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The study utilizes a **second-generation Dynamic Global Vegetation Model (DGVM)** to project the future of India's forest carbon stocks until the year 2100. While traditional narratives focus on forest loss, this research highlights a "Carbon Surge" driven by the physiological responses of vegetation to a warming, CO_2-rich world. However, it also warns that this quantitative increase in carbon storage does not necessarily equate to a qualitative improvement in forest health or ecological stability.

India's forests could nearly double carbon storage by 2100, study finds

The findings, published in *Environmental Research: Climate*, involved researchers from Indian institutes; biggest increases in vegetation carbon are projected in desert and semi-arid zones across Rajasthan, Gujarat and Madhya Pradesh, study says

Jacob Koshy
NEW DELHI

India's forests could store nearly twice as much carbon by the end of this century as they do now if current greenhouse gas emission trends continue, according to a new modelling study published this week in the journal *Environmental Research: Climate*.

The findings, involving researchers from multiple Indian institutes, present a granular forecast of how climate change will reshape the country's forest carbon stocks. Significantly, they diverge in important ways from official estimates compiled by the Forest Survey of India (FSI) - the official source of tree and forest cover data in India.

For this study, the authors used modelling to peer into the future and found that vegetation carbon biomass rises by 35% under a low-emissions future, 62% under a medium-emissions pathway, and as much as 97% under a high-emissions, fossil-fuel-intensive scenario by 2100. Till about 2030, all of the scenarios project roughly the same quantities of vegetation after which they diverge sharply – the steepest acceleration occurring after 2050.

Wake-up call: Climate change is silently rewriting every sector, including our forests, say scientists. SPECIAL ARRANGEMENT

The projected increases are driven primarily by two interacting forces: rising precipitation and elevated atmospheric CO_2. Higher rainfall, projected across much of India under all emissions scenarios, translates to more moisture available for trees to grow. Simultaneously, more available carbon dioxide means enhancing photosynthesis and water-use efficiency. Rainfall effects appear with a lag of roughly two years under low and medium emissions, extending to about four years under the high-emissions scenario to account for the fact that forests do not respond instantly to a single wet year, and that woody biomass accumulates slowly over time.

"Climate change is not just about rising temperatures – it is silently rewriting every sector, including our forests," said lead author Fathima Fitha. "Even where gains appear, they may mask deeper stresses, raising concerns about the stability of today's dense forests and the risk of releasing large stores of carbon. Human pressures, land-use change, and extreme events such as wildfires, droughts, and heatwaves are intensifying these risks. If we undermine our forests today, we risk amplifying emissions tomorrow."

The largest relative increases are projected not in India's established forest heartlands but in its driest margins. Desert and semi-arid zones across Rajasthan, Gujarat, western Madhya Pradesh, and adjoining dry interiors are expected to see vegetation carbon rise by more than 60% compared to historical levels under high emissions. The Trans-Himalayas, the Gangetic forest belt, and the Deccan Peninsula follow. The Western Ghats and the Himalayas – India's most biodiverse and ecologically significant forest zones – are projected to see comparatively smaller relative increases, constrained by ecological saturation and specific climatic pressures those regions face, the study shows.

The increase in vegetation doesn't mean that climate change is acting as a net good, the researchers warned, as the models do not capture disruptive forces such as deforestation, land conversion, fire, and pest outbreaks intensified by warming.

Key Findings: The Granular Forecast

1. Projections by 2100

The study projects a sharp divergence in vegetation carbon biomass (VCB) after **2050**, depending on the global emissions pathway:

- **Low-Emissions (SSP1-2.6):** 35% increase.
- **Medium-Emissions (SSP2-4.5):** 62% increase.
- **High-Emissions (SSP5-8.5):** 97% (nearly double) increase.

2. Primary Drivers of Growth

- **Carbon Fertilization Effect:** Elevated atmospheric CO_2 enhances the rate of photosynthesis and improves the **Water-Use Efficiency (WUE)** of plants.
- **Rising Precipitation:** Increased rainfall availability provides the necessary moisture to sustain faster growth, especially in moisture-stressed regions.
- **Lags in Response:** The study identifies a "memory effect" where forests respond to rainfall changes with a lag of **2 to 4 years**, as woody biomass accumulates slowly.

3. Regional Variations: The Dryland Paradox

Contrary to expectations, the most significant relative gains are projected in India's arid regions rather than its biodiversity hotspots.

Region	Projected Impact	Reason
Arid/Semi-Arid (RJ, GJ, MP)	**>60% Increase**	Higher rainfall in these zones turns them into "greening" frontiers.
Trans-Himalayas & Deccan	Significant Increase	Expanding vegetation cover due to warming and moisture.
Western Ghats & Himalayas	**Modest/Lower Increase**	Already "ecologically saturated"; limited by space and specific climatic stress.

Critical Concerns and "Silent Risks"

Despite the projected greening, scientists warn of several **Negative Feedbacks**:

- **Ecological Integrity:** The models do not fully account for **wildfires, droughts, and pest outbreaks**, which are all intensified by climate change.
- **Stability Risk:** Rapidly grown biomass may be more vulnerable to "sudden release" of carbon if trees die due to heatwaves or disease.

- **Non-Uniform Response:** Regional variations mean that while some areas gain carbon, others may suffer from **moisture stress and aridity**, particularly in the Eastern Himalayas and Western Ghats.
- **Human Pressures:** The study does not incorporate land-use change (deforestation) or infrastructure development, which remains the biggest threat to actual forest cover.

Policy Implications for India

- **NDC Targets:** India's updated **Nationally Determined Contribution (NDC)** aims for an additional carbon sink of **2.5 to 3 billion tonnes** of CO_2 equivalent by 2030. This study suggests that while climate change might "help" reach the numbers, the sink's stability is not guaranteed.
- **Regional Planning:** Forest management cannot be a "one-size-fits-all" approach. Rajasthan's needs (managing greening) differ vastly from the Western Ghats (protecting existing dense carbon pools).
- **FSI vs. Academic Models:** There is a need to reconcile the **Forest Survey of India (FSI)** data, which relies on remote sensing and ground inventory, with these dynamic models to create a more robust "Climate-Aware" forest policy.

Conclusion

The study serves as a dual-edged sword: it highlights the immense potential of India's landscape to act as a global carbon buffer, yet underscores the fragility of this "accidental" benefit. For India to truly harness this potential, climate mitigation must move beyond mere tree-planting to **ecosystem resilience**. As the researchers noted, "greener" does not always mean "healthier." Future forest planning must be rooted in risk prevention to ensure that the carbon stored today does not become the emission of tomorrow.

UPSC Prelims Exam Practice Question

Ques:The term "Carbon Fertilization Effect" refers to:

(a) Increased carbon emissions due to industrial fertilizers

(b) Enhanced plant growth due to elevated atmospheric CO_2

(c) Soil carbon loss due to excessive farming

(d) Artificial carbon sequestration using fertilizers

Ans: b)

UPSC Mains Exam Practice Question

Ques: Discuss how climate-induced increases in forest carbon stocks may impact India's climate commitments under its NDC targets.**150 Words)**

Page 07: GS II : Governance&Social Justice/ Prelims Exam

The UPSC Civil Services Examination (CSE) is increasingly recognized not just as an academic challenge, but as a significant public health and sociological phenomenon. With a success rate of less than 0.1%, the "UPSC Ecosystem" creates a state of chronic anticipatory stress, leading to identity fusion where an individual's self-worth becomes inseparable from their exam results.

Long UPSC prep cycles take a toll on aspirants' mental health

The psychological experience of preparing for UPSC examination differs from other competitive examinations, including JEE for IITs and NEET for medical education, because aspirants typically prepare for the exam for several years, which leads to chronic rather than short-term stress

Rohan Singh
Neeraj Kumar Singh

For lakhs of young Indians, the national civil services examination is not just a test: it becomes part of who they are. More than 10 lakh aspirants take the examination every year. Many spend several years preparing, often relocating to coaching hubs such as Delhi and Hyderabad.

With only around a thousand positions on offer, the examination is among the world's most competitive. Experts are concerned that this prolonged, high-stakes process is also reshaping aspirants' sense of self.

For many aspirants, preparation is marked by long hours of study and constant anxiety about outcomes. One aspirant who requested anonymity said the uncertainty is worse than the workload: "My biggest fear is not performing to my full potential despite consistent effort."

Hidden psychological cost

Passing the qualifying exam for the Union Public Services Commission (UPSC) comes with a sustained form of psychological strain. In a 2024 study involving UPSC aspirants, Madiha Fatima, PhD scholar and senior research fellow at the University of Lucknow's Department of Psychology, found that 70% of aspirants reported moderate to severe distress.

"The pressure of uncertainty whether one will qualify, the vast syllabus, fear of forgetting, and the ever-changing exam pattern all contribute," she said. Persistent self-doubt, she added, often leaves aspirants questioning whether they are capable or simply wasting their time.

"Privileged students don't face the same stress. Underprivileged aspirants struggle to afford courses or materials. Some work part-time, reducing rest and study time," Ms. Fathima said.

Years of repeated failures also erode self-confidence, leading to avoidance and isolation that affects psychological health. She pointed to delayed answer keys, unpredictable paper patterns, and the vast seat-to-aspirant gap as structural stressors.

According to independent psychiatrist A.K. Mishra, such prolonged identification reshapes how aspirants perceive setbacks: "Aspirants often begin to anchor their sense of self-worth almost entirely around the examination."

Chronic stress, burnout

The psychological experience of preparing for the UPSC examination differs from other competitive examinations, including the Joint Entrance Examination (JEE) for the IITs and the National Eligibility cum Entrance Test (NEET) for medical education. This is because aspirants typically prepare for the UPSC exam for several years, which leads to chronic rather than short-term stress.

According to Dr. Mishra, such protracted preparation shifts stress from an acute phase to a persistent background state of cognitive load, decision fatigue, and reduced recovery. He also said prolonged uncertainty can produce "chronic anticipatory stress", where repeated attempts without success diminish the individual's sense of control and also contribute to emotional exhaustion.

Civil service aspirants wait outside an examination centre as they arrive to appear for the UPSC preliminary exam, in Jammu, in March 2026. AM

Abhishek Pathak, a psychiatrist in Lucknow, also said long-term preparation shares features with chronic stress and burnout. Prolonged uncertainty can lead to "anticipatory anxiety and identity fusion." However, he noted that the impact is bidirectional – it enhances risks in some people and promotes growth in others – and that early support can mitigate adverse outcomes.

Prolonged uncertainty is particularly challenging for young adults in their 20s, a phase typically associated with career formation and financial independence. When many years in this stage of life are instead devoted to a single exam, the stakes can become intensely personal.

Why the dream endures

Psychology alone can't explain the toll that preparing for the UPSC exam takes. Sociologists have argued that the appeal of the civil services is rooted in India's social structure, where the bureaucracy has long held authority and prestige and families widely perceive the services to be a path to upward mobility.

South Asian University sociologist Sumedha Dutta traced this aspiration to the colonial origins of India's civil services. After independence, the prestige that came with a member of the civil services, including the high salary, job security, housing, and pension, remained intact. "Civil servants are part of the power elite," she said.

The yearning for government jobs didn't decline even in the post-liberalisation era even as the private sector burgeoned. "Private sector jobs, despite high salaries, do not match up in terms of stability, numerous perks, pension, power, and prestige," Dr. Dutta said.

She pointed to matrimonial advertisements where civil servants rank highly, plus the media's role in valorising successful aspirants, as factors that reinforce the exam's status in the collective imagination.

The aspirant ecosystem surrounding the exam in fact reflects this collective aspiration. Entire neighbourhoods in Delhi and Prayagraj are dedicated to coaching institutes, libraries, and hostels, forming a parallel education economy.

> The pressure of uncertainty whether one will qualify, the vast syllabus, fear of forgetting, and the ever-changing exam pattern all contribute
>
> **MADIHA FATIMA**
> Senior research fellow at the University of Lucknow

Among them, coaching institutes – while they are central to this ecosystem – remain largely unexamined in shaping or mitigating psychological distress. The aspirant quoted earlier said, "Coaching centres benefit financially from prolonged preparation cycles. There is no accountability, no oversight."

Within this ecosystem, aspirants form tightly knit peer groups and share educational materials, attend lectures together, and discuss current affairs late into the night. While these networks offer support, they can also intensify pressure through constant comparison. As Dr. Dutta said, this in-group solidarity is also shaped by a sense of collective superiority.

"UPSC aspirants already envision themselves as part of the elite group which runs the administration of the nation state," she explained. "They believe other career pathways are 'mere professions' while civil servants are the ones who decide the fate of other professionals in many ways."

This shared imagination of a secure, prestigious future, she added, can also help aspirants navigate the hardships that come with prolonged preparation.

Inside the system

Psychologists have stressed that while ambition and perseverance are valuable, preparation ecosystems must also recognise the emotional risks of prolonged uncertainty. Access to counselling, peer support, and realistic career guidance could help reduce this burden.

Harivansh Chaturvedi, director-general of the Institute of Integrated Learning in Management, New Delhi, said that while many aspirants spend years preparing, doing so reflects individual choice within a highly aspirational system rather than a purely systemic failure. However, he acknowledged that unsuccessful attempts can still result in significant personal loss of time and effort.

To this end, he suggested faster evaluation, more frequent preliminary exams, streamlined selection, and specialised undergraduate programmes aligned with public administration.

Ms. Fatima said most research studies have been descriptive: they have identified problems, not solutions. She also argued that the scale of aspiration needs rethinking and suggested encouraging youth towards other professions or startups.

Dr. Mishra added that preparation could, over time, take a maladaptive form in some cases, particularly when it loses flexibility and proportionality. "Key indicators include persistent distress, neglect of alternative roles, inability to reassess goals, and compulsive continuation driven by fear of disengagement," he said.

At the same time, sociologists argue that the popularity of the civil services exam reflects deeper structural issues in India's employment landscape. Dr. Dutta said the UPSC ecosystem "unravels India's development inadequacies". Rising GDP hasn't matched jobs, the informal sector offers little security, and there is a major skill gap.

For many graduates, particularly from smaller towns, the civil services thus remain one of a few career options seen as both prestigious and secure.

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1. The Psychological Dimension: Chronic vs. Acute Stress

The study differentiates UPSC stress from other exams like JEE or NEET based on the **duration of the preparation cycle**.

- **Identity Fusion:** Aspirants often anchor their entire personality to the "IAS/IPS" tag. Failure is perceived not as a setback in a career, but as a total failure of the "self."
- **Burnout & Cognitive Load:** Years of uncertainty lead to **"decision fatigue"** and reduced emotional recovery.

- **The "Memory Effect" of Failure:** Repeated cycles erode self-confidence, leading to social isolation and maladaptive behaviors (compulsive continuation driven by fear of quitting).

2. The Sociological Dimension: The "Elite" Pull

Why do millions undergo this "voluntary hardship"?

- **Colonial Legacy & Power:** The bureaucracy is still seen as the "Power Elite." In a post-liberalization era, the private sector offers money, but the state offers **Prestige, Stability (Pension/Housing), and Authority.**
- **Social Mobility:** For those from underprivileged backgrounds or smaller towns, it is the most credible "elevator" to the highest echelons of Indian society.
- **The Marriage Market:** Success in UPSC significantly inflates social capital, as reflected in matrimonial preferences.

3. Structural & Economic Stressors

- **The "Coaching" Parallel Economy:** Hubs like Old Rajinder Nagar (Delhi) or Prayagraj create a "pressure cooker" environment. The article notes a **lack of accountability** in coaching institutes that benefit financially from longer preparation cycles.
- **Job Market Inadequacies:** The craze for UPSC reflects **"jobless growth"** in the formal sector. If the private sector provided equivalent security and dignity, the desperation for government jobs might subside.
- **The Inequality Gap:** While privileged students have a safety net, underprivileged aspirants face "double stress"—juggling part-time work and extreme financial pressure.

4. Proposed Reforms and Way Forward

Administrative Reforms

- **Streamlining Evaluation:** Reducing the time between exam stages to minimize the "uncertainty period."
- **Lateral Entry & Skill Alignment:** Creating specialized undergraduate programs that align with public administration so that the time spent is "credited" even if the candidate fails.

Psychological & Social Support

- **De-stigmatizing Exit:** Encouraging a culture where choosing an alternative career path or a startup is seen as a "growth pivot" rather than a "quit."
- **Institutional Support:** Coaching centers should be mandated to provide mental health counseling and career guidance for "Plan B" scenarios.

Conclusion

The UPSC preparation cycle is a microcosm of India's broader socio-economic challenges. While the perseverance of aspirants is a testament to India's human capital, the **"chronic distress"** reported by 70% of candidates is a wake-up call. To protect the mental health of our youth, the state must look beyond the "thousand seats" and address the "million-aspirant" ecosystem through structural reforms and a shift in the national narrative regarding success and failure.

UPSC PrelimsExam Practice Question

Ques: The concept of "Identity Fusion" in the context of competitive examinations implies:

(a) Separation of personal and professional identity

(b) Strong alignment of individual identity with a group or goal

(c) Loss of cognitive abilities due to stress

(d) Emotional detachment from outcomes

Ans:b)

UPSC Mains Exam Practice Question

Ques: Identity fusion in high-stakes examinations can transform ambition into psychological vulnerability.Discuss with reference to UPSC aspirants.(**150 Words)**

Page 07 :GS III : Environment/ Prelims Exam

The Sundarbans, the world's largest contiguous mangrove forest and a **Ramsar Site**, is traditionally viewed as a pristine carbon sink. However, new research reveals it is becoming a **"Novel Carbon Reservoir"**—not through natural sequestration, but through the accumulation of microplastics. This "anthropogenic carbon" threatens to disrupt the delicate balance of the Bay of Bengal's food web and its natural carbon budget.

Sundarbans is the largest contiguous mangrove forest in the world. GETTY IMAGES/ISTOCKPHOTO

1. The "Plastisphere" and Biogenic Carbon

The study introduces two critical concepts that redefine how we view marine pollution:

- **The Plastisphere:** Microplastics are not inert; they host complex communities of bacteria and microbes. These "plastispheres" create **biogenic carbon** as a byproduct of their biological activity.
- **Carbon Leaching:** As plastics weather (break down due to UV and salt), they leach **Dissolved Organic Carbon (DOC)** into the water.
- **Microbial Surge:** This excess carbon acts as "junk food" for bacteria, causing them to multiply at unnatural rates, which can potentially deplete oxygen or alter the base of the marine food web.

2. Key Findings: Seasonal and Material Trends

The year-long study near **Sagar Island** (Mooriganga estuary) provided granular data on the pollution profile:

- **Monsoon Surge:** Microplastic concentration was **40% higher** during monsoons. Heavy rainfall acts as a "flushing agent," carrying urban waste from upstream (Ganga/Brahmaputra) into the delta.

Sundarbans may be less blue than it seems

Vasudevan Mukunth

Researchers from the Indian Institute of Science Education and Research (IISER), Kolkata, have reported that microplastics could interfere with the natural food web and alter the carbon budget of the Bay of Bengal.

As microplastics weather and break down, they leach dissolved organic carbon into the water; the microbes living on the plastic also create 'biogenic' carbon, the team reported in a paper due to be published in the May 2026 issue of the *Journal of Hazardous Materials Advances*.

The authors conducted a year-long study to understand how small plastic particles move through the ecosystem and how they might interfere with natural carbon cycles.

The Sundarbans is the world's largest contiguous mangrove forest. Because it sits at the confluence of major rivers like the Ganga and the Brahmaputra, a large amount of waste generated upstream is also carried into the delta.

As microplastics break down in water, they release dissolved organic carbon, which can be food for bacteria to grow and multiply much faster than they would naturally

While scientists have known that the area is polluted, they have lacked detailed information on how microplastics behave in the surface water across different seasons and how much carbon they contribute to the environment.

Between October 2021 and October 2022, the IISER Kolkata collected water samples twice a month from three locations near Sagar Island in the Mooriganga estuary, then used advanced laboratory techniques to identify the types of plastic and observe how the particles were breaking down.

This way, the team uncovered a high concentration of microplastics, ranging from about 5 particles per liter to over 58 particles per liter. Their levels were around 40% higher during the monsoon season because, the researchers concluded, heavy rainfall washed plastic waste from the land and urban drains into the estuary. In these months, they also found a surge in what they called "colourless fragments" – likely older, weathered pieces of plastic being moved by surface runoff.

Around half of the plastics were fibres, likely from textiles, followed by fragments. The most common materials were polypropylene, which is used in packaging, and polyethylene terephthalate, used to make water bottles.

High-resolution imaging revealed that the microplastics were not clean but had cracks, pits, and grooves, suggesting that they were breaking down into even smaller nanoplastics. The researchers also found plastispheres, which are complex communities of bacteria and microbes living on the surface of the plastic.

Crucially, because the plastics are roughly 90% carbon, they were acting as a "novel carbon reservoir", the researchers wrote in their paper. As microplastics break down in water, they release dissolved organic carbon, which can be food for bacteria to grow and multiply much faster than they would naturally. The life-forms growing on the plastic were producing carbon of their own, called biogenic carbon.

Mangroves are blue-carbon ecosystems, meaning they are efficient at capturing and storing carbon dioxide from the atmosphere. However, the authors added, the introduction of carbon in the form of plastics could render them less efficient. Microplastics in the Sundarbans are now a significant part of the ecosystem's carbon cycle.

- **The "Colorless" Threat:** The presence of weathered, colorless fragments indicates "legacy plastic"—waste that has been breaking down in the environment for years before reaching the sea.
- **Chemical Composition:**
    - **50% Fibers:** Primarily from synthetic textiles (laundry runoff).
    - **Polypropylene & PET:** Derived from packaging and single-use bottles.

3. The Impact on "Blue Carbon" Ecosystems

Mangroves are classified as **Blue Carbon** ecosystems because they store carbon in their roots and soil for millennia.

- **Efficiency Dilution:** The introduction of plastic-derived carbon "muddies" the carbon ledger. It makes it harder to measure true natural sequestration and may reduce the efficiency of mangroves as natural filters.
- **Nanoplastic Risk:** High-resolution imaging shows plastics breaking into **nanoplastics**, which are small enough to enter the tissues of fish and crabs (bioaccumulation), eventually reaching human consumers.

4. Why the Sundarbans is Vulnerable

- **Geographic Confluence:** It acts as the "filter" for the entire Indo-Gangetic plain. Waste generated in cities thousands of kilometers upstream eventually settles here.
- **Tidal Dynamics:** The high-energy estuarine environment accelerates the physical breakdown (fragmentation) of plastic into micro and nano-sizes.

Conclusion

The IISER Kolkata study is a "canary in the coal mine" for India's coastal management. It proves that plastic pollution is no longer just a visual or aesthetic issue; it is a **biogeochemical disruptor**. For India to meet its climate goals and protect the Sundarbans, "Blue Carbon" policies must now integrate "Plastic Mitigation" strategies. Without addressing the upstream flow of synthetic fibers and packaging, the world's largest mangrove forest may lose its status as a pure natural ally in the fight against global warming.

UPSC Prelims Exam Practice Question

Ques: **The term "Plastisphere" refers to:**

(a) A layer of plastic waste floating in oceans

(b) Microbial communities colonizing plastic surfaces

(c) A type of biodegradable plastic
(d) A geological layer formed by plastic deposition

Ans:b)

UPSC Mains Exam Practice Question

Ques: Plastic pollution is no longer merely a solid waste issue but a biogeochemical disruptor.Discuss in the context of mangrove ecosystems like the Sundarbans.(**150 Words)**

Page 08:GS II & III : International Relations & Indian Economy / Prelims Exam

India's "LPG Paradox" lies in its success: while the **Pradhan Mantri Ujjwala Yojana (PMUY)** has successfully expanded clean cooking access to over **105 million** households (as of April 2026), it has simultaneously created a massive, inelastic demand for a fuel that India cannot produce in sufficient quantities. Unlike industrial fuel, household LPG is a **strategic necessity**; a shortage in the kitchen is a direct threat to social stability.

The strategic vulnerability in India's LPG supply model

Shrikant Madhav Vaidya

Former Chairman of Indian Oil Corporation Ltd. and an energy strategist

India's Liquefied Petroleum Gas (LPG) problem is not a passing shortage. It comes from a gap that has grown too wide to ignore. India consumed about 33.15 million tonnes of LPG last year, but domestic production met only about 40% of that need. The remaining 60% had to be imported. Put plainly, India's total LPG demand is now about 250% of indigenous production, while annual LPG imports are equal to about 150% of domestic LPG output. That is not a minor balancing gap. It is a significant mismatch between what India produces and what its kitchens consume.

This matters because LPG in India is overwhelmingly a household fuel; commercial LPG accounts for less than 10% of national consumption. So, the imported molecule is not mainly feeding a flexible industrial user that can cut runs or switch feedstock. It is going into domestic kitchens. This is what makes India's LPG dependence more serious than a normal product-import issue. A petrochemical plant can slow down. A household kitchen cannot.

India's LPG use is mainly household-based, heightening import vulnerability

No longer a dependable corridor

The crisis now has exposed this sharply. About 90% of India's LPG imports normally transit the Strait of Hormuz. India must now accept that the Strait of Hormuz cannot be treated as a routinely dependable corridor for household fuel security. Even if the present tensions ease, the old assumption of uninterrupted normality will not return easily. The risk attached to this route has now entered the strategic calculation in a lasting way.

Import dependence alone, however, does not tell the full story. Japan imports a larger share of LPG than India does. China and South Korea also import large volumes of LPG. But what matters is not only how much a country imports. It is where the molecule goes, what alternatives households already have, and how much storage supports the system.

Why India is more exposed

High household dependence and tight global supply make the LPG risk sharper

A household LPG vulnerability matrix

Country	LPG import share of total demand	Total LPG demand as % of domestic production	LPG imports as % of domestic production	Household kitchen criticality of LPG	LPG cover / storage position
India	**60%**	**250%**	**150%**	**Very high**	**15 days operational tankage cover (PPAC); ~1.5 days in cavern-based deep storage**
Japan	70%	333.3%	233.3%	Low	108.3 days
China	40.4%	167.7%	67.7%	Low to moderate	No clear public LPG-days figure verified here
South Korea*	~74.5%	~391.7%	~291.7%	Low	15-30 day stockholding obligation framework

** Indicative, based on publicly available market data*

Who absorbs the global exportable LPG pool?

Country	LPG imports used for comparison	Share of global LPG exports*	Main use of LPG
China	36.7 MMT	26.3%	Mainly petrochemical-driven at the margin
India	**19.89 MMT**	**14.2%**	**Mainly household cooking fuel**
Japan	9.8 MMT	7%	Mixed: household/commercial + chemicals
South Korea*	~7 MMT	~5%	Mixed, with strong industrial/petrochemical role
Total	73.39 MMT	52.5%	-

** Using global LPG exports of 139.8 MMT. South Korea is indicative*

Lessons from Japan

The *table* shows why raw percentages can mislead. Japan appears more import-dependent than India on LPG. Yet, Japanese household vulnerability is far lower – LPG serves only about 40% of households. Electricity accounts for about 55% of residential final energy use, and city gas also has a large residential base. More importantly, Japan has about 108.3 days of LPG stock through national and private reserves. Japan imports more, but it cushions that dependence with alternatives and storage.

China and South Korea are different again. In China, a large share of its LPG demand is driven by the petrochemical sector. In South Korea, household energy is supported much more by natural gas and electricity.

India's position is more exposed because the imported molecule goes overwhelmingly into domestic kitchens. India's problem is not that it imports LPG – many countries do. India's problem is that it imports LPG for the one use that is hardest to defer and also the hardest to replace quickly.

India's storage position also needs to be seen clearly. The Petroleum Planning and Analysis Cell reports about 15 days of LPG tankage cover in the broad operational sense across import locations, bottling plants, refineries and fractionators. But visible underground cavern-based deep storage is only about 140,000 tonnes – 60 TMT at Visakhapatnam (Andhra Pradesh) and 80 TMT at Mangaluru (Karnataka) which is equal to only about 1.5 days of national demand. The first number shows that the system is not empty. The second shows that reserve-style protection is still very thin for a country of India's size and import dependence.

There is another point that deserves attention. India is not buying LPG in a loose, neutral global market. The exportable pool is not large, and it is already heavily claimed by a few Asian buyers.

Just four Asian countries absorb a little over half of the world's exportable LPG pool. And the rest is not sitting idle waiting to be redirected. Much of it is already tied up in petrochemicals, household cooking and heating, and autogas. This is why any sustained loss of dependable Gulf supply can quickly tighten the market.

What India should do

How can India reduce its vulnerability?

First, it should stop treating all LPG molecules as one pool. During the present disruption, India has already directed refiners to prioritise propane and butane for cooking LPG rather than for petrochemical or gasoline-blending use. That logic should continue. Domestically produced LPG and refinery-origin C3/C4 (propane/butane) streams should be reserved first for household fuel security. Petrochemical users should increasingly arrange their own feedstock imports. The government should not have to defend domestic kitchens and industrial feedstock demand from the same protected pool.

Second, India should build a deeper LPG buffer. An initial goal of two to three weeks of protected cover for the household pool would be a sensible start. At current demand levels, that means about 1.3 million tonnes for 14 days and 1.9 million tonnes for 21 days. This is a large jump from the current cavern capacity, but it is the minimum scale at which India can begin to claim meaningful resilience.

Third, India needs a sustained campaign for electric cooking in urban and semi-urban India. This cannot be a one-season appeal. It has to continue over the years. Households with reliable power, adequate wiring and access to induction cooking should be encouraged to shift their primary cooking load away from LPG. A 'Give it up 2.0' plan should be launched.

The aim is simple: reduce the number of homes for which the LPG cylinder remains the first and only kitchen fuel. Piped Natural Gas (PNG) should expand where density supports it, but electricity is the broader lever.

India's LPG vulnerability will continue to persist unless policy addresses a basic mismatch: demand that is too high relative to domestic production; imports that are too concentrated in a single corridor, and excessive dependence concentrated in household kitchens. The answer is not simply to buy more LPG cargoes. It is to reserve domestic molecules for kitchens, separate petrochemical demand, build more storage, and steadily reduce the number of homes that rely on LPG alone.

India's LPG problem is not a passing shortage. It is an enduring mismatch between what the country produces and what its kitchens consume. This is why India's asymmetric LPG demand will remain a lasting vulnerability – unless the design of the system itself changes.

1. The Magnitude of the Mismatch

- **The Production Gap:** India produces only about **40%** of its LPG requirements (roughly 12.8 MMT), leaving a **60% import dependency**.
- **Household Inelasticity:** Over **90%** of LPG is used in domestic kitchens. Unlike a factory that can switch fuels or reduce shifts during a price hike, a household's need for cooking fuel is daily and non-negotiable.

- **The Strategic Bottleneck:** Approximately **90% of imports** transit through the **Strait of Hormuz**. Given 2026's geopolitical volatility, this "single-corridor" reliance is a glaring national security risk.

2. Comparative Vulnerability: India vs. East Asia

The article provides a critical comparison with Japan, China, and South Korea to show that **import volume** matters less than **usage and reserves**.

Feature	India	Japan	South Korea / China
Primary Use	**Domestic Kitchens** (Inelastic)	Mix of Industrial & Residential	Heavy Industrial/Petrochemical use
Alternatives	Limited (Electricity/PNG in infancy)	Electricity (55%) & City Gas	Natural Gas & Electricity
Stock Cover	~18 days (Operational)	**108 days** (Strategic)	High (Integrated into industry)

3. The Storage Crisis: A "Thin Shield"

While official 2026 government statements mention a **74-day** total reserve capacity (including crude and products), the **dedicated strategic LPG storage** is significantly lower:

- **Deep Caverns:** Only about **140,000 tonnes** (Visakhapatnam & Mangaluru), representing just **1.5 days** of national demand.
- **Strategic vs. Operational:** Most of India's stock is "operational" (moving through pipelines and bottling plants) rather than "strategic" (static reserves for emergencies).

4. Strategic Recommendations for India

A. Segregation of the Pool

- **Priority Allocation:** Domestic refineries should prioritize propane/butane streams for the **household pool**.
- **Industrial Autonomy:** Petrochemical and commercial users should be decoupled from the protected domestic pool, forced to arrange their own imports at market rates.

B. Building a "21-Day" Buffer

- India needs to scale up cavern storage from the current **1.5 days** to at least **14–21 days** of "protected cover." This would require an additional storage capacity of approximately **1.3 to 1.9 MMT**.

C. "Give It Up 2.0" & Electric Cooking

- **E-Cooking (Induction):** Urban areas with 24/7 power should be the first to transition. Studies show electric cooking in 2026 is **37% cheaper** than non-subsidized LPG.

- **The Surya Ghar Link:** Leveraging the **PM-Surya Ghar Muft Bijli Yojana** to power induction stoves with rooftop solar, turning households into self-reliant "Prosumers."

Conclusion

India's energy security is currently hostage to a "single molecule" (LPG) and a "single corridor" (Hormuz). To transition from a vulnerable importer to a resilient energy sovereign, the government must treat **Electric Cooking** as a core pillar of national security, not just a lifestyle choice. The goal is to ensure that while the "Ujjwala" flame stays lit in rural India, urban India leads the shift toward a more secure, electrified kitchen.

UPSC Prelims Exam Practice Question

Ques:Which of the following best describes inelastic demand in the context of LPG usage?

(a) Demand that fluctuates with seasonal changes

(b) Demand that is highly sensitive to price changes

(c) Demand that remains relatively constant despite price changes

(d) Demand dependent on industrial output

Ans: c)

UPSC Mains Exam Practice Question

Ques:"India's success in expanding LPG access has paradoxically increased its energy vulnerability."Critically examine.**(150 Words)**

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The Eight Core Industries—**Coal, Crude Oil, Natural Gas, Refinery Products, Fertilizers, Steel, Cement, and Electricity**—comprise **40.27%** of the weight of items included in the IIP. The March 2026 contraction is primarily attributed to "External Shocks" (the West Asia crisis) and "Base Effects," leading to the lowest annual growth (2.6%) since the 2020-21 pandemic year.

Core sector activity contracts 0.4% in March on war impact

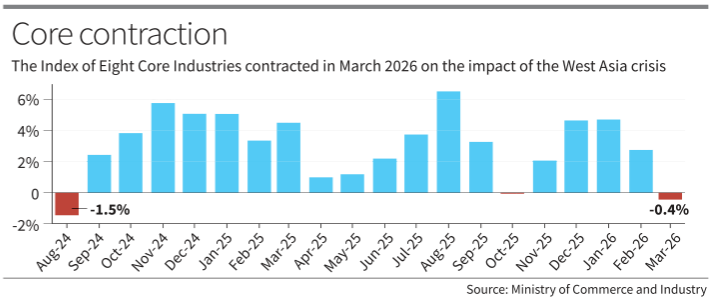
Government data show that four out of the eight core sectors of the economy contracted in March 2026; growth in the full year of 2025-26 was the lowest since the COVID-19 pandemic

T.C.A. Sharad Raghavan
NEW DELHI

Activity in India's eight core industrial sectors contracted by 0.4% in March 2026, the first month after the war in West Asia broke out, according to data released by the government. This was the poorest performance for the sectors in 19-months.

The data on the Index of Eight Core Industries released by the Ministry of Commerce and Industry on Monday also showed that growth in the index stood at 2.6% for the full year 2025-26, the lowest since the COVID-19 pandemic in 2020-21.

In March 2026, the data showed that four out of the eight sectors measured in the index contracted over their levels in March last year. "While an adverse base weighed on electricity generation, a shortage of inputs amidst the West Asia crisis curtailed the fertiliser output, which plunged by an unprecedented 24.6% year-on-year in the month," Aditi Nayar, Chief Economist at ratings agency ICRA said.



The fertiliser sector ended the year 2025-26 with a contraction of 0.1% as compared with a growth of 2.9% in 2024-25, which itself was the lowest since 2021-22.

The electricity sector contracted 0.5% in March 2026 on a relatively high base of 7.5% growth in March 2025. Over the course of 2025-26, the sector grew 0.9%, down from 5.2% in 2024-25.

"Besides, the growth in steel and cement output also weakened in March 2026 relative to February 2026, suggesting that construction activity slowed in the month," Ms. Nayar added.

Steel growth slumps

The steel sector saw growth slump to an 18-month low of 2.2% in March 2026, while the cement sector slowed to a 17-month low of 4%.

The only sector to see relatively robust growth in March 2026 was the natural gas sector, which grew 6.4% as the government pushed oil marketing companies to increase their output in reaction to the constraints brought on by the West Asia crisis.

The crude oil sector, on the other hand, contracted by 5.7% in March 2026, the seventh consecutive month of contraction.

The coal sector contracted by 4% in March 2026, while the refinery products sector grew by 0.1% that month.

1. Sectoral Performance Breakdown

The performance of the eight sectors can be categorized into three zones: **Contraction, Slump, and Resilience.**

A. The Contraction Zone

- **Fertilizers (-24.6%):** The worst performer. This was hit directly by the West Asia war, which disrupted the supply of **feedstock and raw materials** (like rock phosphate and ammonia) essential for production.
- **Crude Oil (-5.7%):** Marked the seventh consecutive month of decline, highlighting India's aging oil fields and the urgent need for upstream investment.
- **Coal (-4.0%):** A surprising contraction, potentially linked to logistical bottlenecks or a shift in focus toward natural gas during the energy crisis.
- **Electricity (-0.5%):** Driven by a "High Base Effect" (strong growth in the previous year) rather than a lack of demand.

B. The Slump Zone (Slowed Growth)

- **Steel (2.2%) & Cement (4.0%):** Both hit multi-month lows. This is a critical indicator that **construction and infrastructure activity**—the primary drivers of the "Viksit Bharat" vision—saw a cooling-off period in early 2026.

C. The Resilience Zone

- **Natural Gas (6.4%):** The "Outlier." Growth here was policy-driven, as the government mandated increased domestic output to mitigate the global supply crunch caused by the West Asia conflict.

2. Macro-Economic Implications

I. Impact on IIP and GDP

Since the core sector has a 40.27% weight in the IIP, the 0.4% contraction suggests that the **IIP for March 2026 will likely be muted or negative**. This, in turn, may lead to a downward revision of the GDP growth estimates for the final quarter (Q4) of FY 2025-26.

II. The "West Asia Crisis" Factor

The report underscores India's **Import Vulnerability**.

- **Supply Chain Disruption:** Fertilizers and Refinery products are highly sensitive to the Strait of Hormuz and Red Sea trade routes.
- **Input Costs:** A rise in global energy prices acts as a "tax" on Indian industry, increasing production costs for steel and cement.

III. The Lowest Growth Since COVID-19

The annual growth of **2.6% for FY26** suggests that the "post-pandemic bounce" has fully faded. The economy is now entering a "Normalization Phase" where growth must be sustained through structural reforms rather than just recovery from a low base.

3. Way Forward: Policy Responses

- **Diversifying Fertilizer Sourcing:** To mitigate the 24.6% plunge, India needs long-term "off-take agreements" with nations outside the immediate conflict zone (e.g., Canada, Morocco, or Russia).
- **Infrastructure Push:** To revive Steel and Cement, the government may need to front-load capital expenditure (Capex) in the first quarter of FY 2026-27.
- **Energy Transition:** The robust growth in Natural Gas highlights the need to speed up the shift toward a **Gas-based economy** and renewable integration to reduce the volatility of crude oil and coal.

onclusion

The core sector's contraction is a **"Warning Bell"** for the Indian economy. It illustrates that despite strong domestic demand, India remains highly susceptible to global geopolitical tremors. For a "Resilient India," the focus must now shift from merely managing demand to securing **supply chain sovereignty**, particularly in energy and fertilizers.

UPSC Prelims Exam Practice Question

Ques: The term "Base Effect" refers to:

(a) Change in production due to policy reforms

(b) Impact of previous year's high or low growth on current growth rate

(c) Variation due to seasonal demand

(d) Change caused by global trade

Ans: b)

UPSC Mains Exam Practice Question

Ques: "The contraction in India's core sector is a reflection of both global shocks and structural weaknesses."Examine.**(150 Words)**

Page : 08 : Editorial Analysis

The price of a war far above the ground

Sanchita Chatterjee

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Associated with CUTS International

The Iran war and geopolitics will reshape global aviation economics

Recently, at New Delhi's Indira Gandhi International Airport, a departure board quietly transitioned from "On Time" to "Delayed," and then to "Rescheduled." The official explanation – rerouting due to airspace restrictions over West Asia – barely concealed the deeper reality of the Iran war steadily redrawing the economic and operational contours of global aviation. What appears as episodic inconvenience is, in truth, an outward manifestation of a structural disturbance whose implications extend far beyond delayed departures.

Airspace closures across critical corridors have forced airlines into circuitous routes, often extending flight durations by two to eight hours depending on the routes, inflating fuel consumption and compressing already slender operating margins. Simultaneously, jet fuel prices surged to nearly $195-$197 a barrel. Given that fuel constitutes between 25% and 40% of total airline operating costs, such increases could destabilise the industry in which net margins rarely exceed 3% to 5%.

The impact is already visible: ticket prices have increased by 10%-20% in several markets, fuel surcharges risen by over 30% in certain cases, and thousands of flights cancelled globally, especially along the Europe-Asia axis. Yet, to dwell excessively on these symptoms is to risk overlooking a deeper question, which is what trajectory this disruption is likely to assume in the near future.

The new normal

The risk of sustained tensions between the United States-Israel and Iran is likely to persist over the medium term. A probable outcome is the gradual normalisation of inefficiency. Rerouted flight paths, once conceived as temporary adjustments, may become embedded within airline operating models, permanently altering route economics. In such a scenario, the industry would witness a sustained elevation in cost structures driven by higher fuel burn, increased crew costs, extended turnaround times, and reduced aircraft utilisation.

Over time, this would lead to rationalisation of airline networks, with marginal long-haul routes, particularly those linking secondary cities, becoming economically untenable. The geography of global aviation itself may undergo a subtle, yet significant, reconfiguration. An outcome of this may be traditional West Asian hubs ceding some of their pre-eminence to alternative transit points in Türkiye, Southeast Asia, or even India. For Indian carriers, however, the implications are more acute. Their structural dependence on West Asian air corridors for connectivity to Europe and North America renders them particularly vulnerable, creating a persistent imbalance between rising costs and the constraints of a price-sensitive market.

A more disquieting possibility lies in the prospect of escalation within or after the ceasefire period. Such a scenario may lead to wider airspace closures and sharper energy market disruptions; the consequences could assume a systemic character. Fuel prices, already volatile, may become both elevated and unpredictable, further amplifying operational uncertainty. Flight networks could contract, particularly across high-density intercontinental corridors, while elevated fares and geopolitical anxiety dampen demand. Unlike the COVID-19 pandemic, where demand collapsed due to health concerns, this would constitute a cost-induced contraction, wherein airlines continue to operate but under severe financial strain.

Handling the disruption

For India, such a scenario would be especially onerous. Aviation turbine fuel (ATF), already burdened by high taxation, would reflect the full force of global price shocks, compounded by currency depreciation. The sector could find itself confronting a confluence of pressures, escalating input costs, weakening demand, and constrained pricing power, potentially precipitating consolidation or strategic retrenchment among carriers with limited financial resilience.

Yet, crises, even of this magnitude, are not without possibilities of bearing latent opportunities.

A third trajectory – less immediate but strategically consequential – lies in adaptive reconfiguration. Faced with sustained geopolitical uncertainty, airlines and policymakers make a strategic decision to recalibrate. This could appear in the form of a diversification of routing strategies, reduced dependence on any single geopolitical corridor, alongside investments in ultra-long-haul aircraft capable of bypassing traditional transit hubs altogether. The emergence of alternative aviation hubs outside conflict-prone regions could gradually redistribute traffic flows, while policy interventions, particularly in markets such as India, may address structural inefficiencies, including the rationalisation of ATF taxation and the renegotiation of bilateral air service agreements. In such a scenario, India's current vulnerability could, with strategic foresight, be transformed into opportunity, positioning the country as an alternative node in the evolving architecture of global aviation.

This is a challenge

Amidst these future possibilities, one conclusion asserts itself with increasing clarity: geopolitics should no longer be treated as an exogenous shock to the aviation sector; rather, it should be seen as an intrinsic variable shaping its economics and operations. The long-standing assumption of predictable skies, upon which the industry's finely optimised networks were constructed, has probably been irreversibly unsettled.

Airlines must now internalise uncertainty, embedding scenario planning, dynamic pricing and strategic flexibility into the core of their operations. Possibly, for airlines, this is the equivalent of a 'Covid-shock' of global supply chains and an opportunity to re-strategise and recalibrate. For India's aviation sector, already navigating the complexities of high input costs and price-sensitive demand, the challenge is particularly formidable.

What is unfolding is not merely a transient disruption, but the gradual emergence of a new aviation order, one defined not by the efficiency of open skies, but by the exigencies of a fractured and uncertain geopolitical landscape. The question is no longer whether turbulence will persist, but whether the industry possesses the strategic agility to navigate it.

GS PaperII & III:International Relations & Indian Economy

UPSC Mains Exam Practice Question:"The 2026 West Asia crisis has exposed the structural vulnerabilities of India's aviation sector."Examine.**(150 Words)**

Context : The 2026 West Asia crisis has shattered the "predictable skies" model of global aviation. For India, this isn't just about delayed flights; it is a **structural crisis**. Because Indian carriers rely heavily on West Asian corridors to reach Europe and North America, the closure of Iranian and (since April 2025) Pakistani airspace has created a "geographical trap," driving up operational costs while testing the limits of passenger price sensitivity.

1. The "Geopolitics of Flight Paths"

The article and 2026 data highlight a shift from efficiency to **exigency**:

- **Circuitous Routes:** Flights from Delhi to Europe or North America now take **15% to 40% longer**. For instance, the Delhi-Tashkent route, which took 2 hours, now stretches to over 5 hours.
- **The "Double Whammy":** Indian carriers are uniquely penalized. While foreign carriers can often bypass conflict zones, Indian airlines must also navigate the **April 2025 closure of Pakistani airspace** (following the Pahalgam attacks), forcing even longer detours through the Arabian Sea or Central Asia.
- **Asset Under-utilization:** Longer flight times mean an aircraft that once did two rotations a day can now only manage 1.5, effectively "shrinking" an airline's fleet capacity without losing a single plane.

2. The "Fuel Sink" and Margin Compression

- **Price Surge:** Aviation Turbine Fuel (ATF) in India hit a record **₹1.04 lakh per kilolitre** in April 2026. While a brief data error suggested prices had doubled to ₹2.07 lakh, the actual 8.5% monthly hike remains an "existential challenge" for an industry with net margins of only **3-5%**.
- **Cost Component:** Fuel now accounts for nearly **45% of operating expenses** in India, exacerbated by high state taxes and a rupee at record lows (near **95 per USD**).
- **Fare Inelasticity:** Although ticket prices have risen by **10-20%**, surcharges cannot fully compensate for the exponential rise in fuel burn on rerouted paths.

3. Strategic Vulnerability vs. Latent Opportunity

The Vulnerability

India's dependence on West Asian transit hubs (Dubai, Doha) makes it a "passive victim" of regional wars. When Dubai International (DXB) suspends operations, as it did in March/April 2026, Indian connectivity to the world collapses.

The Opportunity: "Aviation Hub 2.0"

The crisis presents a chance for India to decouple from the Gulf:

- **The India Node:** With upcoming mega-airports like **Jewar (Noida)** and **Navi Mumbai**, India could position itself as an alternative "East-West" transit hub, bypassing conflict-prone zones.
- **Ultra-Long-Haul Strategy:** Investment in aircraft like the A350 or 777X allows airlines to fly non-stop over greater distances, reducing the need for transit stops in West Asia.
- **Policy Levers:** The article calls for the **rationalization of ATF taxation** and renegotiation of bilateral air service agreements to ensure Indian hubs can compete with Istanbul or Singapore.

Conclusion

The 2026 Iran war is the "Covid-shock" for aviation supply chains. It has proven that "Open Skies" is a fragile concept. For India to survive this new aviation order, it must move beyond crisis management. The focus must shift to **routing diversification** and the internal transformation of Indian airports into global hubs. Geopolitics is no longer an "outside" factor; it is the new fuel for airline strategy.