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The Monsoon Is No Longer Safe: Maharashtra's Rising Compound Drought- Heatwave Risk

DOWN TO EARTH

9 August 2026 ·

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The Monsoon Is No Longer Safe: Maharashtra's Rising Compound Drought-Heatwave Risk

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GS1

GS3



INTERVIEW ANGLE

"India's entire drought classification and relief system is built on rainfall deficit. If a new climatology shows temperature alone can now trigger and deepen drought even when rainfall is adequate, does continuing to define drought by rainfall shortfall amount to measuring the wrong variable for an increasing share of actual events?"

Source: [Original editorial](#)

Down to Earth

✔ Every fact web-verified against primary sources

THE LIFT LINE

A monsoon that arrives on schedule and still leaves a district in drought is not a contradiction in the data. It is the data telling you to stop measuring only rainfall.

WHY THIS EDITORIAL MATTERS FOR YOUR EXAM

This is explicitly a **Sunday feature**, the kind of standalone research-based piece the Ujiyari Research Specialist Protocol flags for **deliberate** search, because aggregators routinely miss Sunday science coverage. It gives you a state-specific case study for GS Paper 1 climatology and GS Paper 3 disaster management, and a genuinely testable conceptual move: that a compound hazard can now be **temperature-triggered** rather than only **rainfall-triggered**, which most students' drought answers do not distinguish.

The transferable skill is separating **frequency** from **duration** when a hazard's data trend is described as "worsening", the study explicitly finds the second is stable while the first is rising sharply, a distinction examiners reward because it resists a lazy, undifferentiated reading of "climate change is making things worse."

GS Paper 1: Important geophysical phenomena; geographical features and their location; changes in critical geographical features and the effects of such changes.

GS Paper 3: Disaster and disaster management; conservation, environmental pollution and degradation.

CONCEPT	MEANING	WHY IT IS TESTABLE
Compound Drought-Heatwave (CDHW) event	The co-occurrence of drought and heatwave conditions, with combined impact exceeding either alone	The core hazard category this study measures
Temperature-triggered drought	Drought caused or amplified by elevated temperature alone, independent of rainfall deficit	The study's central, classification-challenging finding
Joint return period	The average interval between recurrences of two co-occurring extreme events	A statistical measure of how often a compound hazard repeats; under 8 months in Maharashtra's hotspots
Episodic hit	A short-duration, high-intensity extreme event, as distinct from a prolonged event	Distinguishes the study's frequency finding from a duration-based "longer droughts" narrative
Arabian Sea warming	Rising sea surface temperatures in the Arabian Sea, amplifying coastal heat and moisture	The physical mechanism proposed to explain the western Maharashtra hotspot pattern
Manual for Drought Management	India's national framework (Ministry of Agriculture and Farmers Welfare) for classifying and responding to drought, centred on rainfall deficit indicators	The policy framework this study's findings put pressure on

BACKGROUND AND CONTEXT

The trigger is a study published in the **International Journal of Climatology**, led by **Vikas Poonia**, Assistant Professor and Head of the Hydro-climatology Lab at the **Maulana Azad National Institute of Technology (MANIT), Bhopal**, reported by Down To Earth on **9 August 2026**.

PARAMETER	FINDING
Study period	1960 to 2025
Inflection point	1990
Pre-1990 pattern	Western districts: fewer than 15 CDHW events; eastern districts (Gadchiroli, Chandrapur, Bhandara) showed higher frequencies
Post-1990 pattern	Gondia and Yavatmal: more than 25 events; monsoon-season Raigad and Thane: more than 35 events
Seasonal shift	CDHW events, previously concentrated pre-monsoon, are now increasingly occurring during the monsoon itself
Newly affected during monsoon	Nanded, Hingoli, Parbhani, Gondia now record more than 9 monsoon-season CDHW events each
Identified hotspots	Nashik, Yavatmal, Amravati, Jalgaon (joint return period under 8 months); Thane, Raigad, Sindhudurg (coastal, “westward amplification of severity” post-1990)
Joint return period, primary hotspots	Under 8 months (Nashik, Yavatmal, Amravati, Jalgaon)
Duration trend	Relatively stable, i.e. events are more frequent, not individually longer
Proposed mechanism	Arabian Sea warming amplifying coastal heat and moisture patterns

The study’s district list spans both Maharashtra’s western coastal belt (Thane, Raigad, Sindhudurg) and its eastern and northern interior (Nashik, Yavatmal, Amravati, Jalgaon), indicating the risk is not confined to a single agro-climatic zone.

THE ANALYSIS

1. The headline finding inverts a long-standing assumption. Drought, in both public understanding and India’s official framework, is conventionally a rainfall-deficit phenomenon confirmed or worsened by subsequent heat. This study reports the reverse causal pathway is now also operating: temperature alone, without a rainfall shortfall, can trigger and amplify drought stress. That is a mechanism shift, not merely an intensity shift.

2. The 1990 threshold points to a structural break, not gradual drift. A near-doubling of event counts in some districts, from under 15 to over 25, concentrated after a specific year, is more consistent with a structural climatic shift, plausibly linked to broader Indian Ocean and Arabian Sea warming trends that intensified from the 1990s onward, than with simple statistical noise across a long record.

3. The monsoon-season shift has the most direct policy bite. India's entire relief, insurance and water-management calendar assumes the monsoon period is the season of recharge, not risk. Districts like Nanded, Hingoli and Parbhani newly recording significant monsoon-season CDHW events means administrative systems calibrated to treat June-to-September as a season of respite may be misreading real-time conditions on the ground.

4. Frequency, not duration, is the correct lens. The study's finding that average event duration has stayed relatively stable while frequency has risen sharply is a genuinely nuanced result. It implies that resilience planning built around withstanding one long drought per season is the wrong model; the emerging risk is repeated short, sharp shocks, which stresses crop-water scheduling, reservoir operation rules and heat-health advisories differently than a single prolonged event would.

5. The Arabian Sea mechanism explains the coastal-hotspot pattern specifically. Thane, Raigad and Sindhudurg sit directly along Maharashtra's western coast, adjacent to the Arabian Sea, which supports the study's proposed physical link between sea surface warming and amplified coastal heat and moisture extremes. The presence of inland hotspots such as Yavatmal and Amravati indicates additional or compounding factors beyond the coastal mechanism are also at work, a gap the study itself leaves for further research.

6. The counter-argument on data quality deserves a direct answer. Long climatological reconstructions spanning 65 years face genuine station-density and instrumentation caveats, particularly comparing pre- and post-1990 decades. That caveat argues for independent replication before a national classification change, not for dismissing a peer-reviewed, mechanism-based finding published in an established international journal.

DATA AND INSTITUTIONS VAULT

PRELIMS-GRADE FACTS:

Study published in the International Journal of Climatology; lead researcher Vikas Poonia, Assistant Professor and Head, Hydro-climatology Lab, Maulana Azad National Institute of Technology (MANIT), Bhopal

Study period: 1960 to 2025; inflection year: 1990

Pre-1990: western Maharashtra districts recorded fewer than 15 compound drought-heatwave (CDHW) events

Post-1990: Gondia and Yavatmal exceeded 25 events; monsoon-season Raigad and Thane exceeded 35 events

Newly significant monsoon-season CDHW districts: Nanded, Hingoli, Parbhani, Gondia (over 9 events each)

Primary hotspot districts with joint return periods under 8 months: Nashik, Yavatmal, Amravati, Jalgaon; the western coastal districts Thane, Raigad and Sindhudurg show a related but distinct pattern, “westward amplification of severity” post-1990, rather than the same sub-8-month return period statistic

Average event duration found relatively stable; the change is in frequency, not length, of events

Proposed physical mechanism: Arabian Sea warming, amplifying coastal heat and moisture patterns

India’s national drought policy instrument: Manual for Drought Management, Ministry of Agriculture and Farmers Welfare, centred on rainfall-deficit indicators

Maharashtra’s major river basins relevant to drought risk include the Godavari and Krishna basins in the state’s interior, and the west-flowing coastal rivers of the Konkan region (Thane, Raigad, Sindhudurg)

WATCH THE TRAP: “LONGER DROUGHTS” AND “MORE FREQUENT DROUGHTS” ARE DIFFERENT CLAIMS; THIS STUDY EXPLICITLY FINDS DURATION STABLE AND FREQUENCY RISING, SO AN ANSWER THAT SAYS MAHARASHTRA NOW FACES “PROLONGED DROUGHTS” MISSTATES THE FINDING. ALSO DISTINGUISH RAINFALL-DEFICIT DROUGHT (THE CONVENTIONAL DEFINITION) FROM TEMPERATURE-TRIGGERED DROUGHT (THIS STUDY’S SPECIFIC CONTRIBUTION) RATHER THAN TREATING “DROUGHT” AS A SINGLE UNDIFFERENTIATED CATEGORY.

THE DEBATE

Argument FOR revising India’s drought classification framework now. The study is peer-reviewed, mechanism-based (Arabian Sea warming), and covers a 65-year record with a clearly identified structural break at 1990. A framework that only responds to rainfall deficit will systematically miss temperature-

triggered episodes precisely when they occur during the monsoon, when relief systems are least alert to drought risk. Waiting for further confirmation risks repeated administrative blind spots in the identified hotspot districts.

Argument FOR caution before a policy change. A single-institution study, however rigorous, benefits from independent replication, particularly given known station-density and measurement-consistency improvements after 1990 that could inflate the apparent rise in event counts. India's drought manual already incorporates some non-rainfall indicators, including vegetation and soil moisture indices, so recalibrating existing thresholds may be a more proportionate first response than introducing an entirely new classification category.

Balanced verdict. The mechanism is scientifically plausible and the frequency-versus-duration distinction is a genuine analytical advance, but the leap from a state-level study to a national classification revision is a large one. The proportionate near-term step is targeted, hotspot-district monitoring and independent replication, with a framework revision to follow once the finding is corroborated across additional states and datasets.

HOW TO THINK ABOUT THIS

The transferable pattern: **when a hazard's definition assumes a single cause, ask whether a second, independent cause has emerged that the definition was never built to detect.**

Drought was defined around rainfall because, for most of the twentieth century, rainfall deficit was the dominant, near-exclusive cause. A definition built for a single dominant cause will systematically under-detect events driven by an emerging second cause, here, temperature acting independently of rainfall, until the definition itself is revised.

Run the test in three steps.

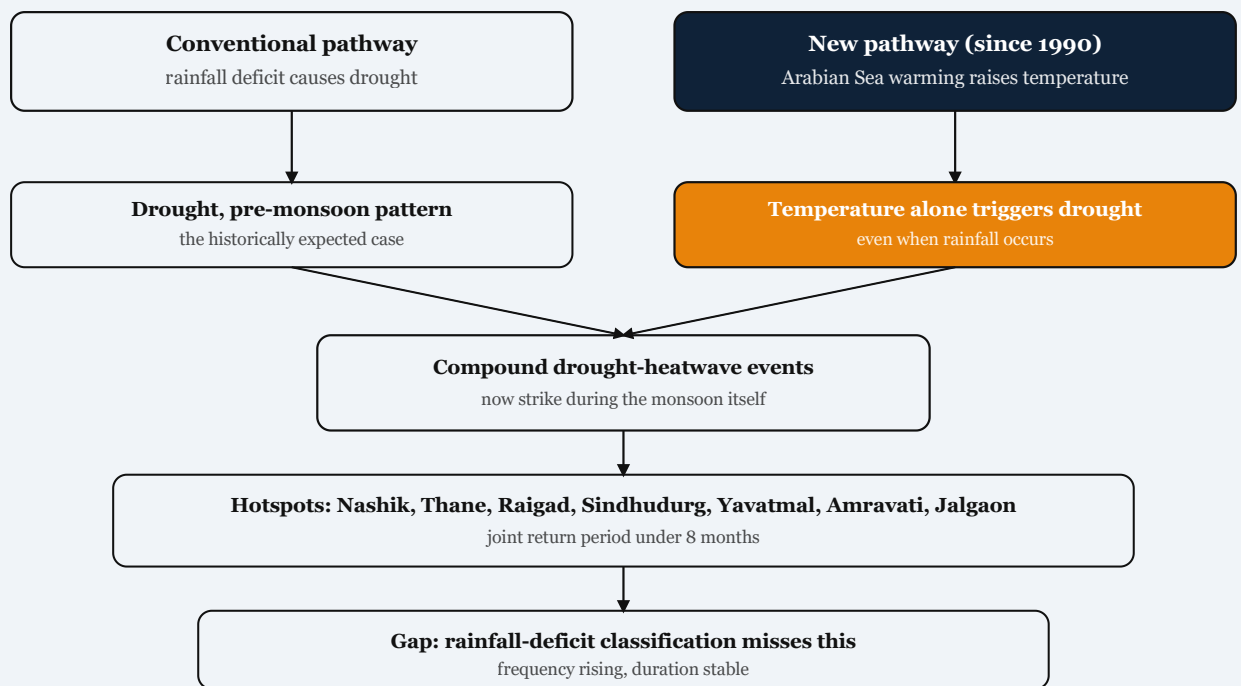
What was the hazard's original defining variable, and why? For drought, it is cumulative seasonal rainfall deficit, because that was historically the dominant driver.

Has a study identified a second, mechanistically distinct pathway to the same hazard? Here, Arabian Sea warming triggering drought stress independent of rainfall.

Does the existing monitoring and response system have the resolution to detect the new pathway? A system built for seasonal cumulative deficits will miss short, frequent, temperature-driven episodic hits, exactly the gap this study identifies.

The same reasoning applies to any hazard whose classification was built around one historically dominant cause: flood risk defined around river discharge alone, missing urban flash-flooding driven by impervious surface runoff, or heatwave thresholds defined around daytime maximum temperature alone, missing the health burden of elevated night-time minimums.

DIAGRAM-IN-WORDS



A second, temperature-driven pathway to drought has opened alongside the conventional rainfall-deficit pathway, converging on compound events that now strike Maharashtra's hotspot districts during the monsoon, a pattern the state's rainfall-centred classification system was not built to catch.

TAKEAWAY BOX

A drought classification built to catch missing rain will miss a drought caused by rising heat, which is exactly the gap this study finds opening across monsoon-season Maharashtra.

*Study in **International Journal of Climatology**, led by **Vikas Poonia**, **MANIT Bhopal**; period **1960-2025**; inflection year **1990**; post-1990 **Gondia, Yavatmal** over **25 events**; monsoon **Raigad, Thane** over **35 events**; primary hotspots **Nashik, Yavatmal, Amravati, Jalgaon** with joint return period under **8 months**; coastal districts **Thane, Raigad, Sindhudurg** show “westward amplification of severity” post-1990; mechanism: **Arabian Sea warming**; duration **stable**, frequency **rising**; India’s drought framework: **Manual for Drought Management**, Ministry of Agriculture and Farmers Welfare.*

a state government’s relief architecture is calibrated to a definition of drought that a peer-reviewed study now says misses an emerging category of risk. Once credible new evidence exists, how long can an administration reasonably wait for further replication before its inaction itself becomes a policy failure?

UPSC has tested drought classification, disaster management frameworks, and the effects of changes in critical geographical features. This editorial supplies a state-specific, mechanism-based case study, Arabian Sea warming as a driver of monsoon-season drought, that most general disaster-management answers do not reach.

“India’s drought classification framework, centred on rainfall deficit, may be structurally unable to detect an emerging category of temperature-triggered drought.” Examine with reference to recent findings from Maharashtra.

Sources: *Down To Earth, International Journal of Climatology, Maulana Azad National Institute of Technology, Bhopal*

Source: The Monsoon Is No Longer Safe: Maharashtra's Rising Compound Drought-Heatwave Risk — Ujiyari.com
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● KEY ARGUMENTS AT A GLANCE

A climatology study of Maharashtra published in the International Journal of Climatology finds that compound drought-heatwave (CDHW) events have intensified sharply since 1990 and are increasingly occurring during the monsoon season rather than being confined to the pre-monsoon summer, because rising temperatures alone can now trigger and amplify drought conditions even when rainfall occurs, a shift that undermines India's rainfall-deficit-centred approach to defining and responding to drought.



SUPPORTING

- The 1990 inflection is stark in the district-level data: western Maharashtra districts recorded fewer than 15 CDHW events before 1990, while post-1990 districts such as Gondia and Yavatmal have exceeded 25 events, and during the monsoon season specifically, frequencies in Raigad and Thane have jumped to more than 35 events, a scale of increase that cannot be explained by normal year-to-year variability alone.
- The mechanism identified is Arabian Sea warming, which amplifies coastal heat and moisture patterns along Maharashtra's western seaboard, enabling elevated temperature by itself, independent of rainfall shortfall, to trigger and intensify compound drought conditions, a departure from the conventional understanding of drought as a purely precipitation-driven phenomenon.
- The finding on duration versus frequency sharpens the policy implication: the study reports that average event duration has remained relatively stable, meaning Maharashtra is not facing longer droughts in the traditional sense but a rising barrage of frequent, high-intensity, short-duration "episodic hits," which is a different disaster-management problem requiring faster-cycle monitoring rather than longer-horizon relief planning.
- The identified hotspots, Nashik, Thane, Raigad, Sindhudurg, Yavatmal, Amravati and Jalgaon, cut across both western coastal and eastern inland Maharashtra, with joint return periods under eight months in the worst-affected districts, indicating that no single agro-climatic zone of the state can now be treated as insulated from compound risk.



COUNTER

A 65-year district-level reconstruction (1960-2025) is subject to the general caveats of long-run climatology: station density and measurement consistency have improved markedly since 1990, so part of the recorded rise in event counts may reflect better detection rather than only

a genuine increase in underlying frequency, and single-institution findings, however methodologically sound, benefit from independent replication before triggering a change in a national classification framework built over decades. The state's existing drought manual, moreover, already incorporates some non-rainfall indicators, so the study's core claim may call for recalibration of thresholds rather than a wholesale reworking of the classification logic.

→ **WAY FORWARD**

Incorporate temperature-triggered and temperature-amplified drought as a recognised category within India's drought classification framework, alongside the existing rainfall-deficit criteria, so relief and monitoring do not wait for a rainfall shortfall that may never arrive even as agronomic and hydrological stress builds; invest in district-level, sub-seasonal monitoring capable of detecting short, high-intensity episodic hits rather than only cumulative seasonal deficits; prioritise the identified hotspot districts, Nashik, Thane, Raigad, Sindhudurg, Yavatmal, Amravati and Jalgaon, for early-warning infrastructure and heat-resilient agricultural advisories during the monsoon itself, not only in the pre-monsoon season; and commission independent replication of the Arabian Sea warming mechanism to strengthen the evidentiary basis before national policy is revised.


MAINS ANSWER FRAMEWORK
QUESTION

A recent climatology study finds that compound drought-heatwave events in Maharashtra are increasingly occurring during, rather than only before, the monsoon season. Discuss the implications of this shift for India's drought classification framework and disaster preparedness architecture. (250 words)

INTRODUCTION

India's drought classification, embedded in the Manual for Drought Management, has historically centred on rainfall deficit as the primary trigger. A new climatology study of Maharashtra, published in the International Journal of Climatology by researchers at the Maulana Azad National Institute of Technology, Bhopal, challenges that premise directly, finding that compound drought-heatwave events have intensified sharply since 1990 and are now increasingly occurring during the monsoon season itself, not only in the pre-monsoon summer when such events were conventionally expected.

BODY

The study reconstructs district-level data from 1960 to 2025 and identifies 1990 as a clear watershed. Before that year, western Maharashtra districts recorded fewer than 15 compound drought-heatwave (CDHW) events, while eastern districts such as Gadchiroli, Chandrapur and Bhandara showed comparatively higher frequencies.

After 1990, the pattern inverts and intensifies: districts including Gondia and Yavatmal now exceed 25 events, and during the monsoon season alone, Raigad and Thane have recorded more than 35 events. The mechanism the study identifies is Arabian Sea warming, which amplifies coastal heat and moisture dynamics along Maharashtra's western seaboard, allowing elevated temperature alone, independent of any rainfall shortfall, to trigger and deepen drought stress.

This is a significant departure from the conventional model of drought as fundamentally a precipitation phenomenon. A second finding refines the policy problem further: average event duration has stayed relatively stable, so the change is not that Maharashtra faces longer droughts but that it faces a higher frequency of short, intense, episodic hits, seven identified hotspot districts, Nashik, Thane, Raigad, Sindhudurg, Yavatmal, Amravati and Jalgaon, showing joint return periods under eight months.

India's existing drought management framework, built around cumulative seasonal rainfall deficit, is not well suited to detecting or responding to this kind of short-cycle, temperature-triggered stress, particularly when it occurs within a nominally normal monsoon.

CONCLUSION

The corrective is not to discard the rainfall-deficit criterion but to supplement it with a recognised temperature-triggered drought category and sub-seasonal, district-level monitoring capable of catching episodic hits that a cumulative seasonal average would miss. Prioritising the identified hotspot districts for early-warning infrastructure, while commissioning independent replication of the Arabian Sea warming mechanism, would let Maharashtra, and by extension other states with similar coastal-inland climate

gradients, adapt its disaster-management architecture to a hazard that current classification was not designed to see.

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