

DIA, DEOGHAR IAS ACADEMY

Daily News Feed

D.N.F

03.06.2025

**Sabaijor Complex, Near Jamunajor Pul, Castair Town
Deoghar, Mob:-9162500508**



How do heatwaves gripping India impact country's labour productivity?

In a report in 2024, the International Labour Organization warned that more than 70% of all workers worldwide are at risk of exposure to excessive heat; It said India lost an estimated \$100 billion from heat-induced productivity losses; small businesses and informal workers bore the brunt.

NEWS ANALYSIS

V. Nivedita

The monsoon has arrived more than a week in advance, giving a respite from the intense heat in India. A heatwave gripped India in early April, though heatwave conditions were observed as early as February 27-28 as large parts of the country witnessed temperatures soar.

Heatwaves could have a drastic impact on the economy. In a report in 2024, the International Labour Organization (ILO) warned that more than 70% of all workers worldwide are at risk of exposure to excessive heat. It added that India lost an estimated \$100 billion from heat-induced productivity losses. Small businesses and informal workers like construction workers, farmers, street vendors and food delivery partners bore the brunt.

Excessive heat can have a devastating impact on agriculture. Studies show just 1 degree of warming reduces wheat yields by about 5.2% in India. Heatwaves, late in rice growing season, can cut yields.

Indians at risk

Heatwaves, a period of unusually high temperatures compared to normal, occur mainly from March to June and hit a peak in May. Most States are prone to



High risk: As per World Bank, up to 75% of India's workforce depend on heat-exposed labour. REUTERS

heat waves in varying degrees with Central, Northwest, East and north Peninsular India bearing the brunt.

Very high risk

A recent report by CEEW states that about 57% of Indian districts, which account for 76% of the country's population, face a high to very high heat risk. Delhi, Maharashtra, Kerala, Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, and Uttar Pradesh face the highest heat risk. It notes over the last 40 years (1981-2022), heat extremes in India rose linearly.

This led to landmark heatwaves in 2013, 2016, 2019, 2022, and 2024.

"Nearly 23 States are heatwave-prone in India.



"Urban areas are at a higher risk because of the population they host. Nearly 76% of India's population lives in 57% of districts [and they are susceptible to the risks]"

There has been a linear increase in the number of very hot days and the number of very warm nights," said Vishwas Chitale, senior programme lead, CEEW, who noted the rate of increase in warm nights exceeds that of hot days.

Rapid urbanisation has only exacerbated the issue as cities tend to retain heat during the day, which delays cooling after sunset,

making nights warmer. This contributes to the "urban heat island effect", where cities get hotter than neighbouring rural areas.

The CEEW report noted between 2005 and 2023, built-up areas have expanded rapidly in almost every Indian district, especially in Tier-II and Tier-III cities like Pune, Thoothukudi, Kolhapur, and Guwahati. "You're not getting any relief from the daytime hot temperature even when you sleep at night. If there are no cooling mechanisms available to you, then your productivity is going to go down," he said.

A 2022 World Bank report points out that up to 75% of India's workforce, or 380 million people, depend on heat-exposed labour, potentially working

in life-threatening temperatures. It also noted 34 million of the projected 80 million global job losses from heat stress-related productivity decline would be in India.

"The income losses for workers in the informal sector are likely to be greater as they are more likely to work outdoors and have less protection from heat," Somanathan, Professor, Economics and Planning Unit, Indian Statistical Institute, said.

Lower earnings

"Net earnings of informal sector workers in Delhi were 40% lower during heatwaves compared to other days in May and June. They were also less likely to be able to go to work due to heat, slept less and less well, and were more likely to have a family member who was sick on hotter days," he said.

Blue-collar workers in factories also suffer. Dr. Somanathan's 2021 study disclosed a slowdown in productivity and increased absenteeism in hot days. "A 1 degree warming is estimated to cut manufacturing output by about 2%."

In rural India, heatwaves hit differently. "Typically, there is little agricultural activity in the peak of summer. But the summer season is also the season for a lot of non-farm activity. A large number of agricultural workers, and even

farmers, go to work part-time in sectors like construction or road building, especially in the lean season," T. Jayaraman, Senior Fellow, Climate Change, MSSRF, said. "Construction activity heats up and road building also attracts labourers and they are prone to the direct risks."

He noted livestock are vulnerable to heat waves.

Dealing with heatwaves

Governments, both at the Central and State levels, is taking action. For example, the National Disaster Management Authority, in collaboration with the Union Ministry of Home Affairs, published guidelines for protecting the Indian workforce. These guidelines, which stress on providing education and regulating work schedules, providing water, medical facilities and appropriate workwear, can be used by officials preparing heatwave action plans for the cities and towns.

Currently, the focus is mostly on urban areas. "Urban areas are at a higher risk because of the population that they host. Nearly 76% of India's population lives in 57% of districts [and they are susceptible to the risks]," Dr. Chitale said. He noted the healthcare infrastructure in rural areas is relatively weak. This puts Indians in rural areas at risk of health-related disorders.



'Rural consumption to drive India's GDP growth this fiscal'

Reuters
MUMBAI

Rural consumption is poised to remain a bright spot in the Indian economy, supporting growth in the ongoing fiscal year, economists said after fourth-quarter GDP growth beat estimates.

India's economic growth rose to a one-year high of 7.4% in the January-to-March quarter, higher than forecast, data showed on Friday. Personal consumption rose 6% during three months after an 8.1% rise in previous quarter.

For the fiscal year ending March, inflation-adjust-



India's economy grew 1-year high of 7.4% in Jan.-to-March.

ed consumption growth of 7.1% outpaced broader economic expansion of 6.5%, reflecting a rural consumption recovery, Citibank said in a note on Friday.

"High frequency data in-

dicates rural demand is faring better even as urban demand is patchy," said A. Prasanna, head of research at ICICI Securities Primary Dealership.

"Given rural consumption is a bigger part of overall consumption pie compared with urban consumption and was generally hurting from COVID shock in last few years, it is likely consumption growth will stay resilient."

Above-average monsoon rains this year and the resultant rise in farm incomes are likely to boost rural demand as will easing inflation, the economists said.



What would a French nuclear umbrella mean for Europe?

Why has French President Emmanuel Macron extended its nuclear deterrent to its European allies?

Franciszek Smarski

The story so far:

In May 14, French President Emmanuel Macron stated that France is “open to dialogue” on potentially stationing its nuclear weapons in other European countries. This development occurred amid security concerns in Europe due to the ongoing Russia-Ukraine war.

What lies behind France's offer?

France's consideration of a broader European role for its nuclear deterrent aligns with its “European strategic autonomy” policy, which aims to enhance the EU's capacity to act independently in security and defence matters. President Macron's Sorbonne University speech emphasised Europe's need to bolster its defence capabilities, in order to be a more “sovereign Europe.” Moreover, U.S. President Donald Trump has questioned

unconditional U.S. security guarantees to NATO allies, linking support to the 2% GDP defence spending target for security guarantees, prompting European nations to seek additional security assurances. Historically, France has fiercely guarded the independence of its nuclear deterrent, viewing it as a strictly national tool. This openness, thus, signifies an evolution in its strategic thinking.

What is the nuclear sharing model?

“Nuclear sharing” involves a nuclear-weapon state stationing nuclear weapons on allied non-nuclear-weapon states' territory, with specific arrangements for potential use. Within NATO, the U.S. has maintained such arrangements for decades. Currently, U.S. B61 tactical nuclear gravity bombs are understood to be deployed in five NATO states: Belgium, Germany, Italy, the Netherlands, and Türkiye.

Under these arrangements, the U.S.

retains legal ownership and custody of the warheads. The U.S. President also retains the power to make the decision to use these weapons, following NATO consultation. This Cold War-era posture aims to demonstrate alliance solidarity, and share nuclear risks.

Does France have enough weapons?

France's arsenal is around 290 nuclear warheads, deliverable by submarine-launched ballistic missiles and air-launched cruise missiles via Rafale jets. A 2023 Centre for Strategic and International Studies report analysed that extending France's nuclear deterrent by basing warheads abroad would pose logistical and doctrinal challenges with its current arsenal size, suggesting that an increase in warheads might be needed for credible extended deterrence. Such deployments would require stationing French Air Force units, including Rafales and support infrastructure, abroad.

Establishing secure command and control systems in a multinational setting would be complex.

Would it strengthen deterrence?

Deploying additional nuclear weapons in Europe has varied security implications. Proponents argue it could enhance deterrence against Russia by increasing NATO's nuclear assets and demonstrating European resolve. Conversely, Russia would likely view such deployments as a significant escalation, potentially leading to “military-technical measures” in response. Russian officials have repeatedly warned against NATO's eastward military expansion. Russia's 2023 stationing of tactical nuclear weapons in Belarus is cited by some as a preceding escalatory step.

Is it legal under international law?

The 1968 Nuclear Non-Proliferation Treaty (NPT) is the primary legal instrument for regulating nuclear weapons. Article I of the treaty prohibits nuclear-weapon states (like France) from transferring nuclear weapons or control over them. Existing NATO nuclear sharing is justified by participants as being NPT-compliant because no “transfer” of legal ownership or control occurs in peacetime; the U.S. maintains custody. Non-proliferation advocates and various research institutions have consistently challenged this legality.

THE GIST

▼ France's consideration of a broader European role for its nuclear deterrent aligns with its “European strategic autonomy” policy, which aims to enhance the EU's capacity to act independently in security and defence matters.

▼ Proponents argue it could enhance deterrence against Russia by increasing NATO's nuclear assets and demonstrating European resolve.

▼ The 1968 Nuclear Non-Proliferation Treaty is the primary legal instrument for regulating nuclear weapons.



How is President's Rule imposed?

What does Article 356 of the Constitution stipulate? How have different Governors dealt with dissolving Legislative Assemblies after President's Rule has been invoked? When did the Supreme Court first intervene in the decision of the Union government to impose President's rule?

EXPLAINER

Rangarajan. R

The story so far:

A delegation of 10 MLAs from the Manipur Assembly met the Governor of the State and pressed for the formation of a viable government in Manipur that has been under President's Rule since February 2025.

What is President's Rule?

Article 356 is invoked to impose President's Rule in a State after removing the State government. While there are duties cast on federal governments in the U.S. and Australia to protect the States, their constitutions do not have any provision for removing State governments. Under Article 356, the President (Central government) may take over the governance of a State when it cannot be carried out in accordance with the provisions of the Constitution. The President can make such a proclamation based on a receipt of report from the Governor of a State or otherwise. The latter situation may arise under Article 365 due to failure of a State to comply with or give effect to any directions of the Union government.

The proclamation of President's Rule must be approved by both Houses of Parliament within two months from the date of its issue by a simple majority. Once approved by Parliament, the President's Rule continues for six months, from the date of proclamation, unless revoked earlier. It can be extended for a further period of six months at a time by an approval of both the Houses of Parliament by a simple majority. The President's Rule cannot extend beyond a period of three years in total.

What has been the history?

Dr. B.R. Ambedkar during the Constituent Assembly debates wished that Article 356 would never be called into operation and



In rage: Women protest against the President's Rule imposed in Manipur, in Imphal West on May 27. ANI

that it would remain a dead letter. However, it has been a travesty that Article 356 was misused on several occasions, removing elected governments that enjoyed majority in the States, violating constitutional principles and federalism. Reasons varied from loss in Lok Sabha elections to deterioration of law and order. When it comes to the dissolution of the Legislative Assembly after imposition of President's Rule, there has been no uniformity in the approach. More than constitutional principles, it was political expediency that drove such decisions in the past.

Various Governors have adopted different approaches in similar situations in regard to the dissolution of the Legislative Assembly. The advice of a Chief Minister, enjoying majority support in the Assembly, is normally binding on the Governor. However, where the Chief

Minister had lost such support, some Governors have refused to dissolve the Legislative Assembly on his/her advice, while others in similar situations, accepted the advice, and dissolved the Assembly. The Assembly was dissolved in Kerala (1970) and in Punjab (1971) on the advice of the Chief Minister whose claim to majority support was doubtful. However, in more or less similar circumstances in Punjab (1967), Uttar Pradesh (1968), Madhya Pradesh (1969), and Orissa (1971), the Legislative Assembly was not dissolved immediately based on the outgoing Ministry's advice. Attempts were made to install alternative Ministries.

What have the courts ruled?

The Supreme Court and High Courts during the first four decades after Independence refrained from interfering

in the decision of the Centre to impose President's Rule in States. It was only after a categorical judgment of the Supreme Court in the *S. R. Bommai* case (1994), that misuse of Article 356 has been restricted. The court in this judgment held that Article 356 should be imposed only in the event of a breakdown of constitutional machinery as distinguished from an ordinary breakdown of law and order. It also held that imposition of President's Rule is subject to judicial review and should not be misused for political reasons. It further ruled that till Parliament approves the imposition of President's Rule, the Legislative Assembly should not be dissolved, and can be only kept under suspended animation.

The higher judiciary has been a watchdog, since the *S. R. Bommai* case, against the arbitrary use of Article 356. Notably in the case of Bihar (2005), Uttarakhand (2016) and Arunachal Pradesh (2016), the courts have struck down the wrongful imposition of President's Rule.

When can it be revoked?

If President's Rule is imposed because of the lack of a government with majority, then usually fresh elections are held. After elections, the President's Rule is revoked and a popularly elected government takes over the governance of the State. Manipur was placed under President's Rule in February 2025 due to the deteriorating security situation and consequent political developments in the State. The assembly, whose five-year term ends in March 2027, has been kept under suspended animation. Considering that more than 18 months are left before the assembly term expires, it would be prudent to install a government that enjoys the confidence of the assembly. More importantly, it should enjoy the confidence of different sections of society of the State.

Rangarajan. R is a former IAS officer and author of 'Courseware on Polity Simplified'. He currently trains at Officers IAS Academy. Views expressed are personal.

THE GIST

▼ Dr. B.R. Ambedkar during the Constituent Assembly debates wished that Article 356 would never be called into operation and that it would remain a dead letter.

▼ The proclamation of President's Rule must be approved by both Houses of Parliament within two months from the date of its issue by a simple majority.

▼ The Supreme Court and High Courts during the first four decades after Independence refrained from interfering in the decision of the Centre to impose President's Rule in States.



Why has net FDI inflow plummeted?

Decline in FDI relative to GDP is a matter of concern and points toward a declining interest among foreign investors

DATA POINT

R. Nagaraj

The RBI Bulletin (May 2025) provides foreign direct investment (FDI) figures for the fiscal year 2024-25. Two contrasting narratives have emerged from it. Focusing on the headline number, government sources and many media outlets have reported that India received an unprecedented \$81 billion of gross inflows. Looking closer at the same data, others have highlighted the plummeting of net FDI at \$353 million. The government and economists monitor these flows as a barometer of the investment climate.

In principle, FDI inflows enhance fixed investments to expand production capacity and bring in newer technologies and global best practices. The reality, however, could be different. So, what do the contrasting numbers reveal?

To interpret the economic significance of the figures, it is necessary to relate them to the country's GDP. The gross foreign inflow-to-GDP ratio steadily declined from 3.1% in 2020-21 to 2.1% in 2024-25. However, the decline was slightly steeper in net FDI, from 1.6% of GDP to zero in the same period, highlighting the divergence between the two flows. The graph also shows a steadily rising outward FDI (OFDI) and 'repatriation and disinvestment' (disinvestment, for short) to account for the difference between the two figures (Chart 1).

Outward FDI refers to Indian companies investing abroad to expand their market and acquire technologies to enhance their domestic capabilities. However, OFDI also includes financial flows to many known tax havens, such as Singapore and Mauritius, which are also the top sources of India's inward FDI. Many have questioned whether such a symmetric inflow and outflow of foreign capital to tax havens represents correlated movements of "hot money" enter-

ing and exiting the country at will. Such flows may hardly expand domestic investment but may allow for global capital tax arbitrage.

In a research paper titled 'What Does Measured FDI Actually Measure?' (October 2016), Olivier Blanchard and Julien Acalin showed that inward and outward FDI flows across emerging market economies are highly correlated, responding to the U.S. policy rate. Large financial conglomerates move liquid capital across the world to take advantage of variations in tax laws, a practice known as 'treaty shopping'.

The study found that India ranked sixth in descending order among 25 emerging market economies in terms of this correlation while China ranked 25th. The study's sharp conclusions seem instructive: "...measured" FDI gross flows are quite different from true flows and may reflect flows through, rather than to, the country, with stops due in part to (legal) tax optimisation. This must be a warning to both researchers and policymakers." In other words, such flows represent the movement of global capital through India to take advantage of tax concessions, and there is a need to assess the value of these flows.

The rising disinvestment is due to the type of FDI India is attracting. The share of private equity (PE) and venture capital (VC) in FDI inflows, commonly referred to as 'alternative investment funds', has increased steadily. By definition, these funds acquire existing firms, factories, and brands, known as brownfield FDI. PE/VC investments have a 3-5-year horizon, and they are made primarily in services such as fintech, retail, healthcare, real estate, banking, and insurance. For instance, Blackstone is investing in Care Hospitals, and ChrysCapital is investing in Lenskart. Such funds are loosely regulated entities that, almost by definition, sell (or liquidate) their holdings ('positions') during the stock market booms - to deliv-

er the best returns for their global investors. It is quite plausible that PE/VC funds selling their holdings during the stock boom boosted disinvestment in FY25.

An estimate of the share of PE/VC funds in FDI inflow shows a steady rise during the last decade, from 12.2% in 2009-10 to over 75.9% in 2020-21 (Chart 2) ('Reversing India's Industrial Decline,' EPW, March 15, 2025). In contrast, a declining share of FDI is invested in greenfield projects, contributing modestly to capital formation.

Despite much hand-wringing, it is essential to appreciate that FDI inflows are a modest and declining share of gross fixed capital formation (GFCF). The gross inflows peaked at 7.5% of GFCF in FY21 in the past decade at current prices, declining precipitously thereafter (Chart 3). The same applies to the net FDI-to-GDP ratio.

Net FDI (and gross FDI), relative to GDP, has declined steadily since FY21. This, in contrast to many policymakers' optimistic claims, is a matter of concern. Declining interest in India among foreign investors is in line with tepid domestic corporate investment. However, it is worth noting that FDI inflow has been modest, ranging between 1% and 3% of GDP and 1% and 7% of GFCF since FY14.

There are, however, more serious concerns about the composition and utilisation of FDI. The majority of it consists of alternative investment funds, which hardly contribute to enhancing long-term capital formation, technology acquisition, and augmenting India's potential output. The rising share of outward FDI suggests that India may be used as a conduit for tax arbitrage by international capital. If these concerns are valid, there may be a need to reform foreign capital regulations to serve domestic capital interests and improve domestic capabilities to overcome industrial and technological challenges.

R. Nagaraj is with the Centre for Liberal Education, IIT Bombay



Declining trends

The data for the charts were sourced from the Reserve Bank of India's bulletin

Chart 1: The trends in FDI as a % of GDP (2013-14 to 2024-25)

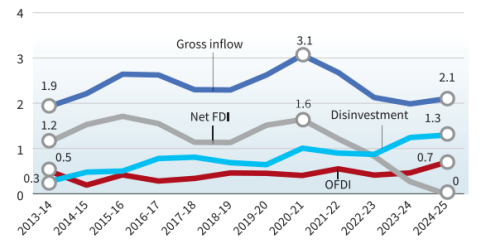


Chart 2: The PE investment as a % of gross FDI (2001-02 to 2020-21)

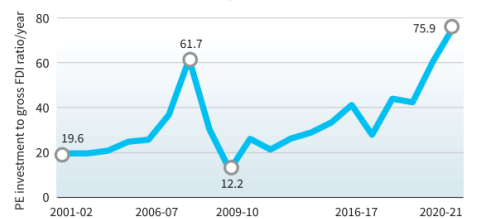
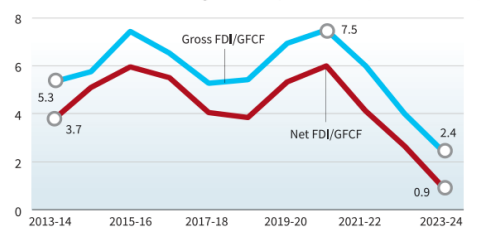


Chart 3: The FDI inflow as a % of gross fixed capital formation (2013-14 to 2024-25)



Strengthening the U.S.-India subsea cable agenda

Bilateral commercial engagement between India and the United States is accelerating across multiple fronts, not limited to an imminent trade agreement. The two administrations are working closely on strategic sectors, with a shared understanding of the need to diversify and de-risk technology supply chains in an increasingly volatile world. This includes efforts to finesse the Technology for Resilient, Open and Unified Security and Trust (TRUST) framework – the spiritual successor to the U.S.-India Initiative on Critical and Emerging Technology, or ICET.

Later this year, United States President Donald Trump is expected to visit India for the Quad (India, Australia, Japan, U.S.) Summit. The first tranche of a bilateral trade agreement between India and the U.S. will be signed in advance of this summit, which will set a solid baseline of deepened cooperation across digital technologies and markets.

Amidst these developments, subsea cables – the physical backbone of the global Internet – are emerging as an area of focus. They carry over 95% of international data traffic, enabling nearly all digital interactions. Once these cables reach land, they either connect directly to users or link to the data centres that power cloud services and critical infrastructure. China's rapid expansion of subsea infrastructure across the Indo-Pacific through its Digital Silk Road Initiative underscores the strategic importance of trusted alternatives.

Part of global public good

A strong India-American pledge to develop resilient, secure subsea systems would serve as a global public good. The TRUST framework recognises India's growing role as a net security provider in the Indo-Pacific, while also advancing plans to invest in regional subsea cable infrastructure using trusted vendors. India hosts around 17 subsea cables, with a few more under construction. But these are cumulatively less than Singapore's 26, despite its much smaller size. This must change because we are well-positioned to

Vedika Pandey

is a technology policy researcher at the Koan Advisory Group, New Delhi

Dhruv Shekhar

is a technology policy researcher at the Koan Advisory Group, New Delhi

Samriddhi Kumar

is a technology policy researcher at the Koan Advisory Group, New Delhi

It is crucial to improving the region's digital resilience and advancing shared strategic and commercial goals

become a regional connectivity hub. We have all the necessary ingredients: a sprawling 11,098-kilometre coastline, a central location in the Indo-Pacific, and a fast-growing digital economy.

India's coastline accounts for nearly two-thirds of its boundary. Yet, 15 of the country's 17 international subsea cables converge on a six-kilometre stretch in Mumbai. Cable landing stations, coastline facilities that connect subsea cables to terrestrial networks, are concentrated in five cities: Mumbai, Chennai, Kochi, Tuticorin, and Thiruvananthapuram. Continued diversification of network infrastructure is in order since disruptions in one region, such as natural calamities, human error or sabotage, can have devastating implications.

A spread-out network of landing stations would also increase redundancy – which is the ability of a network to reroute data across other links when there is a disruption. In 2024, Houthi rebels allegedly damaged subsea cables in the Red Sea. Indian operators were forced to reroute traffic to other cable systems to avoid disruption. A similar disruption closer to home could lead to breakdowns in both domestic and international communications.

Potential as a transit hub

Subsea cable routes tend to mirror historical maritime trade routes. Positioned between Europe, Southeast Asia, and Africa, India sits near key maritime choke points – the Strait of Hormuz, the Strait of Malacca and Bab-el-Mandeb. This makes the country a natural hub for global cable networks.

India is also situated at the centre of a region with the fastest broadband expansion, serving rising demand in dynamic economies across Africa and Asia, including Indonesia. It serves as a key junction for nearly all Africa-Asia and Europe-Asia submarine cables. Enhanced connectivity is also important for serving surging domestic demand. India's bandwidth requirement is projected to grow at 38% between

2021 and 2028, fuelled by rising consumption and data centre investments.

Countering Beijing's influence in the Indo-Pacific is an enduring American policy stance. India's digital infrastructure, particularly subsea cables, is a front line asset that requires greater fortification, in this context.

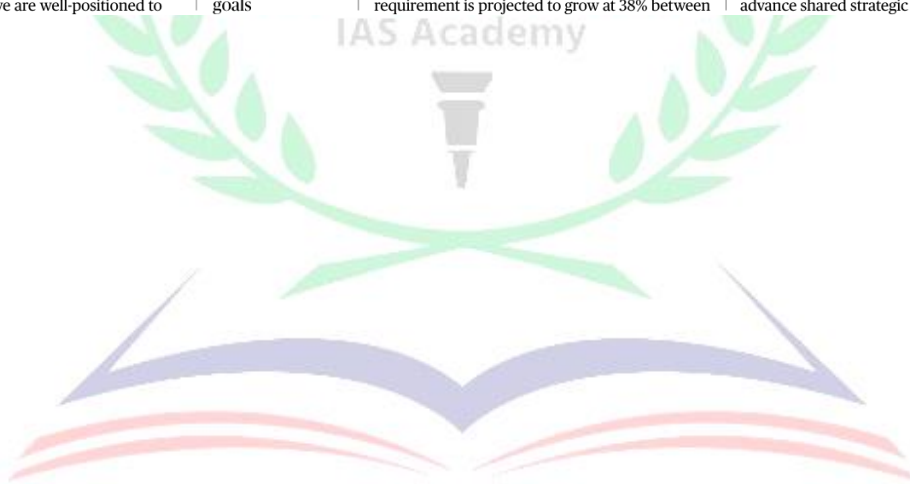
Steps needed

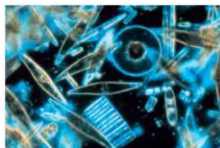
For its part, India must lower entry barriers to greater investment. The licensing regime for undersea cables remains prohibitively complex and must be reformed. Cables need upwards of 50 clearances from multiple Ministries. Further, India continues to rely on foreign-flagged cable repair ships, primarily based out of Singapore and Dubai. These vessels typically take between three to five months to respond to outages – delays driven by long travel times and a cumbersome clearance process involving customs, naval permissions, and crew approvals. These lags are a commercial liability.

America also needs to step up investments in critical digital infrastructure in the Indo-Pacific. This includes inward concessional finance, technical assistance for cable route diversification and cybersecurity, and encouraging U.S. firms to take anchor positions in cable projects. An example is Meta's multi-year investment in a 50,000-kilometre undersea cable project to enhance Indian Ocean connectivity, highlighted in the United States-India Joint Leaders' Statement (February 2025). The project is set to begin soon and will connect five continents. Supporting the development of a domestic subsea cable repair ecosystem, including depot infrastructure and Indian-flagged vessels, should also find mention under the TRUST framework.

Finally, enhanced subsea cable collaboration will complement the broader U.S.-India trade deal currently being negotiated since it is also premised on more dynamic technology cooperation. Swift action on these fronts will improve the region's digital resilience and advance shared strategic and commercial goals.

IAS Academy





Phytoplankton are at the base of marine food chains. NOAA

Phytoplankton overfed on iron, depleting ocean nutrients faster

Vasudevan Mukunth

A new study has unearthed strong observational evidence that industrial pollution is altering nutrient cycles and ecosystem boundaries in the ocean.

According to the researchers, from across institutions in the U.S., iron released due to human activities enhances spring phytoplankton blooms as well as speeds up the rate at which nutrients are consumed. The changes may work in synergy with climate-driven ocean warming and stratification, speeding up the transition to nutrient-poor conditions across broader swaths of the ocean, they added.

The team published its findings in *Proceedings of the National Academy of Sciences* on June 2.

The authors conducted four oceanographic expeditions between 2016 and 2019 to measure dissolved iron and its isotopic composition in the north Pacific Ocean. They also used satellite observations and gene expression analyses to understand the biological responses to the element's presence.

The team collected data during three springtime cruises in 2016, 2017, and 2019 and one autumnal cruise in 2018 to track seasonal changes in iron chemistry. Team members measured the amount of dissolved iron in the water and its isotopic composition using trace-metal clean techniques and mass spectrometry. They also analysed metatranscriptomic data from phytoplankton samples to look for the expression of genes associated with iron stress – bio-physiological changes induced by exposure to the element.

Satellite data were used to assess long-term changes in phytoplankton distribution and productivity. The team focused especially on chlorophyll-a levels, for which they used data “produced by the Ocean Colour Climate Change Initiative” of the European Space Agency, according to the paper. The Initiative “integrates observations across multiple

Iron released by human activities speeds up the rate at which nutrients are consumed. This may speed up the transition to nutrient-poor conditions across broader swaths of the ocean

ocean colour platforms to form a continuous 26-year record.”

This way, the team reported that about 39% of surface ocean iron during spring comes from atmospheric pollution, particularly emissions from East Asia. They found this “anthropogenic iron” has a distinct isotopic signature that makes it traceable in seawater. Its input peaked during spring, when westerly winds have been known to carry aerosols across the Pacific Ocean.

The predictably higher iron concentration in spring appeared to make the phytoplankton more productive, especially that north of the transition zone chlorophyll front (TZCF) – the boundary between nutrient-rich and nutrient-poor waters.

The greater access to iron enhanced the growth of the phytoplankton, which consumed more nitrates. The team wrote in its paper, “Over the past 25 years, increasing anthropogenic iron input appears to have stimulated springtime phytoplankton growth, ultimately leading to faster depletion of ... nitrate. Thus, large-scale iron pollution may be increasing the prevalence of nitrogen limitation,” expanding the size of the nutrient-poor part of the ocean. The retreat of an ecosystem boundary can have severe ecological and socioeconomic consequences. Phytoplankton are at the base of marine food chains, so a change in their distribution will affect zooplankton, fish, and larger predators like seabirds and whales. Species that can't migrate or adapt fast enough may decline or go extinct.

(mukunth.v@thehindu.co.in)



Team from CCMB finds clues to Darwin's 'abominable mystery'

In the last 450 million years, as plants moved to drier land, their life-cycles changed significantly, but something curious happened 130 million years ago, after flowering plants first appeared: fossils suggest these plants diversified rapidly in terms of anatomies and habitats; this emergence is a puzzle

Somdatta Karak

Life on the earth depends on plants. Microscopic aquatic plants and algae make most of the oxygen on the planet. The land plants are the primary producers of human and animal food. This is why it's important to understand how they grow and reproduce.

In the last 450 million years, as plants slowly evolved from freshwater algae and moved from aquatic ecosystems to moist land to drier land, their life-cycles also changed significantly.

But something curious happened about 130 million years ago, soon after flowering plants first appeared. Fossils from that period suggest flowering plants diversified rapidly in terms of their anatomies and habitats. Evolution is understood to be a gradual process, and the rapid emergence of diverse flowering plants has thus been a puzzle. Charles Darwin called this an "abominable mystery."

A recent paper by a team of researchers at the CSIR-Centre for Cellular and Molecular Biology (CCMB), Hyderabad, shed light on the molecular innovations in flowering plants that could help understand this mystery.

Life-cycles of land plants

A plant's life-cycle has two distinct phases: when it's a gametophyte (gamete-making plant) and when it's a sporophyte (spore-making plant). The phases dictate their anatomies and functions.

Gametophyte cells contain one set of genes and make either sperm or eggs. The fusion of a sperm and an egg gives rise to a sporophyte. Each sporophyte contains two sets of genes, one from each contributing gamete.

When it matures, the sporophyte cells divide to make new cells called spores. The spores have novel combinations of a single set of genes – and the diversity here is responsible for creating plants with diverse traits within a population.

Early land plants and those that evolved later are different in the duration of their phases. Mosses – which retain many features of the ancestors of the earliest land plants – spend most of their lives in the gametophyte stage. When moss makes sperm cells, it distributes them in its watery environment. The sperm cells swim to find egg cells. When a sperm fertilises an egg, a sporophyte is formed that remains attached to the gametophyte. It grows as a stalk, emerging with a capsule at the end. The capsule develops spores that disperse and grow into new gametophytes.

But flowering plants that evolved more recently spend most of their lives in the sporophyte phase. The flowers produce spores that give rise to the gametophytes. However, the number of gametophyte cells is small, and they are completely enclosed in the sporophyte.

The gametophytes differentiate into male and female gametophytes. The male gametophytes develop as sperm-containing pollen that delivers sperm to the egg cells in female gametophytes through the wind, insects, or other animals that come in contact with the flowers. The union of sperm cells and eggs gives rise to seeds, which germinate to make new sporophytes of



A patch of moss showing both gametophytes (low, leaf-like forms) and sporophytes (tall, stalk-like forms). BOB BLAYLOCK (CC BY-SA)

flowering plants.

Scientists had previously found that genes controlling the early steps of sperm and egg development are conserved between mosses and flowering plants. That is, even as plants and mosses evolve and their genes change, those underlying the early steps of sperm and egg development don't. Since moss gametophytes grow independently from the sporophyte, scientists assumed the mechanisms controlling flowering plant gametophyte development are also independent of the sporophyte.

But the recent report from CCMB challenges this assumption: the researchers have shown that the sporophyte controls gametophyte development in flowering plants.

Rapid evolution in flowering plants

The study, recently published in *Nature Plants*, described the role of a newfound gene called *SHUKR* (meaning 'sperm' in many Indian languages) in the plant *Arabidopsis thaliana*. This gene is expressed in the flower's sporophyte cells and affects the development of pollen.

When a functional *SHUKR* gene is absent, the flower fails to produce viable pollen.

(The researchers first found *SHUKR* in *A. thaliana* because it's a model organism for plant biologists. They subsequently also found the gene in other eudicots through genome analyses but restricted their detailed studies of the effects of *SHUKR* to *A. thaliana* alone.)

The *SHUKR* gene was also found to regulate a class of genes called F-box genes in pollen. These genes remove proteins that have served their functions and make room for new proteins to act in pollen development.

The team, led by emeritus scientist Imran Siddiqi, found the *SHUKR* gene in

The drastic evolutionary changes among flowering plants about 125 million years ago could have happened because of the *SHUKR* gene and its ability to control pollen quality, dictated by the conditions and needs of the larger sporophyte plant

eudicots – a plant group that comprises 75% of all flowering plants. The gene first emerged in these plants about 125 million years ago. The team also found that the *SHUKR* gene and the pollen-specific F-box genes under *SHUKR*'s control are evolving rapidly.

Unlike mosses, where sperm cells always have enough water to swim through towards the egg cells, flowering plants operate in more variable conditions. Various families of flowering plants have to survive heat, cold, high humidity, and high aridity.

Siddiqi suggested that the fast-evolving nature of *SHUKR* and the F-box genes allowed the eudicot plants to explore, adapt to, and successfully reproduce in various environmental conditions through variations in pollen. According to him, this could provide key molecular insights to cracking Darwin's "abominable mystery."

Put another way, the sudden and drastic evolutionary changes among flowering plants about 125 million years ago could have happened because of the emergence of the *SHUKR* gene and its ability to control pollen quality, dictated by the conditions and needs of the larger sporophyte plant.

These adaptations add to others in many forms of land plants, including those that enabled them to grow on land

and reproduce without constant access to abundant water. These abilities include a robust root system to draw water from the ground, a vasculature that allows water and minerals to move from the roots to different cells of the plant body, and the evolution of many forms of flower-pollinator strategies.

Focus on food security

If evolutionary success among plants was an exam, flowering plants would be the top scorers. Seeds in the form of cereals, pulses, and oilseeds are the biggest source of food for all animals on the earth. They also contribute to a billion-dollar global food industry.

Climate change poses a significant threat to these systems today and imperils food security. Higher temperature affects plant growth and reproduction by inducing metabolic changes in pollen and causing male sterility.

The new study and others like it can help researchers identify new mechanisms that ensure plants can survive increasingly harsh environments. Scientists are even today exploring genes responsible for plants' physical sturdiness, immunity, and/or tolerance to salinity and drought. In this vein, *SHUKR* opens a new path to plant fitness.

Siddiqi and his team members have speculated that when exposed to a specific environmental condition, the sporophyte of a eudicot may create pollen fit for those conditions by modulating the protein composition in the pollen. Using the preconditioned pollen, it may be possible to naturally improve environmental resilience in plants.

(Somdatta Karak heads science communication at CSIR-CCMB. somdattakar@ccmb.res.in)

Health facilities not fully prepared for diabetes, hypertension care: study

Bindu Shajan Perappadan
NEW DELHI

Public primary health centres (PHCs) are better prepared for diabetes and hypertension care than sub-centres, community health centres (CHCs), and sub-district hospitals, a study undertaken by the Indian Council of Medical Research-National Centre for Disease Informatics and Research (ICMR-NCDIR), Bengaluru has found.

A cross-sectional survey of health facilities was conducted in 19 districts of seven States in India, which included an assessment of both public and private health facilities.

The study was undertaken to assess “preparedness of public & private health facilities for management of diabetes & hypertension in 19 districts in India”.

It found that the overall readiness score for provid-



Matter of discussion: A cross-sectional survey of health facilities was conducted in 19 districts of seven States in India. R. RAGU

ing hypertension and diabetes services was lowest for sub-centres (61%) and CHCs (59%).

The readiness score for public PHCs and private primary care facilities (level 2) was 73% and 57%, respectively. The readiness score of district hospitals, government private medical colleges, and other private tertiary care facilities was above 70%, and they were considered prepared for services.

The study found that

out of the 415 health facilities covered in the survey, 75.7% were public facilities. More than half (57.6%) were primary care facilities, and 53.3% of them were situated in rural areas.

Experts have now recommended ensuring the availability of adequate human resources, uninterrupted supply of essential medicines, and programme managers for all public health facilities, to ensure full utilisation of

healthcare centres for diabetes and hypertension care.

“Diagnostic services were less available at district hospitals, indicating that secondary, higher-level public health facilities were not fully prepared to manage complications of these two conditions. Efforts to strengthen diagnostic services are essential for the continuum of care, as there will be in-referrals of patients from peripheral public health facilities to district hospitals,” the study said, adding that work must be done to ensure a reliable drug supply, and accurate information systems in primary health-care facilities.

Equipment, medicines, diagnostics capacity, staff, the availability of guidelines, and overall readiness score were calculated following the World Health Organization’s Service Availability and Readiness Assessment manual.



India, Paraguay can strengthen trade ties: PM

Kallol Bhattacharjee
NEW DELHI

India and Paraguay can partner in expanding regional commerce in Latin America, said Prime Minister Narendra Modi on Monday.

Mr. Modi welcomed Paraguay's President Santiago Pena Palacios and presented the MERCOSUR trade bloc in Latin America as an arena where India and Paraguay can work together closely. Mr. Pena, who is on his first visit to India, described India as a "key strategic partner" of his country.

"We see new opportunities for cooperation in areas such as digital technology, critical minerals, energy, agriculture, health-care, defence, railways,



New steps: Prime Minister Narendra Modi exchanges greetings with Paraguay's President Santiago Pena in New Delhi on Monday. ANI

space, and overall economic partnership. We have a Preferential Trade Agreement with MERCOSUR. We can work together to further expand it," said Mr. Modi in his remarks at the bilateral meeting between the two delegations.

The visit by Paraguay's

President has come against the backdrop of a churn in global commerce after Donald Trump became the U.S. President.

India's relations with Paraguay dates back to 1961 when bilateral diplomatic ties were established. India opened its embassy in Pa-

raguay's capital Asuncion in August 2022. MERCOSUR, a trade bloc including Brazil, Argentina, Paraguay and Uruguay, was formed in 1991 and a framework agreement was signed between India and MERCOSUR on June 17, 2003. This agreement was followed by the MERCOSUR-India Preferential Trade Agreement (PTA) signed in New Delhi in 2004.

Strategic partner

"India with its vast population and global leadership in technology and innovation, represents a key strategic partner for Paraguay. During my official visit, I had a productive meeting with the Prime Minister Narendra Modi, with whom we agreed on the

importance of strengthening our bilateral relationship," said Mr. Pena.

An official, speaking off the record, said Paraguay has the potential to be a reliable regional partner to India as it follows a cautious foreign policy without antagonising any of the major regional and global stakeholders. For India, a special attraction is the natural resources and minerals of Paraguay.

Officials said Paraguay has always been cautious about its foreign policy in a region dominated by Argentina and Brazil. Brazil, under left-leaning President Luiz Inacio Lula da Silva and Argentina's right-leaning President Javier Milei have been holding pole positions in Latin America and MERCOSUR.



Pahalgam terror attack casts shadow on Kheer Bhawani festival turnout

Arrival of Kashmiri Pandits dip; first batch of 2,500 devotees reach temple as against 4,500 last year; State politicians allay safety fears and urge devotees to attend festival in large numbers

The Hindu Bureau
SRINAGAR

The Pahalgam terror attack has cast a shadow on the annual festival of Zyestha Ashtami at the Kheer Bhawani Temple in Kashmir.

According to official figures, the first batch of 2,500 Kashmiri Pandits has arrived to take part in the festival, compared to around 4,500 last year. These devotees have come from several parts of the country.

In all, over 30,000 devotees paid obeisance at the temple last year.

Tight security

The festival is held on the occasion of Zyestha Ashtami, which falls on Tuesday, and is being organised at Tulmulla in Ganderbal, Tikker in Kupwara, Devsar and Manzam in Kulgam and Logripora in Anantnag. Extra security arrangements have been made this year for the festival, officials said.

While Lieutenant Gover-



Kashmiri Pandit devotees arrange earthen lamps on the eve of the Kheer Bhawani Mela at Janipur in Jammu on Monday. PTI

nor Manoj Sinha extended his greetings to devotees, local politicians also urged Pandits to visit the Valley temples.

Congress leader Karan Singh on Monday urged devotees to attend the festival in large numbers. "All necessary security arrangements are in place in Kashmir, especially in Tulmulla in Ganderbal district, home to the Kheer Bhawani Temple," said Mr. Singh, who paid obeisance on Monday.

"We must not be afraid

and must show the world that we are strong in our faith. People of Kashmir have suffered the most during the conflict. All need to rise above fear and support the region's revival by participating in religious and cultural events," he said.

'Symbol of harmony'

"The festival has historically been a remarkable example of communal harmony. Even during the challenging years following the exodus of Kashmiri Pandits

from the Valley, local Kashmiri Muslims took on the responsibility of maintaining and protecting the Kheer Bhawani shrine, ensuring its sanctity was preserved. This underscores the deep ties of mutual respect and coexistence," said former J&K Chief Minister and Peoples Democratic Party president Mehbooba Mufti.

J&K Apni Party president Altaf Bukhari said the Kheer Bhawani Mela has been the symbol of Kashmir's pluralistic ethos for centuries. "This festival has played a vital role in fostering communal harmony, brotherhood, and mutual respect among the diverse communities," he said.

Officials said the district administration has made elaborate arrangements for devotees. "To cater to the food and water needs of the pilgrims, *langar* services and drinking water points have been ensured. Health facilities, including the presence of medical teams and ambulances, remain on standby," an official said.