A.P. braces for second cyclone within a week

Nellore Sravani
VIJAYAWADA

Barely a week after being battered by "very severe" Cyclone Arnab, Andhra Pradesh is bracing for Cyclone Murasu, expected to make landfall on Tuesday, with five districts put on red alert.

The weather system over the Bay of Bengal intensified into a cyclonic storm and was centred at around 350 km east of Chennai on Sunday night.

As per the India Meteorological Department (IMD), the storm, which is likely to bring heavy rainfall to several Tamil Nadu districts as well, is expected to move west-northwestward and intensify into a severe cyclonic storm by Monday morning.

Between Monday night and early hours of Tuesday, it is likely to cross into Andhra Pradesh with wind speeds gusting up to 120 km per hour between Nellore and Narsapur.



The storm is likely to bring heavy rain to Tamil Nadu and Odisha as well. B. VELANKANNI RAJ

Andhra Pradesh Chief Minister N. Chandrababu Naidu, who cancelled his visit to Delhi, held a review meeting on Sunday and directed officials to step up preparedness to tackle the possible impact of the storm.

Odisha, which reported multiple landslides during Cyclone Arnab, is also bracing for the impact of Murasu, with authorities saying southern districts were likely to receive heavy rainfall.

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A.P. braces for second cyclone within a week

Cyclone Murasu comes at a time when Andhra Pradesh is just beginning to recover from the impact of Cyclone Arnab which killed five people and submerged crops in more than 3.5 lakh hectares of land. It also damaged about 2,425 km of roads and brought down some 15,000 electric poles. The Andhra Pradesh government puts its losses at ₹4,600 crore, and officials now have little time to prepare for the next storm.

As many as 1,688 medical teams and 116 relief camps have been prepared in Andhra Pradesh districts likely to be affected by the latest cyclone, the Chief Minister's office said in a post on X.

The Health Department has also made available 13,165 emergency beds, essential medicines, and 43,672 anti-snake venom injections.

The Chief Minister on Sunday instructed authorities to mobilise adequate manpower and equipment in advance to ensure prompt restoration of essential services. He also directed officials to issue updates on the cyclone situation every four hours and asked telecom service providers to take precautionary measures to maintain uninterrupted mobile connectivity during the storm.

While it was the northern part of Andhra Pradesh that bore the brunt last week, this time, the central and southern coastal parts of the State are likely to be affected, according to the Andhra Pradesh State Disaster Management Authority (APSDMA). Officials identified 20 mandals that could experience extremely heavy rainfall, including nine mandals in Eluru district, five each in Krishna and NTR districts, and one in Bapatla district.

The IMD has put five districts in the State – SPSR Nellore, Prakasam, Guntur, Bapatla, and Krishna – on red alert for November 2. A warning has been issued to coastal districts between West Godavari and SPSR Nellore, as 100-110 kmph winds, gusting to 120 kmph, may prevail from Monday evening. When Cyclone Arnab crossed the coast near Narsapur in West Godavari district on October 28, winds gusted up to 150 kmph.

In Tamil Nadu, for the 24-hour period from 8.30 a.m. on Monday, heavy to very heavy rain is likely at isolated places over Chennai and Tiruvallur districts. The rain could be accompanied by thunderstorms and lightning, with gusty wind speeds reaching 40-50 kmph at some places.

In Odisha, the State government has identified 150 landslide-prone locations in Gajapati district alone ahead of Cyclonic Storm Murasu.

The Tamil word "Murasu" is one India's submissions to the rotating list of names for cyclones in the region and means war drums.

(With inputs from Deepa Ramakrishnan in Chennai and Satyasundar Barik in Bhubaneswar)

GS I – Geography | GS III – Disaster Management

Key Pointers

- What conditions are required for the formation of a tropical cyclone?
- Why is the Bay of Bengal more prone to cyclones than the Arabian Sea?
- What is the difference between a depression, deep depression and cyclonic storm?
- How does the India Meteorological Department (IMD) classify and track cyclones?
- What are the roles of the State Disaster Management Authority and National Disaster Management Authority during a cyclone?
- How do early warnings, evacuation and relief camps reduce loss of life?
- What measures can improve cyclone preparedness?

Commercial LPG now costlier by ₹10 after third consecutive hike; jet fuel price up ₹1.37 a litre

Saptaparno Ghosh
NEW DELHI

In the run-up to the festive season, oil-marketing companies increased prices of the commercial variant of liquefied petroleum gas (LPG) cylinders by about ₹10 a cylinder on Sunday.

Further, the prices of the 5-kg free-trade LPG (FTL) refill - primarily catering to migrant workers - were raised by nearly ₹2.5 a cylinder. However, the price of the domestic variant remains unchanged.

The price of aviation turbine fuel for domestic carriers was also increased by ₹1.37 a litre to ₹138.5. This was the fourth such hike in jet fuel prices since they were last slashed in July.

Steepest hike in Kolkata

After the latest hike, in Delhi, the 19-kg commercial cylinder now costs ₹2,820 (increase of ₹10) and the 5-kg FTL costs ₹782 a refill. In Mumbai, prices of the 19-kg cylinder were hiked by ₹10.5 to ₹2,775.

Kolkata has seen the steepest revision – the cylinder is costlier by ₹17 and priced at ₹2,971. In Chennai, prices increased by ₹11.5 a cylinder to ₹2,994.5.

Though Sunday's standalone hike is marginal, it is the third consecutive hike since July and August, when prices of the 19-kg cylinder were cumulatively reduced by ₹380 per cylinder. Prices of the commercial variant have cumulatively increased by about ₹85 across three tranches since then.

Prior to the reduction in July and August, prices had cumulatively increased by ₹1,345 for each cylinder across four tranches after March 7.

The hike comes amid a rise in projected under-recoveries for LPG in November and December.

State-owned oil-marketing companies predicted under-recoveries to range between ₹309 and ₹328 per cylinder in November and rise further to as much as ₹370 in December.

Separately, they said the softening of benchmark Saudi CP prices helped minimise the under-recoveries in the September-end quarter.

Domestic LPG accounts for about 87% of the bottled hydrocarbon gas sold in the country with the commercial segment accounting for about 9.3%.

GS III – Indian Economy | Energy Security

Key Pointers

- What is Liquefied Petroleum Gas (LPG), and how is it produced?
- What is the difference between domestic LPG and commercial LPG?
- How are LPG prices influenced by international crude oil and petroleum product prices?
- What is the role of oil marketing companies in the pricing and distribution of LPG?
- How can higher fuel prices affect transport costs, inflation and businesses?
- Why does India depend on imports to meet a large part of its crude oil and LPG requirements?
- How can energy diversification, domestic production and renewable energy improve India's energy security?

Day 1 of entry curbs: 714 vehicles turned back, 38 impounded

Agencies check 7,000 vehicles for emission norms as 3-month ban on non-BS-VI vehicles registered outside city kicks in; snarls at border areas

Shrimansi Kaushik
NEW DELHI

The Delhi government's time-bound measures to curb winter air pollution came into force on Sunday, with non-Delhi-registered vehicles not meeting BS-VI emission norms being denied entry at the borders. The enforcement led to long traffic jams along Delhi-Gurugram routes.

The entry of non-BS-VI vehicles registered outside Delhi has been barred till January 31. Only BS-VI-compliant vehicles with valid PUC certificates, CNG vehicles and e-vehicles will be allowed into the city during this period while trucks will be diverted via expressways.

10 challans issued

Joint Commissioner of Police (Traffic) Sanjay Tyagi said, "From 12 a.m. to 8 p.m., 7,279 vehicles were checked. Of these, 714 non-destined vehicles were turned away. At least 10 were issued challans for non-compliance with restrictions and 38 end-of-life vehicles were impounded."

According to Traffic Police data, of the vehicles checked, 6,285 were checked in north Delhi, including the border areas of Singhu and Auchandi. A total of 445 vehicles at checkpoints along these areas were turned away.



Delhi Police personnel checking a vehicle at the Delhi-U.P. border in Ghazipur on Sunday as anti-pollution measures come into force. PTI

Major restrictions

All major borders saw heavy deployment and checkposts to keep non-compliant vehicles out. Despite it being a Sunday, traffic snarls were reported at multiple entry/exit points as vehicular movement slowed to a crawl.

"I have a BS-IV bike and because of the restrictions, I cannot take rides from Delhi," said Hamad, a gig worker. "I have had to change routes because of that and ply only around the borders, in Noida and Faridabad," he added.

For those entering Delhi through the Sirhaul and Kapashera borders, the restrictions led to traffic jams from 10 a.m.

"Besides commuters, we are also asking non-destined vehicles to use peripheral expressways and outer Delhi roads. A lot of goods-carrying trucks were diverted," said an officer at the Sirhaul checkpoint.

The enforcement drive was carried out by multiple agencies. "We have been told to ensure that no vehicle without proper compliance is allowed to enter the city. Most vehicles are new. Only some have been noted to be older vehicles and they are being asked to go back," said Assistant Sub-Inspector Diwan Singh from the Transport Department, who was deployed at the Delhi-Noida border at Kalindi Kunj.

"We have intercepted nearly 50-60 vehicles since morning and sent those back," said a constable at Kalindi Kunj.

GS III – Environment | Air Pollution

Key Pointers

- What are Bharat Stage (BS) emission standards, and why were they introduced?
- How do older vehicles contribute to air pollution?
- What is the difference between BS-IV and BS-VI emission standards?
- What are the major pollutants released by motor vehicles?
- What is a Pollution Under Control (PUC) certificate, and why is it required?
- How can public transport, electric vehicles and cleaner fuels reduce vehicular pollution?
- What is the role of the Commission for Air Quality Management (CAQM) in controlling pollution in Delhi-NCR?
- How can States coordinate their transport and pollution-control policies to improve air quality?

AMRITA IAS
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Slow recovery

ISRO needs more human and material resources to fulfil its mandate

With the successful launch of the GSLV-F18 mission and the NVS-03 satellite's healthy status, the Indian Space Research Organisation (ISRO) is on course to heave a sigh of relief. Its last 18 months have been constrained by the consequences of two launch failures involving PSLV rockets, which share some of their design aspects with GSLV, to the extent that the F18 mission was only the second successful launch of 2026. If the NVS-03 satellite is successfully manoeuvred into its final intended orbital slot and commissioned, ISRO will also have pulled off a rescue mission for the 'Navigation with Indian Constellation' (NavIC) programme, which has been at least one functional satellite short for the last six months and thus unable to meet its primary purpose of providing standalone positioning services over the Indian subcontinent. The three second-generation NVS satellites thus far are distinguished by having at least one indigenously made atomic clock onboard, in line with the recommendations of the Parliamentary Standing Committee (PSC) on Science and Technology and India's investments in quantum timekeeping, and away from the imported clocks onboard the first-generation IRNSS satellites.

The PSC had also flagged procurement bottlenecks across ISRO's programmes, including difficulties with obtaining specialised components and ensuring vendor readiness on the timelines that NavIC needs. The ISRO Space Applications Centre's 'request for proposals' in 2025 also specified a large lead time of nearly two years between a contract's start and the first two flight models. The Electronics Component Manufacturing Scheme and the programme to modernise the Semiconductor Laboratory can be tweaked to serve these needs, with the Electronics Ministry also setting aside dedicated funds for developing specialised components and their qualification tests in a five- to seven-year programme. In tandem, the government must allocate around ₹17,000 crore in the 2027-28 Union Budget for the Department of Space, against ₹13,705.6 crore in 2026-27, with the hike focusing on manufacturing launch vehicles, replacing satellites, and recruitment. Besides, NavIC also requires a dedicated operator, so that ISRO can be left to focus on its core mandate, and India needs a national space law addressing private participation in this enterprise, and liability. Two successful orbital missions in five-sixths of a year is unbecoming of a national space programme with imminent plans of human spaceflight, a space station, and reusable launch vehicle capabilities. Without significant measures, ISRO will lurch from one mission to the next as and when its inadequate workforce is able to make do with its inadequate allocation.

GS III – Science and Technology | Space Technology

Key Pointers

- What are the main functions of the Indian Space Research Organisation (ISRO)?
- What is the Navigation with Indian Constellation (NavIC) system, and how does it help India?
- How is NavIC different from the Global Positioning System (GPS)?
- What is the role of atomic clocks in satellite navigation?
- Why is indigenous development of space technology important for India?
- What are the major challenges faced by ISRO in developing satellites and launch vehicles?
- Why are specialised components and skilled human resources important for space missions?
- Why does India need a national space law to regulate private companies and commercial space activities?

Even as unemployment falls, lack of 'decent work' in India

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India's unemployment rate fell from 6.1% in 2017-18 to 3.2% in 2023-24. At the same time, female workforce participation increased for the first time in decades as has been widely reported in government documents. In light of these positive developments, it is the right time to ask what kind of jobs have been generated in India recently, and what working conditions accompany them.

This is important because employment alone does not inherently ensure dignity, security, or a stable livelihood. A worker engaged in garment sewing without a formal contract, a gig worker without insurance coverage, or a construction labourer without paid leave may technically be considered employed, but they remain outside the promise of decent work. The International Labour Organization (ILO) defines 'decent work' as employment that offers equitable income, workplace rights, social security and dignity. This principle is integrated into Sustainable Development Goal 8 (SDG-8), which advocates "decent work for all". Measured this way, India's labour market persistently exhibits high levels of informality, insecure employment, and increasing inequalities.

Measuring decent work

Using two rounds of the Periodic Labour Force Survey (PLFS), 2017-18 and 2023-24, the quality of employment in India has been analysed. By constructing a multidimensional Decent Work Index (DWI) based on three subdimensions – employment status, employment opportunity, and social security – across five major industries (agriculture, manufacturing, construction, wholesale and retail, and transport), it was observed that India has made progress in improving work conditions over time. The overall DWI increased from 0.247 in 2017-18 to 0.302 in 2023-24. While this indicates some improvement in job quality, the overall level remains alarmingly low. More importantly, progress has been uneven across sectors, regions, gender and caste groups.

Manufacturing in the secondary sector and transport in the tertiary sector showed the highest improvement in decent work conditions during this period. The manufacturing sector's DWI increased from 0.324 to 0.411 due to a gradual rise in formalisation and digitalisation. The transport sector also experienced significant progress (from 0.285 to 0.35), largely due to the expansion of urban logistics and app-based platform work. However, these improvements also reveal an important concern. Even in sectors where employment conditions have improved, access to social security remains limited. A large number of workers still do not have written contracts, paid leave, provident fund benefits or insurance coverage. Though employment opportunities are increasing, labour protections and job security are not improving at the same pace. Agriculture, which continues to employ the largest share of India's workforce, remains the lowest-quality employment generating sector. The agricultural sector's DWI marginally increased from 0.211 to 0.267 during the study period; most agricultural workers continue to be self-employed or unpaid family workers without stable income or labour protections. The issue is not merely low productivity; rather it is the rise of informal jobs. Construction and retail sectors tell a similar story. Workers remain dependent on casual employment, subcontracting chains and insecure labour arrangements. Welfare schemes exist on paper but implementation gaps continue to exclude millions of workers.

> Poor-quality employment generation has consequences for economic growth. Workers without social security spend less, save less and remain vulnerable to economic shocks

Nearly 90% of India's workforce remains informally employed, a share that has risen since 2019, according to the India Employment Report 2024 (ILO-IHD). It has expanded into supply chains, app-based work in the gig and platform economy, logistics, home-based production, and in even organised industries through contractualisation and outsourcing.

The challenge becomes even more serious when viewed in the context of social inequality. The analysis by the authors shows that decent work outcomes improve significantly with education, formal enterprise employment and skill training. However, informalisation of jobs reduces decent work creation in India over time. Especially concerning is the growing intersection of caste and gender disadvantage: women from Scheduled Tribes and Other Backward Classes experienced a decline in decent-work outcomes between 2017-18 and 2023-24, even as outcomes for men improved. The labour market penalty for being both female and socially marginalised has intensified after the COVID-19 pandemic. This shows that inequality in India's labour market is not just economic, it is also structurally rooted in caste and gender hierarchies.

Regional disparities further expose the uneven nature of labour market progress. States such as Goa, Keralam, Tamil Nadu, and Haryana perform substantially better in terms of decent-work creation; in contrast, Bihar, Jharkhand, and Uttar Pradesh continue to lag behind.

The findings point to a serious policy concern: while India has been able to create more jobs, it is still struggling to ensure that these jobs provide decent working conditions and security.

Poor-quality employment generation has consequences for economic growth. Workers without social security spend less, save less and remain vulnerable to economic shocks. Moreover, informality depresses productivity, weakens tax capacity, and increases inequality. India cannot measure labour market success only through reduction in unemployment rates and income growth. A country aspiring to become Viksit Bharat by 2047 cannot rely indefinitely on insecure, low-paid and unprotected labour. Economic growth without decent work can create a workforce that may have jobs, but still lives with insecurity, instability and a lack of protection. India has to shift from a 'job-counting approach' to a 'job-quality approach'.

The way forward

The findings point toward where policy should focus. First, social protection must extend to all workers – gig and platform workers, self-employed, farmers, and informal workers – through systems that are portable and accessible regardless of employment status. Platforms such as e-Shram are a good start, but registering alone does not guarantee protection; workers need real protection, not just a database entry.

Second, formalisation policies should focus on labour conditions, not just business registration. Enterprises receiving tax incentives or subsidies should be linked to mandatory worker protections such as written contracts, paid leave, and social security contributions.

Third, labour policies need to be more intersectional. Given that women from marginalised caste groups are the group whose outcomes worsened rather than improved, targeted measures – childcare facilities, safe transportation, skill training and safeguards against workplace discrimination – should not be an afterthought. Finally, labour reforms should be designed around the needs of workers first, rather than being framed primarily as a means of easing the cost of doing business.

The four Labour Codes were introduced in 2025 with the promise of simplifying labour regulation and expanding protections. However, implementation remains partial and inconsistent. Critics argue that while compliance has been eased for businesses, worker protections may have diminished with rising contractualisation.

The real test of development is not whether workers have some kind of work; it is whether that work provides dignity and security. Until then, India's employment success story will remain incomplete – no nation can call itself developed while its workforce remains insecure.

GS III – Indian Economy | Employment

Key Pointers

- What is the difference between employment, unemployment and underemployment?
- What is decent work, and why is it important for workers?
- What are the four main elements of decent work under the International Labour Organization (ILO)?
- What is the Periodic Labour Force Survey (PLFS), and how does it measure employment?
- What is informal employment, and why do many Indian workers lack social security?
- How do gender and caste inequalities affect access to decent employment?
- What is the role of the e-Shram portal in registering unorganised workers?

An energy revolution in the making



Pralhad Joshi

is Union Minister for New and Renewable Energy, Government of India & President of ISA Assembly

More than 21 lakh of the 65 lakh homes with PM Surya Ghar rooftop solar have received a zero electricity bill. Life for young Indians, once marked by monthly bills and regular power cuts, has seen a sea change. Now, they ask how an inverter works, what a battery costs, and whether AI can run decentralised solar. Such questions are creating engineers, entrepreneurs, skilled technicians, and informed citizens. India is raising its first generation of power producers and innovators, and I believe they will shape our energy economy for Viksit Bharat by 2047.

This rests on a decade of initiatives led by Hon'ble Prime Minister Shri Narendra Modi. In the last 12 years, India has achieved both speed and scale, with installed solar capacity up by around 6007%, from 2.8 GW in 2014 to 171 GW today. Solar power that cost around ₹8 a unit in 2014-15 now sells for as low as ₹2.15, thanks to an ecosystem, including PM-KUSUM scheme, built on the vision to achieve 500 GW of installed power capacity from non-fossil fuel sources by 2030. India stands as the only G20 country to have met its 2030 target of 50% non-fossil capacity five years early. This first chapter has proved that solar works for Indian households.

Now, the second will take agri-photovoltaics to farmers under PM-KUSUM 2.0, pair storage with solar, prioritise State-level green corridors, deepen rooftop solar penetration, and digitise our networks for more renewables. Our 500 GW commitment needs $220 billion investment – $150 billion domestic and $70 billion as FDI. Capital, manufacturing, storage, and people will decide how well we do it, along with Global South partners.

Solar power that cost close to ₹10 a unit in 2014 now sells for as low as ₹2.15, thanks to an ecosystem built on the vision to achieve 500 GW of installed power capacity from non-fossil fuel sources by 2030

Capital comes first. The first milestone of one lakh PM Surya Ghar solar installations took months; now, we achieve the number every six days. Under PM-KUSUM, our 'annadata' has become our 'urjadata' too, with over 30 lakh standalone solar pumps installed. The private sector will lead the build-out, with our States as partners, by building parks such as Khavda, the world's largest hybrid renewable energy park. Next, rooftops and pumps must become a bankable asset class with a clear pipeline for Indian and foreign pension funds and institutional investors.

Manufacturing is next. The PLI scheme brought high-efficiency module-making home. The capacity of solar module now exceeds 225 GW and around 45 GW of cells. Investment must now go into cells, wafers, and polysilicon. The National Green Hydrogen Mission is building an electrolyser industry for 5 million tonnes a year by 2030.

Storage comes third. The Central Electricity Authority sees a need for 236 GWh of batteries by 2031-32, and the Cabinet-approved third phase of the Green Energy Corridor will support 50 GWh with ₹50,000 crore and new transmission.

The last but most important is people. Rooftop solar creates significantly more jobs than ground-mounted projects. It requires local teams for surveying, designing, installing, connecting and servicing the systems – taking green jobs beyond major cities to places closer home for lakhs of youth. It also employs a high share of women. Our 500 GW target and the Green Hydrogen Mission could also support lakhs of full-time-equivalent jobs by 2030.

Under India's 2023 G20 Presidency, the African Union joined the G20 permanently, and leaders agreed to work towards tripling renewables capacity by 2030. This September, as BRICS Chair, we saw the New Delhi Declaration adopted unanimously, backing a BRICS Solar PV Cooperation Roadmap and principles for smart grids and storage.

The International Solar Alliance, launched by India and France in Paris in 2015, turns that agenda into delivery. The first 1,000 GW of global solar power took 25 years; the next came in two. With 130 signatory and member countries, ISA is helping build skills through a Global Capability Centre, an AI-driven ISA Academy, and centres of excellence in 17 countries, with capital from the $200-million Africa Solar Facility, managed with Africa50.

The Bharat Renewable Energy Summit & Expo 2026 at Bharat Mandapam on November 2-5, to be inaugurated by the Hon'ble Prime Minister, will host, for the first time, the Ninth ISA Assembly and the Fourth International Conference on Green Hydrogen together. With the participating countries and institutions, we will discuss what solar can do for them and how they can achieve reliable power, energy security without imported fuel, and food security through solar irrigation, all in the spirit of Vasudhaiva Kutumbakam.

GS III – Infrastructure | Climate Change

Key Pointers

- What is renewable energy, and how is it different from conventional energy sources?
- What is the objective of the PM Surya Ghar: Muft Bijli Yojana?
- How does PM-KUSUM help farmers adopt solar energy?
- What are agrivoltaics, and how can solar panels be used along with farming?
- Why are battery storage and smart grids important for renewable energy?
- What is the objective of the National Green Hydrogen Mission?
- How do Production Linked Incentive (PLI) schemes support domestic solar manufacturing?
- What are the objectives of the International Solar Alliance, and how does it promote global solar energy cooperation?

AMRITA IAS
An Amrita Group Institution

Navy to launch ₹80,000-cr. warship project

Saurabh Trivedi
NEW DELHI

The government has given a major push to the Indian Navy's next-generation destroyer programme amid the growing maritime security challenges posed by China and Pakistan, both of which are strengthening their own underwater warfare capabilities.

The Defence Acquisition Council (DAC), chaired by Defence Minister Rajnath Singh, had recently accorded in-principle approval to futuristic warships under Project 18A.

The delivery of the warships is expected to begin five to 10 years after the contract is signed, given the complexity and scale of the programme.

A senior Defence Ministry official confirmed the development. The proposed programme, estimated to cost around ₹80,000 crore, aims to develop a new generation of stealth-guided missile destroyers equipped with advanced weapons, sensors, and technologies, the official said.

The warships are expected to have nearly 75% indigenous content, with both defence public sector undertakings (DPSUs) and private sector companies eligible to participate in the competitive bidding process, the official added.

The programme assumes significance as China continues to expand its naval presence in the Indian Ocean Region and enhance its submarine fleet, while Pakistan is also strengthening its underwater warfare capabilities with the induction of advanced submarines.

The evolving security environment has underscored the need for India to strengthen its surface combat fleet and maintain a credible maritime deterrence across the Indian Ocean Region.



The next-generation destroyers are expected to substantially enhance multi-domain combat capabilities. REUTERS

Futuristic capabilities

Several existing destroyers of the Indian Navy are due for decommissioning in coming years, making the induction of advanced frontline surface combatants essential to maintaining the fleet's operational strength, the official added.

The futuristic destroyers, to be designed by the Navy's Warship Design Bureau, are expected to feature significantly more advanced systems than the Visakhapatnam-class destroyers.

These warships are likely to have enhanced firepower, sophisticated surveillance sensors, improved air defence systems, and advanced anti-submarine warfare capabilities, providing the Navy with greater operational flexibility against emerging maritime threats.

The Indian Navy currently operates around 12 or 13 relatively new guided-missile destroyers, which form the backbone of its surface combat fleet and provide capabilities across air defence, anti-surface warfare, and anti-submarine operations.

These include the Visakhapatnam-class, Kolkata-class, and Delhi-class destroyers.

The existing warships are equipped with an array of advanced weapon systems, including BrahMos supersonic cruise missiles, surface-to-air missiles, naval guns, close-in weapon systems, and anti-submarine warfare equipment.

The next-generation destroyers are expected to substantially enhance India's firepower, surveillance, and multi-domain combat capabilities.

GS III – Internal Security | Defence and Technology

Key Pointers

- What is a destroyer, and what role does it play in naval warfare?
- What are the main roles of the Indian Navy in protecting India's maritime interests?
- What is the importance of the Indian Ocean Region for India's security and trade?
- What is multi-domain warfare, and how do modern warships support it?
- What technologies are used in modern destroyers for air defence, anti-submarine warfare and surveillance?
- What is stealth technology, and how does it help naval ships?
- Why is indigenous defence production important for India's defence preparedness?
- What is the role of the Defence Acquisition Council in approving major defence projects?

AMRITA IAS

Why even a strong El Niño does not guarantee a poor Indian monsoon

Seven Indian monsoons since 1950 have run into a moderate or strong El Niño; of these, in five years, including 2026, monsoon rainfall levels were at least 10% lower than the long-term average; the IMD refers to this level as 'deficient'; the 2023 season was something of an exception with 'below average' rainfall; however, 1997 had 'average' rainfall

Ankit Mishra

In the summer of 1997, one of the strongest El Niños of the 20th century took shape in the Pacific Ocean. The India Meteorological Department (IMD) predicted a monsoon rainfall deficit of 8% below the average, as was expected in El Niño years. However, by the end of September that year, rainfall levels were nearly normal.

This year, a "ferocious" El Niño is taking shape, and is expected to peak only in December. The 2026 southwest monsoon ended nearly 13% below the long-term average of 87 cm. East and Northeast India had their driest season since records began in 1901.

So what happened differently in 1997?

El Niño and the monsoon

Near the Earth's equator, steady winds blow across the Pacific Ocean from east to west. These winds drive warm surface water into Indonesia. The water then warms the air over it, and the warm air rises, creating rain clouds.

These winds diminish every 2-7 years. The warm water flows back east to South America, with the rain clouds trailing behind. Scientists call this phenomenon the El Niño Southern Oscillation.

This upsurge of warmer air from the Pacific eventually has to descend somewhere – and one portion sinks over India. As the air subsides, it becomes warmer and drier, and rain clouds struggle to form in it, which can weaken monsoon rains.

Records maintained by the U.S. National Oceanic and Atmospheric Administration show that seven Indian monsoons since 1950 have run into a moderate or strong El Niño. Of these, in five years, including 2026, monsoon rainfall levels were at least 10% lower than the long-term average. The IMD refers to this level as "deficient". The 2023 season was something of an exception with 'below average' rainfall.

Nonetheless, only 1997 had average rainfall.

During the monsoons, the 1997 and the 2015 El Niño were about equally strong. Sea surface temperatures in the equatorial Pacific were 1.64 degree Celsius above normal in 1997 and 1.59 degree Celsius in 2015, according to NOAA's Oceanic Niño Index. This year the figure was 1.98 degree Celsius.

Nevertheless, India received normal rainfall in 1997 but around 13% less than the normal in 2015. This is partly because of another ocean.

Indian Ocean Dipole

Like the Southern Oscillation, there is a see-saw in the Indian Ocean as well called the Indian Ocean Dipole (IOD). One end of the IOD is in the west, near Africa, and the other is in the east, near Indonesia. In specific years, the western extremity becomes warmer than usual and the eastern extremity cooler. This is known as the positive phase and is beneficial to India. The air over the warmer western waters rises more strongly, draws moist winds, and the monsoon carries more of that moisture over India. In most years, there is no tendency towards either end and the IOD is said to be neutral.

The IOD tends to tip around June and is most pronounced September-to-November, which means its impact tends to be later in the monsoon. And it tends to go into the positive phase when an El Niño occurs.

The see-saw shifted in India's favour in 1997 and offset the El Niño. In 2015, however, it barely moved. One 2024 study by researchers from India and the U.S., including IIT-Delhi, IIT-Kharagpur, NIT-Rourkela found why: a change in the belt of winds that encircles Antarctica sent westerly winds across the southern Indian Ocean, which kept the see-saw from tipping.

The IOD was again favourable in 2023. According to IMD, India received 36% less rain than normal in August 2023, the driest August since 1901.

The Department partly blamed the Madden-Julian Oscillation, a wave of clouds and rain that passes around the tropics every 30 to 60 days, which resided over Africa and the Americas during the month. The see-saw tipped in India's favour in late August and early September and extended itself into the seas off Indonesia, where it favours rains over the subcontinent.

Where an El Niño's warmest water sits also affects India's rain, according to a 2006 study in *Science*. If that water is in the middle of the Pacific Ocean, the sinking air is more likely to settle on India, which increases the odds of less rain. In 1997, the warmest waters were located further east around South America.

A study published this July in *Nature Communications* suggested that the see-saw is not the only explanation for 1997.

It also indicated other factors that occurred in July and August, notably an unusual high-pressure system high above the Iranian plateau in West Asia and additional moisture coming in from the Arabian Sea. The study also said that 1983 and 1997 were two years that made El Niño's influence on the monsoon appear less powerful than it was in reality.

Farmers and food prices

Seasons like 1997 are easier to explain in hindsight than in advance. Since 1997, IMD has changed its approach, and now updates its April forecast at the end of May. Also, since 2021, it has combined the forecasts of several global climate models into one. In both 2023 and 2026, both El Niño years, the season's rainfall levels fell within the error margin of IMD's forecast. In 2023 it forecast 96% of the long-term average, give or take 5 points, and the season ended at 94.7%. For 2026 it forecast 92%, give or take 5 points, and the season ended at 87.4%.

That said, this year was not spared complications or surprises. The IMD predicted the monsoon to be 'below normal' in April but it turned out to be 'deficient'. Only one of its four regional forecasts, for the south peninsula, came true.

Forecasters also disagreed about the IOD's see-saw. In April, IMD said "the latest climate models" showed the IOD turning positive towards the end of the monsoon season, and in early September the WMO still expected a positive IOD between September and November. The IMD's own model predicted the IOD would remain neutral from late May. Its records show it was neutral throughout the season.

The monsoon brings about three-quarters of India's yearly rain. About 40% of the country's farmland has no irrigation and depends on it, per the agriculture ministry's latest figures. Farmers plan their sowing around the forecast and officials use it to manage food stocks and water releases from dams. The onset of a weak monsoon thus reduces farmers' incomes and leads to higher food prices. IMD's May forecast also warned of "pressure on drinking water resources" nationwide.

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Scorched Earth: A farmer staring at a patch ofi dry agricultural land in Shivamogga, Karnataka. S.K. DINESH

THE GIST

The Indian Ocean Dipole helped off set El Niño's impact in 1997, but had little eff ect in 2015, with one 2024 study linking this to wind changes around Antarctica that prevented the dipole from strengthening

IMD has improved its monsoon forecasting since 1997 by updating its April forecast in late May and, since 2021, using a combination of multiple global climate models

Despite El Niño conditions in 2023 and 2026, seasonal rainfall remained within the forecast error margin, highlighting gains in forecast accuracy

GS I – Geography, GS III – Environment | Climate Change

Key Pointers

- What is El Niño, and how does it develop in the Pacific Ocean?
- How does El Niño affect sea surface temperatures and wind patterns in the Pacific?
- Why does El Niño often weaken the Southwest Monsoon in India?
- Why does a strong El Niño not always lead to a poor Indian monsoon?
- What is the Indian Ocean Dipole (IOD), and how can it influence monsoon rainfall?
- What is the Madden-Julian Oscillation (MJO), and how does it affect rainfall in India?
- How can changes in global wind patterns and ocean temperatures influence the Indian monsoon?
- How can better weather forecasts help farmers prepare for rainfall shortages and protect food production?

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