-coding regions.

Polymorphisms or variations in the non-coding regions of the human genome, particularly the mutations that are evolutionarily conserved, will help in tracing evolutionary history. Tracing evolutionary history becomes important as many of the "contemporary Indian populations have originated from a few founding groups and have maintained distinct identities through centuries of endogamy."

What is the significance of the mutations in endogamous groups?

Endogamy is highly prevalent in all the 83 population groups under study, though the degree varies. As a result of the centuries-long practice of endogamy, population-specific unique variations, including distinct disease-causing mutations with amplified frequencies, are likely to be seen within specific groups. While the global genomic landscape is predominantly Eurocentric, and other genome projects have documented genetic diversity, India, with its prolific and distinct endogamous populations, has been severely underrepresented in these studies. The study is therefore important for having captured the genetic diversity of "one of the highly underrepresented populations in the global genomics landscape". Genetic mutations found associated with endogamous population-specific diseases will help the government to come up with targeted public health policies.

What are the medical implications?

The 130 million variations identified are expected to spur studies that aim to determine the possible roles of population-specific genetic mutations in various diseases. Understanding genetic variations can pave the way for precision medicine, ensuring treatments and interventions tailor-made for Indian genetic profiles. The data on variants associated with diseases will enable the development of affordable, genomics-based diagnostic tools, facilitating early detection, and prevention and management of diseases in India.

ISTOCKPHOTO

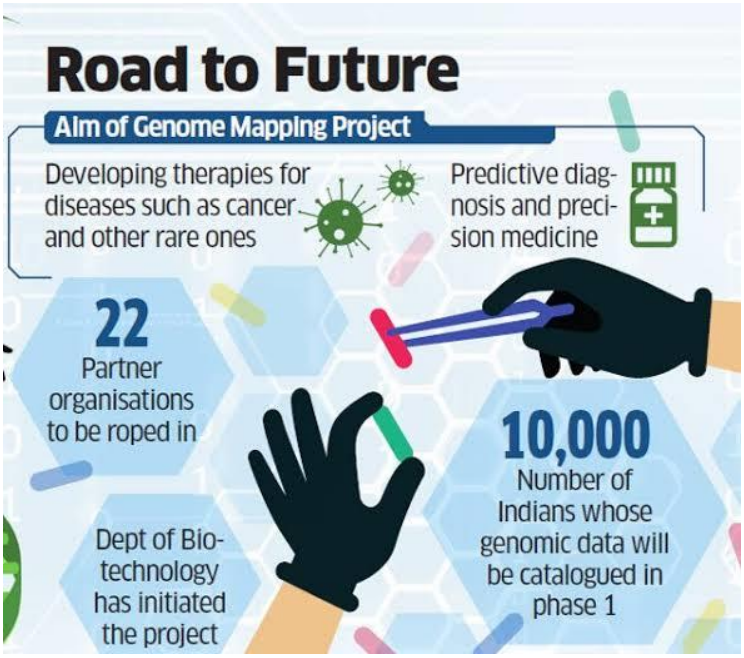
Genome sequencing provides crucial insights into the genetic structure, hereditary diseases, evolutionary origins, and susceptibility to illnesses. In a country like India, which is characterized by **immense ethnic, linguistic, and cultural diversity**, genome sequencing becomes particularly significant because of the presence of hundreds of **endogamous groups** — communities that have practiced intra-group marriage for centuries, leading to unique genetic variations.

The GenomeIndia Project: Objectives and Methodology

The **GenomeIndia Project**, launched in January 2020 by the **Department of Biotechnology (DBT)**, is a landmark initiative aimed at mapping the genetic diversity of the Indian population. Its core objective is to

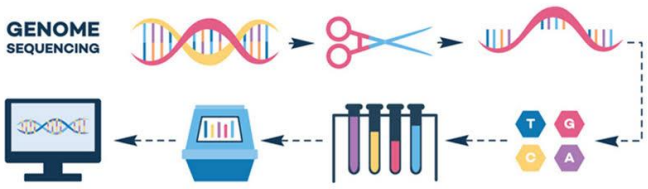
sequence the **whole genomes of 10,000 healthy and unrelated individuals** representing India's diverse population groups, including tribal and non-tribal communities.

Key elements of the study:



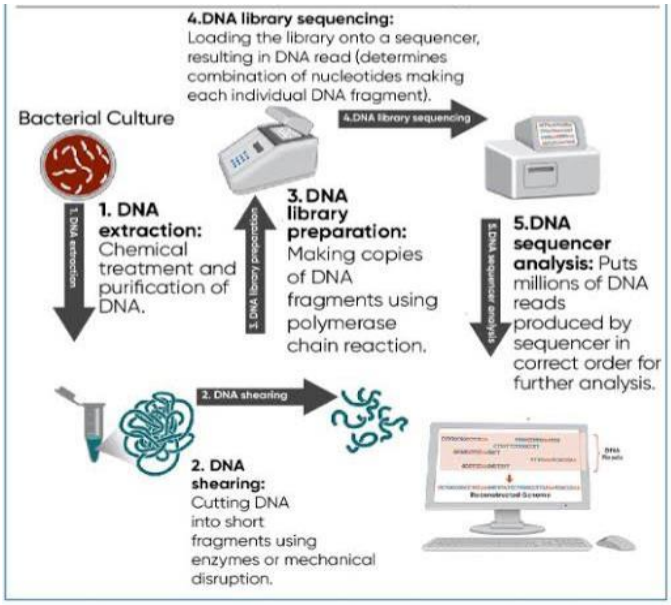
- **Collaborative effort by 20 Indian institutions** including IISc Bengaluru, CCMB Hyderabad, NIBMG Kolkata, IGIB Delhi, and GBRC Gandhinagar.
- Samples collected from **83 population groups** (30 tribal and 53 non-tribal).
- Focus on **ethnolinguistic and geographic diversity**, covering over 100 distinct regions.
- Representation of major language families: **Indo-European, Dravidian, Tibeto-Burman, Austro-Asiatic**.
- Special attention given to **parent-child pairs** to identify *de novo* mutations (those not inherited from parents but arising spontaneously).
- Whole genome sequencing conducted on **9,772 individuals** after filtering out incomplete or inconsistent samples.

Significant Findings

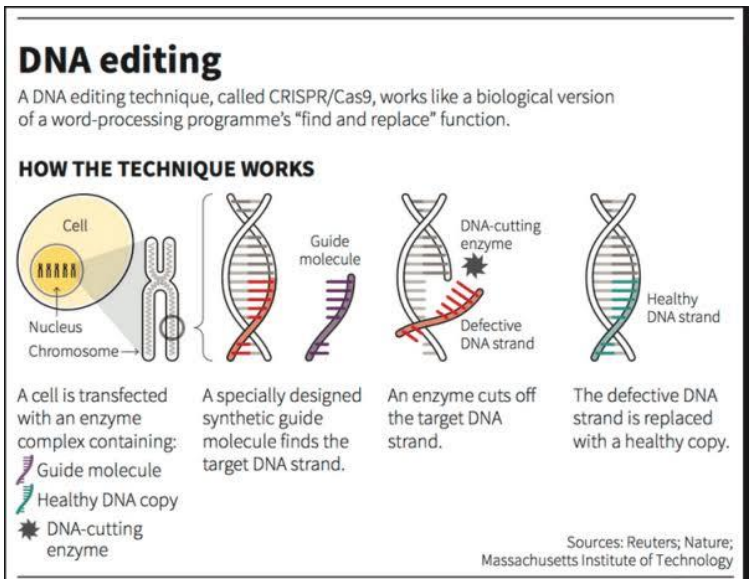


1. **Discovery of 180 Million Genetic Variants**:
   - 130 million mutations found in non-sex chromosomes.
   - 50 million in sex chromosomes (X and Y).
   - A large percentage of these mutations are located in **non-coding regions** of DNA, which do not produce proteins but play vital regulatory roles.
2. **High Degree of Endogamy**:
   The study reveals that most Indian communities maintain **distinct endogamous identities**, which has led to population-specific mutations. These mutations can increase the frequency of **hereditary diseases** within these groups, making genome mapping essential for public health planning.
3. **Evolutionary Insights**:
   Variations found in non-coding but evolutionarily conserved regions can trace the **ancestral origins and migration patterns** of Indian populations. The genetic footprints of tribal groups like the Austro-Asiatic and Dravidian tribes help us understand deep-rooted histories of Indian civilization.

Medical and Public Health Implications



- **Precision Medicine**:
  Understanding genetic variants specific to Indian sub-populations can enable **personalized treatments** based on individual genetic profiles, particularly for diseases like diabetes, cancer, cardiovascular disorders, and rare genetic conditions.
- **Affordable Diagnostics**:
  The data collected can lead to the development of **genomics-based diagnostic tools** that are inexpensive and specific to Indian genetic contexts. Early detection and intervention become possible for many inherited diseases.
- **Targeted Health Policies**:
  By identifying population-specific disease susceptibilities, the government can design **region-specific health schemes**, vaccination drives, and awareness campaigns. This is critical in tribal areas and rural populations with distinct genetic traits.
- **Preventive Healthcare**:
  Data can help create **genetic risk profiles** for communities, facilitating early lifestyle modifications, medical surveillance, and preventive strategies, thus reducing long-term health costs.



Why India's Genetic Mapping is Crucial Globally

Historically, global genomics studies have been **Eurocentric**, underrepresenting populations from Asia, Africa, and Latin America. The GenomeIndia project addresses this imbalance by documenting the **unique and underrepresented genetic diversity** of India — a country with over 1.4 billion people and a complex history of migrations, admixtures, and endogamy.

Such a comprehensive genetic repository can:

- Contribute to **global genomic databases**.
- Enable **international collaboration** in disease control and research.
- Help understand how **genetic factors interact with environment and lifestyle**, especially in the Indian context.

Major Government Initiatives in Genomics and Genetic Research

1. **GenomeIndia Initiative (2020)**:
   Flagship initiative under DBT, sequencing 10,000 genomes from diverse population groups to build a comprehensive genetic map of India.
2. **IndiGen Programme (2019)**:
   Launched by the **Council of Scientific and Industrial Research (CSIR)**, the programme sequenced genomes of 1,008 Indians to develop **clinical applications** in predictive and preventive healthcare.
3. **National Biopharma Mission**:
   Promotes development of **biologics and diagnostics** using genomics and bioinformatics to boost India's healthcare sector.
4. **Biobank and Genomic Repositories**:
   Establishment of **biobanks** across research institutions to store and catalogue genetic data and biological samples for future research and drug discovery.
5. **Human Genome Variation Consortium**:
   Earlier efforts to understand human genetic variation across Indian populations, laying the groundwork for GenomeIndia.

Prelims Practice Question:
Q. With reference to the GenomeIndia Project, consider the following statements:

1. It aims to sequence the genomes of 10,000 individuals from diverse ethnic and geographical backgrounds across India.
2. The project excludes tribal populations to maintain homogeneity in genetic data.
3. One of the objectives is to identify genetic mutations specific to Indian population groups for improved healthcare planning.
4. GenomeIndia is an initiative solely implemented by the Indian Council of Medical Research (ICMR).

Which of the above statements are correct?

A. 1 and 3 only
B. 1, 2 and 3 only
C. 1 and 2 only
D. 2 and 4 only

Answer: A. 1 and 3 only

Explanation:

- **Statement 1 is correct:** The GenomeIndia Project aims to sequence 10,000 genomes from across India's diverse populations including tribal and non-tribal groups.

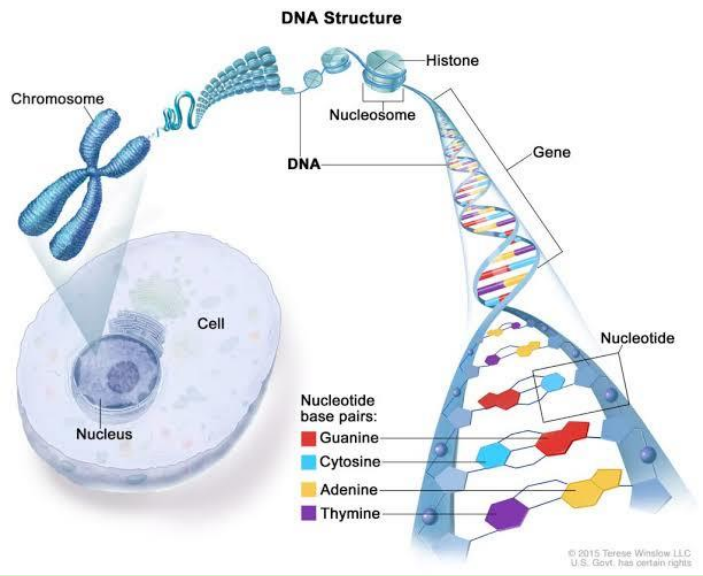
- **Statement 2 is incorrect:** The project specifically includes tribal populations to capture India's genetic diversity.
- **Statement 3 is correct:** A key goal is to identify population-specific mutations to aid in disease prediction, diagnosis, and health policy.
- **Statement 4 is incorrect:** The project is coordinated by the Department of Biotechnology and implemented through a consortium of 20 institutions, not solely by ICMR.

Mains Model Question:

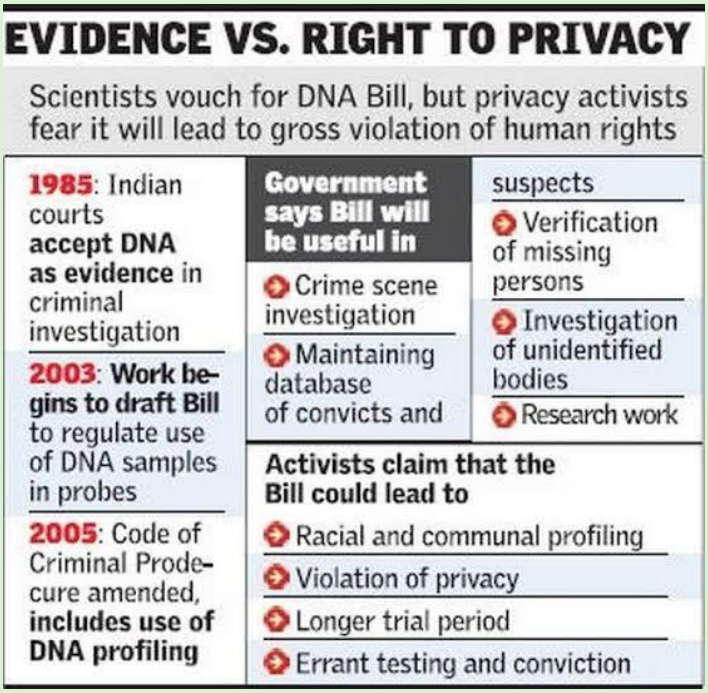
Q. Examine the significance of the GenomeIndia Project and its potential impact on public health policy in India. Discuss the role of genetic diversity in understanding complex diseases and how the project will help address population-specific health issues.

The GenomeIndia Project, launched in 2020, is a pioneering initiative aimed at sequencing the genomes of 10,000 individuals from diverse ethnic and geographical backgrounds across India. The project stands out for its inclusive approach, incorporating 83 distinct population groups, including both tribal and non-tribal communities. This is crucial as India is home to immense ethnolinguistic and genetic diversity, which has been largely underrepresented in global genomics studies.

The significance of this project lies in its potential to identify genetic mutations specific to the Indian population, which are often overlooked in Western-centric genomic research. India's population has a high degree of endogamy, leading to the prevalence of unique genetic variations that can be linked to both common and rare diseases. The data generated from sequencing 10,000 genomes will provide insights into the mutations that play a key role in the susceptibility to diseases such as diabetes, cardiovascular conditions, and various cancers. This, in turn, can lead to the development of more accurate diagnostic tools and personalized treatments tailored to the genetic makeup of Indian individuals.



Moreover, the GenomeIndia Project will enable the government to formulate targeted public health policies. By identifying population-specific health risks, policymakers can devise more effective prevention strategies, ensuring that healthcare resources are directed to areas where they are most needed. It can also help in the development of affordable genomics-based diagnostic tools, which are crucial for early detection, timely interventions, and the management of diseases. This project is poised to play a critical role in shaping India's health policy, aligning it with the genetic needs of its diverse population and helping address long-standing healthcare challenges with precision medicine.



GenomeIndia Project is a vital step towards integrating genomics into India's healthcare framework, ensuring better healthcare outcomes through precision medicine and data-driven policies.

Topic : Iran's Nuclear Programme and Stance

Relevance : GS Paper 2 International Relaions

Source : Indian Express

Context :

Initial Purpose: Iran's nuclear programme, which began as a peaceful initiative for energy production and

An atomic tug of war

Iran's nuclear programme

Iran, which has come under increasing pressure since the start of the Gaza war, has taken up the offer for talks put forth by U.S. President Donald Trump, who has threatened military action in combination with Israel, if those discussions were to fail

Yasudevan Mukunth
Stanly Johny

The U.S. and Iran have started talks about the latter's controversial nuclear programme. After Donald Trump, in his first term, unilaterally withdrew the U.S. from the 2015 nuclear deal, officially known as the Joint Comprehensive Plan of Action (JCPOA), Iran had maintained that it would not hold direct talks with the U.S. There were multiple rounds of indirect talks in Vienna after Joe Biden became President in 2021, but those efforts were inconclusive. Iran, in this period, substantially accelerated its nuclear programme.

In recent months, Iran came under increasing pressure – its so-called axis of resistance has been bumbled by Israel, it lost an ally in Syria, and its economy is in serious trouble. As the heat on Iran rose, Mr. Trump offered dialogue. "We can't let Iran have a nuclear bomb," he said last week in a joint press conference at the White House with the visiting Israeli Prime Minister, Benjamin Netanyahu. Faced with the threat of war in a moment of weakness, Iran has agreed to engage the Americans diplomatically.

Iran, a signatory of the Nuclear Non-Proliferation Treaty (NPT), ceased to cooperate with the International Atomic Energy Agency (IAEA) after the 1979 revolution. Ever since, the Islamic Republic faced allegations that it has been pursuing a clandestine nuclear programme. In 2022, the IAEA launched an investigation into Iran's alleged nuclear activities. In November 2011, the agency reported that Iran appeared to have worked on designing an atom bomb. Iran has always maintained that its nuclear programme was for peaceful purposes. But its critics pointed to its stockpile of highly enriched uranium as evidence of the country's clandestine designs.

Iran's uranium enrichment story, however, is a long, complex one.

In natural settings, U-235, the uranium isotope that can sustain nuclear fission chain reactions, makes up around 0.7% of uranium. The rest is U-238. Before its use in nuclear settings, uranium is enriched to increase the concentration of U-235. Both low-enriched uranium (LEU) and high-assay low-enriched uranium (HALEU) are enriched up to 20% for use in different kinds of nuclear reactors. Highly enriched uranium (HEU) refers to enrichment beyond 20%. Weapons-grade uranium is typically 90% or more.

Centrifuges are the world's enrichment technology of choice. These containers spin their contents at several thousand revolutions per minute. Because U-238 is slightly denser than U-235, the centrifugal force pushes it more towards the periphery. The feed is uranium hexafluoride (UF6) gas. Enrichment facilities have hundreds or thousands of centrifuges operating in cascades, with each cascade accepting as its feed the output of the previous cascade. At each step, more-enriched UF6 is passed to the next while the rest, called tails, is recycled or processed for long-term storage. Each centrifuge's enrichment service is measured in separative work units (SWUs). Depending on the centrifuge design, producing 1 kg of weapons-grade uranium from natural uranium may need around 250 SWUs.

In 2006, Iran enriched uranium to about 3.5% using 164 IR-1 centrifuges, each of which delivers around 0.8 SWU/year. In 2010, the IAEA confirmed that Iran had enriched uranium to 19.75% at the Natanz Fuel Enrichment Plant and in 2012 at the Fordow plant. By 2013, the country had a stockpile of about 7.6 tonnes of 3.5% LEU and 0.2 tonnes of 19.75% LEU gas.

Terms of the original deal

The 2015 Iran nuclear deal (JCPOA), between Tehran, the five permanent members of the UN Security Council, and the European Union, provided a short-lived solution to the nuclear crisis. The deal promised to remove international sanctions on Iran in return for the country removing most of its centrifuges, limiting enrichment to 3.67%, and capping its LEU stockpile at 300 kg, among other measures. Iran was fully compliant with the terms when Mr. Trump pulled the U.S. out of it in May 2018 and reimposed sanctions on Tehran. Iran has since accelerated its nuclear programme breaching the agreement, which saw the country enriching uranium to 60% at its plants.

This is crucial. If 126 SWUs are required to enrich uranium from 0.7% such that it yields 1 kg of 60% HEU plus 0.3% tails, only 2.2 SWUs are required to enrich 60% HEU to 1 kg of 90% weapons-grade level plus 20% tails (which is higher at higher enrichment). In other words, 60% HEU will have completed more than 90% of the work required to produce weapons-grade uranium. According to some estimates, Iran has around 70 kg of 60% HEU, sufficient for five to eight nuclear warheads.

While the number of SWUs decreases with more enrichment, the energy cost skyrockets. But Iran's commitment suggests the centrifuges will not want for power.

Iran Watch has estimated that all centrifuges "presently installed in production mode" in Iran could produce 168-269 kg of 60% high-enriched uranium in "up to two weeks" (assuming 1% tails and 54% feed enrichment). The time to produce enough U-235 for one warhead may thus have dropped from around a year during the JCPOA to a few weeks today.

The IAEA suggests a "significant quantity" of 25 kg per warhead with a blast yield of 20 kilotonnes (to compare, Hiroshima was devastated by a yield of 13-16 kilotonnes). Newer designs could have the same yield with lighter cores. Iran may also assemble more weapons of lower yield.

Iran's centrifuges also raise questions about how quickly it can assemble a bomb. Post-enrichment, engineers must convert the uranium in UF6 to metallic form and machine it into the bomb's core. Second, they need to develop explosives, detonators, arming and firing systems, neutron initiators, explosive lenses, and launch and re-entry vehicles. And they need to conduct tests. The second set can be done in parallel with enrichment, however. According to data from the IAEA and the U.S. Office of the Director of National Intelligence, among others, Iran ran a programme in 1999-2003 during which it also focused on these activities.

Ramifications of talks failure

Harvard University Belfer Center for Science and International Affairs scholar Hui Zhang has written that if Iran's steps towards its first nuclear weapon are like China's in 1964, Iran will need "probably less than three weeks" between gaseous weapons-grade uranium and a bomb.

Thus, Iran may be able to develop a deployable warhead in a matter of months if it decides to do so.

As of now there is no evidence to suggest Iran has made that decision. But Iran's growing stockpile of HEU and shrinking breakout time – the time taken to convert weapons-grade fuel into a bomb – have already set alarm bells ringing in Israel. Tel Aviv has made it clear that it will not hesitate to bomb Iran's nuclear facilities. Mr. Trump has also threatened Iran with military action. But before that, he wants to try the path of diplomacy. If the talks collapse, there would be bombing, he threatened. "If it requires military, we're going to have military. Israel will obviously be very much involved in that – it'll be the leader of that."

Following the breakdown of the JCPOA, Iran has accelerated its nuclear programme, with the country enriching uranium to 60% at its plants. AP

THE GIST

- Iran, a signatory of the Nuclear Non-Proliferation Treaty (NPT), ceased to cooperate with the International Atomic Energy Agency after the 1979 revolution
- The 2015 Iran nuclear deal (JCPOA), between Tehran, the five permanent members of the UN Security Council, and the European Union, provided a short-lived solution to the nuclear crisis. However, Donald Trump, during his first presidency, pulled the U.S. out of the deal in May 2018, and reimposed sanctions on Iran
- Expert says that if Iran's steps towards its first nuclear weapon are like China's in 1964, Iran will need "probably less than three weeks" between gaseous weapons-grade uranium and a bomb

medical purposes, has become a point of contention globally due to concerns over its potential for weaponization.

NPT Signatory: Iran is a signatory of the Nuclear Non-Proliferation Treaty (NPT), which aims to prevent the spread of nuclear weapons. However, its actions, including uranium enrichment to higher levels, have raised alarms about the true purpose of its nuclear ambitions.

The 2015 Iran Nuclear Deal (JCPOA)

- **JCPOA Agreement**: The Joint Comprehensive Plan of Action (JCPOA) was a diplomatic effort to limit Iran's nuclear activities. Iran agreed to restrict uranium enrichment to 3.67%, and the deal included sanctions relief in exchange for compliance.
- **U.S. Withdrawal**: In 2018, President Trump unilaterally withdrew the U.S. from the deal, arguing it was flawed as it didn't address Iran's missile programme and regional destabilizing activities. Following this, Iran began breaching the terms of the agreement, including enriching uranium to levels beyond the agreed limits.

Iran's Uranium Enrichment and Weapons-Grade Potential

The **Joint Comprehensive Plan of Action (JCPOA)** known commonly as the **Iran nuclear deal** or **Iran deal**, is an agreement on the Iranian nuclear program reached in Vienna on 14 July 2015, between Iran and the P5+1 (the five permanent members of the United Nations Security Council—China, France, Russia, United Kingdom, United States—plus Germany) together with the European Union.

Formal negotiations toward JCPOA began with the adoption of the Joint Plan of Action, an interim agreement signed between Iran and the P5+1 countries in November 2013. Iran and the P5+1 countries engaged in negotiations for the next 20 months and in April 2015 agreed on a framework for the final agreement. In July 2015 Iran and the P5+1 confirmed agreement on the plan along with the "Roadmap Agreement" between Iran and the IAEA

- **Enrichment Levels**: Iran's uranium enrichment activities have raised concerns, with the country enriching uranium to 60%, close to weapons-grade levels. While 90% is required for a bomb, the 60% level significantly reduces the time needed for Iran to potentially build a nuclear weapon.
- **Centrifuge Efficiency**: Iran's advanced centrifuges have made its enrichment process faster and more efficient, shortening the time needed to produce enough weapons-grade uranium for a bomb.

Diplomatic Efforts and Military Threats

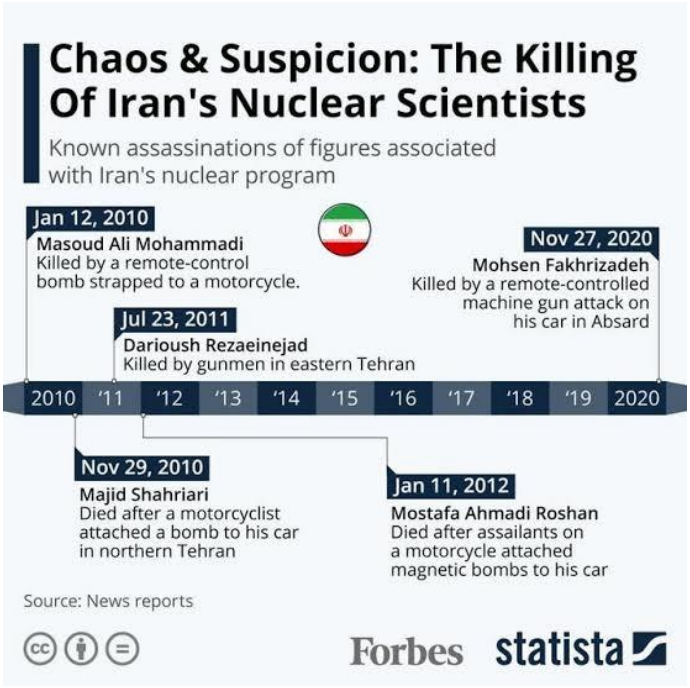
- **Diplomatic Talks**: After the U.S. withdrawal from the JCPOA, there were multiple indirect talks between Iran and the U.S., but these have largely been inconclusive. Diplomatic efforts were revived when President Trump, in a shift from his earlier stance, proposed direct talks. However, the prospect of talks has been complicated by increasing mutual distrust and accusations over non-compliance with the original terms.
- **U.S. Pressure on Iran**: The Trump administration, followed by the Biden administration, has maintained that Iran must return to compliance with the original terms of the JCPOA before sanctions relief could be considered. The U.S. has also threatened military action if diplomatic negotiations fail, particularly following Iran's expansion of its nuclear programme.

- **Iran's Refusal to Meet U.S. Conditions**: Iran has refused to engage in direct talks unless the U.S. first lifts sanctions, as it perceives the re-imposition of these sanctions as an unjust act after the U.S. withdrawal. This has created a deadlock, as the U.S. has insisted on full compliance with the nuclear restrictions before offering sanctions relief.

Ramifications of Talks Failure

- **Breakout Time**: Iran's growing stockpile of uranium enriched to 60% and its increasing efficiency in uranium enrichment processes have drastically reduced the breakout time—the time it would take for Iran to produce weapons-grade uranium. This has increased concerns in Israel and other Western powers, which fear that Iran could develop a nuclear weapon within months if it chooses to do so.
- **Potential Military Action**: As diplomatic talks remain stuck, Israel has voiced its intention to take military action against Iran's nuclear facilities if the situation worsens. The U.S. has similarly warned of military intervention if diplomatic efforts fail, leading to an escalating threat of a military conflict in the region.

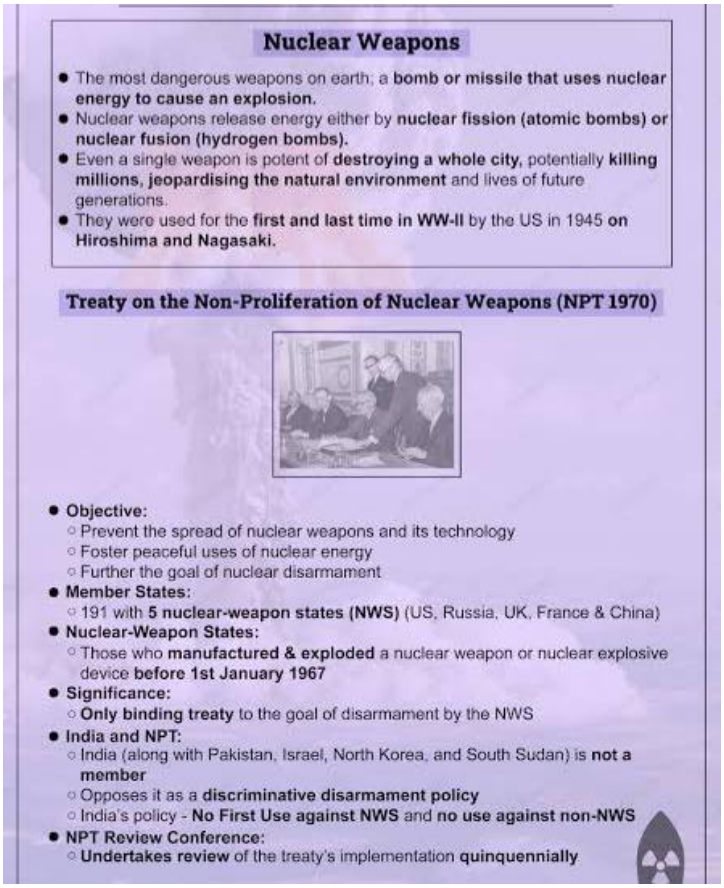
U.S. and Iran's Ongoing Disputes



- **Sanctions and Diplomatic Stalemate**: The primary issue between the U.S. and Iran revolves around sanctions. Iran insists that the U.S. must lift the sanctions that were re-imposed after its withdrawal from the JCPOA before it will fully return to compliance. The U.S., however, demands that Iran halt its nuclear advancements and return to the terms of the deal before sanctions relief is considered. This disagreement has kept the two sides in a deadlock.
- **Iran's Regional Actions**: Beyond the nuclear issue, the U.S. is concerned about Iran's involvement in regional conflicts, its missile program, and its support for groups it designates as terrorist organizations. These factors complicate any attempts at a comprehensive diplomatic resolution.

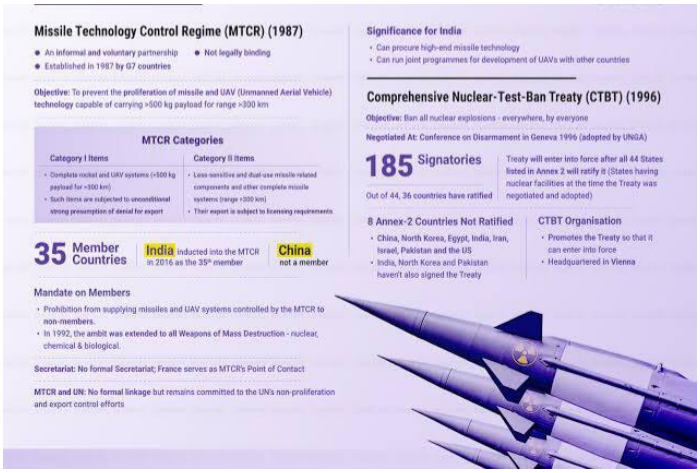
Israel's Role and Military Threat

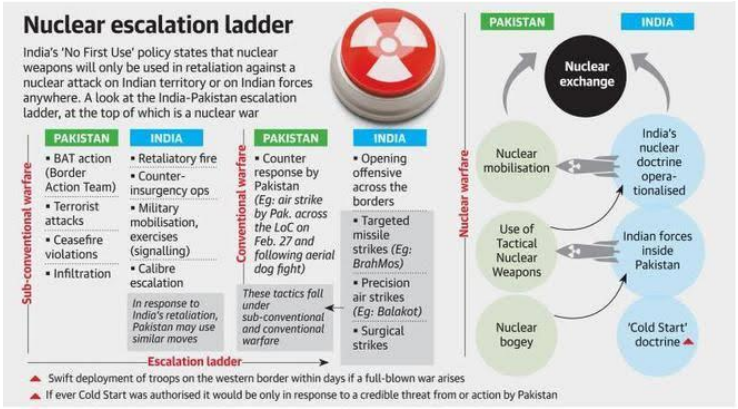
- **Israel's Concerns**: Israel has been one of the loudest critics of the JCPOA, viewing a nuclear-armed Iran as an existential threat. Israel has made it clear that it would not hesitate to take unilateral military action if Iran is perceived to be on the verge of developing a nuclear weapon. The potential for Israeli military strikes further complicates diplomatic efforts and heightens the stakes of the ongoing nuclear dispute.
- **Trump's Military Threats**: President Trump's threat of military action, coupled with Israel's readiness to strike Iran, has created a precarious situation where diplomacy faces significant obstacles. The failure of talks could easily lead to military escalation, especially if either side perceives the other as acting in bad faith.



Impact on India

- **Strategic Relations with Iran**: Iran plays a significant role in India's energy security, as a key supplier of oil. Additionally, projects like the Chabahar Port enhance India's strategic position in Central Asia and Afghanistan.
- **Balancing Global Relations**: India's relationship with the U.S. and its growing partnership with Western powers have complicated its stance on Iran. While India supports the diplomatic resolution of Iran's nuclear issue, it also had to comply with U.S. sanctions, reducing its oil imports from Iran. India's position remains delicate as it seeks to maintain a balance between its economic and strategic interests.





Other Nuclear Agreements

- **NPT and CTBT**: The NPT remains the core international treaty aimed at preventing nuclear proliferation, but other agreements like the Comprehensive Nuclear-Test-Ban Treaty (CTBT) also play a role in limiting nuclear weapons development by banning nuclear tests.
- **India's Nuclear Agreement**: The 2008 U.S.-India Civil Nuclear Deal allowed India to access civilian nuclear technology despite not being a signatory to the NPT. This deal marked a shift in India's nuclear diplomacy, acknowledging it as a responsible nuclear power.

Iran's nuclear programme remains a critical issue in global security. While diplomatic efforts, such as the JCPOA, attempted to limit Iran's nuclear capabilities, the failure of these talks and Iran's accelerated enrichment process have raised concerns about the country's intentions. For India, the Iranian nuclear issue is intricately linked to its energy security, regional stability, and diplomatic relations with both the U.S. and Iran. The NPT continues to be the foundation of global non-proliferation efforts, but its effectiveness relies on the commitment of all signatory states.

Prelims Practice Question

Q. Consider the following statements regarding Iran's nuclear programme:

1. Iran is a signatory of the Nuclear Non-Proliferation Treaty (NPT) and has fully complied with its provisions since 1979.
2. The 2015 Joint Comprehensive Plan of Action (JCPOA) limited Iran's uranium enrichment to 3.67% and capped its LEU stockpile at 300 kg.
3. The United States unilaterally withdrew from the JCPOA in 2018, which led to an acceleration of Iran's nuclear programme.
4. Iran's uranium enrichment to 60% is considered a significant step towards weapons-grade uranium, which is above the required 90% enrichment for nuclear weapons.

Which of the above statements are correct?

a) 1, 2, and 3 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:

- **Statement 1** is incorrect. Iran is a signatory of the Nuclear Non-Proliferation Treaty (NPT), but after the 1979 revolution, it ceased cooperating with the International Atomic Energy Agency (IAEA), and allegations of a clandestine nuclear programme emerged.

- **Statement 2** is correct. The 2015 JCPOA agreement did limit Iran's uranium enrichment to 3.67% and capped its Low-Enriched Uranium (LEU) stockpile at 300 kg in exchange for sanctions relief.
- **Statement 3** is correct. The United States, under President Trump, withdrew from the JCPOA in 2018, re-imposing sanctions on Iran, which led to Iran accelerating its nuclear programme and breaching the terms of the agreement.
- **Statement 4** is correct. Iran's enrichment of uranium to 60% significantly reduces the time it would need to produce weapons-grade uranium (90% enrichment). While 90% is required for weapons-grade material, 60% is considered a near-threshold enrichment level.

Mains **Model** Question

Q. Discuss the implications of Iran's nuclear programme on global security, particularly in the context of the breakdown of the Joint Comprehensive Plan of Action (JCPOA) and the ongoing tensions with the United States. How does Iran's nuclear stance impact India?

Iran's nuclear programme has been a focal point of international concern, especially after the breakdown of the 2015 Joint Comprehensive Plan of Action (JCPOA). The JCPOA, signed by Iran and world powers, was designed to limit Iran's nuclear activities in exchange for sanctions relief. However, the United States, under President Donald Trump, unilaterally withdrew from the deal in 2018, re-imposing stringent sanctions. This withdrawal intensified tensions and led Iran to gradually scale back its compliance, most notably by enriching uranium to levels far exceeding the agreement's limits. Enrichment to 60% purity, which is a significant step towards weapons-grade uranium, raised alarms about Iran's potential to develop nuclear weapons, destabilizing the region and sparking concerns among global powers like Israel and the United States.

The ongoing tensions between Iran and the U.S. revolve around Iran's nuclear ambitions and the demand for a new agreement or modifications to the existing one. Iran insists its nuclear programme is for peaceful purposes, while critics point to its stockpile of highly enriched uranium as evidence of weapons ambitions. The U.S. continues to threaten military action if diplomacy fails, further straining relations.

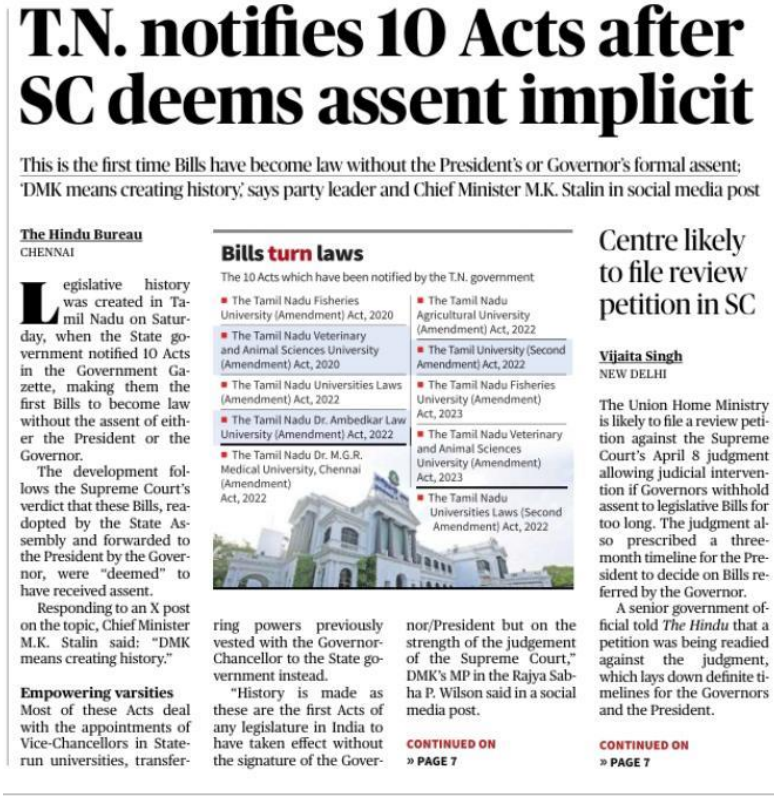
The implications of this situation for global security are profound, as Iran's nuclear capabilities could ignite an arms race in the Middle East, especially involving countries like Saudi Arabia, Israel, and Turkey. For India, the situation is crucial due to its strategic interests in the region, energy needs, and longstanding ties with both the U.S. and Iran. India's energy security is partially reliant on Iranian oil exports, and a military escalation would disrupt regional stability, impacting India's economic and geopolitical interests. Additionally, India's stance on non-proliferation aligns with the global desire to prevent the spread of nuclear weapons, making it imperative for India to advocate for diplomatic solutions in dealing with Iran's nuclear issue.

Topic : Supreme Court verdict involving Tamil Nadu Governor R.N. Ravi

Relevance : GS Paper 2 Polity and Governance

Source : The Hindu

Context :



T.N. notifies 10 Acts after SC deems assent implicit

This is the first time Bills have become law without the President's or Governor's formal assent; 'DMK means creating history,' says party leader and Chief Minister M.K. Stalin in social media post

The Hindu Bureau
CHENNAI

Legislative history was created in Tamil Nadu on Saturday, when the State government notified 10 Acts in the Government Gazette, making them the first Bills to become law without the assent of either the President or the Governor.

The development follows the Supreme Court's verdict that these Bills, readopted by the State Assembly and forwarded to the President by the Governor, were "deemed" to have received assent.

Responding to an X post on the topic, Chief Minister M.K. Stalin said: "DMK means creating history."

Empowering varsities

Most of these Acts deal with the appointments of Vice-Chancellors in State-run universities, transferring powers previously vested with the Governor-Chancellor to the State government instead.

"History is made as these are the first Acts of any legislature in India to have taken effect without the signature of the Governor/President but on the strength of the judgement of the Supreme Court," DMK's MP in the Rajya Sabha P. Wilson said in a social media post.

CONTINUED ON » PAGE 7

Bills turn laws

The 10 Acts which have been notified by the T.N. government

- The Tamil Nadu Fisheries University (Amendment) Act, 2020
- The Tamil Nadu Veterinary and Animal Sciences University (Amendment) Act, 2020
- The Tamil Nadu Universities Laws (Amendment) Act, 2022
- The Tamil Nadu Dr. Ambedkar Law University (Amendment) Act, 2022
- The Tamil Nadu Dr. M.G.R. Medical University, Chennai (Amendment) Act, 2022
- The Tamil Nadu Agricultural University (Amendment) Act, 2022
- The Tamil University (Second Amendment) Act, 2022
- The Tamil Nadu Fisheries University (Amendment) Act, 2023
- The Tamil Nadu Veterinary and Animal Sciences University (Amendment) Act, 2023
- The Tamil Nadu Universities Laws (Second Amendment) Act, 2022

Centre likely to file review petition in SC

Vijaita Singh
NEW DELHI

The Union Home Ministry is likely to file a review petition against the Supreme Court's April 8 judgment allowing judicial intervention if Governors withhold assent to legislative Bills for too long. The judgment also prescribed a three-month timeline for the President to decide on Bills referred by the Governor.

A senior government official told *The Hindu* that a petition was being readied against the judgment, which lays down definite timelines for the Governors and the President.

CONTINUED ON » PAGE 7

Background of the Case

The Supreme Court of India, on April 8, 2025, delivered a landmark judgment against Tamil Nadu Governor R.N. Ravi for his prolonged delay in granting assent to ten Bills passed by the Tamil Nadu Legislative Assembly. This judicial intervention marked a turning point in addressing the misuse of gubernatorial discretion in withholding or delaying assent to legislation in Opposition-ruled States.

Constitutional Provisions Involved

- **Article 200** of the Constitution empowers the Governor to either:
    1. Grant assent to a Bill;
    2. Withhold assent and return the Bill for reconsideration (except in the case of Money Bills);
    3. Reserve the Bill for the President's consideration.
- **First Proviso to Article 200** mandates that if the Governor returns a Bill for reconsideration and it is re-passed by the legislature, he is constitutionally obliged to give his assent.

Supreme Court's Observations

- **Illegal Delay**: The Court held that the Governor's prolonged inaction amounted to an abuse of constitutional power. A refusal to act on Bills for months without justification was termed "erroneous in law."
- **No Pocket Veto**: The Court firmly rejected the practice of indefinite delay without formal rejection, commonly referred to as a "pocket veto." It interpreted the use of the word "shall" in Article 200 to mean that action must be taken "as soon as possible."
- **Reiteration of Cooperative Federalism**: The judgment strongly emphasized the principles of cooperative federalism, calling out increasing politicisation of gubernatorial posts.

What has the SC ruled on the T.N. Governor?

What does the verdict say on R.N. Ravi's refusal to give his assent to several Bills? What are the timelines set for both the Governor and the President? Does this give Opposition-ruled State governments a constitutional remedy against inordinate delays by Governors in clearing Bills?

Aaratrika Bhaumik

The story so far:

On April 8, the Supreme Court declared Tamil Nadu Governor R.N. Ravi's prolonged refusal to give his assent to 10 Bills as illegal and erroneous in law. In a landmark verdict, Justices J.B. Pardiwala and R. Mahadevan underscored the importance of cooperative federalism, amid growing concerns over the increasing politicisation of the Governor's office in Opposition-ruled States.

"The ruling upholds the principles of federalism and provides Opposition-ruled States a clear constitutional remedy"

What is the process of granting assent?

Article 200 of the Constitution delineates the powers conferred upon a Governor when a Bill, having been passed by the State legislature, is presented for assent. The only exception is Money Bills, which are deemed to have automatically received assent. In all other cases, once a Bill has been passed by both Houses of the legislature, the Governor can exercise one of three options: grant assent, withhold assent and return the Bill to the Assembly for reconsideration, or reserve it for the President's consideration. However, only those Bills that undermine the High Court's powers to the extent of endangering its constitutionally mandated role can be reserved for Presidential consideration.

The first proviso to Article 200 stipulates that if the Governor decides to withhold assent, the Bill must be returned to the Assembly "as soon as possible", accompanied by a request to reconsider the proposed legislation or suggest amendments. However, if the Assembly, upon such reconsideration, passes the Bill with or without the amendments, the Governor is constitutionally obliged to grant assent.

Turning tide: Tamil Nadu Governor R. N. Ravi. S.R. RAGHUNATHAN

Can the Governor exercise a 'pocket veto'?

The ongoing impasse between the Governors and Opposition-ruled State governments primarily hinges on the interpretation of this proviso. While it mandates prompt action, it stops short of prescribing a definitive timeline. This constitutional silence has often been exploited by Governors to indefinitely delay action on a Bill without formally returning it – a tactic colloquially known as the "pocket veto."

However, the judges pointed out that the use of the term "shall" in the substantive portion of Article 200, when read in conjunction with the phrase "as soon as possible" in its proviso, precludes the possibility of any such pocket veto. Justice Pardiwala, who authored the judgment, clarified that the Governor's option to "withhold assent" cannot be equated with an unqualified power to reject or veto legislation duly enacted by the State legislature. He cautioned that such an interpretation would undermine the very foundation of a representative democracy.

When about President's consideration?

Further limiting the discretionary powers of the Governor, the court ruled that a Bill cannot be reserved for the President's consideration once it has been returned to the State legislature, reconsidered and resubmitted for assent. The only exception is if the Bill, in its second iteration, is materially different from the original version. The judgment also clarified that such reservation cannot be based on "personal dissatisfaction" or "political expediency" and is only permissible in instances where there is a grave threat to democratic principles.

Notably, the judges have set a three-month deadline for the President to decide whether to assent to Bills referred by the Governor. The clock will begin ticking from the day the reference is received. "Any delay beyond this period must be accompanied by justifiable reasons and communicated to the concerned State," the ruling states. A recommendation has also been made to the President to seek the Supreme Court's advice on such Bills, in line with the procedure outlined in Article 143 of the Constitution, as a measure of prudence. The judges pointed out that this course of action is important, given the lack of a mechanism at the State level for the Governor to refer Bills to constitutional courts for their opinion.

What are the timelines prescribed?

The court has imposed similar timelines on the Governor to prevent any obstruction of the State's legislative process. It clarified that when the Governor, acting on the Cabinet's advice, opts to withhold assent or reserve a Bill for the President's consideration, such action must be taken forthwith and no later than one month. If the Governor withholds assent contrary to ministerial advice, the Bill must be returned within three months, accompanied by a message detailing the rationale for the decision. Similarly, if the Governor reserves a Bill for the President against the Cabinet's recommendation, this must also be done within three months. Finally, if the Bill is re-passed by the State legislature after reconsideration, the Governor is required to grant assent within one month. However, the ruling noted that any departure from these timelines may be condoned if there are "reasonable grounds".

Is judicial review permissible?

The judges emphasised that any exercise of gubernatorial discretion must be amenable to judicial review to prevent any "disregard" for the will of the people, as expressed through their elected representatives. Invoking its inherent powers under Article 142 of the Constitution, the court deemed the 10 pending Bills to have received assent. Justice Pardiwala reasoned that the exercise of such extraordinary powers was warranted, given the Governor's "scant respect" for prior rulings. He was particularly critical of the Governor's decision to return the Bills without providing reasons, in clear violation of the court's binding directive in *State of Punjab versus Principal Secretary to the Governor of Punjab* (2024).

What are the potential implications?

P.D.T. Achary, former Secretary General of the Lok Sabha, told *The Hindu* that the ruling upholds the principles of federalism and provides Opposition-ruled State governments a clear constitutional remedy against inordinate delays by Governors in granting assent to Bills passed by the legislature. "The Supreme Court has been reining in the discretionary powers of Governors for some time now. However, what sets this judgment apart is its articulation of definitive timelines for both the Governor and the President, ensuring that the enactment of crucial legislation is not indefinitely stalled," he said. Senior advocate Shadan Farsat noted that the top court has rarely invoked its inherent powers to create a legal fiction of deemed assent. "By recognising automatic assent in cases where the Governor fails to adhere to the prescribed timelines, the court has instituted a crucial safeguard against abuse of the office," he said. He added that the ruling could pave the way for similar judicial intervention in cases where the Union government delays acting on collegium recommendations. "Extending such powers to judicial appointments would help prevent an executive veto over the collegium's decisions," he told *The Hindu*.

Timelines Mandated by the Supreme Court

1. **Governor's Action**:
   - Must act on a Bill within **one month** if intending to withhold or reserve it.
   - If the Bill is returned and re-passed, the Governor must **give assent within one month**.
   - If the Governor withholds assent against Cabinet advice, it must be returned **within three months** with reasons.

'President ought to consult SC on Bills referred by Governor'

In the judgment setting a three-month deadline for the President to decide whether or not to assent to State Bills that are referred to her, the top court says such consultation will remove any apprehensions of bias or *mala fides* by the Centre

Krishnadas Rajagopal
NEW DELHI

The Supreme Court, in its 414-page April 8 judgment in the State of Tamil Nadu vs the Governor of Tamil Nadu and other parties, released late on Friday, has set a three-month deadline for the President to decide whether or not to assent to State Bills referred to her by a Governor.

The clock will begin ticking from the day the Governor referred the Bill to the President for her consideration.

"In case of any delay beyond this period, appropriate reasons would have to be recorded and conveyed to the State concerned," the court held. The States, in turn, must be cooperative to any queries or suggestions from the Centre on the Bills.

A Bench of Justices J.B. Pardiwala and R. Mahadevan declared that the President ought to, as a measure of prudence, seek the

> We are of the considered view that although the option to refer a Bill to the Supreme Court under Article 143 may not be mandatory, yet the President, as a measure of prudence, ought to seek an opinion with respect to Bills on grounds of perceived unconstitutionality.
> JUSTICES J.B. PARDIWALA & R. MAHADEVAN

Supreme Court's advice on Bills reserved by a Governor for her consideration on grounds of perceived unconstitutionality.

The judgment authored by Justice Pardiwala said the need for the President to consult the Supreme Court on Bills referred to her by the Governor was necessary as there was no mechanism at the State level for Governors to refer Bills to constitutional courts for their advice or opinion.

"We are of the considered view that although the option to refer a Bill to the Supreme Court under Article 143 [of the Constitution] may not be mandatory, yet the President, as a measure of prudence, ought to seek an opinion with respect to Bills reserved for the consideration of the President on grounds of perceived unconstitutionality. This is all the more necessary as there is no mechanism at the State level for the Governor to refer Bills to the constitutional courts for their advice or opinion thereupon," the judgment observed. The judgment was based on a writ petition filed by Tamil Nadu against its Governor, R.N. Ravi. The court has held the Tamil Nadu Governor's decision to reserve 10 Bills to the President for her consideration after sitting over them for months "erroneous in law".

The President's recourse to Article 143 (under which the President can seek advice from the Supreme Court on matters of public importance or legal disputes) palliates any apprehensions of bias or *mala fides* in the Union government's approach to Bills reserved under Article 200, the court reasoned.

Sri Lankan model

In this context, Justice Pardiwala drew attention to Sri Lanka, where the President referred Bills to the Supreme Court for opinion. "If the Governor is of the opinion that a statute enacted by a provincial council is unconstitutional, then he may refer the Bill to the President, who in turn is obligated to make a reference to the Supreme Court of Sri Lanka for obtaining a pronouncement on the constitutional vires of such a Bill. Where the Supreme Court holds the statute to be constitutional, then the Governor is bound to grant assent," Justice Pardiwala detailed.

Constitutional courts cannot be precluded from making suggestions or opining about the constitutional validity of a Bill before it becomes law.

Application of judicial mind to a proposed law saves both time and public resources by preventing costly litigation and delay that naturally follows if a faulty Bill becomes a law. However, the court warned, this "approach of prevention before cure" must not be stretched to the extent that the process of reservation of a Bill for consideration of the President by itself becomes a resort for thwarting the legislative powers of the States.

Governor led by extraneous considerations in discharge of his functions, observes SC

Krishnadas Rajagopal
NEW DELHI

R.N. Ravi

The Supreme Court, which published its much-anticipated judgment late on Friday, declared Tamil Nadu Governor R.N. Ravi's months-long delay, by withholding consent and subsequent reservation of the 10 re-passed Bills to President Droupadi Murmu for her consideration on November 28, 2023, "erroneous in law and non-est".

The court equally set aside consequential steps taken by President Murmu on the Bills as *non-est*.

The Bench of Justices J.B. Pardiwala and R. Mahadevan said the Governor's inaction for an unduly long period of time for which these Bills were kept pending by him, and his ultimate declaration of withholding of assent coupled with the scant respect shown by him to judgments of the Supreme Court for adherence to aid and advice of the State's Council of Ministers showed "other extraneous considerations" writ large in the discharge of his functions. "We are left with no other option but to exercise our inherent powers under Article 142 of the Constitution for the purpose of declaring these 10 Bills as deemed to have been assented on the date when they were presented to the Governor after being reconsidered by the State legislature i.e., on November 18, 2023," the court declared.

'Tinkering with ideals'

The court reminded constitutional authorities occupying high offices that they must be guided by the values of the Constitution.

These values that are so cherished by the people of India are a result of years of struggle and sacrifice of our forefathers. "When called upon to take decisions, such authorities must not give in to ephemeral political considerations but rather be guided by the spirit that underlies the Constitution," Justice Pardiwala wrote.

If the authorities attempt to deliberately bypass the constitutional mandate, they are tinkering with the very ideals revered by its people upon which this country has been built, the apex court cautioned.

"We take this opportunity to quote Dr. B.R. Ambedkar's concluding speech in the Constituent Assembly, which is as relevant today as it was in 1949 – 'However good a Constitution may be, it is sure to turn out bad because those who are called to work it, happen to be a bad lot. However bad a Constitution may be, it may turn out to be good if those who are called to work it, happen to be a good lot,'" Justice Pardiwala said in his judgment.

2. **President's Action**:
    - Once a Bill is referred to the President, a **decision must be made within three months**.
    - Delays beyond this period must include justifiable reasons and be communicated to the State.

Judicial Review and Deemed Assent

- The Court clarified that **gubernatorial discretion is subject to judicial review** to avoid undermining the democratic mandate of the State legislature.
- Using Article 142, the Court declared the ten pending Tamil Nadu Bills as having **received deemed assent**, an unprecedented judicial move aimed at preventing constitutional paralysis.

Implications for Federalism and Opposition-ruled States

- This ruling acts as a **constitutional safeguard** for States, especially Opposition-ruled ones, against undue delays by Governors.
- The judgment strengthens the State legislature's autonomy and **reduces the scope for politically motivated delays**.
- It may serve as a precedent in future cases, including situations involving **delays in judicial appointments**, as highlighted by legal experts.

Relevance of the President's Role and Article 143

- The Court advised that the President should **seek the Supreme Court's opinion under Article 143** in cases involving serious constitutional questions, since there is no equivalent referral mechanism available to Governors.
- This would ensure the Centre's decisions are **legally sound and unbiased**, particularly when handling controversial State legislation.

SC recalls first President's struggle over Hindu Code Bill assent in 1951

Krishnadas Rajagopal
NEW DELHI

The Supreme Court, in its Tamil Nadu Governor judgment, recalled how an infant India watched with trepidation as its first President claimed to have the power to exert his discretion and withhold assent to Bills even against the aid and advice of the Council of Ministers.

A Bench of Justices J.B. Pardiwala and R. Mahadevan recounted that Dr. Rajendra Prasad expressed reservations about the Hindu Code Bill, which proposed considerable reforms in the Hindu personal law, introduced in 1951.

The President had sought to assert his independent authority to withhold assent to the legislation.

The Jawaharlal Nehru government had referred the issue to the first Attorney-General of India, M.C. Setalvad, for an opinion.

"Mr. Setalvad clarified that the role of the President under the Indian Constitution was analogous to that of the British monarch, and he was expected to serve as a constitutional figurehead. The Attorney General opined that the President does not possess the authority to act contrary to the advice of the Council of Ministers," Justice Pardiwala narrated in his judgment pronounced on April 8 but published late on April 11.

The judge, however, said the opinion of the Attorney-General was, with respect and magnanimity, "accepted" by the President, and the ensuing controversy between the Prime Minister and the President was laid to rest.

Dr. Rajendra Prasad with the members of Central Cabinet at Government House in New Delhi in January 1950. THE HINDU ARCHIVES

'Orthodox Hindu'

However, Mr. Setalvad's autobiography, *My Life - Law and Other Small Things*, suggested that his opinion had rankled Mr. Prasad, an "orthodox Hindu".

Tamil Nadu's Legislative Response

- Following the verdict, Tamil Nadu notified the 10 Bills in the State Gazette without waiting for the Governor or President's signature, invoking the Supreme Court's authority.
- Most of these Acts transfer the power of **appointing Vice-Chancellors in State universities** from the Governor to the State government.
- This is the **first instance in India** where Bills have become law solely based on the Supreme Court's ruling of deemed assent.

Broader Constitutional Significance

- The judgment establishes **binding timelines** for executive action on legislation, preventing constitutional deadlocks.
- It reinforces the **primacy of the legislative process** and the importance of **democratic accountability**.
- This legal development also sets a **comparative model**, referencing Sri Lanka's system where the President must consult the Supreme Court before rejecting Bills on constitutional grounds.

Prelims Practice Question:

Q. With reference to the powers of the Governor under Article 200 of the Indian Constitution, consider the following statements:

1. The Governor is constitutionally bound to give assent to a Bill that has been re-passed by the State Legislature after being returned once.
2. The Constitution prescribes a fixed time limit within which the Governor must act on a Bill passed by the State Legislature.
3. The Governor may reserve any Bill for the consideration of the President, irrespective of its nature.

Which of the statements given above is/are correct?

A. 1 only
B. 1 and 3 only
C. 2 and 3 only
D. 1, 2 and 3

Answer: A. 1 only

Explanation:

- **Statement 1 – Correct**: As per the *first proviso to Article 200*, if the Governor returns a Bill and it is re-passed by the State Legislature, the Governor **shall not withhold assent**. This is a binding obligation.
- **Statement 2 – Incorrect**: The Constitution **does not prescribe a specific time limit** for the Governor to act on a Bill. However, the **Supreme Court in 2025** ruled that action must be taken *"as soon as possible"*, effectively limiting indefinite delay, but this is a judicial interpretation—not an express constitutional provision.
- **Statement 3 – Incorrect**: The Governor **cannot reserve any Bill arbitrarily**. Bills that are **ultra vires the Constitution, conflict with Union laws, or concern national importance** may be reserved for the President. The power is not absolute or discretionary in all cases.

Mains Model Question:
Q. Discuss the recent Supreme Court judgment regarding the powers of the Governor under Article 200 in the context of Tamil Nadu. How does this verdict impact the functioning of federalism and the legislative process in Indian States?

The recent Supreme Court judgment on April 8, 2025, concerning the Tamil Nadu Governor R.N. Ravi's delay in granting assent to ten Bills marks a significant development in Indian constitutional jurisprudence. The Court ruled that the Governor's inaction was illegal and contrary to the principles of constitutional governance. It emphasized that the Governor does not possess absolute discretion in withholding assent, especially after a Bill has been reconsidered and re-passed by the legislature, as per Article 200 of the Constitution.

'Personal dissatisfaction, political expediency no cause for holding Bills'

Krishnadas Rajagopal
NEW DELHI

The Supreme Court has held that reservation of a State Bill by a Governor for the consideration of the President on grounds such as his personal dissatisfaction, political expediency, or any other "extraneous or irrelevant considerations" is strictly impermissible by the Constitution.

A Governor's reference of a Bill to the President for these reasons would be liable to be set aside forthwith by the Constitutional courts.

The court was interpreting Article 200, which deals with the role of the Governor in giving assent to Bills.

"Where the reservation

State government can seek an expeditious decision on the Bill through the courts

of a Bill by the Governor for the consideration of the President is on the grounds of peril to democracy or democratic principles or on other exceptional grounds then the Governor would be expected to make a specific and clear reference to the President properly indicating the reasons for entertaining such a belief by pinpointing the specific provisions in this regard and the consequent effect that may ensue if such a Bill were to be allowed to become a law," the judgment noted.

The Governor, while making such a reference, should also indicate his subjective satisfaction as to why the aforesaid consequences that may ensue cannot be possibly curtailed or contained by taking recourse to the constitutional courts of the country, Justice J.B. Pardiwala observed.

The State governments can challenge such a reservation on the ground of failure on the part of the Governor to furnish the necessary reasons. They can argue that the reasons indicated by the Governor in question were wholly irrelevant, *mala fide*, arbitrary, unnecessary, or motivated by extraneous considerations. The issue would be "fully justiciable" by Constitutional courts.

The government can approach the competent court with a writ of mandamus if a Governor sits on a Bill for a period exceeding the time limit of three months.

The State government can seek an expeditious decision on the Bill through the courts, provided the Governor is unable to furnish a sufficient explanation for his delay.

"Where the Governor reserves a Bill for the consideration of the President and the President, in turn, withholds assent thereto, then it shall be open to the State government to assail such an action before the Supreme Court," Justice Pardiwala has held.

This verdict strikes at the root of the growing trend where Governors, particularly in Opposition-ruled States, have been accused of stalling legislation through inaction or political bias. The Court clarified that the term "as soon as possible" in Article 200 implies that the Governor must act within a reasonable timeframe, setting a de facto upper limit of one month. It also laid down a three-month limit for the President to decide on Bills reserved for her consideration. Importantly, if the Governor fails to act within the stipulated time, assent can be deemed granted, as happened with the ten Tamil Nadu Bills, making them the first laws in India to come into effect without formal assent.

This judgment not only reaffirms the supremacy of the elected legislature but also reinforces the principle of cooperative federalism by ensuring that gubernatorial discretion does not undermine democratic mandates. The Court's invocation of Article 142 to create legal fiction of deemed assent showcases the judiciary's proactive role in preserving the legislative autonomy of States. Moreover, the recommendation for Presidential reference to the Supreme Court under Article 143 for constitutional clarity adds a new layer of legal prudence to the process. Overall, the verdict is a landmark in checking arbitrary gubernatorial actions and strengthening Indian federalism.