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Mount Olympus, home of ancient Greek gods, nominated for UNESCO World Heritage List

**Costas Kantouris
& Elena Becatoros**

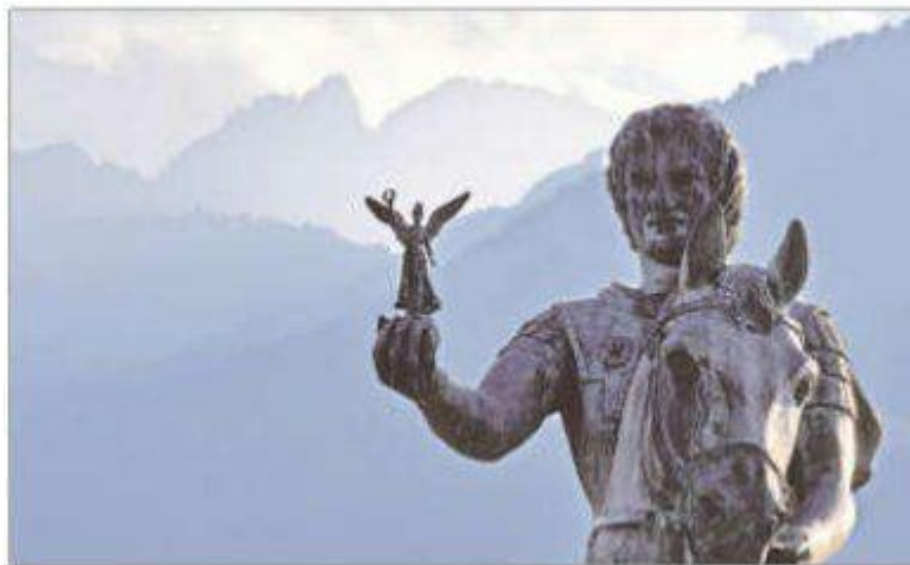
Litochoro, July 18

SNOW-CAPPED for much of the year, Mount Olympus, mythological home of ancient Greece's 12 Olympian gods, has captured the imagination through the millennia.

Rising to 2,918 metres from a base practically at sea level, the ancient Greeks believed the throne of Zeus, king of the gods, stood on the highest of its craggy, often mist-shrouded peaks.

Now, modern-day Greeks hope their tallest mountain will be inducted into UNESCO's World Heritage List as a mixed cultural and natural site.

The nomination is to be dis-



A statue of Alexander the Great holding Nike, the Greek goddess of victory, with Mount Olympus in the background. AP

cussed when the World Heritage Committee meets in Busan, South Korea from Sunday through July 29.

"Olympus is our life. It is the place we grew up in," said Evangelos Geroliolios, mayor of Dion-Olympus, based in Lito-

choro, the mountain's main town.

"It is the place we see every day, but at the same time, it is also a place which carries with it myth, history, biodiversity, extraordinary beauty and a very great cultural weight."

It was here that Zeus was said to have established his court after overthrowing his father, Cronus, in a 10-year war that ended the reign of the Titans. Interest in Olympus may receive another boost with the theatrical release this week of Christopher Nolan's "The Odyssey," a new adaptation of Homer's epic, in which the mountain serves as the home of Zeus and the Olympian gods who influence Odysseus' journey. AP

- **Key Terms and Explanations**
- **UNESCO Mixed World Heritage Site:** Most heritage sites are designated either for their outstanding cultural value (like ancient monuments) or natural value (like pristine national parks). A "Mixed Site" satisfies both criteria simultaneously. It recognizes landscapes where human culture, history, or mythology have become permanently intertwined with unique biodiversity and geological features.
 - *Example:* India's **Khangchendzonga National Park** is a premier example, protected both for its unique alpine ecology and its profound sacred significance in Buddhist and indigenous Lepcha folklore.
- **World Heritage Committee:** A specialized body within UNESCO consisting of representatives from 21 State Parties. It meets annually to review nominations, monitor the state of conservation of existing properties, and decide which sites enter the coveted World Heritage List.
- **Geomythology:** A modern interdisciplinary field of study that examines how ancient human civilizations explained cataclysmic geological events, unique landforms, or striking landscapes through the creation of myths, folklore, and religious epics.
 - *Example:* Attributing the towering, mist-shrouded peaks of a massive mountain to the physical thrones of ancient deities, blending physical geography with the spiritual consciousness of a society.
- **Ecological Integrity:** The capability of an ecosystem to support and maintain a balanced, integrated, and adaptive community of local organisms. When a site faces a global spotlight, maintaining this integrity against the pressures of human encroachment becomes the primary conservation objective.
- **Cultural Soft Power:** A diplomatic concept popularized by Joseph Nye, referring to a nation's ability to influence international relations and build global goodwill through cultural attraction, history, and values, rather than military or economic coercion.

Main Arguments and Substantive Parts

The global discourse surrounding the nomination of prominent geo-mythological sites like Mount Olympus to the UNESCO World Heritage List revolves around three primary arguments:

The Convergence of Ecology and Civilizational Myth

The core thesis asserts that natural landscapes of extraordinary physical scale often act as the cradle for a civilization's foundational identity. Towering landforms are rarely just geological anomalies; they are living repositories of intangible cultural heritage. The argument emphasizes that protecting the physical ecosystem (such as alpine biodiversity and unique peaks) is structurally inseparable from preserving the psychological and historical memory of humanity.

Global Validation as a Catalyst for Soft Power

Securing a global heritage status operates as a significant geopolitical and cultural milestone. When a state successfully nominates a landmark at an international forum like the World Heritage Committee, it achieves two objectives:

It elevates its historical narrative to a matter of universal human value.

It leverages contemporary global media and pop culture (such as cinematic adaptations of classical epics) to revitalize international interest in its ancient roots, boosting its modern soft power profile.

The Preservation-Commodification Dilemma

A significant counterargument raised by conservationists centers on the inherent paradox of global recognition. While a UNESCO listing brings prestige and conservation funding, it also triggers an exponential surge in international tourism. The substantive challenge is whether fragile alpine environments can withstand the transition from a local sacred space to a global tourism hotspot without suffering irreversible ecological degradation.

- **Historical Evolution of Heritage Conservation**
- **The Ancient and Pre-Colonial Era (Sacred Sanctions):** For millennia, prominent mountains, rivers, and forests were protected through community-enforced taboos, spiritual reverence, and religious decrees. Conservation was organic and localized. The landscape was preserved because it was seen as the literal or symbolic domain of the divine, keeping human exploitation in check.
- **The Colonial and Early Modern Era (Material Extraction):** The advent of industrialization and colonial expansion reframed natural landscapes primarily as economic assets to be harvested. Heritage protection during this era was fragmented and heavily biased toward physical, built structures—such as fortresses or temples—via early legislation like British India's Ancient Monuments Preservation Act of 1904, completely ignoring the surrounding natural ecosystems.
- **The Post-WWII and UNESCO Era (Universal Heritage):** The catastrophic destruction of world culture during the World Wars prompted the creation of global institutions. A watershed moment arrived with the **1972 UNESCO World Heritage Convention**, which explicitly linked nature conservation with cultural preservation, introducing the revolutionary concept that certain sites possess an "Outstanding Universal Value" that transcends national borders.
- **The 21st Century Paradigm (Integrated Landscape Management):** Today, international conservation has moved beyond protecting isolated monuments. The current focus heavily prioritizes "Cultural Landscapes" and "Mixed Sites." This approach recognizes that the divide between nature and human culture is artificial, acknowledging intangible factors like mythology, folklore, and local community identity as vital elements of ecological preservation.
- **Way Forward**
- **Implementing a Dynamic Carrying Capacity Model:** Rather than permitting unregulated tourist influxes, administrative bodies must execute rigorous scientific assessments to determine the daily and seasonal "ecological carrying capacity" of these fragile mountain ecosystems. Utilizing digital booking systems and seasonal caps can prevent environmental degradation.
- **Empowering Local Communities via Co-Management:** Conservation models must transition from top-down bureaucratic control to inclusive community-led governance. Local municipalities and indigenous populations should be institutionalized as primary custodians. This ensures that tourism revenues are directly reinvested into local healthcare, education, and ecological restoration.
- **Enforcing Strict Legal and Spatial Zoning:** Comprehensive master plans must clearly separate fragile zones. The core ecological and mythological summits must be designated as strict no-development zones, while sustainable, low-impact infrastructure (such as eco-lodges and solar-powered information centers) should be confined strictly to outer buffer zones.
- **Leveraging Responsible Media and Digital Archiving:** As popular culture and global cinema amplify public interest in ancient epics, authorities should leverage this attention responsibly. Developing high-fidelity virtual reality (VR) tours and digital museums can satisfy global curiosity and educate the public without placing physical, onshore foot traffic pressure on vulnerable ecosystems.

UPSC CSE PREP: Comprehensive Analysis - UNESCO World Heritage Site Nomination (e.g., Mount Olympus)

UNPACKING KEY TERMS

UNESCO Mixed Site

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Geomythology

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Cultural Soft Power

Cultural soft power on cultural communication and ecological sapares



Ecological Integrity

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World Heritage Committee

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LINKAGES WITH NCERT & UPSC SYLLABUS



NCERT

- ✓ Class 11 World History
Physical Geography
- ✓ Class 12 Indian History
(Thinking & Buildings)



UPSC



- ✓ GS Paper 1
(Culture/Geography)
- ✓ GS Paper 2
(Global Forums/Governance)
- ✓ GS Paper 3
(Conservation/Eco-Tourism)
- ✓ GS Paper 4
(Ethics/Essay)

WAY FORWARD & REFORMS



Implement Dynamic Carrying Capacity Model

- Implement commutic carrying capacity model
- Empower local communities via ovcent and nature



Empower Local Communities via Co-Management

- Empower to local communities via Co-management
- Encuro mevental enforceaxer management



Enforce Strict Legal Zoning (Core vs. Buffer)

- Enforce strict legal al zoning anto poors
- Responsible to commute in sacred spaces



Responsible Media & Digital Archiving

- Responsible media ides & Digital archiving

ALL PREVIOUS YEARS' QUESTIONS (UPSC/APSC)



Mains	2020	2020 GS1: Philosophy sustaining sustaining monuments
	2023	GS3: Damaging ecosystems
Prelims	2018	2018: Mixed Site in India 2019: UNESCO site criteria
	APSC	examples for cultural landscapes

HISTORICAL EVOLUTION OF ISSUES



Pre-Colonial
(Sacred
Sanctions)

Colonial
(Material
Extraction,
eg. laws)

Post-WWII
(Universal
Heritage, 1972
Convention)

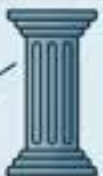
21st Century
(Integrated
Landscape/
Mixed Sites)

LOGICAL & PHILOSOPHICAL BASE

Rejection of
Cartesian
Dualism

Geomythology
as Cognitive
Framework

Intergenerational
Equity & Global
Commons



Rejection of

Protected landscape

Protected
Commons

'ARTICLE 370' BEST FEATURE FILM

National Film Awards for Mammooty, Kartik, Yami

ENS & PTI

New Delhi, July 18

POLITICAL DRAMA *Article 370* emerged as the biggest winner at the 72nd National Film Awards on Saturday, bagging the best feature film honours, while its lead star Yami Gautam was named best actress.

Veteran Malayalam actor Mammooty and Bollywood star Kartik Aaryan shared the best actor award for *Bramayugam* and *Chandu Champion* respectively. Inspired by the government's decision to abrogate the special status accorded to the erstwhile state of Jammu and Kashmir, *Article 370* features Gautam as an intelligence officer involved in a covert operation linked to the developments leading up to the abrogation. It is directed by Aditya Sutan Jambhale.

Announcing the awards for the year 2024, chairperson of the 11-member central jury, Malayalam filmmaker Jayaraj, said the film "centres on the mission to fully integrate Jammu and Kashmir into Indian union. Emphasising a unified and indivisible nation, it highlights the battle against local corruption and dismantling of a conflict economy".

On Gautam's role, Jayaraj said the actor delivered "a nuanced performance that portrays a law enforcement agent's unwavering pursuit of truth and justice with sensitivity, courage and compassion."

Actor-filmmaker Randeep

Winners of the 72nd edition

● Best Feature Film: *Article 370*

● Best Feature Film Providing Wholesome Entertainment:
Kalki 2998 AD

● Best Director: Rajkumar Periasamy, *Aman*

● Best Actress in Supporting Role:
Ropashree Varkey, *Mithya*
Sachana Namidass, *Maharaja*

● Best Actor in Supporting Role:
Sanjay Mishra, *Bhaskhak*

● Best Debut Film of a Director:
Swatantrya Veer Savarkar

● Best Cinematography:
Shahrad Jaleel, *Bramayugam*

● Best Screenplay (Original):



Best Actor
MAMMOOTY
BRAMAYUGAM



Best Actress
YAMI GAUTAM
ARTICLE 370



Best Actor
KARTIK AARYAN
CHANDU CHAMPION

Sukumar, *Pursha 2*

● Best Music Direction: *Shashwat Sachdev*, *Article 370*

● Best Lyrics: *Manoj Muntashir*, *Maddam*

● Best Male Playback Singer:

Abhay Jodhpurkar, *Gharat Ganpati* from *Navasachi Gaun Mati*

● Best Female Playback Singer:
Vaisham Vijayalakshmi, *"Ange Vaana Konfu"* from *ARM*

● Best Choreography:
Vijay Ganguly, *Soor 2*

● Best Hindi Film: *Srikanth*

● Special Mention: *Dhanush*, *Captain Miller*, *Suren G*, *Meeyazhagan*

Hooda won the best debut director award for *Swatantrya Veer Savarkar*, his first directorial venture in which he also plays Vinayak Damodar Savarkar. The Hindi biographical drama traces Savarkar's life, including his years as a revolutionary in London, his incarceration in the Cellular Jail in the Andaman and Nicobar Islands, and his later political career.

Chandu Champion, Kabir Khan's biographical sports drama, is based on the life of Murlikant Petkar, India's first Paralympic gold medalist.

Meanwhile, Telugu science-fiction epic *Kalki 2998 AD* won

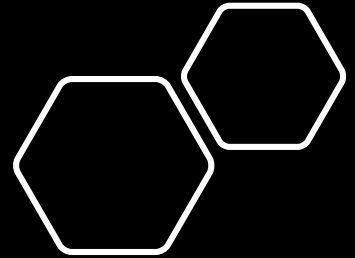
the award for best popular film "providing wholesome entertainment". Directed by Nag Ashwin and starring Prabhas, Amitabh Bachchan, Deepika Padukone and Kamal Haasan, the film blends elements from Indian mythology with a futuristic dystopian setting and was among the biggest commercial successes of the year.

Tamil film *Captain Miller*, directed by Anun Matheswaran and starring Dhanush, won the award for best feature film promoting "National, Social and Environmental Values".

Rajkumar Periasamy was named best director for *Ana-*

ram, the Tamil biographical action drama based on the life of Ashok Chakra awardee (post-humous) Major Mukund Varadarajan. Actor Sanjay Mishra won the best actor in a supporting role award for the Hindi crime drama *Bhaskhak*, which centres on a journalist investigating abuse at a shelter home.

Manoj Muntashir won the best lyrics award for the song *Jaane De* from the Hindi film *Maddam*, starring Ajay Devgn. The film is based on the life of legendary football coach Syed Abdul Rahim, who guided the Indian football team during one of its most successful periods.



- **Key Terms and Explanations**

- **Article 370:** A temporary provision in the Indian Constitution that granted a distinct autonomous status to the erstwhile state of Jammu and Kashmir. It permitted the state to have its own constitution, a separate flag, and internal administrative autonomy, restricting the Indian Parliament's legislative powers over it to defense, foreign affairs, finance, and communications.
- **Asymmetric Federalism:** A structural arrangement within a federation where different constituent states possess varying degrees of autonomy and distinct constitutional relationships with the central authority, rather than enjoying uniform powers.
- **Conflict Economy:** An economic system born out of protracted institutional instability and violence, where local financial networks, parallel power structures, and vested interest groups benefit directly from ongoing instability, militancy, and illicit financial flows (such as hawala transacting or terror funding), thereby actively resisting peace and integration.
- **Soft Power and Cultural Hegemony:** The capability of a nation-state to shape preferences, build consensus, and influence public consciousness through cultural assets, media, and state-sponsored recognitions rather than coercion or economic inducements.
- **National Film Awards:** Instituted in 1954, these are the premier state-administered awards given to encourage the production of films featuring high aesthetic, technical, and educational value, functioning as a vital instrument for projecting India's diverse socio-political landscape.

- **Main Arguments and Substantive Parts**

- The contemporary discourse surrounding constitutional integration, administrative reforms, and their representation in popular media centers on several core arguments regarding state sovereignty and national identity:
- **The Transition from Autonomy to Complete Integration:** A primary argument posits that the dismantling of special constitutional statuses represents the definitive closure of post-partition territorial consolidation. Proponents argue that a unified administrative framework is imperative for national sovereignty, emphasizing that an "indivisible nation" cannot sustain permanent internal legal enclaves. The focus is on demonstrating how intelligence operations, strategic administrative foresight, and political will converge to execute complex constitutional shifts without triggering large-scale instability.
- **Dismantling the Vested Infrastructure of the Conflict Economy:** A substantive point of discussion is the systemic economic cleansing of conflict zones. The core thesis argues that administrative integration is not merely a legal exercise but a socio-economic liberation. By choking illicit funding channels, countering local institutional corruption, and introducing direct central accountability, the state aims to replace a self-sustaining cycle of violence with formal developmental economics, infrastructure building, and transparency.
- **The Reclamation of Historical and Cultural Narratives:** There is a pronounced emphasis on using mainstream media and state recognition to reposition national icons and military sacrifices into the public consciousness. Whether celebrating the strategic contributions of revolutionaries, honoring the supreme sacrifices of modern gallantry awardees, or highlighting the achievements of subaltern sports figures, the objective is to build a robust, patriotic national ethos that counters long-standing historical distortions.
- **Counterarguments and Critical Perspectives:** Conversely, critics and constitutional purists raise questions regarding the methodology of asymmetric changes, arguing that federal arrangements based on historical compacts should ideally involve deeper consultations with local legislative bodies. Furthermore, within the cultural sphere, debates persist over the thin line between authentic historical documentation and state-patronized narratives, with concerns that heavy emphasis on nationalist themes might overshadow regional, socio-realist, or alternative creative expressions.

- **Historical Evolution of the Issue**
- **The Era of Accession and Access (1947–1950):** Following the tribal invasion backed by Pakistan, Maharaja Hari Singh signed the Instrument of Accession in October 1947. Due to the volatile geopolitical environment, Article 370 (initially Article 306A) was introduced into the draft Constitution under the stewardship of N. Gopalaswami Ayyangar as a temporary bridge until permanent stability could be established.
- **Institutionalization and Creeping Integration (1954–1980s):** The Constitution (Application to Jammu and Kashmir) Order, 1954, extended several provisions of the Indian Constitution to the state. Over the subsequent decades, multiple Presidential Orders gradually extended the jurisdiction of the Supreme Court, the Comptroller and Auditor General (CAG), and major parts of the Union List to J&K, though its special status and separate constitution remained intact. Simultaneously, the state initiated the National Film Awards in 1954 to cultivate a shared, post-colonial Indian identity through cinema.
- **The Rise of the Conflict Economy (1980s–2018):** The outbreak of cross-border sponsored militancy in the late 1980s altered the regional dynamic. The collapse of local governance structures led to the emergence of a "conflict economy," characterized by terror financing, widespread radicalization, systemic stone-pelting, and economic stagnation, which effectively alienated the youth from the national mainstream for nearly three decades.
- **The Constitutional Paradigm Shift (2019–Present):** In August 2019, through Presidential Orders C.O. 272 and C.O. 273, the statutory mechanism of Article 370 was effectively neutralized. The Jammu and Kashmir Reorganisation Act, 2019, bifurcated the state into the Union Territories of Jammu & Kashmir, and Ladakh. This historic move was validated by a landmark five-judge Constitution Bench of the Supreme Court in December 2023, which ruled that Jammu and Kashmir held no internal sovereignty after accession and that Article 370 was purely a temporary, transitional provision.
- **Way Forward**
- **Democratic Consolidation and Institutional Restitution:** While administrative integration has established basic stability, restoring full political rights is vital. Following successful local body elections, holding regular legislative assembly elections and progressively restoring full statehood—as committed by the Union Government and directed by the judiciary—will deeply re-anchor the region's democratic process.
- **Transitioning from Security Stabilization to an Open Economy:** The elimination of the conflict economy must be followed by robust, sustainable private investment. Developing dedicated industrial zones, providing incentives for ecological tourism, upgrading food-processing infrastructure for local agriculture, and improving digital connectivity will generate meaningful employment, steering local youth away from radicalization.
- **Grassroots Grievance Redressal and Comprehensive Development:** The administrative structure must focus heavily on transparency and public accountability. Strengthening the Panchayati Raj framework with adequate financial resources and administrative support ensures that welfare benefits are distributed equitably, effectively countering old patterns of institutional corruption.
- **Fostering Inclusive Cultural Narratives:** While using popular media to celebrate national milestones is valuable, cultural policy should remain broad and inclusive. Encouraging diverse regional voices, protecting unique linguistic heritages, and supporting independent artistic expressions will foster a more resilient and multi-layered national identity, ensuring that integration is embraced culturally as well as politically.

COMPREHENSIVE ANALYSIS: NATIONAL INTEGRATION & J&K CONSTITUTIONAL REFORMS

KEY TERMS & CONCEPTS



ARTICLE 370

GRANTED DISTINCT
AUTONOMOUS STATUS TO
JAMMU & KASHMIR (J&K).
NOW NEUTRALIZED.



ASYMMETRIC FEDERALISM

constituent states
possessing varying
degrees of autonomy.



CONFLICT ECONOMY

economic system
benefiting from instability,
militancy, illicit finance.



SOFT POWER & CULTURAL HEGEMONY

national influence through
culture, media, and state
recognition.

MULTIDIMENSIONAL IMPACT ANALYSIS

SOCIAL DIMENSION



GENDER
JUSTICE

MARGINALIZED
GROUPS
RIGHTS



COUNTER-
RADICALIZATION
BOOKS
NO FACES

POLITICAL DIMENSION



DECENTRALIZED
POWER PYRAMID
FROM UNION
TO PRIS

NEW
GRASSROOTS
LEADERSHIPS
LEADERSHIP

LEGAL DIMENSION



INDIAN
CONSTITUTION

ARTICLE 370
ABROGATION
SUPREME COURT
VALIDATION

ETHICAL DIMENSION



STATE SECURITY

HISTORICAL
TRUTH

RESPONSIBLE
MEDIA PEN

HISTORICAL
TRUTH

INTERNATIONAL & SECURITY



INTELLIGENCE
COORDINATION

DECLINED
MILITANCY

ECONOMIC DIMENSION



CLEAN MONEY
FLOWS

NATURAL
FLOW

INFRASTRUCTURE
& TOURISM



CONFLICT ECONOMY

PREVIOUS YEARS' QUESTIONS (SAMPLE)

UPSC CSE FRAMEWORK & RELEVANCE

POST-
INDEPENDENCE
CONSOLIDATION

GS-1



Reorganizing UTs

POST-
CONSTITUTIONAL
PROVISIONS &
FEDERALISM

GS-2



INTERNAL
SECURITY
CONFLICT
ECONOMY

GS-3



ETHICS &
ESSAY TOPICS

GS-4



INTEGRITY

NATIONAL
UNITY

HISTORICAL EVOLUTION TIMELINE

1947 to Present



MAINS
Analyze dynamic nature
of Indian federalism

PRELIMS
Analyze *yanomuneshant v*
J&K Reorganisation

CORE INFLATION NUMBERS SUGGEST CONSUMPTION IS SUBDUED

India's 3 inflations: Clues from prices on consumption, profits & China dependence

Siddharth Upasani
New Delhi, July 18

THIS WEEK, the government released three different measures of inflation — Consumer Price Index (CPI), Wholesale Price Index (WPI), and Producer Price Index (PPI) — for the month of June.

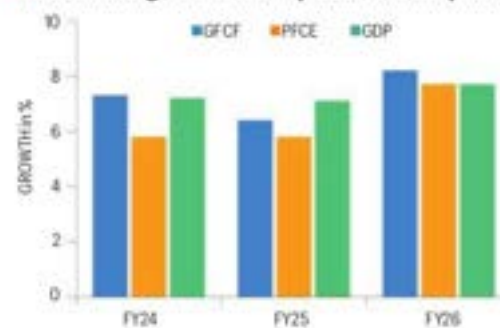
The common theme across all three was that prices rose at a faster rate in June compared to May on the back of higher food inflation and elevated fuel prices, thanks to the weak rains and the West Asia war.

CPI inflation, which is relevant for households, rose to 4.38% from 3.93% in May; WPI inflation, which measures the year-on-year change in wholesale prices, increased to 9.87% from 9.68%; and output PPI inflation edged up to 9.57% from 9.38%. But the price situation in the country is more complex than just an increase in inflation.

Core inflation and consumption

The 4% inflation the Reserve Bank of India targets refers to headline CPI inflation. And while that crossed 4% in June for the first time in 17 months, core inflation was unchanged at 3.9%. Core inflation measures the year-on-year change in prices for items other than food and fuel, which can be volatile. Households also

Investment growth has outpaced consumption



NOTES: GFCF IS GROSS FIXED CAPITAL FORMATION; PFCE IS PRIVATE FINAL CONSUMPTION EXPENDITURE. DATA IN CONSTANT PRICE TERMS. SOURCE: MATHUR

may not drastically change their consumption of food and fuel just because prices rose or fell — people can't give up eating and necessary travel.

This is why focussing on the non-food-non-fuel portion of the CPI can provide more useful information. Economists think core inflation suggests consumption is subdued.

The most widely-used core inflation measure has risen only 20 basis points over the last six months from 3.7% in January. A narrower version of core inflation that also excludes gold and silver jewellery — precious metal prices have

rapidly risen and fallen over the last 12 months or so — has edged up to 2.5%. It was as high as 6% in early 2023.

But how did core inflation fall from 2023 to 2026 even as India recorded a world-beating 7%-plus growth? According to ANZ economists Dhiraj Nim and Sanjay Mathur, the answer may lie in what has been driving India's growth in recent years: investments.

"In the last four fiscal years, gross fixed capital formation (GFCF) growth has consistently driven GDP, outpacing private consumption growth. In other words, the productive capacity

of the economy has grown faster than consumption demand," Nim and Mathur said in a note Wednesday.

The China factor

Also pulling down India's non-food-non-fuel-non-precious metal inflation is falling prices of Chinese goods. According to ANZ, movement in Chinese producer prices is the second-most important driver of this narrow core inflation in India. With China's Producer Price Index (PPI) inflation in negative territory from October 2022 to February 2026, India has been importing 'deflation' from China.

"India's increased supply chain dependence on China means price spillovers are becoming stronger. India's goods imports from China now exceed \$130 billion annually, representing close to 3.5% of India's GDP, ranging all kinds of goods," Nim and Mathur said. The GST rate cuts and the subsequent price reductions of last year also explain why core inflation has been subdued over the better part of the last one year. However, this low base effect will vanish in a couple of months.

Dining out gets expensive

One part of core inflation which has risen sharply since the West Asia war started is prices charged by restaurants

and cafes. From 2.73% in February, restaurant and cafe inflation has risen to 6.94% in June because of higher commercial LPG prices.

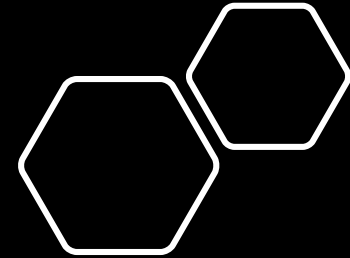
With eateries passing on higher costs to diners, the second-round impact of the LPG price hikes is clearly visible, although the cut in cylinder prices earlier this month may rein it in.

Profit margin pressures

Restaurants and cafes are especially sensitive to higher costs. But the manufacturing sector has seemingly stomachached the increased input prices, possibly in the face of weak consumer demand.

Consider this: the output PPI — which measures the change in prices received by producers excluding net taxes at the factory gate — for the manufacturing sector declined 0.3% in June from May. At the same time, the sector's input PPI — currently being released on an experimental basis — jumped 2.1% month-on-month in June. Is it absurd to read so much into inflation data? Perhaps not. According to DSP Mutual Fund, inflation is "by far...the cleanest indicator of the underlying strength of consumption", especially with the CPI series having been updated.

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- **Key Terms and Explanations**

- **Headline Inflation:** This represents the total inflation within an economy, capturing price changes across a comprehensive basket of goods and services, including highly volatile sectors like food and energy. For instance, when erratic monsoon rains cause tomato prices to skyrocket or geopolitical conflicts spike crude oil prices, the immediate impact is visible here.
- **Core Inflation:** A more stable economic metric, core inflation isolates price movements by completely excluding volatile components such as food and fuel. It acts as a diagnostic tool for central planners to gauge long-term demand. If headline inflation is high but core inflation remains low, it indicates that price pressures are driven by temporary supply shocks rather than overheating consumer demand.
- **Narrow Core Inflation:** This is a further refined subset of core inflation that strips away not just food and fuel, but also volatile luxury assets like gold and silver jewelry. By eliminating these components—which often fluctuate based on global currency movements and festival seasons—it reveals the true, unvarnished purchasing trends of domestic consumers for standard manufactured goods and services.
- **Wholesale Price Index (WPI) & Consumer Price Index (CPI):** WPI measures the price of goods at the wholesale stage, capturing bulk transactions traded between corporations. CPI, conversely, tracks the retail prices paid directly by the final consumer at the market level. A wide gap between the two often signals structural inefficiencies or shifting profit margins within the supply chain.
- **Producer Price Index (PPI) - Input vs. Output:** PPI tracks price changes from the perspective of the domestic producer. **Input PPI** measures the cost of raw materials and intermediate goods entering the factory gate (e.g., raw steel, chemicals). **Output PPI** measures the prices received by the manufacturer for the finished product as it leaves the factory. When Input PPI rises while Output PPI falls, it signals that manufacturers are facing a severe profit squeeze.
- **Gross Fixed Capital Formation (GFCF) vs. Private Final Consumption Expenditure (PFCE):** GFCF represents the total value of physical investments made within an economy, such as infrastructure, machinery, and factory construction, largely driven by corporate or government spending. PFCE, on the other hand, measures the total spending by households on individual consumption, serving as the ultimate metric for consumer confidence and aggregate domestic demand.

- **Main Arguments and Substantive Parts**

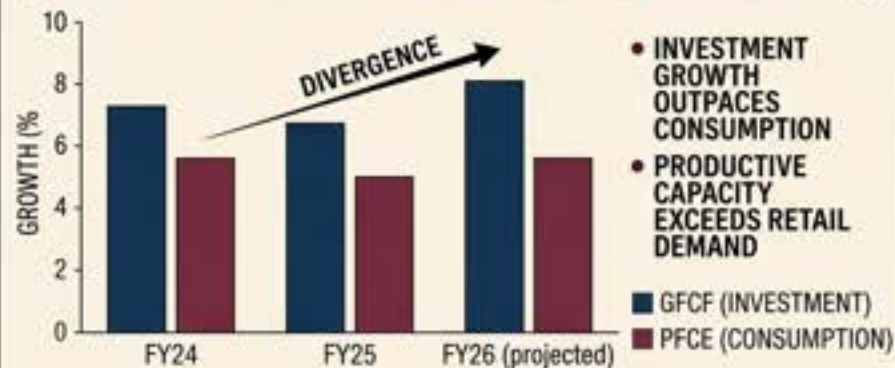
- The structural core of the current economic discourse centers on a fascinating macroeconomic paradox: India is experiencing world-beating GDP growth exceeding 7%, yet core inflationary indicators remain heavily subdued.
- **The Consumption-Investment Divergence**
 - The primary driver behind this phenomenon is an asymmetrical growth model where productive capacity is expanding far faster than actual consumer demand. Over recent fiscal years, Gross Fixed Capital Formation (GFCF) has consistently outpaced Private Final Consumption Expenditure (PFCE). The government's aggressive capital expenditure push and corporate investments have successfully expanded the nation's industrial and infrastructural base. However, because domestic retail demand remains soft, this newly created productive capacity is not being met with matching consumption, preventing core prices from rising.
- **The Mechanism of Imported Deflation**
 - A critical external factor keeping domestic core inflation low is the massive reliance on industrial imports from China. As China faces domestic economic deceleration, its Producer Price Index (PPI) has lingered in negative territory for an extended period, leading to a surplus of cheap manufactured goods. With India's annual merchandise imports from China hovering around \$130 billion—constituting nearly 3.5% of India's GDP—the domestic market is effectively importing Chinese deflation. This influx of low-cost intermediate and finished goods forcefully depresses the non-food, non-fuel manufacturing component of India's core inflation.
- **The Corporate Profit Squeeze**
 - While service sectors like restaurants and cafes have been able to pass on rising operational costs (such as commercial LPG hikes driven by West Asian instability) to consumers, the broader manufacturing sector is facing a severe dilemma. Experimental data reveals a stark divergence: monthly Input PPI jumped by 2.1%, while Output PPI at the factory gate actually fell by 0.3%. This proves that manufacturers are actively absorbing rising raw material costs. They are forced to compress their own profit margins because they recognize that the underlying strength of retail consumption is too weak to absorb higher prices.

- **Historical Evolution of the Issue**
- **The Pre-1991 Era of Structural Scarcity:** In the decades following independence, the Indian economy was defined by the "Hindu rate of growth" and persistent structural supply bottlenecks. Inflation during this era was heavily driven by agricultural failures and global oil shocks (such as in 1973 and 1979). The state relied on administered price mechanisms, and the concepts of core inflation or producer indices were secondary to the urgent need to manage basic food security and wholesale hoarding.
- **The Post-Reforms Era and the Chinese Influx (1991–2010s):** Liberalization opened up the economy to global market forces. Concurrently, China's entry into the World Trade Organization (WTO) in 2001 transformed global supply chains. Indian manufacturing increasingly integrated with cheap Chinese inputs, particularly in electronics, active pharmaceutical ingredients (APIs), and machinery. This period saw structural shifts where domestic wholesale prices became progressively tied to global commodity cycles and foreign industrial capacities.
- **The Introduction of Inflation Targeting (2016):** Following the recommendations of the Urjit Patel Committee, India formally moved to a Flexible Inflation Targeting (FIT) framework, mandating the Reserve Bank of India (RBI) to maintain headline CPI at 4% within a tolerance band of +/- 2%. This shifted the analytical spotlight from WPI to CPI. It forced policymakers to look deeper into the structural sub-components of inflation, separating transient food shocks from the underlying demand trends reflected in core inflation.
- **The Post-Pandemic CapEx Paradigm (2020s–2026):** In the wake of the pandemic, the government engineered a deliberate pivot toward investment-led growth, significantly expanding capital expenditure outlays to build roads, railways, and digital infrastructure. While this successfully insulated the headline GDP growth figure, it created a unique historical anomaly: a high-growth economy where private household consumption remains subdued, and core inflation stays soft due to an unprecedented reliance on imported intermediate inputs.
- **Way Forward**
- **Reviving Private Consumption via Targeted Fiscal Measures**
- To correct the imbalance between GFCF and PFCE, direct policy interventions are needed to put disposable income back into the hands of lower and middle-income households.
- **GST Rationalization:** The government should lower GST rates on common consumer durables, mass consumption items, and essential services to lower final retail prices and spur demand.
- **Boosting Rural Incomes:** Increasing budget allocations for rural employment guarantees (like MGNREGS) and raising minimum support prices (MSPs) in line with real input costs will immediately boost rural purchasing power, helping to lift core inflation naturally.
- **Accelerating Structural De-risking from China**
- While importing cheap inputs helps control domestic inflation in the short term, it creates long-term economic vulnerabilities.
- **Expanding the PLI Scheme:** The Production Linked Incentive (PLI) scheme needs to expand beyond simple final assembly to focus heavily on the domestic manufacture of intermediate components, chemicals, and active pharmaceutical ingredients.
- **Import Diversification:** Policymakers should build trade partnerships with alternative manufacturing hubs in Southeast Asia (e.g., Vietnam, Thailand) to reduce the strategic risks associated with Chinese supply chain dominance.
- **Formalizing and Utilizing the Producer Price Index (PPI)**
- India needs to transition from relying on WPI to fully adopting a formalized PPI framework to better guide monetary policy.
- **Data-Driven Policy:** Standardizing the experimental Input and Output PPI will give the Monetary Policy Committee a much clearer, real-time look at factory-gate cost pressures. This ensures that the RBI does not overly tighten interest rates based solely on food-driven headline inflation shocks, protecting manufacturing profit margins from unnecessary pressure.



INDIA'S ECONOMIC PARADOX: ANALYSING GROWTH, DEMAND, AND DEPENDENCE FOR UPSC CSE

STRUCTURAL PARADOX: INVESTMENT VS CONSUMPTION



THE PROFIT MARGIN SQUEEZE

INPUTS:

Class 11

Raw material and Exarics

Class 12

EPI topics

EXPERIMENTAL DATA

INPUT PPI vs **OUTPUT PPI**
↑ **+2.1%** vs **-0.3%**
Raw material vs Finished product



MANIPULATING PROFIT



MANUFACTURING PROFIT

HEADLINE INFLATION



- TOTAL INFLATION** (Includes erratic food/energy)
- Targets immediate supply shocks



CORE INFLATION



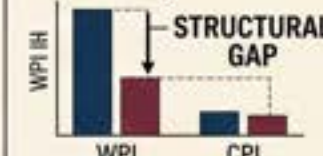
- STABLE MEASURE** (Excludes volatile items)
- Gauges long-term demand trends



WPI vs CPI GAP



- WPI: wholesale prices. CPI: retail prices.
- Gap signals structural inefficiency



PRODUCER PRICE INDEX (PPI)



- INPUT PPI:** cost entering factory gate (Experimental data).
- OUTPUT PPI:** price at factory exit.



HISTORICAL EVOLUTION



MULTIDIMENSIONAL ANALYSIS



WAY FORWARD



UPSC SYLLABUS LINKAGES

PYQ Corner

Prelims. 2011 2013 2015 2020

Mains GS3 prompt: 'lhasical themes'
Mains GS3 prompt: 'soon' prompt themes

Stone Age to Sangam era, Tenkasi settlement thrived across millenia

Arun Janarthanan
Chennai, July 18

ON THE banks of the Vaigyar river in Tamil Nadu's Tenkasi district, archaeologists are slowly uncovering the story of a settlement that appears to have survived — and thrived — for thousands of years.

At Marudiyipatti near Kattankulathurai, where excavations have been underway since April, each trench is adding another layer to a remarkably continuous sequence of human occupation.

From tiny microlithic stone tools left behind by some of the region's earliest inhabitants to expansive Sangam-era brick structures, iron-working evidence and iron production debris, the site is emerging more of an urban Tamil Nadu's most significant archaeological landscapes.

Unlike northern Tamil Nadu, where archaeology has established a clear transition from the Microlithic to the Neolithic and then the Iron Age, Kattankulathurai appears to follow a different trajectory. Archaeologists say the evidence points to continuous occupation from the Microlithic period through the Iron Age, including the Early Historic and Historic periods, bypassing the Neolithic or Chalcolithic phases — a cultural sequence that mirrors discoveries at sites such as Marupadi, Tirupattur and Adichanallur.

The excavation, being carried out by the Tamil Nadu State Department of Archaeology (TNDA), has opened 18 trenches so far and forms part of the state's broader archaeological programme that also includes Korkali.

The site's importance was first recognised nearly a century ago after human ruins were reported from the region. The then Travancore Deputy Collector, L.A. Cammelly, surveyed the area, while the Madras Museum's 1932-33 annual report documented glass beads and burial urns collected from local residents.

Those early references have now acquired fresh significance as archaeologists uncover evidence suggesting the settlement was not merely inhabited over centuries, but also functioned as a manufacturing centre.

The discovery made in the

Microlithic tools to Early Historic brick structures found during excavation point to uninterrupted cultural sequence



The red-slipped burial pot decorated with painted peacocks found in Tamil Nadu's Tenkasi district

district settlement.

Archaeologists have recovered human and iron artefacts, iron implements, large quantities of glass beads, terracotta figurines, graffiti-marked pottery, beads, plectrums, black-and-red ware and ceramics associated with the Early Historic period.

A long-lived settlement

One of the excavation's most significant finds is a large brick structure measuring about 8.7 metres by 4.2 metres, built with bricks measuring 40 x 25 x 7 centimetres. The structure, which includes descending steps, is believed to have served either as an underground granary or a residential harvesting tank.

The discovery has prompted archaeologists to consider the possibility of sophisticated water management despite the settlement's proximity to the Vaigyar river. Soil analysis is expected to help determine its precise function, while carbon-dating samples have been sent to Beta Analytical Laboratory in Florida for scientific dating.

The dimensions and style of the bricks resemble those found at Korkali, Alagankulam and Poompuhar, suggesting that the structure belongs to the Early Historic or Sangam period.

Another discovery has drawn attention because it ap-

pears to be an ancient Tamil incense burner.

Archaeologists unearthed a red-slipped burial pot decorated with painted peacocks on its shoulder.

Molar and premolar teeth recovered outside the vessel, along with a black-and-red ware pot placed beneath it, suggest it served as a burial urn.

Researchers note that peacocks have previously been associated with burials at Perambalur and even in Harappan Cemetery H contexts.

Similar vessels discovered at Harappa, Indus and Mohenjo-daro depict peacocks with intricate human figures enclosed within their bodies, suggesting ritual significance, human sacrifice, particularly Akashman, also refers to decorating memorial stones with peacock features, lending literary resonance to the archaeological evidence.

The significance

The excavation is only halfway through, but it has already yielded an expanding inventory of artefacts that reflect everyday life, craftsmanship and trade.

More than 200 artefacts have been recovered over the past three months, according to School Education and Tamil Development Minister A. Rajendran.

In a post on X, the minister said archaeologists had

tools, shell bangles, terracotta spindle wheels used in weaving, terracotta discs, terracotta and metal beads, a gold bead, rectangular gaming pieces, iron artefacts and copper coins. He also said excavations had revealed Sangam-era square brick structures, iron weaponry, black-painted lidded vessels and perforated bowls.

Rajendran said the structural evidence suggested that "iron tool-making, bead manufacturing, shell bangle production and weaving workshops were available in the region during the Sangam period".

The minister said the discovery highlighted the "technological sophistication, artisanal excellence and economic vitality" of ancient Tamil society.

Expressing confidence in the excavation, Rajendran said continued archaeological work and scientific studies would further establish "the antiquity of the Tamil before the world".

The evidence emerging from Kattankulathurai increasingly suggests that this was not simply a habitation site but a specialised production centre connected to wider trade networks.

Located along an ancient route linking the eastern and western coasts, the settlement appears to have combined habitation, manufacturing and commerce over successive historical periods.

The findings also add another chapter to Tamil Nadu's growing body of archaeological evidence that has steadily reshaped our understanding of the region's antiquity.

Sites such as Korkali revived public interest after carbon-dating pushed the beginning of the Sangam era further back than previously believed, while Tirupattur yielded coin hoards dated to 1345 BC, among the earliest known evidence of minted coin.

As archaeologists continue excavating the remaining trenches and undertake specialised analyses of ceramics, metals and organic samples, Kattankulathurai may yet reveal how one settlement endured across millennia — its people adapting, manufacturing and leaving behind a continuous archaeological record stretching from the Stone Age to the flourishing urban culture of

- **Key Terms and Explanations**
 - **Continuous Cultural Sequence:** This refers to an archaeological phenomenon where a single geographic site displays uninterrupted human occupation across distinct historical epochs without occupational breaks or abandonment. For instance, a site moving seamlessly from primitive stone tool usage into advanced metalworking indicates an adaptable, resilient community that survived environmental and social shifts.
 - **Microlithic Tools:** Small, flint-based stone tools, typically ranging from 1 to 5 centimeters in length, predominant during the Mesolithic era. These geometric blades were hafted onto wooden or bone handles to create composite weapons like spears or arrows. A modern analogy would be replaceable utility blades, representing a massive leap in prehistoric hunting efficiency.
 - **Sangam Era:** The classical golden age of South Indian history, traditionally dated from the 3rd century BCE to the 3rd century CE, though recent scientific advancements have pushed its origins further back. It is characterized by highly sophisticated Tamil academy poetry, flourishing urban centers, and vast maritime trading networks.
 - **Black-and-Red Ware (BRW):** A distinct class of ancient pottery featuring a dual-color appearance—black on the interior and around the rim, and red on the exterior. This effect was achieved through an advanced technique called inverted firing, where the pot was placed upside down in the kiln, restricting oxygen to the inside while allowing the outside to oxidize.
 - **Hematite:** A heavy, reddish-black mineral form of iron oxide. In antiquity, the presence of hematite at an archaeological site serves as direct evidence of local iron-ore processing and primary metallurgical industries, moving beyond mere usage of metal to actual manufacturing.
 - **Spindle Whorls:** Small, circular discs with a central hole, fitted onto a spinning spindle to provide momentum and stability. Finding these in excavations provides definitive proof of a developed textile industry, indicating that the community was engaged in spinning thread and weaving cloth.
- **Main Arguments and Substantive Parts**
 - The core thesis of recent archaeological explorations revolves around the idea that peninsular India hosted highly sophisticated, self-sustaining industrial and urban hubs that enjoyed uninterrupted cultural longevity for thousands of years.
- **The Theory of Uninterrupted Technological Transition**
 - A pivotal argument put forth by material evidence is the unique developmental trajectory of southern settlements. Unlike northern zones that generally followed a linear progression from the Stone Age to the Neolithic, Chalcolithic (Bronze), and finally the Iron Age, certain southern landscapes reveal a direct transition from Microlithic hunter-gatherer phases straight into the Iron Age and Early Historic periods. This bypasses the traditional Neolithic or copper-using phases entirely, proving that technological evolution is not uniform and that communities adapted directly to the rich iron-ore reserves of their immediate ecology.
- **From Habitation to Industrial Specialization**
 - The discoveries strongly challenge the older historiographical assumption that ancient rural sites were merely small agricultural hamlets. The physical remnants point to an advanced division of labor and specialized manufacturing zones. The co-existence of iron-smelting furnaces, bead-making hearths, shell-bangle workshops, and textile weaving apparatuses reveals an organized, market-oriented industrial setup. These sites produced high-value consumer goods and utility tools far exceeding the survival needs of the local population.
- **Pan-Indian Ritual and Trade Networks**
 - Another substantive part of the discoveries is the unmistakable link between southern mortuary practices and broader pan-Indian cultures. The unearthing of burial urns featuring intricate peacock motifs draws a striking parallel to the Harappan Cemetery-H and late Bronze Age contexts of Northern India. This indicates that despite vast geographical distances, there existed an underlying, shared symbolic or ritualistic universe across the subcontinent. Furthermore, the strategic location of these settlements along trans-peninsular routes connecting the eastern and western coasts shows they functioned as crucial economic arteries feeding into global maritime networks.

- **Historical Evolution of the Issue**
- **Pre-Independence Explorations (Late 19th Century to 1930s)**
 - The initial recognition of peninsular India's antiquity was driven by colonial administrators and antiquarians who stumbled upon Roman coins, indicating ancient global trade connections. In the early decades of the 20th century, regional administrators began systematic surface surveys. By 1932-33, institutional records like those of the Madras Museum began documenting glass beads and large burial urns retrieved from southern river valleys, laying the rudimentary groundwork for Megalithic studies.
- **Post-Independence and the Gangetic Focus (1950s–1990s)**
 - Following independence, the primary focus of Indian archaeology shifted heavily toward the Indus Valley sites left in India and the Gangetic Plain to trace the roots of the "Second Urbanization." Peninsular India was frequently viewed through an asymmetric lens, categorized largely by its massive stone graves (Megaliths) rather than urban architecture. The prevailing narrative assumed that urban civilization diffused from the north to the south at a much later date.
- **The Contemporary Reshaping of Antiquity (2000s–Present)**
 - The turn of the 21st century brought a revolutionary paradigm shift, led by state archaeological departments utilizing absolute scientific dating methods. The landmark excavations at Keeladi pushed the boundaries of the Sangam era back to the 6th century BCE, proving a contemporary urban civilization existed in the south alongside the Mahajanapadas of the Gangetic valley. Subsequent excavations at sites like Sivagalai—revealing iron use dating back to the 4th millennium BCE—and current multi-trench operations along the Vaippar river valley have firmly established a timeline of deep, unbroken civilizational continuity.
- **Way Forward**
- **Upscaling Chronometric and Scientific Infrastructure**
 - India must drastically expand its domestic capacity for high-precision scientific dating. Relying heavily on overseas laboratories for Accelerator Mass Spectrometry (AMS) carbon dating slows down the pace of research. Investing in state-of-the-art, indigenous mass spectrometry labs and advanced metallurgical testing facilities will allow for rapid, onsite scientific analysis.
- **Implementing Multidisciplinary Research Frameworks**
 - Future excavations must move beyond traditional artifact recovery. Field archaeology should systematically integrate disciplines like **paleo-botany** (to analyze ancient seed remnants), **paleo-genomics** (to study ancient DNA from burial teeth), and **soil morphology**. This holistic approach is crucial to determine the exact functions of enigmatic public buildings, such as distinguishing whether a structure served as a granary or a water management system.
- **Developing Site Museums and Heritage Corridors**
 - Taking inspiration from the successful Keeladi museum model, the state should develop localized, world-class site museums directly at major excavation zones. Transforming these active archaeological landscapes into educational eco-tourism hubs will not only preserve the artifacts in their original context but also generate sustainable livelihood opportunities for local rural communities.
- **Creation of a Digital Heritage Grid**
 - The Archaeological Survey of India (ASI) along with State Departments should launch a unified national digital archive. By creating high-resolution 3D digital scans of excavated sites, tools, and pottery graffiti, these invaluable historical assets will be permanently preserved in the cloud, opening up opportunities for global scholars to collaborate virtually and enrich our collective understanding of India's past.

THE ANCIENT TENKASI SETTLEMENT: MILLENNIA OF CULTURAL CONTINUITY

UNBROKEN CHRONOLOGICAL TIMELINE

MICROLITHIC PHASE

(Stone Age)

STONE AGE



Evidence of earliest inhabitants, microlithic stone tools.

IRON AGE



Hematite ore



Finding haematite for iron extraction for iron extraction.

Iron extraction (hematite), specialized metalworking workshops.

EARLY HISTORIC / SANGAM ERA

(C. 3rd Cent BCE onwards)



Weaving loom



Granary



Shell bangles

- Large Brick Structure (8.7m x 4.2m) - Granary/Water Management with Standardized Bricks.

- Brick-making and standard with standardized, and standardized sizes.

SPECIALIZED PRODUCTION CENTRE & INDUSTRIAL HUB

Manufacturing, and commerce combining habitation and advanced industrial specialization.

IRON WORKING



Slag

TEXTILE PRODUCTION



HEARTHES
Glass beads

TEXTILE PRODUCTION



Weaving looms forms, weaving



Spindle whorls

Manufacturing, and commerce combining habitation and advanced industrial specialization.

SHELL BANGLE PRODUCTION



Glass beads



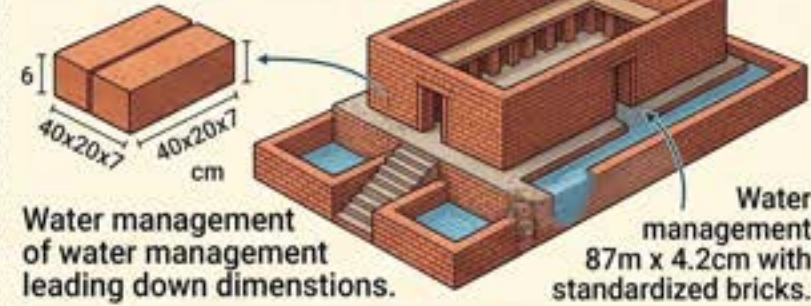
Shell bangle



Shell waste

CIVIC, TRADE & RITUAL SIGNIFICANCE

CIVIC INFRASTRUCTURE



TRADE NETWORK

Ancient trade route linking eastern and western coasts.

Strategic location connected to wider trade networks and Roman influence.



RITUAL CONTINUITY & CULTURAL RESONANCE

Unique painted motifs with direct parallels to Harappan Cemetery-H, ritual significance linking to wider cultures.

Note: Reshaped Sangam dating nshaped dating sailed dectored to Waar, 2024.



RESHAPING TAMIL NADU'S ANTIQUITY: UNDERSTANDING ANCIENT CIVIC ORG, INDUSTRIAL SKILLS, AND WIDER TRADE CONNECTIONS.

India's first privately made orbital rocket Vikram-1 places payloads into orbit

Hemant G.S.
KOLKATA

India achieved a major milestone in its space journey on Saturday as the country's first privately developed orbital rocket, Vikram-1, successfully placed multiple technology demonstration payloads and postcards – including from Prime Minister Narendra Modi – into a low earth orbit.

Dubbed 'Mission Agni' (meaning arrival), the launch marked India's entry into an elite group of nations, becoming only the third country in the world to achieve the feat through a privately developed launch vehicle.

The mission was a "grand success", said private space launch company Skyroot Aerospace, which developed the rocket.

Vikram-1 lifted off from the Satish Dhawan Space Centre in Sriharikota at 12.05 p.m.

Defining moment: PM

Pawan Kumar Chaudhary, co-founder and CEO, Skyroot Aerospace, said that during the flight, Vikram-1 completed every principal mission milestone, validating the performance of its propulsion, avionics, and guidance, navigation and control systems under true operational conditions.

Following the successful launch, Prime Minister Narendra Modi had a phone conversation with the team of Skyroot Aerospace. Speaking to Mr. Chaudhary, the Prime Minister said that the launch is a defining moment in India's space journey.

"The growing participation of our private sector is opening new frontiers and accelerating innovation. This achievement will encourage youngsters to dream bigger and innovate fearlessly," Mr. Modi said.

Private entry

The 'Mission Agni' makes India the third country in the world to attain private orbital launch capacity

- Developed by Skyroot Aerospace, Vikram-1 is a multi-stage orbital launch vehicle built with an all-carbon composite structure
- It is powered by in-house developed propulsion systems, including 3D-printed engines
- It is designed to carry small satellites weighing up to 250 kg to low earth orbit

PAYLOADS

- Postcard by Cosmoserve Space
- Satellite by Grahav Space
- Scope Satellite by Skyroot Aerospace

COMPOSITION

Three solid stages and a liquid orbital adjustment module



- uQIP and mQIP by Germany's DLR
- Cosmos Bloom by Cosmos Diamonds
- Microsatellite by Sri Ramakrishna Mission

New payload: Vikram-1's first flight lift-off from the Satish Dhawan Space Centre in Sriharikota on Saturday, PM

The launch comes 46 years after India launched its first experimental sand-lire launch vehicle, SLV-3. On July 18, 1980, India became the sixth member of an exclusive club of space-faring nations when the SLV-3 was successfully launched from the same venue as Vikram-1.

"The vehicle deployed its customer payloads and generated a wealth of in-flight data that will directly inform future Vikram missions and the continual evolution of Skyroot's launch programme," Mr. Chaudhary said.

"We have a team of freshers, experienced persons and a diversified workforce," he said.

Vikram-1 is a seven-storey-tall, multi-stage orbital launch vehicle built with an all-carbon composite structure and powered by in-house developed propulsion systems, including 3D-printed engines and

high-thrust solid-fuel rocket boosters. It is designed to carry small satellites weighing up to 250 kg to low earth orbit.

During the flight, Vikram-1 deployed six technology demonstration payloads from Grahav Space, Cosmoserve, DCube2 and Skyroot, along with Cosmos Diamonds' artwork 'Cosmic Bloom', and a micro-art piece.

Pawan Goenka, chairman, DSpace, said: "Only a handful of nations can reach space on their own, and today a private Indian company joined that exclusive club. What lifted off today is the culmination of years of work, a team of over a thousand people, and efforts of close to 400 suppliers with it. Congratulations to team Skyroot. You have given us an India moment."

STEEP CLIMB

» PAGE 13

- **Key Terms and Explanations**

- **Low Earth Orbit (LEO):** This refers to an orbital altitude relatively close to the Earth's surface, typically spanning from 160 kilometers to 2,000 kilometers. LEO is highly coveted for commercial and scientific purposes because satellites placed here require less propulsion energy to launch and offer low-latency communication. Popular examples include the International Space Station and modern mega-constellations used for global broadband internet.
- **Multi-Stage Launch Vehicle:** A rocket that utilizes two or more distinct sections, or stages, each containing its own engines and propellant. As each stage exhausts its fuel, it detaches and falls away to shed unnecessary dead weight. This sequential shedding allows the remaining part of the rocket to accelerate more efficiently toward its final orbital destination.
- **All-Carbon Composite Structure:** A manufacturing paradigm that replaces traditional aerospace metals like aluminum or titanium with advanced carbon fiber materials. These composites offer an extraordinary strength-to-weight ratio, dramatically reducing the structural mass of the launch vehicle while ensuring it can withstand the extreme mechanical stresses of atmospheric departure.
- **3D-Printed Rocket Engines:** An innovation leveraging additive manufacturing to build complex engine components layer by layer from metal alloys. This technology bypasses traditional casting and machining, significantly reducing production timelines, lowering component counts, minimizing points of failure, and offering rapid prototyping capabilities for space startups.
- **Solid vs. Liquid Propulsion Modules:** Solid propulsion uses pre-mixed chemical fuel that delivers massive, reliable thrust upon ignition but cannot be easily throttled or shut off once started, making it ideal for the initial launch stages. Conversely, liquid propulsion modules allow for precise throttle control, shutdown, and restart capabilities, making them perfect for the final orbital adjustment module to delicately place payloads into their exact target orbits.
- **IN-SPACe (Indian National Space Promotion and Authorization Center):** An autonomous, single-window nodal agency under the Department of Space designed to act as a bridge between the Indian Space Research Organisation (ISRO) and private space entities. It regulates, promotes, and authorizes private sector participation in space activities, ensuring a level playing field.

- **Main Arguments and Substantive Parts**
 - The core thesis surrounding the evolution of space capabilities centers on a deliberate transition from a state-monopolized, strategically insulated domain to a vibrant, multi-player ecosystem driven by private enterprise and commercial viability.
 - **The Paradigm Shift in Launch Autonomy:** For decades, the capability to build and launch an orbital rocket was exclusively restricted to well-funded state space agencies. The emergence of independently developed private orbital launch vehicles demonstrates that private players now possess the technical maturity to manage end-to-end mission architectures. This shifts the state's role from being the sole operator to an active facilitator.
 - **Democratization of the Low Earth Orbit Market:** The global demand for small satellite deployments is expanding exponentially, driven by agriculture, climate monitoring, and telecommunications. Building agile, low-capacity rockets designed specifically to carry payloads up to 350 kg ensures that domestic and international customer satellites no longer have to wait as secondary payloads on massive state-led missions. They can get dedicated, on-demand access to space.
 - **Technological Validation of Additive and Composite Engineering:** The successful deployment of multiple technology demonstration payloads via private launch infrastructure proves the viability of low-cost manufacturing methodologies. Using carbon composites for the body and 3D printing for the engines validates that cost-effective, high-tech manufacturing can happen within the domestic ecosystem, setting a blueprint for future commercial space iterations.
 - **Strategic De-risking and Resource Optimization:** By delegating routine commercial satellite launches to private entities, the state space agency can strategically reallocate its intellectual and financial resources toward deep-space exploration, interplanetary missions, and foundational scientific research. This collaborative model maximizes the national return on investment in the space sector.
- **Historical Evolution of the Issue**
 - The journey of India's space program reflects a systematic progression from humble, societal-benefit origins to an open, hyper-competitive commercial market.
 - **The Foundational Era (1960s–1970s):** Under the visionary leadership of Dr. Vikram Sarabhai, the Indian National Committee for Space Research (INCOSPAR) was set up in 1962, followed by the birth of ISRO in 1969. The early philosophy was deeply rooted in using space technology exclusively for socio-economic development, such as tele-education, weather forecasting, and remote sensing, completely insulated from private commercial motives.
 - **The Experimental and Launch Validation Milestone (1980):** On July 18, 1980, India successfully launched its first experimental Satellite Launch Vehicle (SLV-3), deploying the Rohini satellite. This monumental achievement made India the sixth member of an exclusive club of spacefaring nations capable of indigenous launches. The venue where this occurred established a historical foundation for all future state and private launch architectures.
 - **The Commercial and Operational Expansion (1990s–2010s):** The development of the Polar Satellite Launch Vehicle (PSLV) turned India into a reliable global launch hub. During this phase, the private sector's role was strictly limited to that of tier-1 or tier-2 vendors—manufacturing nuts, bolts, and sub-assemblies under the tight oversight of ISRO. The commercial arm, Antrix Corporation, handled international marketing, but the entire ecosystem remained heavily centralized.
 - **The Institutional Reforms and Policy Shift (2020–Present):** A major structural pivot occurred in 2020 when the government formally unlocked the space sector for private entities. The establishment of IN-SPACe provided the regulatory framework needed to grant private players access to ISRO's world-class testing and launch facilities. This culminated in the landmark Indian Space Policy of 2023 and the subsequent realization of private orbital capabilities through missions like 'Mission Aagaman', transforming the country into a global hub for private space technology.

- **Way Forward**

- **Enacting a Comprehensive Space Act:** The government must expedite the passage of a dedicated, comprehensive national Space Act. This legislation should explicitly institutionalize the policies managed by IN-SPACe, establish clear liability insurance frameworks for private operators in case of launch mishaps, and offer long-term regulatory certainty to domestic and international investors.
- **Liberalizing FDI and Boosting Venture Capital Inflow:** While the recent easing of Foreign Direct Investment (FDI) norms in the space sector is a positive step, the bureaucratic process for approvals must be streamlined. Creating dedicated space-tech venture funds and offering tax incentives for early-stage investments will ensure that Indian startups are not choked of capital during their intensive R&D phases.
- **Institutionalizing Infrastructure Sharing Mechanisms:** The pricing model for private players utilizing ISRO's premium infrastructure—like launch pads, integration facilities, and tracking networks—should be kept deeply subsidized and transparent. Creating a digital, hassle-free booking platform for state-owned facilities will drastically reduce turnaround times for private launches.
- **Fostering Academic-Industrial Integration:** Universities and elite technical institutes like the IITs and IIST must realign their curricula to focus heavily on practical aerospace engineering, additive manufacturing, and space data analytics. Government-backed research grants should be awarded to collaborative consortiums of academia and startups to develop cutting-edge innovations, such as reusable launch vehicles and green propellants.
- **Mandating Space Sustainability Guidelines:** India should position itself as a responsible leader in space sustainability. Regulatory bodies must mandate that all private satellites and launch vehicles include end-of-life de-orbiting mechanisms right from the design phase. Actively developing domestic technologies for active debris removal will safeguard the long-term viability of low Earth orbits.

- **UPSC CSE Prelims Relevant Questions**

- **1. With reference to India's satellite launch vehicles, consider the following statements:**
 - PSLVs launch the satellites useful for Earth resources monitoring whereas GSLVs are designed mainly to launch communication satellites.
 - Satellites launched by PSLV appear to remain permanently fixed in the same position in the sky as viewed from a particular location on Earth.
 - GSLV Mk III is a four-stage launch vehicle with the first and third stages using solid rocket motors; and the second and fourth stages using liquid rocket engines.

Which of the statements given above is/are correct? (A) 1 only (B) 2 and 3 (C) 1 and 2 (D) 3 only



AXIA
IAS ACADEMY
RISE ABOVE THE BEST

COMPREHENSIVE ANALYSIS: PRIVATIZATION OF INDIA'S SPACE SECTOR (UPSC-CSE FOCUS)



HISTORICAL EVOLUTION TIMELINE



KEY TERMS & INSTITUTIONS GLOSSARY



MULTIDIMENSIONAL IMPACT ANALYSIS



SYLLABUS & NCERT LINKAGES

- ✓ GS Papers 1-4
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- ✓ Essay
- ✓ Optionals

NCERTs

- PHYSICS
- ECONOMICS
- GEOGRAPHY

WAY FORWARD: PRACTICAL SOLUTIONS



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Shah reviews indigenous border security technology in West Bengal

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NEW DELHI/KOLKATA

Union Home Minister Amit Shah on Saturday said the Siliguri corridor in West Bengal, that was "once a corridor of infiltration under previous governments", is now becoming synonymous with a secure border.

As part of his three-day visit to the State, which ends on July 19, Mr. Shah visited Jhumagachh Border Outpost of the 18th Battalion of the BSF's North Bengal Frontier in Siliguri, where he inspected indigenous and state-of-the-art technologies for strengthening border security.

"I reviewed the operational preparedness by observing the exhibition of the Intruder Warning System, Radio-based Fence Intrusion Detection System, Gate Management Software, and the Indigenous Border Security System installed on the new-design fence. Our borders, equipped with state-of-the-art equipment and mod-



Amit Shah inspects the surveillance system at Jhumagachh Border Outpost of the 18th Battalion of the BSF's North Bengal Frontier in Siliguri on Saturday. ANI

ern alert systems, are becoming an ideal example of modern border security," Mr. Shah wrote on social media.

He also chaired a high-level meeting with senior BSF officers in Siliguri, which was also attended by Chief Minister Suwendu Adhikari, Members of Parliament, Union Home Secretary Govind Mohan, Border Management Secretary Rajendra Kumar, Intelligence Bureau Director Mahesh Dixit, BSF Director General Praveen Kumar, senior State police officers, State government officials, and district admini-

stration officials.

Earlier, State Minister Agnimitra Paul said Mr. Shah's visit would focus on border fencing and security in the Siliguri Corridor, commonly referred to as 'Chicken's Neck'.

Projects worth ₹77 cr.

Mr. Shah virtually laid the foundation stone for and inaugurated development projects worth ₹77.06 crore. The projects included laying the foundation for the construction of a 4-km border fence to be built at ₹30 crore on newly acquired land for two border outposts in West Bengal.

Speaking during the event, the Minister stated that the government is establishing a quadrangular security grid to fortify the borders. He emphasised that the welfare of security personnel guarding the nation's borders and their families is a top priority for the government. The government is working towards making the borders completely secure and preventing infiltration in border areas through the concept of 'Smart Borders'.

The BSF has already said that it will expedite border fencing in coordination with other government departments. However, the Sundarbans with its thick mangrove forests and several river channels remains a challenge.

Soon after the BJP assumed power in West Bengal, Mr. Shah had said that the party's victory in the State would plug "one of the biggest holes" in the country's border security.

India shares a 4,096-km border with Bangladesh, of which 2,216 km lies in West Bengal.

- **Key Terms and Explanations**
- **The Siliguri Corridor ("Chicken's Neck"):** This highly sensitive geographical chokepoint is a narrow stretch of land located in West Bengal, measuring roughly 20 to 22 kilometers at its narrowest point. It connects the seven northeastern states to the rest of the Indian mainland. Sandwiched between Nepal, Bhutan, and Bangladesh, it represents a geopolitical vulnerability where any hostile disruption could potentially isolate the entire North-East region from mainland India.
- **Smart Borders and CIBMS:** The concept of "Smart Borders" marks a shift away from relying solely on physical human patrolling toward a dynamic, technology-driven surveillance framework. At its core is the Comprehensive Integrated Border Management System (CIBMS). This framework seamlessly unifies high-tech components—such as thermal imagers, infrared sensors, underground acoustic sensors, and aerostats—into a single operational loop, ensuring round-the-clock surveillance even in adverse weather conditions.
- **Quadrangular Security Grid:** This operational framework coordinates multiple security, intelligence, and administrative tiers to fortify a frontier. In the context of eastern border management, it synchronizes the efforts of border-guarding forces (like the Border Security Force), central intelligence agencies, state police departments, and local civil administrations. This integrated approach closes functional gaps and ensures rapid, coordinated responses to cross-border threats.
- **Radio-Based Fence Intrusion Detection System (FIDS):** This advanced tactical technology uses radio frequency waves or sensor-embedded cabling woven directly into border fencing. When an intruder attempts to cut, climb, or breach the physical barrier, the system detects disturbances in the electromagnetic field or mechanical vibrations. It instantly transmits precise coordinate alerts to nearby border outposts, enabling rapid interception.
- **Main Arguments and Substantive Parts**
- The contemporary discourse on safeguarding India's frontiers centers on a clear thesis: traditional, passive physical barriers are no longer sufficient to secure highly volatile and ecologically complex border zones. Modern national security requires an active transition toward indigenous, state-of-the-art technological ecosystems.
- **The Paradigm Shift from Vulnerability to Resilience:** Historically, sensitive choke points like the Siliguri Corridor were highly vulnerable to illegal infiltration, cross-border cattle smuggling, and fake Indian currency notes (FICN) trafficking. The current strategy actively transforms these vulnerable corridors into heavily fortified frontiers. This is achieved by combining advanced, newly designed physical fencing with indigenous automated warning software.
- **The Strategic Value of Indigenous Technology:** Relying on domestic technology for national security serves a dual purpose. From a tactical standpoint, custom-built tools like specialized Gate Management Software and Intruder Warning Systems are tailored to India's unique terrain. From a strategic perspective, using indigenous software protects critical border security networks from external cyber espionage, backdoor vulnerabilities, and supply chain disruptions.
- **The Complex Challenge of Diverse Terrains:** A uniform border policy cannot account for India's diverse geography. While plains and cleared lands are well-suited for standard fencing, regions like the Sundarbans present severe operational difficulties. The vast mangrove forests, shifting mudflats, and intricate networks of tidal river channels make physical fencing nearly impossible. These areas require non-physical, high-tech alternatives like sonar, radar, and underwater acoustic sensors.
- **Counterarguments and Implementation Hurdles:** Despite the clear benefits of high-tech border management, significant obstacles remain. The high initial capital required for technology deployment, combined with the recurring costs of maintaining delicate electronics in humid, saline, or riverine environments, places a heavy burden on the national exchequer. Furthermore, executing these projects depends heavily on smooth coordination between central agencies and state governments, particularly regarding land acquisition for border outposts.

- **Historical Evolution of the Issue**

- **The Genesis of Partition (1947):** The demarcation of the Radcliffe Line left a poorly defined, highly porous 4,096-kilometer border with what was then East Pakistan. The line paid little attention to local geography, cutting through communities, agricultural fields, and river systems. This structural flaw turned the region into an early hub for undocumented migration and informal cross-border trade.
- **The 1971 Watershed and the 1974 Indira-Mujib Pact:** The liberation of Bangladesh brought a massive influx of refugees and fundamentally changed the geopolitical landscape. The Land Boundary Agreement (LBA) of 1974 attempted to resolve complex territorial issues like enclaves and adverse possessions. However, actual implementation languished for decades, leaving border enforcement poorly coordinated and inconsistent.
- **The Fencing Mandate of the 1980s and 1990s:** Driven by internal security challenges and regional anxieties, the Government of India launched systematic, phase-wise physical fencing projects along the Indo-Bangladesh border. While these barriers reduced mass migration in plain areas, they struggled with shifting river courses, seasonal flooding, and dense jungle terrains, which consistently washed away physical structures.
- **The Kargil Review Committee and Institutional Overhauls (2000s):** The recommendations of the Kargil Review Committee led to a complete restructuring of India's border management under the principle of "One Border, One Force." The Border Security Force (BSF) was officially designated as the sole agency protecting the Indo-Bangladesh border, standardizing command structures and paving the way for modern technological integration.
- **The Era of Smart Borders and Strategic Infrastructure (Present Day):** Today, border security has evolved past simple barbed wire. The focus has shifted to comprehensive technological deployment, featuring the implementation of CIBMS, the resolution of long-standing enclaves through the historic 2015 LBA ratification, and substantial financial investments aimed at building zero-line smart fences and modern border outposts.

- **Way Forward**

- **Accelerating the Deployment of Next-Generation CIBMS:** The government should prioritize the installation of non-physical surveillance barriers in challenging terrains like the Sundarbans. Replacing vulnerable physical fences with a network of high-frequency satellite imaging, thermal arrays, and underwater sonar sensors will ensure continuous, reliable monitoring without disrupting fragile local ecosystems.
- **Institutionalizing Central-State Security Architecture:** To resolve jurisdictional friction and accelerate land acquisition for border projects, the government should establish a permanent, statutory Border Coordination Council. This body would bring together central defense officials, BSF commanders, and state home secretaries to streamline administrative approvals and coordinate internal security operations.
- **Empowering Local Communities as Development Partners:** Border management strategies should actively integrate local populations through programs like the Vibrant Villages initiative. By investing in local education, healthcare, and digital infrastructure, the state can reduce economic reliance on informal cross-border trade and encourage border communities to assist security forces as reliable partners on the ground.
- **Deepening Bilateral Security Cooperation:** Long-term border stability requires sustained diplomatic engagement with neighboring countries. India should expand coordinated joint patrolling and real-time intelligence sharing with the Border Guard Bangladesh (BGB). Establishing more cross-border Border Haats can transition local border economies toward formal, legal trade, reducing the operational burden on security personnel.



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INDIA'S BORDER SECURITY:

A COMPREHENSIVE ANALYSIS FOR CIVIL SERVICES EXAMINATIONS

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KEY TERMS & CONCEPTS

Siliguri Corridor ("Chicken's Neck")

Narrow land stretch in West Bengal



Geopolitical Vulnerability

Smart Borders & CIBMS



Quadrangular Security Grid



Radio-Based Fence Intrusion Detection (FIDS)



MAIN ARGUMENTS & PARADIGM SHIFTS

From Vulnerability to Resilience



Strategic Value of Indigenous Technology



Terrain Challenges (e.g., Sundarbans)



HISTORICAL EVOLUTION



LOGICAL & PHILOSOPHICAL BASE

Principled frames



MULTIDIMENSIONAL ANALYSIS

DIMENSION	DIMENSION	KEY IMPACTS
Social	Border Communities Land separation	Identity Dynamics Demographic anxieties
Political	Federal Friction Jurisdiction limits	National Security Strong governance
Legal	Citizenship Acts Foreigners Act, Passports Act	Border Mandates Precise legal enforcement
Ethical	Humanitarian Focus Trafficking victims vs criminals	Force Usage Non-lethal tech
International	Bilateral Relations Bangladesh coordination	Regional Choke Points China/Chumbi Valley
Economic	Smuggling Disruption Narcotics, FICN	Trade Corridors Formal trade routes

WAY FORWARD

Actionable steps



SYLLABUS LINKAGES & PREVIOUS YEARS QUESTIONS (PYQs)

UPSC/APSAC SYLLABUS	PYQs (Examples)	PRELIMS ANSWER KEY
GS 3: Internal Security: Border areas, crime GS 2: IR/Governance: Neighborhood, Federal GS 1: Geography: Siliguri corridor	Themes on Smart Borders, Siliguri vulnerabilities, 'One Border, One Force', riverine challenges (UPSC & APSAC)	A) 1 only B) Technological project C) 1 and 2 only

Unwanted guests turn sweet hosts for Assam butterflies

Rahul Karmakar
GUWAHATI

Butterflies have revealed that some invasive plant species, disliked by conservationists and farmers, and avoided by herbivores, serve an ecological purpose.

Bishal Basumatary, a research scholar at Bodoland University, set out to document the butterflies and their nectar sources in Raimona National Park. The university is on the outskirts of Kokrajhar, the administrative headquarters of the Bodoland Territorial Region, about 220 km west of Guwahati.

The research was conducted under the supervision of Kushal Choudhury, an associate professor at the university's Department of Zoology, between 2022 and 2025.

Their study document-

ed 220 species of butterflies, 56 species of larval host plants, and 41 species of nectar plants in the 422 sq. km national park that forms a large transboundary conservation landscape with Bhutan's Phibsoo Wildlife Sanctuary.

"One of the most significant findings is that *Lantana camara*, *Chromolaena odorata*, and *Ziziphus mauritiana*, which are generally regarded as invasive exotic species and are often excluded from forest management practices, serve as major nectar sources for a large number of butterfly species in the park," Mr. Choudhury said. *Lantana camara* and *Chromolaena odorata* are recognised among the world's most aggressive invasive plant species and regarded as ecologically undesirable because of their negative impacts on native



Plot twist: *Lantana camara* and a few other plant species are often excluded from forest management practices but they also function as host plants. SPECIAL ARRANGEMENT

vegetation and ecosystem functioning.

Abundant nectar

Larval host plants serve as the food source for butterfly larvae during their developmental stages, whereas nectar plants provide nectar, the principal nutritional resource for adult butterflies. The study revealed that some invasive plant

species provide abundant nectar supply for adult butterflies, particularly during periods when native wildflowers are scarce in the park. Their prolonged flowering period and high nectar availability were also found to have helped sustain butterfly populations during seasons of limited floral resources.

The researchers ob-

served that *Lantana camara* attracted exceptionally large numbers of butterflies. "The species produces flower clusters that change colour as the flowers age, resulting in multi-coloured inflorescences that serve as highly conspicuous visual cues for foraging butterflies. Coupled with its continuous nectar production, this characteristic likely contributes to its high attractiveness and frequent visitation by diverse butterfly species," they noted.

The study showed *Lantana camara* alone attracted more than 30 butterfly species between April and October, while *Chromolaena odorata* supported 24 butterfly species from December to February.

In addition to serving as nectar sources, several invasive plant species were also found to function as

larval host plants, highlighting their multifaceted ecological importance. These include *Ricinus communis*, *Senna alata*, *Portulaca oleracea*, *Sida rhombifolia*, *Cleome rutidosperma*, *Gomphocarpus physocarpus*, *Ageratum conyzoides*, *Chromolaena odorata*, *Tridax procumbens*, *Mikania micrantha*, *Mesosphaerum suaveolens*, *Spermacoce latifolia*, *Cyanthillium cinereum*, *Heliotropium indicum*, *Persicaria hydropiper*, *Persicaria sagittata*, *Sida acuta*, *Leucas aspera*, and *Urena lobata*.

The researchers recommended maintaining small, carefully managed patches of *Lantana camara*, *Chromolaena odorata*, and *Ziziphus mauritiana* in suitable areas of protected landscapes to provide a continuous nectar supply for butterflies.

- **Key Terms and Explanations**
 - **Invasive Exotic Species:** These are non-native organisms introduced to an ecosystem—either accidentally or intentionally—that rapidly proliferate, outcompete native species, and alter the fundamental structure of the habitat. For instance, *Lantana camara*, originally brought to India as an ornamental plant, has become an aggressive invader that chokes forest floors and displaces indigenous vegetation.
 - **Larval Host Plants vs. Nectar Plants:** This distinction highlights the two distinct phases of a butterfly's life cycle. Larval host plants act as the exclusive nursery and food source for caterpillars (larvae), which are highly selective and dependent on specific plant chemistry for survival. Nectar plants, conversely, serve as the energy stations for adult butterflies, offering sugar-rich secretions to fuel their flight and mating activities.
 - **Transboundary Conservation Landscape:** A contiguous ecological corridor that spans across international borders, managed cooperatively to protect shared biodiversity. A prime example is the contiguous belt formed by India's Raimona National Park and Bhutan's Phibsoo Wildlife Sanctuary, which allows free genetic flow and wildlife movement across geopolitical boundaries.
 - **Conspicuous Visual Cues & Inflorescence:** Inflorescence refers to the specific arrangement and clustering of flowers on a plant stem. When plants like *Lantana* feature color-changing flower clusters as they age, they create a multicolored inflorescence. This acts as a highly conspicuous visual advertisement, signaling nectar availability to foraging insects from a distance.
 - **Ecological Paradox:** A situation where an environmental element produces two directly contradictory outcomes. In this context, it represents the dual nature of aggressive weeds that ruin native plant diversity while simultaneously serving as an indispensable survival tool for local pollinator populations.
- **Main Arguments and Substantive Parts**
 - The core discourse shifts away from traditional, black-and-white conservation narratives, introducing a nuanced reality regarding habitat management and biodiversity maintenance.
- **The Central Thesis**
 - The primary argument posits that certain aggressive, invasive alien plants, traditionally vilified by conservationists and targeted for complete eradication, actually perform vital ecological stabilizing functions by acting as primary nectar and larval hosts for native insect populations.
- **The Lifeline During Lean Seasons**
 - **Extended Flowering Phenology:** Invasive weeds like *Lantana camara* and *Chromolaena odorata* possess prolonged flowering periods that extend far beyond those of native wildflowers.
 - **Bridging Resource Gaps:** During critical periods when native floral resources dry up, these exotic plants provide a continuous, reliable supply of nectar, effectively preventing mass starvation among adult butterfly communities.
- **Visual and Nutritional Magnetism**
 - **Multicolored Attractants:** The physical architecture of these plants, particularly the changing colors within *Lantana* inflorescences, optimizes the foraging efficiency of insects by signaling precise nectar locations.
 - **Supporting Species Richness:** Field data confirms this massive draw, showing that *Lantana* alone sustains over 30 distinct butterfly species during the monsoon and post-monsoon months, while *Chromolaena* steps in to support two dozen species during the harsh winter gap.
- **The Counter-Perspective and Conservation Dilemma**
 - **Monoculture Risks:** While these invaders support pollinators, they aggressively suppress native saplings, alter soil chemistry, and reduce the forage available to large mammalian herbivores like elephants and deer.
 - **The Micro-Management Compromise:** Rather than pursuing total eradication—which could inadvertently trigger a collapse in pollinator numbers—the modern approach advocates for maintaining small, strictly controlled patches of these exotics within protected zones to act as controlled ecological oases.

- **Historical Evolution of the Issue**

- **The Era of Colonial Introductions (Early 19th Century):** The roots of the crisis trace back to the British colonial administration, notably around 1807, when plants like *Lantana camara* were brought into royal botanical gardens as exotic ornamental hedges. Lacking natural local predators, these species escaped cultivation and began their quiet march across India's diverse landscapes.
- **Post-Independence Fragmentation and Proliferation (1970s–1980s):** As large-scale infrastructure projects, logging, and habitat fragmentation disrupted India's pristine forests, highly adaptable invasive species rapidly colonized these disturbed edges. They quickly overran degraded community pastures, Reserved Forests, and nascent Protected Areas, outcompeting native grass species.
- **The Complete Eradication Impasse (Late 2000s):** Forest departments across India launched massive budget-intensive campaigns aimed at the root-and-branch uprooting of invasive weeds. However, these mechanical and chemical eradication drives often backfired, leaving behind cleared, vulnerable soil that was quickly re-colonized by even more aggressive weed cohorts, while simultaneously removing existing ground cover for local insects.
- **The Shift to Paradigm Coexistence (Present Day):** Modern conservation science has arrived at a pragmatic crossroads. Recognizing that total eradication is a financial and physical impossibility, ecologists are moving toward adaptive containment, viewing these naturalized exotic weeds not just as pure biological hazards, but as functional components of modified ecosystems.

- **Way Forward**

- **Implementing Micro-Patch Management:** Forest departments should move away from indiscriminate clearance policies. Instead, they should adopt a strategy of zoned containment, preserving small, isolated, and strictly monitored patches of naturalized exotics within degraded zones to serve as pollinator sanctuaries during lean seasons, while aggressively clearing them from core primary forests.
- **Phased Bio-Restoration:** Eradication should never occur in a vacuum. Any mechanical removal of invasive species must be immediately paired with the dense replanting of native nectar-producing trees and larval host plants that feature staggered flowering cycles, ensuring that local insect populations face no sudden gaps in food availability.
- **Institutionalizing Transboundary Green Corridors:** India and Bhutan should build upon the Raimona-Phibsoo link to establish a standardized, joint ecological management framework. This would allow both nations to coordinate weed containment schedules, share research data on pollinator migration, and ensure continuous habitat safety across borders.
- **Investing in Long-Term Trophic Research:** Government funding should be directed toward long-term field studies that map the exact relationship between local insects and exotic plants. Understanding these connections helps forest managers avoid the unintended consequences of broad, unscientific habitat modifications.



ECOLOGICAL PARADOX: INVASIVE WEEDS & BUTTERFLY CONSERVATION IN ASSAM

A COMPREHENSIVE UPSC CSE ANALYSIS | RAIMOMA NATIONAL PARK | BODOLAND TERRITORIAL REGION

1. KEY TERMS & EXPLANATIONS



Invasive Exotic Species:
(Non-native plant aggressively altering habitat, e.g., Lantana).



Larval Host Plant:
(Exclusive nursery & food for caterpillars).



Nectar Plant:
(Energy stations for adult butterflies).



Transboundary Conservation:
(Contiguous habitat across international borders, e.g., Raimona-Phibsoo).



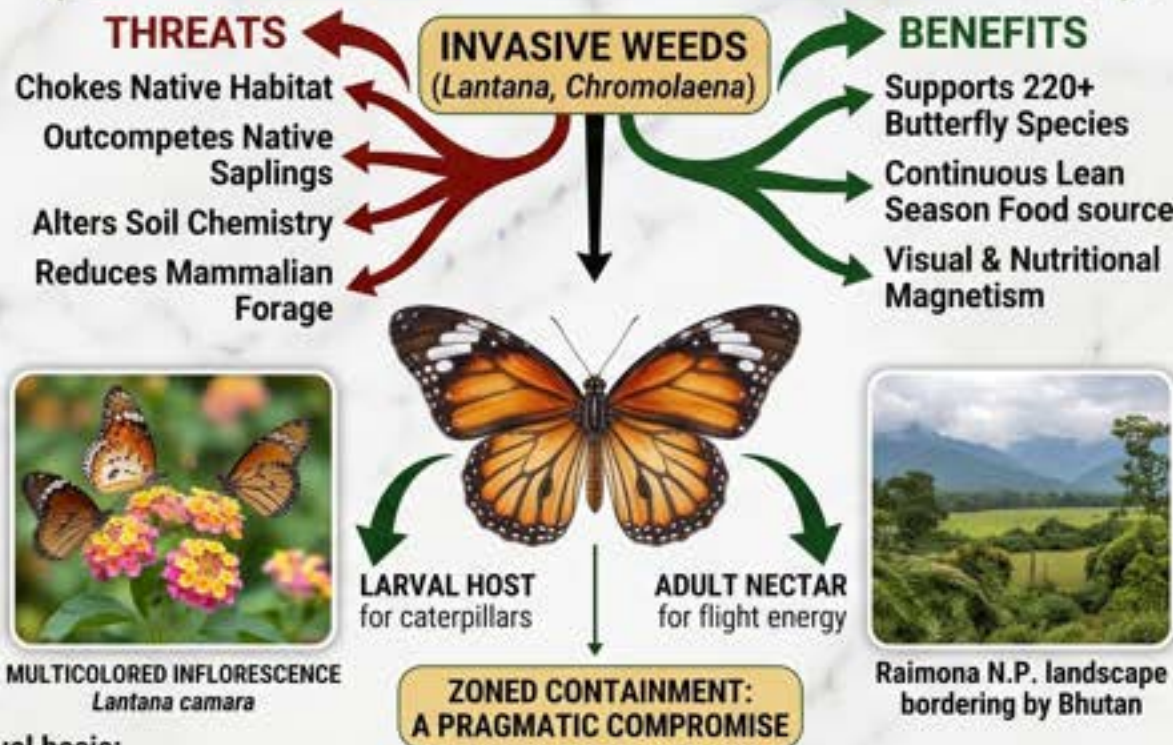
Conspicuous Visual Cues:
(Color-changing flower clusters, 'Inflorescence', signaling nectar).

4. MULTIDIMENSIONAL ANALYSIS

Detail elaborate points from the analysis conceptual basis:

- **SOCIAL:** Chokes native habitat, theobas, and comudiuanies.
- **POLITICAL:** Non-native plant and outcompetes native saplings.
- **LEGAL:** Chokes socrat insipritat and encaud tanimechocologies and finacsonmular figation.
- **ETHICAL:** Consides habitats for global cntical, rhorioquans using legals.
- **INTERNATIONAL:** Conniguous flower across general international and species.
- **ECONOMIC:** Governmantcs community evohwiment afutonce to human defusions, comservation, environment.

THE LANTANA CONUNDRUM



2. MAIN ARGUMENTS

- Aggressive weeds as functional ecospace (e.g., econopolice)
- Survival tools during lean seasons, and crean, and economcs remedies
- Pragmatic compromises for habitats to uertes fnilectnie nectar

3. HISTORICAL EVOLUTION



6. WAY FORWARD

List of balanced solutions with:



Zoned Patch Management



Phased Bio-Restoration



Transboundary Green Corridors



Trophic Research Funding

5. UPSC & NCERT LINKAGES



Map to GS Papers I, III, IV, Essay, Optionals like Botany/Zoology and NCERT Class XII Biology & Geography

What goals does Semicon 2.0 aim to achieve?

What are the key focus areas of Semicon 2.0? How is it different from the first phase? Why is India focusing on semiconductor manufacturing? What incentives does the Mobile Phone Manufacturing Scheme offer?

Aroon Deep

The story so far:

In July 15, the Union Cabinet cleared the second phase of the India Semiconductor Mission (ISM), and the Mobile Phone Manufacturing Scheme (MPMS), with a ₹1.27 lakh crore and ₹62,500 crore outlay, respectively. The programmes are aimed at encouraging the next cohort of semiconductor fabrication, assembly, and packaging facilities in India, as well as following through on encouraging more phone assembly and component manufacturing in the country. The government expects the scheme to draw ₹4 lakh crore in investment, ₹2 lakh crore in production, and ₹1 lakh crore in exports over its tenure of five years.

How is this different from the first phase?

ISM's first phase was approved in December 2021 with an outlay of ₹76,000 crore. Following an amendment in 2022, the programme was empowered to provide for up to 50% capital subsidy for big-ticket projects, such as Micron's memory chip packaging facility in Sanand, Gujarat. The funds were also directed to the Electronics Component Manufacturing Scheme, which was designed to incentivise additional

The government has insisted that building domestic capacities is essential even if it takes decades to reach the level of countries, such as the Netherlands and Taiwan, whose companies are critical in chipmaking

manufacturing of smaller electronics components.

The Gazette notification laying out the precise details of the second phase is set to be published by next month. In the meantime, Information Technology Minister Ashwini Vaishnaw and Ministry of Electronics and Information Technology (MeitY) Additional Secretary Amitesh Kumar Sinha have offered a few details of the expanded scope of the programme.

The main change is that the ISM programme will now cover a larger part of the electronics manufacturing ecosystem, including areas that were partially addressed in the previous phase. These include encouraging chip design talent, capital machinery (the large equipment used in chip-making facilities), chemicals and gases that are of semiconductor-grade purity, and research and development efforts.

The newer scheme will also trim capital subsidies to 30-40%, Mr. Sinha said, as the semiconductor industry is likely to get more attractive in India even with less incentives. The government is also less likely to offer land support, as State governments have shown increasing enthusiasm for hosting such projects by providing land at token prices and offering their own incentives on top of those provided by the Union government.

What have been the outcomes of phase 1?

Of the 12 manufacturing and packaging units approved in phase 1, with a total committed investment of ₹1.64 lakh crore, most are semiconductor packaging units. Nine such units are spread across Gujarat, Uttar Pradesh, Punjab, Assam, Odisha, and Andhra Pradesh. In addition, there is a silicon fabrication unit, and one gallium-nitride Micro LED display fabrication unit. The Tata Electronics fab is set to start commercial production in 2028.

The scheme included a design-linked incentive programme, under which 24 projects have been approved. The government has also obtained licences for expensive semiconductor design software and provided them free of cost

to universities and startups. The Semiconductor Lab, Mohali, which is being revamped, is being positioned as a facility to help "tape out" chips designed by students and researchers.

Why is India focusing on semiconductor manufacturing?

From the COVID-19 era supply chain disruptions to export controls initiated by the U.S. during the trade war with China, there has been a growing sense that India needs to integrate more tightly with global electronics value chains. The government has insisted that building domestic capacities is essential even if it takes decades to reach the level of countries, such as the Netherlands and Taiwan, whose companies are critical in chipmaking.

How sophisticated are the chips targeted in the current facilities?

While the most powerful phones use "frontier" grade chips, with a process node of 7 nanometres or even less, the Union government has targeted 28nm chips (which are made in what are called "legacy" process nodes). There is a massive market for these chips, Mr. Vaishnaw reasoned, as everyday electronics, where size and computing power are not constraints, require such components too.

As ISM 2.0 progresses, the government hopes that the ecosystem will progress to frontier nodes, especially by improving the level of domestically owned intellectual property and research for such chips. While semiconductor designers are aplenty in India, most work for either foreign firms or on their behalf, leaving royalties and expertise outside the domestic industry.

Why is MPMS being notified?

While a growing share of iPhone sales around the world come from handsets assembled in India, most components remain imported, and there are barely any Indian-designed handsets in the market. The MPMS aims to incentivise both the expansion of domestic phone assembly as a way to grow the ancillary market, and to incentivise domestic design and research and development. To that end, the scheme provides for incentives ranging from 2.25% to 5%, depending on the level of local design involved in the handsets.



Union IT Minister Ashwini Vaishnaw showcases 'Made in India' semiconductor chips while speaking during a Cabinet briefing in New Delhi. PTI

- **Key Terms and Explanations**
- **Semiconductor Fabrication (Fab)**
 - A semiconductor fabrication plant, commonly known as a "fab," is a highly specialized industrial facility dedicated to manufacturing integrated circuits (ICs) or microchips. These facilities operate under extreme cleanroom conditions to prevent microscopic dust particles from ruining the intricate circuitry etched onto silicon wafers.
- **OSAT and ATMP (Assembly, Testing, Marking, and Packaging)**
 - Outsourced Semiconductor Assembly and Test (OSAT) or Assembly, Testing, Marking, and Packaging (ATMP) represents the downstream phase of the semiconductor value chain. Once a fab etches circuits onto a silicon wafer, the wafer is sliced into individual dies. These dies are then tested for defects, encapsulated in a protective plastic or ceramic casing (packaging), and marked for identification before being integrated into electronic devices.
- **Legacy vs. Frontier Process Nodes**
 - Process nodes, measured in nanometers (nm), refer to the size of the transistors on a chip and the precision of the manufacturing technology.
 - **Frontier Nodes (7 nm or less):** These represent the cutting-edge frontier of technology, packing billions of microscopic transistors closely together to offer maximum computing power and energy efficiency. They power premium smartphones, artificial intelligence clusters, and supercomputers.
 - **Legacy Nodes (28 nm or larger):** These are older, mature generations of chip technology. While they lack the dense processing power of frontier nodes, they are highly reliable, cost-effective, and form the backbone of everyday electronics.
 - *Contextual Example:* Frontier chips are like high-performance racing cars engineered for extreme speed, whereas legacy chips are like reliable utility trucks—not meant for racing, but absolutely essential for daily transport, operating consumer appliances, automotive systems, and medical equipment.
- **Design-Linked Incentive (DLI) Scheme**
 - This is a targeted fiscal intervention aimed at nurturing the early stages of the chip-making pipeline: intellectual property (IP) creation and product architecture. Instead of subsidizing heavy concrete factories, the DLI scheme provides financial support, infrastructure access, and software design tools to local startups, researchers, and domestic design firms.
- **Tape-Out**
 - In semiconductor design, a "tape-out" is the final result of the design phase. It occurs when the blueprint of the integrated circuit is completely finalized and the digital file is sent to the manufacturing facility (the fab) to begin physical production. The term is a historical holdover from the days when magnetic tapes were used to transport these massive digital design files.
- **Gallium Nitride (GaN) Semiconductors**
 - Unlike traditional silicon chips, Gallium Nitride is a wide-bandgap compound semiconductor material. It represents the next wave of power electronics due to its ability to handle significantly higher voltages, temperatures, and frequencies than silicon, all while minimizing energy loss.

- **Main Arguments and Substantive Parts**

- **The Strategic Shift from Infancy to Ecosystem Maturity**

- The foundational logic of India's semiconductor journey marks a deliberate evolution from attracting raw industrial volume to cultivating a dense, self-sustaining technological ecosystem. While the initial policy intervention (Phase 1) focused heavily on securing large-ticket anchor investments through massive fiscal cushions, the subsequent policy phase (Semicon 2.0) expands its perimeter. It shifts focus toward the deeper, more complex layers of the supply chain: cultivating design talent, setting up capital machinery manufacturing, securing semiconductor-grade high-purity chemicals, and scaling up domestic Research and Development (R&D).

- **Calibrating Fiscal Incentives and Harnessing Competitive Federalism**

- A major shift in economic strategy is evident in the structural adjustment of capital subsidies. As the domestic investment landscape matures and gains credibility, central capital subsidies are being scaled down from a flat 50% to a more calibrated range of 30--40%. The underlying argument is that the semiconductor market in India has crossed its initial trust deficit. Furthermore, the financial burden on the Union government is being optimized by a wave of competitive federalism, where state governments actively step in to offer rock-bottom token land prices, dedicated water infrastructures, and top-up financial incentives to attract these projects to their respective regions.

- **The Realistic Pragmatism of the "Legacy Node" Focus**

- Rather than chasing the elusive and highly restricted sub-7 nm frontier nodes dominated by global giants, the immediate strategic focus is fixed on mastering 28 nm legacy nodes. The rationale here is rooted in market demand and structural pragmatism. The vast majority of global electronics—ranging from smart televisions and washing machines to automotive engine control units—rely exclusively on mature legacy chips. By capturing this massive, high-volume market first, the nation builds immediate commercial viability, develops operational expertise, and creates a domestic ecosystem before attempting the high-risk leap toward frontier technology.

- **Capturing the Value of Domestic Intellectual Property**

- A key structural vulnerability identified in the Indian technology landscape is that while the nation possesses an abundance of brilliant semiconductor designers, the vast majority work as back-office assets for foreign transnational firms. Consequently, the intellectual property, royalties, and core technological expertise flow straight out of the country. To reverse this trend, strategic policy interventions like the Mobile Phone Manufacturing Scheme (MPMS) are being deployed. By offering tiered incentives (2.25--5%) tied directly to the degree of local design integration, the state is pushing companies to shift from superficial "screwdriver assembly" to genuine, high-value domestic design ownership.

- **Historical Evolution of the Issue**

- **The Post-Independence Era and Missed Opportunities (1947–1980s)**

- In the early decades after independence, the state's approach to electronics was largely confined to public sector undertakings (PSUs) like Bharat Electronics Limited (BEL) and Indian Telephone Industries (ITI), focused primarily on strategic defense and basic telecommunications. The turning point occurred in 1983 with the establishment of the Semiconductor Laboratory (SML) in Mohali, Punjab. SML was a pioneering effort meant to put the country on par with global chip development. However, a devastating fire in 1989 completely gutted the facility, halting its technological momentum. During the subsequent years of reconstruction, East Asian economies like Taiwan and South Korea made massive, uninterrupted investments, effectively leaving India behind in the first global silicon wave.

- **The Liberalization Wave and the Design Boom (1990s–2010s)**

- Following the 1991 economic reforms, the nation emerged as a global hub for software services and back-office IT operations. While the country missed out on physical hardware manufacturing, global chip design giants recognized the high-caliber engineering talent emerging from Indian institutes. Bengaluru, Hyderabad, and Noida transformed into major global design hubs where engineers designed cutting-edge chips for foreign firms, even as the domestic market remained completely dependent on imported physical hardware. Early policy frameworks like the National Policy on Electronics (NPE 2012) and the Modified Special Incentive Package Scheme (M-SIPS) attempted to catalyze manufacturing, but were largely constrained by infrastructural deficits and a lack of ecosystem scale.

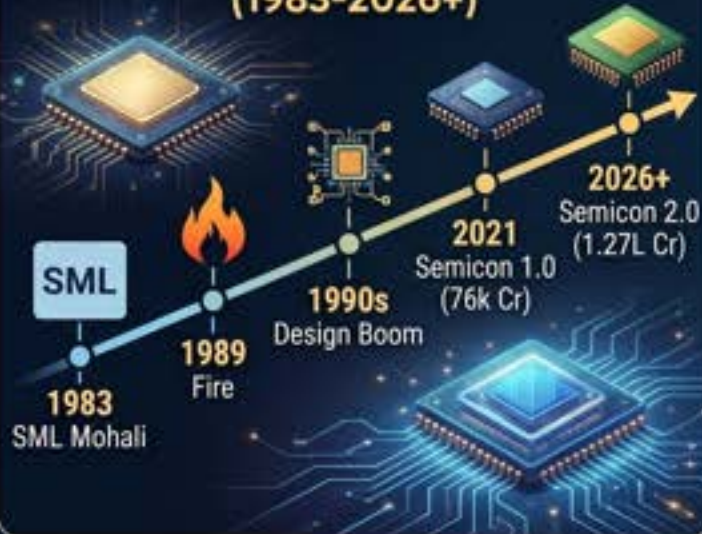
- **The Geopolitical Awakening and Semicon 1.0 (2020–2024)**

- The COVID-19 pandemic caused severe global supply chain disruptions, exposing the extreme vulnerabilities of being entirely dependent on a few geographic corridors for microchips. This structural vulnerability, coupled with tightening export controls driven by the US-China trade war, forced a fundamental shift in strategy. In December 2021, the Union government launched the India Semiconductor Mission (ISM) with an outlay of ₹76,000 crore (Semicon 1.0). Offering a uniform 50% capital subsidy, this phase successfully broke the ground by approving 12 manufacturing and packaging units across multiple states, bringing global players into the domestic fold.

- **The Modern Phase: Ecosystem Deepening (2025–Present)**

- Moving beyond the initial setup phase, the policy has matured into a comprehensive layout (Semicon 2.0) with an expanded budget of ₹1.27 lakh crore, supplemented by the ₹62,500 crore Mobile Phone Manufacturing Scheme. The historical focus has now permanently shifted from merely importing raw components for assembly to building complete local ownership. This includes producing raw materials, indigenizing capital machinery, and offering specialized training to scale up local design talent.

HISTORICAL EVOLUTION (1983-2026+)



WAY FORWARD: STRATEGIC ROADMAP

SHORT-TERM (1-3 Yrs)

- Secure legacy markets
- Secure legacy and low markets

MEDIUM-TERM (3-7 Yrs)

- Scale local IP to entrance communities
- Scale local, local nodes

LONG-TERM (7+ Yrs)

- Achieve end-to-end resilience
- Achieve end-to-end bound end warden nodes

STRATEGIC SHIFT & TARGET APPROACH



MULTIDIMENSIONAL IMPACT ANALYSIS

SOCIAL - Reverse brain drain - Reverse legacy and building and pontition - Government	POLITICAL - Competitive federalism - Pronenace of innoparence - Competivity and soration	LEGAL - Competitive IP jurisprudence - IP jurisprudence of legal prncipality
ETHICAL - Resource ethics to dicipile - Ecnomical contimination	INTERNATIONAL - Global alignments - Competitle stioning alignments	ECONOMIC - Summarize and economic - Local eretonef ecnomics



FAB
Wafer & complex roadmap



OSAT/ATMP
Dies to package with book binding



Legacy vs Frontier Nodes
old vs new cars



TAPE-OUT
design to manufacture

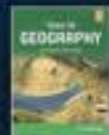


Gallium Nitride
(GaN charger)

ASPIRANT CONNECT



Class 12 Physics
Brief analytical values
analytical value



Class 10 Geography
Brief analytical values
and analytical value



Class 11 Economics
Brief analytical values
and analytical value

UPSC/APSC GENERAL STUDIES PAPERS

GS-3

Brief summary on past questions on PLI, vulnerabilities of PLI

GS-2

Brief summary on PLI, vulnerabilities
Strategic autonomy, strategic autonomy

GS-4

Brief summary and past questions on Assam semiconductor unit significance

How does India's newly launched train powered by hydrogen work?

How new is this technology? What is its future in India? Is hydrogen a safe fuel?

Maitri Peracha

The story so far:

In July 17, Prime Minister Narendra Modi flagged off India's first train powered by hydrogen. It operates on an 89-km stretch between Jind and Sonapat in Haryana.

What is a hydrogen-powered train?

India's hydrogen fuel cell-powered train is a 30-coach train with a capacity of carrying around 2,600 passengers. Unlike conventional electric trains that draw power from overhead lines, it generates its own electricity onboard using hydrogen, known as the cleanest fuel.

Unlike conventional diesel locomotives that burn fuel to generate mechanical power, a hydrogen train carries a small power plant onboard in the form of a proton exchange membrane fuel cell. In this cell, the train's cylinders combine with oxygen from the surrounding air inside the fuel cell, producing electricity that powers the traction motors and turns the wheels. The only direct by-products of this electrochemical reaction are water vapour and heat. There is no combustion, no smoke, and no carbon dioxide emissions.

The train consists of two hydrogen-fueled power cars (H₂FC) and eight trailer coaches. Each H₂FC houses fuel cells, lithium iron phosphate batteries, and hydrogen storage cylinders that work together to provide traction

Hydrogen is inflammable and needs to be handled with care. Since it cannot be seen or smelled, the project's safety design focuses on detecting even the smallest leak instantly.

2,400 kW output enables the train to reach its design speed of 110 km/h.

Where does the hydrogen come from?

The dedicated hydrogen storage, compression and dispensing facility established at Jind will support refuelling operations. The Indian Railways has stated that, like a petrol pump or a CNG station, the train needs a place to refuel.

First, hydrogen is produced on-site through electrolysis, in which it is split into hydrogen and oxygen using electricity at the green hydrogen plant, and is then stored safely in dedicated storage tanks. In the second step, the hydrogen is compressed to 510 bar, enabling a larger quantity to be stored in a smaller volume. Finally, it is dispensed through two independent hydrogen dispensers at a regulated pressure of 350 bar, allowing both H₂FCs to be refuelled simultaneously and reducing turnaround time. The facility stores nearly 1,000 kg of hydrogen at a time, sufficient to support regular operations of the train set, and its storage and supply system has been approved by the Petroleum and Explosives Safety Organisation.

Is it safe to travel on a hydrogen-powered train when hydrogen is an inflammable fuel?

Hydrogen is colourless, odourless, tasteless and non-toxic. However, it is inflammable and needs to be handled with care. Since it cannot be seen or smelled, the project's safety design focuses on detecting even the smallest leak instantly.

The train and the plant are fitted with devices that continuously search for hydrogen leaks, unusual heat, flames, or smoke. Continuous ventilation keeps air moving through the train at all times, so that even if a tiny amount of hydrogen were to leak, it is safely carried away and diluted in the open air.

There is also an automatic shut-off system. If any unwanted activity is detected, the system can automatically cut off the hydrogen supply on its own, without waiting for a person to react.

The Jind hydrogen plant has protections, including leak detectors, flame detectors, automatic shutdown systems, water sprays to control any fire, and fire alarms.

Before being certified, the entire system underwent an independent third-party safety assessment by TÜV SÜD, Germany, one of the world's leading technical inspection and certification agencies, an Indian Railways spokesperson said.

What is the status of hydrogen-powered trains globally?

They are still at a nascent stage. Germany was the first country to introduce commercial hydrogen passenger trains, while France, Italy, China, Japan and others are pursuing pilot projects or limited deployments. However, these trains typically have two to four coaches and serve mainly regional routes.

What is the future of such trains in India?

Indian Railways is exploring the deployment of hydrogen technology on heritage railways, including the Kalka-Shimla route. They intend to transition to a structured national programme for hydrogen-powered rolling stock, which will contribute to the National Green Hydrogen Mission and the country's long-term Net Zero goal, an Indian Railways spokesperson said.

- **Key Terms and Explanations**
- **Hydrogen Fuel Cell (Proton Exchange Membrane Fuel Cell - PEMFC):** This is an electrochemical device that converts the chemical energy of hydrogen and oxygen directly into electrical energy. Unlike a regular combustion engine, it doesn't burn anything. Think of it like a continuous battery where you keep supplying fuel; as long as hydrogen and oxygen flow in, electricity flows out, leaving behind only water vapor and heat.
- **Green Hydrogen:** Hydrogen produced through the electrolysis of water, splitting it into hydrogen and oxygen ($2H_2O \rightarrow 2H_2 + O_2$), using electricity derived entirely from renewable energy sources like solar or wind power. It is the gold standard for clean energy because its production loop emits zero carbon.
- **Electrolysis:** A chemical process that uses an electric current to drive an otherwise non-spontaneous chemical reaction—in this case, splitting water molecules into their constituent gases. It serves as the bridge between renewable electricity and storable chemical energy.
- **Hydrogen Driving Power Cars (DPCs):** Specialized railway units situated at the ends of a train set that house the fuel cells, hydrogen storage cylinders, lithium-iron-phosphate batteries, and power management systems. They serve as moving, localized power plants that generate the electricity required by the train's traction motors.
- **Bar (Unit of Pressure):** A metric unit of pressure equal to 100,000 Pascals, or roughly the atmospheric pressure at sea level. Hydrogen is compressed to high pressures (e.g., 500 bar for storage, 350 bar for dispensing) because it has a very low volumetric density; compressing it ensures enough mass can be stored in a limited space to offer a viable operational range.
- **PESO (Petroleum and Explosives Safety Organisation):** The nodal statutory body in India under the Ministry of Commerce and Industry that administers regulations governing safety in the manufacture, storage, transport, and handling of explosives, petroleum, and compressed gases. Its approval is mandatory for any commercial hydrogen infrastructure.

Main Arguments and Substantive Parts

- The introduction of hydrogen-powered rail transport marks a fundamental shift in green mobility. The technology presents unique advantages, operational challenges, and distinct global trajectories:
- **Decentralized Clean Generation:** The core thesis centers on shifting from centralized grid dependence (typical of conventional electric trains using overhead lines) or fossil-fuel dependency (diesel engines) to decentralized, onboard zero-emission power plants. By utilizing an electrochemical reaction instead of combustion, trains achieve zero tailpipe emissions, producing only water vapor and heat.
- **The Operational Architecture:** Operationally, a hydrogen train relies on a hybrid power system. While the fuel cell provides steady, baseline power, lithium-iron-phosphate batteries handle sudden load peaks during acceleration and store energy recovered during regenerative braking. The infrastructure requires highly specialized, localized production plants capable of on-site electrolysis, compression up to 500 bar, and regulated dispensing at 350 bar to minimize turnaround times.
- **Addressing the Safety Imperative:** Because hydrogen is highly flammable, colorless, and odorless, safety engineering forms the backbone of its deployment. The system relies on multi-layered mitigation: instant leak detection, constant active ventilation to prevent gas accumulation, automatic shut-off valves, and third-party certifications (such as by Germany's TÜV SÜD) to ensure the system fails safely without human intervention.
- **Global and Domestic Outlook:** Globally, hydrogen rail technology is in its nascent, regional stage, with Germany leading commercial implementation, followed by pilot deployments in nations like France, Italy, China, and Japan. Domestically, India is leveraging this technology to transition its heritage circuits (like the Kalka-Shimla route) and scale up toward a structured national programme for hydrogen-powered rolling stock, integrating with the National Green Hydrogen Mission.

- **Way Forward**

- To successfully scale hydrogen-powered rail transport from regional pilots to a national framework, India should consider a multi-pronged strategy:

- **Establishing Integrated Green Hydrogen Hubs:** To minimize transmission losses and logistics costs, dedicated solar/wind generation plants should be co-located with railway electrolysis and refueling stations. Creating these closed-loop regional hubs ensures a steady supply of green hydrogen directly to the tracks.

- **Developing a Standardized Domestic Regulatory Code:** The government should fast-track the creation of a comprehensive, updated safety code by PESO tailored for mass public hydrogen transport. Standardizing domestic certifications will reduce reliance on foreign agencies like TÜV SÜD and lower project gestation periods.

- **Prioritizing Water-Sustainable Electrolysis:** To prevent competition with local communities for freshwater, R&D should focus on commercializing sea-water electrolysis and using treated industrial wastewater for hydrogen production. This ensures that green transport initiatives do not inadvertently worsen regional water stress.

- **Phased Scaling via Public-Private Partnerships (PPP):** Initial deployments should target eco-sensitive zones, heritage mountain railways, and heavily polluted industrial bypass loops where the environmental returns are highest. Using a PPP model for rolling stock manufacturing can attract private capital and accelerate technological maturation, eventually driving down costs across the wider network.

- **Civil Services Examination (Prelims)**

- **With reference to 'Green Hydrogen', consider the following statements: (2023)**

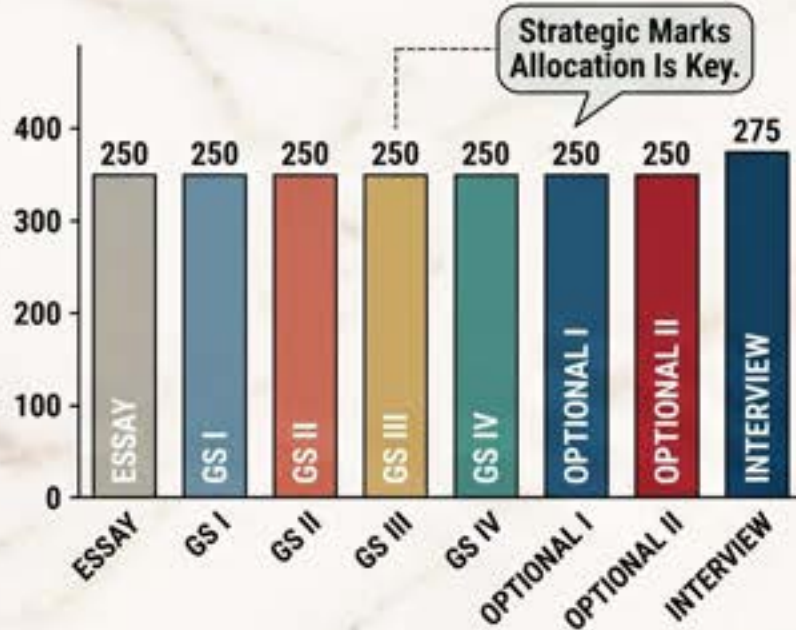
- It can be used directly as a fuel for internal combustion.
- It can be blended with natural gas and used as fuel for heat and power generation.
- It can be used in the hydrogen fuel cell to run vehicles.

Which of the statements given above are correct? (a) 1 and 2 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3

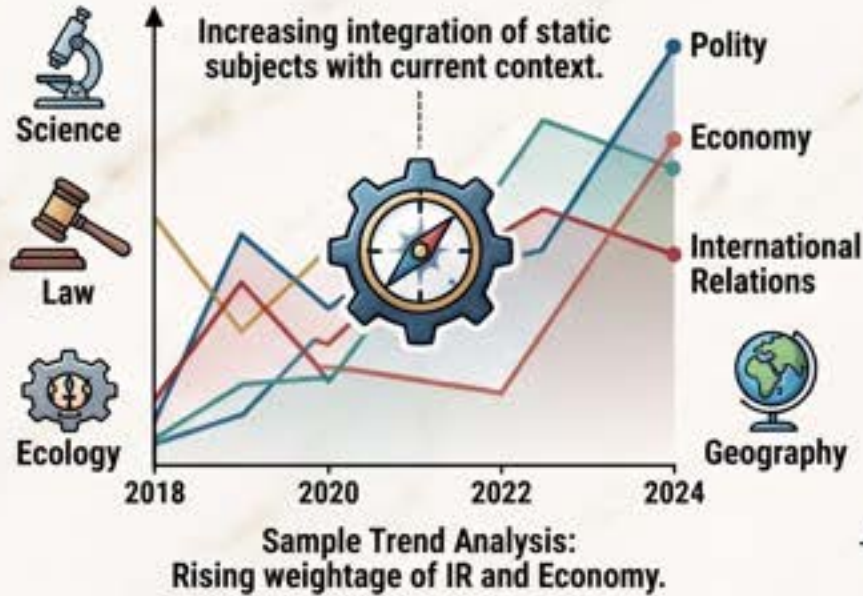


AXIA IAS ACADEMY: DATA-DRIVEN STRATEGIES FOR UPSC CIVIL SERVICES SUCCESS

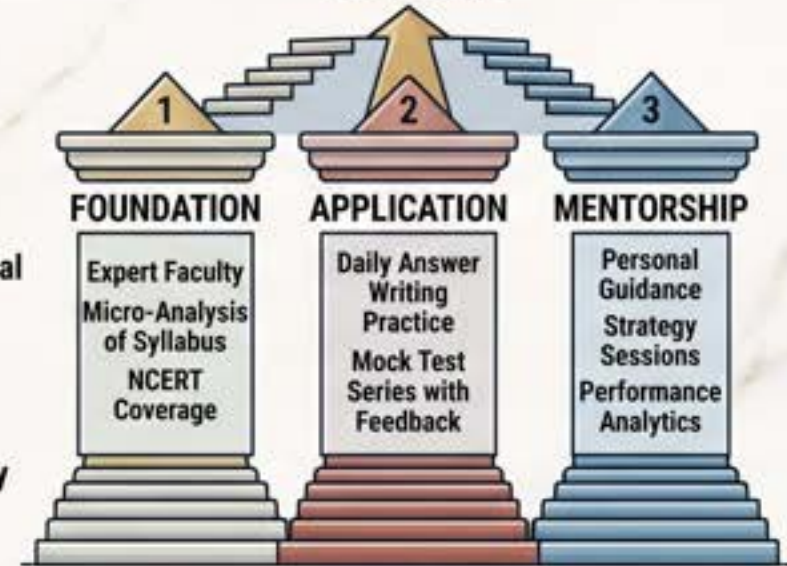
SECTION 1: UPSC MAINS EXAMINATION PATTERN



SECTION 2: DYNAMIC CURRENT AFFAIRS TRENDS (ILLUSTRATIVE)



SECTION 3: KEY PREPARATION PILLARS



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Non-animal testing is key to next phase of pharma growth

Animal studies continue to play an important role and cannot be entirely replaced at present; however, advances in non-animal testing models are enabling a more scientific approach that can reduce dependence on lab animals

S.K. Ganguly

For every medicine that reaches a pharmacy shelf, many others do not – not necessarily because the science was flawed but because testing models do not always predict how those medicines will behave in the human body. This long-standing challenge is at the heart of global drug development. But for India, which supplies affordable medicines to more than 200 countries, it also presents an opportunity.

As the sector matures, future growth must be anchored in creating value through original drug discovery, complex biologics, and stronger domestic innovation. Central to this transition will be India's ability to adopt and scale non-animal testing models (NAMs).

Only 10-14% of drug candidates worldwide entering phase I clinical trials ultimately receive regulatory approval. One significant reason is animal testing, which often struggles to accurately predict how a compound will behave in humans.

The consequence is not only high attrition and rising costs but also delays in bringing effective treatments to patients.

NAM is emerging as a complement to this system. NAMs include organoids, organ-on-chip platforms, advanced computational models, and artificial intelligence-enabled approaches designed to generate insights

Animals of medicine

Only 10-14% of drug candidates entering phase I trials ultimately receive regulatory approval

High failure rates in global drug development often stem from the poor predictive accuracy of animal models

Transitioning to non-animal models is essential for India to move from generic manufacturing towards discovering original drugs

Technologies like organoids and artificial intelligence can improve predictive accuracy while significantly shortening drug development timelines

India must establish a national framework and clear regulations to effectively integrate these innovative testing methods

Implementing these models in generic and biosimilar testing offers an immediate way to enhance domestic pharmaceutical efficiency

Adopting advanced testing technologies will position India as a competitive leader in the evolving global medical landscape



WILLY BEYER Animal testing often struggles to accurately predict how a compound will behave in humans. (Photo: iStock)

grounded in human biology. Increasingly, these tools are demonstrating the ability to improve predictive accuracy, shorten drug development timelines, and support more informed decision-making.

India's engagement with NAMs has evolved steadily over the years. Greater emphasis on laboratory animal ethics and institutional oversight encouraged researchers to explore alternative approaches. This led to the adoption of a range of platforms, including *Caenorhabditis elegans*, *Drosophila melanogaster*, zebrafish, yeast based models, and *ex vivo* tissue studies. More recently, 3D organoids and human-relevant cellular models have expanded the scientific toolkit available for research.

The U.S., the European Union, the U.K., and Japan

have already established national centres, dedicated funding streams, and validation programmes for NAMs. For India, engaging early with this shift will be critical to remain competitive and to play a role in shaping emerging global standards.

India's existing strengths include a robust generics industry, growing biosimilars capability, and a well-established contract research ecosystem. However, moving from scale to innovation will require a decisive shift in how we approach drug development. Integrating NAMs into research and development pipelines can enable more reliable science and faster development cycles. In this sense, NAMs can enable India's ambition to become a hub for drug discovery and innovation.

Incorporating NAMs in-

to quality testing of generics and biosimilar development could enhance efficiency without disrupting existing systems. In areas such as pyrogen and endotoxin testing, validated non-animal alternatives are already available and can be adopted at scale. For more complex therapies, NAMs can complement conventional approaches.

NAMs' relevance extends beyond pharmaceuticals. In the cosmetics and personal care sectors, virtual skin models and computational testing platforms have demonstrated an ability to generate robust safety data without relying exclusively on animal studies.

While India possesses significant scientific capabilities and research infrastructure relevant to NAMs, much of this capacity re-

mains underutilised and is not formally integrated into regulatory pathways. Progress remains constrained by limited regulatory clarity and the absence of a unified national strategy. Addressing these gaps will require aligning existing strengths with a clear and shared direction that recognises NAMs as a strategic priority.

A national framework to adopt NAMs would provide that direction. A central coordinating mechanism can help align stakeholders, prioritise investments, and ensure India moves in step with global developments. The regulatory system already permits the use of NAMs in areas such as proof-of-concept studies, target identification, drug screening, and aspects of toxicology. As a next step, clear guidance on the use and acceptance of NAMs generated data will give industry confidence and accelerate adoption.

The broader implication is not limited to improving efficiency in drug development. It is about positioning India as an active participant in defining the future of medical science. While animal studies continue to play an important role and cannot be entirely replaced at present, advances in NAMs are enabling a more balanced and scientifically informed approach that can progressively reduce dependence on laboratory animals.

(S.K. Ganguly is former director-general, Indian Council of Medical Research)

- **Key Terms and Explanations**
- **Non-Animal Methods (NAMs):** This is an umbrella term for innovative scientific testing technologies that do not involve living vertebrate animals. They utilize human cell cultures, computational algorithms, and microphysiological systems to predict how chemical compounds behave in human bodies.
- **Organoids:** These are three-dimensional, microscopic structures grown from human stem cells in a laboratory. They replicate the structural and functional complexities of real human organs.
- **Organ-on-a-Chip Platforms:** These are microfluidic biomimetic devices lined with living human cells that simulate the physiological mechanics, activities, and blood flow of entire organ system.
- **Biosimilars:** These are biological medical products that are highly similar copycat versions of already approved, complex biological drugs (like monoclonal antibodies or insulin). Unlike simple chemical generics, biosimilars are grown in living systems and require highly sophisticated quality control testing.
- **Pyrogen and Endotoxin Testing:** These are safety assays conducted to ensure that injectable medicines and medical devices are free from bacterial byproducts (pyrogens) that cause life-threatening fevers in patients. Traditionally, this required testing on rabbits or using the blood of horseshoe crabs.
- **Clinical Trial Phase I:** The initial stage of testing a new drug candidate in a small group of human volunteers (typically 20–100) to evaluate its safety, determine a safe dosage range, and identify side effects after preclinical testing is complete.

- **Main Arguments and Substantive Parts**

- The pharmaceutical landscape stands at a critical juncture where conventional scientific methodologies are clashing with economic and clinical realities. The primary discourses center around the following structural elements:
- **The Crisis of Predictability and High Attrition Rates**
- The foundation of modern drug discovery is bottlenecked by a stark statistical reality: approximately 86% to 90% of drug candidates that successfully pass preclinical animal testing fail when they enter human clinical trials. This systemic failure stems from the fundamental biological divergence between animal models (like mice and rats) and human physiology. Animals often fail to mirror human metabolic pathways, immune responses, and toxicological vulnerabilities, resulting in massive sunk costs and delayed access to life-saving therapies.
- **Value-Chain Transition for Emerging Economies**
- For major pharmaceutical producers like India—historically recognized as the "Pharmacy of the World" for high-volume generic drug manufacturing—the status quo is no longer sufficient. To transition from a low-margin generic supplier to a high-value innovator of original drug discovery and complex biosimilars, adopting advanced testing frameworks is non-negotiable. NAMs offer the technological leverage required to shorten drug development timelines and establish competitive global standing.
- **The Complementary vs. Replacement Nuance**
- While the ultimate objective is the complete obsolescence of laboratory animal testing, current technological limitations present a nuanced reality. Complex, systemic physiological interactions—such as how a drug affects the cross-talk between the nervous, endocrine, and immune systems simultaneously—cannot yet be fully replicated by isolated organ-on-a-chip models. Therefore, the current strategic imperative focuses on a hybrid model: using NAMs early in the pipeline for high-throughput screening to drastically reduce animal dependency, while progressively phasing them out as technology matures.

- **Historical Evolution of the Issue**

- **The Early Empirical Era:** Prior to the mid-20th century, drug safety evaluation relied heavily on empirical observation in live animal models. The Thalidomide tragedy of the late 1950s and early 1960s globally institutionalized rigid, multi-species animal testing mandates within regulatory frameworks to prevent teratogenic disasters.
- **The Codification of Animal Ethics (1960s):** In India, the enactment of the *Prevention of Cruelty to Animals Act, 1960* laid the foundation for regulatory oversight, eventually leading to the formation of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA). This introduced structured compliance, ethical clearance, and institutional oversight for laboratory animals.
- **The Rise of the 3Rs Framework (Late 20th Century):** The international scientific community began formally adopting the principles of **Replacement, Reduction, and Refinement (the 3Rs)**. Research shifted toward optimizing animal use, minimizing pain, and exploring basic cell cultures or lower-order organisms (like fruit flies and zebrafish) for initial screening phases.
- **The Modern Regulatory Paradigm Shift (Present Day):** Global frontrunners have fundamentally altered their legal architectures. The passage of the *FDA Modernization Act 2.0* in the United States eliminated the statutory mandate requiring animal testing for new drug applications, opening direct pathways for computer modeling and cell-based alternatives. Emerging economies are now under pressure to harmonize their local regulatory landscapes with these international benchmarks.

- **Way Forward**

- **Establish a Unified National Framework:** A centralized coordinating mechanism must be established to align academic research institutes, private pharmaceutical giants, and regulatory bodies. This body should formulate a clear national roadmap designating NAMs as a strategic priority for biotechnology infrastructure.
- **Implement Phased Regulatory Integration:** Regulatory authorities (such as the CDSCO) should introduce clear guidelines on the acceptance and validation of NAMs-generated data. A practical first step would be mandating the total replacement of animals in simpler quality-control assays—such as pyrogen and endotoxin testing—where non-animal alternatives are already scaled and validated internationally.
- **Create Dedicated Funding Streams:** The Ministry of Science and Technology, alongside bodies like the Department of Biotechnology (DBT), should create dedicated financial grants for the domestic development of human stem cell repositories, microfluidic chip fabrication, and advanced AI-driven toxicological software.
- **Foster Public-Private Partnerships (PPPs):** Encourage joint ventures between domestic contract research organizations (CROs), technology startups, and established generic manufacturing hubs. This will lower the capital entry barrier for smaller firms and accelerate the commercial scaling of organoid and computational testing models.

TRANSITION TO **NON-ANIMAL METHODS (NAMs)** IN PHARMA R&D: A COMPREHENSIVE UPSC CSE ANALYSIS

The Traditional Testing Bottleneck

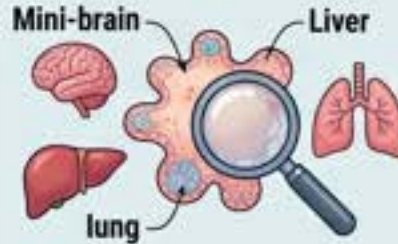


- Animal models often fail to mirror human biology
- Delays in clinical trials
- High R&D costs

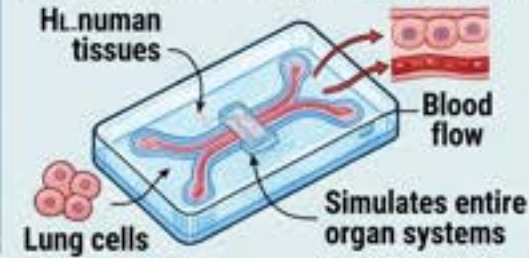
Stat: Only 10-14% of drug candidates in Phase I succeed

Advanced Non-Animal Testing Models

ORGANOIDS (3D mini-organs from human stem cells)



ORGAN-ON-A-CHIP (microfluidic platforms with human cells)



COMPUTATIONAL MODELS & AI (predictive algorithms)



Multidimensional Analysis

SOCIAL

equity, access, speed



- Faster Access to Cures

POLITICAL

national sovereignty, status



- Global Pharma Leader
- Domestic Autonomy

LEGAL

regulatory updates, CDSCO reforms



- Clear regulatory guidelines
- Validation & acceptance of NAMs data

ETHICAL

3Rs to replacement, compassionate ethics



- From Refinement to Replacement
- Compassionate science

INTERNATIONAL

global standards, harmonization



- Alignment with FDA Modernization Act 2.0
- Export credibility

ECONOMIC

R&D efficiency, high-value growth



- Reduced sunk costs
- Moving up value chain

Historical Evolution Timeline

Pre-1960
(Empirical)

1960 PCA Act
(India)

Late 20th C.
(3Rs Framework)

Present
(NAMs & AI Paradigm Shift)

Strategic Way Forward

- National Unified Framework
- Regulatory Integration (e.g., Pyrogen tests)
- Dedicated Funding Streams
- Public-Private Partnerships (PPPs)

UN to list more sites as 'in danger' from armed conflict or climate change

Agence France-Presse
PARIS

The United Nations looks set to list a Biblical site, Lebanese castles, an antelope migration path and the world's deepest lake as world treasures under threat, including from war or climate change.

The 196 members states of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) are to cast votes from Friday next week on new additions to its World Heritage and World Heritage in Danger lists when they meet in Busan, South Korea.

"We may not have the means to deploy peacekeepers... but we can send



A drone view of archaeological remains in the ancient village of Sebastia, near Nablus in the Israeli-occupied West Bank. REUTERS

a message to the entire world," the director of UNESCO's World Heritage Centre, Lazare Eloundou Assomo said.

Safeguarding "heritage allows communities that have been traumatised, victims of conflicts, to be-

gin to come back and rebuild," he added.

A site being qualified as heritage in danger, Mr. Assomo said, was not a reprimand but a measure meant to help states "find funding, partners and attention" to better preserve

it. Some 1,200 sites around the globe are listed as part of UNESCO World Heritage.

The sites expected to be voted on include Sebastia, identified as being Biblical Samaria, in the Israeli-occupied Palestinian territory of the West Bank; five castles in south Lebanon, one of which – the Crusader fortress of Qalaat al-Chakif or Beaufort Castle – Israeli troops captured in May; Boma-Badingilo

grassland and woodland savannahs in South Sudan; and Lake Baikal in Russia.

Israel left UNESCO in 2017, but remains a member of the World Heritage Committee, which has the final say on which sites are inscribed on each list.

- **Key Terms and Explanations**
- **UNESCO (United Nations Educational, Scientific and Cultural Organization):** Established post-World War II in 1945, this specialized UN agency operates on the premise that peace must be founded upon the intellectual and moral solidarity of mankind. It acts as the primary global facilitator for educational reforms, scientific collaboration, and cultural preservation.
- **UNESCO World Heritage Site:** A specific landmark, area, or ecosystem legally protected by an international convention administered by UNESCO. These sites are deemed to possess "Outstanding Universal Value" (OUV) across cultural, natural, or mixed categories.
- **List of World Heritage in Danger:** A specialized regulatory inventory maintained under Article 11(4) of the 1972 World Heritage Convention. It acts as an emergency alert system, highlighting sites threatened by accelerated degradation, large-scale public or private projects, rapid urban development, armed conflict, or environmental catastrophes.
- **Conflict-Induced Heritage Attrition:** The deliberate targeted destruction or secondary collateral damage inflicted upon historical and archaeological structures during military operations and geopolitical warfare.
- **Climate-Driven Ecological Vulnerability:** The systemic degradation of natural ecosystems, migratory pathways, and hydrological wonders due to anthropogenic climate shifts, rising global temperatures, and habitat fragmentation.
- **Main Arguments and Substantive Parts**
- The global conversation around heritage conservation revolves around a defining thesis: **The safeguarding of human history and ecological marvels can no longer be decoupled from the realities of geopolitical warfare and the global climate emergency.** The international community must pivot from treating heritage as a static monument-keeping exercise to utilizing it as a dynamic instrument of soft power and post-conflict reconciliation.
- **Core Supporting Arguments**
- **The Proactive Utility of the 'In Danger' Status:** Far from being a punitive measure or a diplomatic reprimand to shame a sovereign state, the designation functions as a global SOS protocol. It is designed to mobilize international solidarity, streamline targeted financial aid, unlock technical conservation partnerships, and focus global media attention on vulnerable zones.
- **Heritage as an Anchor for Post-Traumatic Rehabilitation:** Preserving physical history provides communities traumatized by war a tangible sense of continuity and identity. The restoration of shared spaces acts as a vital psychological baseline for societal rebuilding after protracted conflicts.
- **The Institutional Dichotomy of Hard vs. Soft Power:** Multilateral bodies lack the mandate to deploy armed peacekeepers to defend physical structures. Instead, their leverage relies entirely on soft power—sending a unified normative message to the global community to alter state behavior through diplomatic peer pressure.
- **Geopolitical Complexities and Counterarguments**
- **Structural Disconnect in Governance:** A significant paradox exists where nation-states can formally exit global cultural bodies due to political friction, yet strategically retain their voting seats within specialized committees (such as the World Heritage Committee). This allows them to project structural influence over what gets protected, demonstrating that cultural diplomacy is frequently used as an extension of realpolitik.
- **Sovereignty vs. International Oversight:** Tensions frequently emerge when domestic governments view an "In Danger" listing as an unwanted international intrusion into their sovereign territorial management, particularly concerning natural resource extraction or infrastructure development in ecologically sensitive zones.

- **Historical Evolution of the Issue**
- **Pre-Independence and Early Formulations (Late 19th to Early 20th Century)**
 - The Hague Conventions of 1899 and 1907 laid down the earliest international legal provisions prohibiting the deliberate destruction of historical monuments, institutions dedicated to religion, charity, and education during naval and land bombardments. However, these frameworks lacked centralized institutional monitoring and were heavily Eurocentric.
- **The Post-WWII Institutional Pivot (1945–1954)**
 - The catastrophic structural devastation of European cities during the Second World War catalyzed the creation of UNESCO in 1945. This was followed by the landmark **1954 Hague Convention for the Protection of Cultural Property in the Event of Armed Conflict**, which explicitly codified for the first time that damage to the cultural property of any people means damage to the cultural heritage of all mankind.
- **The Era of the 1972 World Heritage Convention**
 - The adoption of the *Convention Concerning the Protection of the World Cultural and Natural Heritage* in 1972 fundamentally altered global conservation. It successfully bridged the protection of cultural monuments with the preservation of natural ecosystems under a unified international treaty, formalizing the creation of both the World Heritage List and the "In Danger" sub-list.
- **The Post-Cold War and Asymmetric Warfare Era (1990s–2010s)**
 - The dynamic of heritage threats shifted dramatically with the rise of asymmetric warfare and non-state actors. The deliberate, ideologically driven demolition of the Bamiyan Buddhas in 2001 and the systematic looting of ancient sites in Palmyra during the mid-2010s forced the international community to treat heritage destruction not just as collateral damage, but as a weaponized strategy of cultural erasure. This shift led the International Criminal Court (ICC) to classify the deliberate destruction of historic monuments as a distinct war crime.
- **Present-Day Realities (2020s)**
 - The current landscape reflects a dual-threat matrix. While traditional armed conflicts continue to endanger ancient fortresses and disputed biblical territories, the accelerating impacts of climate change—such as severe droughts, shifting mammalian migration paths, and the ecological alteration of ancient deep-water lakes—have emerged as equally urgent drivers for emergency listings.
- **Way Forward**
 - **Insulating Conservation Governance from Realpolitik:** The voting mechanics of the World Heritage Committee should be reformed to prioritize independent, expert-led evaluations over geopolitical considerations. A blinded, expert-panel peer review system for "In Danger" listings would help ensure decisions are based on objective conservation needs rather than bilateral diplomacy.
 - **Establishing a Global Heritage Emergency Rapid-Response Fund:** International financial endowments must be structured to allow for immediate, bureaucratic-free disbursement when a site enters an active conflict zone or suffers a sudden climate disaster. This fund should be supported by public-private partnerships, global philanthropic foundations, and micro-contributions from global tourism.
 - **Institutionalizing Community-Led (Endogenous) Conservation:** Conservation strategies must place local and indigenous communities at the center of the management framework. Empowering local populations as primary stakeholders ensures the sustainable protection of wildlife corridors and historical structures, turning conservation into a driver of local economic growth.
 - **Deploying Advanced Technological Monitoring:** Where physical access is restricted due to warfare or dangerous terrain, the international community should utilize satellite imagery, real-time AI-driven climate modeling, and 3D digital mapping ("digital twins"). This allows experts to monitor structural integrity and ecological changes remotely, creating detailed records for future restoration efforts.



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World Heritage Site



'In Danger' List



Conflict-Induced Attrition



Climate Vulnerability

GLOBAL HERITAGE UNDER SIEGE: ANALYSIS OF UNESCO 'IN DANGER' LIST

KEY TERMS & EXPLANATIONS



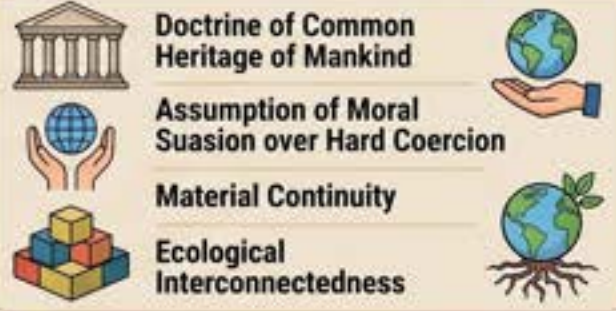
THE VISUAL ESSENCE OF HERITAGE PRESERVATION



MULTIDIMENSIONAL ANALYSIS



LOGICAL/PHILOSOPHICAL BASE



UPSC SYLLABUS MAPPING

GS1:	GS2:	GS3:	GS4:
Art & Geo	UN Fora, Mandates	Ecology & Security	IR Ethics, Commons
Artistic & Geo critical aspects	Institutions, global politics	Conservation, environment, security risks	Ethics in global relation commons

NCERT LINKAGES

Class XI Intro to Indian Art	Class XII Themes I
Class XI Fundamentals Physical Geography	Class XII Contemporary World Politics

WAY FORWARD





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