EDITORIAL HIGHLIGHTS

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DRDO showcases critical defence technologies in three flight tests

Saurabh Trivedi
NEW DELHI

The Defence Research and Development Organisation (DRDO) has successfully demonstrated a range of critical defence technologies through three consecutive flight tests conducted on Wednesday and Thursday, significantly enhancing India's capabilities against diverse aerial and maritime threats.

Defence milestone

According to the Ministry of Defence, the tests showcased a multi-layered Ballistic Missile Defence (BMD) system and the maiden flight test of the Naval Anti-Ship Missile-Medium Range (NASM-MR), marking a major milestone in India's indigenous defence technology development.

It further mentioned that the multi-layered BMD capability was successfully demonstrated with interceptor missiles engaging and destroying their designated targets.

The tests showcased a multi-layered ballistic missile defence system and the anti-ship missile. SPECIAL ARRANGEMENT

The Defence Minister congratulated the DRDO and associated teams on the successful tests

The systems, developed using advanced technologies, are designed to counter emerging missile threats across a broad spectrum.

Anti-ship missile

The successful trials have placed India among a select group of countries possessing BMD capabilities capable of engaging threats up to Intercontinental Ballistic Missiles, significantly strengthening the country's strategic defence shield.

In another key achievement, DRDO successfully carried out the maiden flight test of the Naval Anti-Ship Missile-Medium Range (NASM-MR), demonstrating enhanced anti-ship strike capability at medium ranges.

The flight tests were witnessed by senior officials of DRDO and the Armed Forces.

Rajnath lauds DRDO

Defence Minister Rajnath Singh congratulated DRDO and associated teams for the successful demonstration of the crucial technologies, stating that the achievements would further strengthen India's defence preparedness.

Secretary, Department of Defence R&D and Chairman DRDO, Rajesh Kumar Singh, closely monitored the trials and lauded the combined efforts of DRDO scientists, industry partners and the Armed Forces in achieving the milestone.

Sanskriti IAS

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Why are there protests in PoK?

Why was the Joint Awami Action Committee formed in 2023 and what are their demands? What are the economic concerns in the region? Why is the demand for the abolishment of reservation for 12 refugee seats in the PoK Assembly at the heart of the protests? How has India reacted?

Joan Sony Cherian

The story so far:

Pakistan-occupied Kashmir (PoK) is again in the throes of civilian unrest as protests for economic justice and equitable political representation rage across the region. The Joint Awami Action Committee (JAAC), which called for the protests, has since been banned by the regional government, for "engaging in terrorism".

What is the JAAC and why did it call for protests?

The JAAC, an umbrella organisation of various civil society groups, trade bodies, students organisations and socio-religious groups based in PoK, was formed in 2023, out of protests against rising electricity tariffs and inflation. They brought out a 38-point Charter of Demands which included access to subsidised wheat flour, fair electricity pricing based on hydropower generation costs from the local Mangla dam, and the abolishment of the reservation of 12 seats for refugees in PoK's Legislative Assembly.

While the JAAC was given assurances regarding electricity tariffs, their "non-fulfillment" led to wider protests. In May 2024, the JAAC called for a march to Muzaffarabad over their demands, which led to the police arresting around 70 members of the organisation. Outrage against the arrests resulted in clashes between civilians and the police, leaving at least four dead and hundreds injured. In the wake of this violence, Pakistan Prime Minister Shehbaz Sharif approved the grant of a $86.25 million subsidy programme.

In October 2025, protests again emerged due to a breakdown of talks between officials and the JAAC. The ensuing violence killed at least 10 people. The government then agreed to some demands which included providing compensation for those killed in the violence, releasing funds for the implementation of health cards, and issuing a grant of PKR 10 billion for the improvement of the electricity system.

While it was also decided that a high-powered committee comprising legal and constitutional experts would deliberate on the issue of members of the PoK Assembly, the central question remained unaddressed.

The 12 reserved seats are for communities who migrated to Pakistan from Jammu and Kashmir during Partition. Over the years, these groups have integrated into Pakistani cities and polity

File photo of protesters of JAAC and activists at a funeral in Muzaffarabad, the capital of PoK, on May 14, 2024. AFP

How did the situation escalate?

Elections to the regional government of PoK have been scheduled for July 27. The JAAC announced that they would take out a protest march to Muzaffarabad, calling for an end to the reservation of the 12 refugee seats, on June 9 – the same day on which the filing of nominations for the elections was to begin.

In an effort to nip the march in the bud, the regional authorities banned the JAAC under a 2014 anti-terrorism law and placed a bounty for its most prominent leaders. They said the organisation had acted in a manner "prejudicial to peace and security" of the state. This led to widespread protests in various cities, particularly Mirpur, Rawalakot and Muzaffarabad, with police personnel clashing with civilian protesters.

On June 8, at least 11 people, including four police officers, were killed and dozens injured when regional authorities opened fire on activists and protesters gathered in Rawalakot for the funeral of a local trade activist who had been killed during an earlier protest.

While the proscribed JAAC has called for strikes, leaving life paralysed in the streets of Muzaffarabad, many parts of the region continue to witness violent clashes, with reports indicating that the death toll has crossed 30.

Regional authorities have deployed paramilitary troops in the region to restore law and order and have also issued a strict travel advisory urging visitors to avoid travelling to the region. Reports also say that Internet in the region has been severely restricted.

Why has the reservation of refugees become a flashpoint?

The political question regarding the 12 reserved refugee seats is at the heart of the protests. The regional Assembly of the PoK has a total of 53 seats. Of these, 45 seats are directly elected by the public (33 are elected by the general public while 12 seats are reserved for refugees). The remaining eight seats are reserved (five for women, one for a technocrat, one for a religious scholar and one is a diaspora seat) and are filled via nominations after the general elections.

The 12 reserved seats are for communities who migrated to Pakistan from Jammu and Kashmir during Partition. Over the years, these groups have integrated into Pakistani cities and polity. In fact, most of these 12 seats have often been won by political parties such as the Pakistan Peoples Party or the Pakistan Tehreek-e-Insaf. As the journalist Luv Puri writes, "...the 12 refugee seats account for around 4.36 lakh registered voters, while the remaining 33 directly elected seats in PoK have around 33 lakh voters. In effect, one refugee vote cast from Pakistan carries electoral weight far greater than that of a voter residing in PoK".

Pakistan maintains that PoK, or what it calls 'Azad Jammu and Kashmir', is an independent region with its own polity and that Pakistan supports its right to self-determination. At the same time, candidates who are elected to the regional Parliament have to sign loyalty oaths supporting the "cause of accession of the State of Jammu and Kashmir to Pakistan". This has led to questions regarding the undue influence of Islamabad in the regional politics of PoK.

In a further setback to such regional demands, on June 7, the Supreme Court of PoK observed that the 12 legislative seats reserved for refugees are constitutionally protected and cannot be abolished through administrative or executive measures; only a constitutional amendment can fulfil the demand to abolish refugee representation.

How have the Indian and Pakistani governments reacted?

On June 9, India asked the international community to hold Pakistan responsible for the civilian killings and human rights abuses in PoK. "There are reports of severe police brutality in Pakistan Occupied Kashmir in which several protesters have been killed and many injured. We hope the international community will hold Pakistan accountable for its misdeeds and abuses," said Ministry of External Affairs spokesperson Randhir Jaiswal during a press briefing. National Conference president Farooq Abdullah condemned the violence and demanded a probe by the United Nations into the incidents of atrocities.

Pakistan Foreign Office spokesperson Tahir Andrabi dismissed India's statements "in their entirety" and went on to state that "it is untenable" for a country like India which has "consistently denied the people of Jammu and Kashmir their right to self-determination to claim concerns over the rights of Kashmiris."

The unrest has also generated global outrage. Human rights groups such as Amnesty International stated that the regional administration's sweeping crackdown on protests is a continuation of the "alarming deterioration of human rights in the region".

On June 6, a group of nearly 30 British parliamentarians, in a letter to the U.K. Foreign Office, raised concerns over reports of communication disruptions, arrests, and "escalating tensions" in the PoK. They urged the British government to engage proactively and use diplomatic channels to encourage a peaceful de-escalation in the region.

Sanskriti IAS

GS 3: ECONOMY
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Why is the Zojila tunnel a game changer?

Why is the tunnel an engineering marvel and what were the challenges in building it? How does it improve connectivity and ensure travellers' safety? How does it provide strategic access in the border region? When will it open for civilian traffic?

Peerzada Ashiq

The story so far:

The world's longest high-altitude tunnel, spanning 13.14 kilometres at an altitude of 11,578 feet, achieved a breakthrough on June 9, 2026. Built at a cost of ₹6,800 crore, the Zojila tunnel will provide all-weather connectivity between the Kashmir Valley and Ladakh, traversing a region that was long considered to be formidable in the Himalayas. Union Minister for Road Transport and Highways Nitin Gadkari, who pressed the blast button for the 2.5 metre-long last leg, termed the breakthrough "a historic day for India's infrastructure development and a milestone in India's technical expertise, engineering prowess, and indomitable resolve".

The Zojila tunnel is expected to provide year-long transportation access to the Indian forces stationed in Ladakh

What makes the Zojila tunnel an engineering marvel?

Zojila tunnel is India's first longest single-tube bi-directional tunnel and an engineering marvel for several reasons. The underground works were highly challenging due to the difficult terrain. The western Himalayan range around the Zojila Pass has been daunting for engineers and planners, with the fragile geology, sensitive rock formations, avalanche-prone terrain, and harsh winter conditions all complicating the execution of the project.

(R-L): J&K LG Manoj Sinha with Union Minister Nitin Gadkari and Chief Minister Omar Abdullah at the breakthrough ceremony of Zojila tunnel, in Ladakh. PTI

The Zojila tunnel connects Sonamarg's Baltal in central Kashmir's Ganderbal district with Meenamarg in Ladakh's Drass district. To ensure safe passage up to the mouth of the Zojila tunnel at Baltal, additional roadways, three bridges, and two tunnels were constructed over a stretch of 31 km in Sonamarg. These were designed to withstand the vagaries of winter, as avalanches and snow slides are often reported in the area.

It is a combined system of tunnels and roadways that forms a comprehensive corridor between the Union Territories of Jammu and Kashmir and Ladakh. The tunnel is equipped with catch dams, protection walls, and deflector dams over a 6-km stretch for protection from snowstorms. It will have automatic and emergency lighting, emergency phone, message signalling, and radio to ensure travellers' safety.

Why is this a memorable project for engineers?

The tunnel was dug in extreme weather conditions, with temperatures dropping to minus 20 degrees Celsius on the Kashmir side and minus 30 degrees Celsius on the Drass side. Official estimates suggested that extreme weather conditions were prevalent for nearly 100 days a year. Then, there were avalanche risks: five major avalanches left two workers dead and over 172 workers stranded and later rescued. Snow accumulation was dealt with by a fleet of small and large snow blowers. Officials said the rock classification also changed 67 times across the 13-km stretch, "shifting constantly between good and poor formations."

Why is the tunnel significant for strategic connectivity?

India has witnessed repeated military confrontations with China and Pakistan since 1947, particularly in the regions of Ladakh and Kashmir, most notably in 1962 and 1999. India's full-scale military response was always hampered by lack of connectivity and poor mobility of men and material in the region, both along the Line of Control in the west and the Line of Actual Control in the east. Officials believe that restricted movement of military vehicles led to delays. The Zojila tunnel is now expected to provide year-long transportation access to the Indian forces stationed in Ladakh, significantly improving mobility, logistics reliability, and strategic access in the border region. This is why Mr. Gadkari described it as "a game changer from a security perspective and the perspective of national integration".

What does it means for locals?

Ladakh has always been cut off from the Kashmir Valley during winters. Heavy snow and landslides would often close the Zojila Pass for 4-6 months. There have also been frequent reports of commuter deaths on the Zojila Pass due to landslides triggered by rains and avalanches occurring during sunny winters. All this resulted in severe hardships for patients and students in the Kargil-Drass range. Stocks would deplete, but the problem could not be attended to because of road closure. Locals relied on sun-dried vegetables and cereals during winters. Now, the is expected to be movement of people and goods and no more weather-related isolation for the region. Additionally, the tunnel will put a spotlight on activities such as adventure tourism and skiing in Drass, which will contribute to the economy.

When will the tunnel open for civilians?

In spite of the breakthrough, the tunnel is likely to take two years to be fully functional. Water seepage, benching, and electronic layouts are still being worked out. However, officials said the tunnel could be thrown open in case of emergencies, especially to security forces.

The tunnel will also help pilgrims on the Amarnath Yatra, whose base camp is in Baltal. Officials said vehicles can travel at a speed of 80 km per hour through the tunnel. Earlier, drivers could not drive more than 30-40 km per hour on the Zojila Pass, because of steep roads and hair-pin curves.

Officials said the project is moving closer to its long-envisioned goal of seamless all-weather connectivity that will spur long-term benefits in terms of mobility, economic integration, and strategic resilience.

GS 2& 3: HEALTH AND SCIENCE AND TECHNOLOGY

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Virulent bacterium

Shigella

Kerala has seen a new outbreak of shigellosis, caused by this gram-negative, contagious bacterium, which infects millions globally every year

Ramya Kannan

GETTY IMAGES

Stained, and viewed under a microscope, Shigella is a captivating sight. The rod-shaped bacteria resemble fat, furry cartoon caterpillars. In reality, however, this gram-negative, contagious bacterium, which causes shigellosis, can be remarkably dangerous. Shigella is back in the news, after an outbreak in Kerala that was first detected in late March 2026 and has continued into June. According to the Kerala health department, 132 confirmed cases and about 75 probable cases of shigellosis had been reported till June 12. Three deaths have been linked to the disease this year, two of which were children under five.

Shigellosis is a diarrhoeal disease marked by fever, abdominal cramps, and bloody diarrhoea (dysentery). It was bacteriologist Kiyoshi Shiga, who isolated the shigella dysenteriae, in 1897, after Japan experienced a severe dysentery epidemic. The genus eventually took his name.

Transmission is mostly through the faeco-oral route, when people ingest tiny amounts of faecal matter through contaminated food, water or hands. As low as 10-100 bacteria can cause the infection, and even an outbreak. It is estimated that globally, shigella causes 80-165 million infections annually and about 6,00,000 deaths, particularly among children under five in sub-Saharan Africa and South Asia.

In an article in the *Indian Journal of Medical Research*, Neelam Taneja and Abhishek Mewara write about th
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aquatic bodies (rivers, surface waters as well as coastal waters), free living amoebae, insects, birds and wild animals."

Taneja and Mewara explain that several aquatic bodies in India have been found to show the presence of shigella. So a potential source of infection could be fish if it is harvested from sewage-contaminated water. Even ingesting small amounts of contaminated water while swimming or bathing, or the consumption of crops cultivated in soil/water contaminated by shigella can cause severe infection. The paper argues that while no individual can be considered immune to shigellosis, "certain individuals are at increased risk. Globally, the incidence of shigellosis is highest among children under five. The incidence of shigello-

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reported a shigellosis outbreak in Kuttikkattoor, Kozhikode, where a three-year-old girl died and over 60 residents (mostly children) fell ill. Soon, clusters came up in Wayanad, Malappuram and Kannur. A major cluster emerged at a Wayanad school where over 300 children were hospitalised. So far, experts have traced the infections to contaminated water and food sources, alongside poor hygiene practices in communal environments such as schools.

This is not Kerala's first brush with shigellosis. In 2009, over 300 people reportedly contracted a food-borne shigella infection across the State. In December 2020, an outbreak, again in Kozhikode, killed an 11-year-old and infected 40 others; in May 2022, shigella was said to be behind a mass food poisoning incident, in Kasargod, where 30 people were hospitalised and a 16-year old girl died. While mild shigella infections typically clear on their own with hydration, severe cases require antibiotics to shorten the duration of the illness, reduce the severity and prevent complications, according to the U.S. Centers for Disease Control. However, some antibiotics are not effective against certain types of shigella. Healthcare providers must order laboratory tests to determine which antibiotics are likely to work.

Taneja and Mewara point out in their article that "there is a nationwide presence of multi-drug resistant shigella developing rapid resistance to most antibiotics available. Thus, judicious use of antibiotics is among the most essential measures to combat shigellosis." This calls for a continuous and strong surveillance of antibiotic resistance across the country for periodic updates of the local antibiograms, in order to allow doctors to effectively identify the right antimicrobial drug to use.

GS 3: ENVIRONMENT THE HINDU PAGE: 10

Meet the frogs that build 'cloudy' nests in South Africa's trees

D.P. Kasbekar

For most frogs, life begins as a game of odds. They lay their eggs in the water, where fish and insects gobble up about 98% of them before they even have a chance to hatch. The African grey foam-nest tree frog (*Chiromantis xerampelina*) figured a way out: it took its nest into the air.

In the rainy season between October and February, a female frog finds a branch overhanging a pool and begins secreting a special fluid. As the male and the female mate, the pair uses their hind legs like whisks to churn the secretions into a thick, bubbly froth. The result is a foamy nest.

A few days later, the eggs hatch inside this nest. When the tadpoles are ready, they simply break through the bottom of the foam and drop into the pool below, beginning the next stage of their lives.

While a single pair of frogs can build a nest, these frogs prefer a 'foam party' approach. Researchers from three Australian universities recently studied these frogs in South Africa and found that when it comes to nesting, there is real strength in numbers.

The findings were published in the journal *Evolution* on June 2.

Sometimes, a single female is joined by a dozen or more males. This results in a better home rather than chaos.

More males meant more legs churning, leading to nests up to three times larger than those built by a single pair.

While smaller nests dry out quickly, killing the eggs inside, larger nests hold onto moisture for longer, ensuring more tadpoles survive from the nest.

You might wonder: why would a male frog help build a nest if he is competing with 12 other frogs? Using DNA testing, the researchers found that in these crowded nests, paternity is often split. By cooperating to build a large, moist fortress, the males ensure at least some of their offspring survive, rather than losing all of them to a dried-out nest.

The scientists also suspected that the males' skin and fluids contain surfactants – compounds similar to laundry detergent – that keep the bubbles from popping.

The African grey foam-nest tree frog reminds us that survival is not always about being the strongest or the fastest. Sometimes, it is about having the best teammates, the best chemistry, and the most impressive bubble-making skills in the forest.

(D.P. Kasbekar is a retired scientist)

How ants cope with disease outbreaks

SPEAKING OF SCIENCE

D. Balasubramanian

Ants are associated with a range of very positive qualities – including a self-motivated work ethic, preparedness and long-term thinking, and a preference for collective effort. Many ant species are also social, and living in social groups offers many advantages. However, there are downsides too.

Among humans, the occurrence of seasonal outbreaks of infections such as influenza and other diseases is the result of the nature of the social structures humans live in. That is how we have learnt the basic rules of limiting these outbreaks' effects. If you notice a general build-up of symptoms, you take leave from your workplace and isolate yourself for a few days.

Altering one's social contact networks reduces the spread of pathogens. This process requires collective discipline – just the kind of qualities that ants are famous for.

So how do ants living in their colonies cope with pathogens? In some ant species, individuals spread antimicrobial secretions from the metapleural gland on themselves, on larvae, and on their fellow nest dwellers. This gives rise to a 'social immunity': every individual in the colony has some protection against infections.

Other, more dramatic measures have been observed. Researchers at the University of Lausanne in Switzerland introduced a worker black ant whose leg had been experimentally injured back among its companions. It was seen that the fellow ants quickly amputated this leg by repeated bites at the joint linking the leg to the body (*Current Biology*, 34, 2024). A wounded limb would have attracted disease-causing microbes and endangered other ants in the colony.

Black garden ants tend to mealybugs. KATJA SCHULZ (CC BY)

A more recent study looked at how ant colonies respond to an epidemic (*Science*, 390, 266, 2025). The ant studied was the black garden ant, which is related to the Indian black ants that we see in and around our homes. The black garden ants build complex underground nests that have one main entrance, a central portion housing the queen, eggs, and larvae, and several satellite chambers used by other ants in the colony and to store food and collect waste. Tunnels connect various parts of the nest. There is a clear division of labour, with some worker ants acting as nurse caretakers and others acting as foragers.

In the experiments, a single queen, with around 200 worker ants, began to build a nest. All ants have miniature QR codes stuck on them and video cameras follow their movements. The scientists monitored the nest structures using micro-CT scans. One day later, 20 worker ants that had been exposed to a pathogenic fungus were introduced to the colony.

Over the next few days, the infected ants exited the nest more often and spent more time outside than their nestmates. This was self-isolating behavior. The architecture of the nest had also adapted: the entrances were spaced further apart than normal. The pace of work became frantic and focused on digging longer tunnels. There were also fewer connections between chambers.

Together, these changes led to more segregation and restricted interactions between the segregated groups. High-value ants like the queen and the nurses had significantly lower exposure to the forager ants and remained healthy.

Sounds familiar? Humans maintain quarantines, wear masks when interacting with others, and wash their hands often when faced with an epidemic in our communities. Ants seem to have evolved their own, very effective social distancing measures.

(The article was written in collaboration with Sushil Chandani, who works in molecular modelling)

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GS 3: SCIENCE AND TECHNOLOGY THE HINDU PAGE: 10

Droughts can drive antibiotic resistance in soil bacteria

Research has revealed that drought-induced soil stress concentrates natural antibiotics, accelerating evolution of resistant bacteria; this phenomenon threatens to worsen global antibiotic resistance by 2050, particularly in drought-prone regions

Sharmila Vaidyanathan

Droughts can increase the levels of antibiotic resistance in soil, researchers from the California Institute of Technology have reported. Their study also projected that by 2050, several parts of India and other drought-prone countries will grapple with severe antibiotic resistance (ABR).

The study, in *Nature Microbiology*, revealed that when soil dries due to drought stress, the concentration of natural antibiotics increases, favouring the survival of resistant bacteria. Soil has been an important source of antibiotics.

"The current study spotlights a broader ecological perspective where climate-driven environmental changes might also influence resistance," the study's authors, postdoctoral research scholar Xiaoyu Shan and the Gordon M. Binder/Amgen professor of biology and geobiology Dianne Newman, wrote in an email.

By analysing soil DNA datasets from the U.S., China, and Europe and across cropland, wetland, grassland, and a forest site, the team found that drought increased the prevalence of genes that both produce antibiotics and help organisms resist them. The team also replicated the findings using synthetic soil samples inoculated with soil bacteria and treated with a known antibiotic. When the soil was dried, antibiotic-resistant bacteria better survived the adverse conditions.

"Previous studies have documented antibiotic resistance genes in wastewater, rivers, and soils, but these patterns have largely been interpreted as consequences of anthropogenic contamination, such as antibiotic overuse in medicine and agriculture," the two co-authors wrote. "Our work asked a fundamentally different question: could environmental stress, independent of direct antibiotic pollution, actively shape the evolution and enrichment of resistance?"

The links between climate change and ABR are becoming more prominent. In one recent study, scientists found that subjecting experimental grassland plots to warming conditions over 11 years rendered ABR genes 24% more abundant. Droughts are also becoming more severe due to climate change.

The study's authors examined hospital data in 116 countries and found that drier regions reported more infections due to antibiotic resistance. Research has already shown ABR resistance can move from the environment to humans through horizontal gene transfer, where genetic elements carrying antibiotic resistance are transferred to human pathogens, and bacterial transmission via aerosols, polluted soil and water, and agriculture.

"India is vulnerable because it simultaneously faces several challenges relating to increased frequency of droughts, heavy antibiotic use in humans and livestock, wastewater irrigation, dense human-animal-soil interactions, and heavy agricultural dependence," G. Ravikanth, senior fellow and convenor, Ashoka Trust for Research in Ecology and the Environment, Bengaluru, said.

"India's drought-prone regions overlap substantially with the rural districts where access to formal healthcare is weakest," Erta Kalanxhi, fellow and director of partnerships at One Health Trust, a global health research organisation, said. "In this context, climate change may intensify the selection pressure on [antibiotic resistance] in the populations least equipped to manage the clinical consequences."

Dr. Ravikanth emphasised the need for long-term monitoring stations in arid regions to track microbial community shifts, drought intensity, and antibiotic resistance. He added that existing Krishi Vigyan Kendrascould be mobilised for data on antibiotic residues in agricultural soils, poultry and dairy farms, and to understand the spread of resistant microbes.

In a recent One Health Trust policy brief, in collaboration with Christian Medical College, Vellore, the authors underscored the role of vaccines. "Apart from concentrating natural antibiotics in soil and intensifying resistance, droughts also create the conditions under which enteric pathogens such as *Salmonella typhi* thrive," Dr. Kalanxhi said. "Scaling up vaccination suppresses the disease burden that drought amplifies and reduces the empirical antibiotic demand that drives resistance selection in clinics."

The authors Drs. Shan and Newman also said the study encourages a deeper exploration of how these natural products shape the environments in which they reside – including understanding if antibiotics in soil have other functions or control the development of microbial communities near the roots of plants. They emphasised that integrated approaches that combine microbiome sampling and sequencing of soil, airborne dust, and the human body, epidemiological monitoring of exposed human populations, and longitudinal drought and climate records can help provide actionable insights.

(Sharmila Vaidyanathan is an independent writer from Bengaluru)

Under pressure

When soil dries, the concentration of natural antibiotics increases, favouring the survival of resistant bacteria

Per a 2024 report, 91 districts in India are in the 'very high' drought risk category while 188 districts face 'high' drought risk. AFP

- New research has found that drought conditions increase natural antibiotic levels in soil, fuelling antibiotic resistance
- Researchers project that several countries, especially India, will face severe antibiotic resistance challenges by the year 2050
- Environmental stress from droughts independently shapes the evolution and enrichment of resistant bacteria within various soil ecosystems
- Antibiotic resistance can move from the environment to humans through horizontal gene transfer and contaminated agricultural products
- India faces heightened risks due to frequent droughts, dense populations, and heavy antibiotic use in livestock industries
- Experts recommend using vaccines and integrated monitoring systems to reduce the disease burden amplified by climate change