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About E-magazine

"Earth Root" is an open access e-magazine in the discipline of Environmental sciences published by Earth Root Foundation. The aim of the e-magazine is to provide information and upgradation of knowledge about environmental issues on wider scale and to share ideas and resources to the readers. Using essential knowledge people can lead a healthy life, which is more sustainable and can connect with ongoing efforts for stopping catastrophically the climate change. E-magazine caters to all related environmental aspects ranging from big issues like climate change, renewable energy and pollutants in the atmosphere to the health of human and living beings on Earth. We also take topics of water resources and efforts and measurement to provide optimum use of it; including large scale atmospheric circulation linked with oceans and ecology.

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WHEN NORTHERN INDIA'S SMOG TRAVELS SOUTH: HOW AEROSOLS WORSEN CHENNAI'S AIR

-Dr. Vivek Panwar,
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A hidden journey in the sky

Every winter, a strange and invisible journey takes place in India's skies. Massive swirls of air currents lift microscopic particles soot, dust, sulfates, and smoke from the fields and cities of northern India and sweep them thousands of kilometers away. Where do they go? Scientists from IIT Madras and SRM Institute of Science and Technology have now shown that a surprising destination is the southeastern coast of India, including Chennai, one of the country's busiest megacities.

The study reveals that these long-distance travelers called aerosols play a crucial role in degrading air quality over Chennai. Their arrival reduces the atmosphere's capacity to disperse pollutants, traps fine particulate matter close to the ground, and leaves millions exposed to unhealthy air. What was once thought to be a "local" pollution problem turns out to have deep roots in India's interconnected atmospheric systems.

What exactly are aerosols?

In simple terms, aerosols are tiny particles or droplets suspended in the air. Some come from natural sources like sea spray or dust storms. But in India, a huge fraction originates from human activities, burning coal and biomass, vehicle emissions, stubble burning in Punjab and Haryana, and urban-industrial growth in the Indo-Gangetic Plain (IGP).

During winter, the IGP becomes a hotspot of pollution, with heavy smog often blanketing cities like Delhi and Lucknow. Until recently, the assumption was that such pollution stayed relatively local. However, winds and circulation patterns can pick up these aerosols and carry them hundreds to thousands of kilometers away a process called regional transport.

The IIT Madras–SRM discovery

The research team, led by Dr. Chandan Sarangi (IIT Madras), Dr. Saleem Ali (Amal College, Kerala), and Dr. Sanjay Mehta (SRM Institute, Chennai), combined satellite data, ground-based weather instruments, and advanced modeling to trace these invisible movements.

They found that during the winter months (December–March), anticyclonic circulation a clockwise swirl of winds over India acts like a conveyor belt. It pulls polluted air from the north,

funnels it into the Bay of Bengal, and then curves it back toward the southeastern coastline. The result is a steady stream of haze that can linger over Chennai for 2–4 days at a time, sometimes even longer.

What happens when this haze arrives in Chennai?

The study paints a striking picture of what these aerosol transport episodes (RTEs) do to Chennai's air and climate:

- Aerosol layers form at 1–3 km altitude: These "invisible blankets" absorb sunlight and heat the air above, while simultaneously cooling the surface below.
- Boundary layer shrinks: Mixing height drops from ~2–2.5 km on clear days to <1 km during RTEs, trapping pollutants.
- ·PM2.5 levels spike by 50–60%: With the mixing suppressed, fine particulate matter accumulates near the surface. Residents breathe air that is significantly dirtier than on haze-free days.
- Persistent episodes last up to a week: Some winters, these hazy conditions cover 10–15% of the season, and the trend has been rising over the last decade.

Why does this matter?

Chennai often thinks of its air pollution as a local issue caused by traffic congestion, industrial clusters, or construction dust. But this study shows that the city's air is also at the mercy of distant fires and emissions from the north.

This raises several important concerns:

- Public health: Fine particulate matter (PM2.5) is linked to asthma, cardiovascular diseases, and premature deaths. If regional transport increases PM2.5 levels by more than 50%, millions face elevated risks.
- Climate effects: Aerosols alter radiation balance cooling the surface and warming the lower atmosphere. This can disrupt weather patterns and even influence rainfall.
- Policy blind spots: Air quality management in India has often been city-centric. But if pollution in Chennai partly originates in Punjab's stubble fires or Uttar Pradesh's factories, local measures alone will not suffice.

Chennai's vulnerability

Being a coastal megacity, it already experiences complex meteorology. Sea breezes interact with land heating, creating fluctuations in how air circulates vertically. When an external blanket of aerosols arrives, it amplifies this instability, making dispersion even harder.

Moreover, the city's population of more than 11 million is already grappling with urban expansion, heat stress, and flooding risks. Poor air quality adds yet another burden, particularly on children, the elderly, and those with pre-existing respiratory problems.

A national and regional problem

This study suggests that pollution is a national issue, and actions taken by one state can affect citizens living thousands of kilometers away. For example, farm fires in Punjab can worsen air quality in Chennai, while industrial clusters in the Indo-Gangetic Plain may indirectly impact the respiratory health of people in Tamil Nadu. This highlights the need for coordinated interstate action, going beyond city-level efforts like the NCAP.

The road ahead

The IIT Madras–SRM study is only a starting point. More observations, advanced models, and ground networks are needed to understand aerosol transport. Still, the findings highlight urgent actions:

- Interstate cooperation – Pollution crosses borders, so states must work together.
- Early warning systems – Predicting transport episodes can help cities like Chennai issue health advisories.
- Source reduction – Lasting improvement requires cutting emissions in the Indo-Gangetic Plain through cleaner fuels, stricter norms, and alternatives to crop burning.

A warning from the skies

The study shows that Chennai's air quality and public health depend on choices made far away. Northern India's haze worsens southern India's air, reminding us that pollution is shared, and so must be the solutions.

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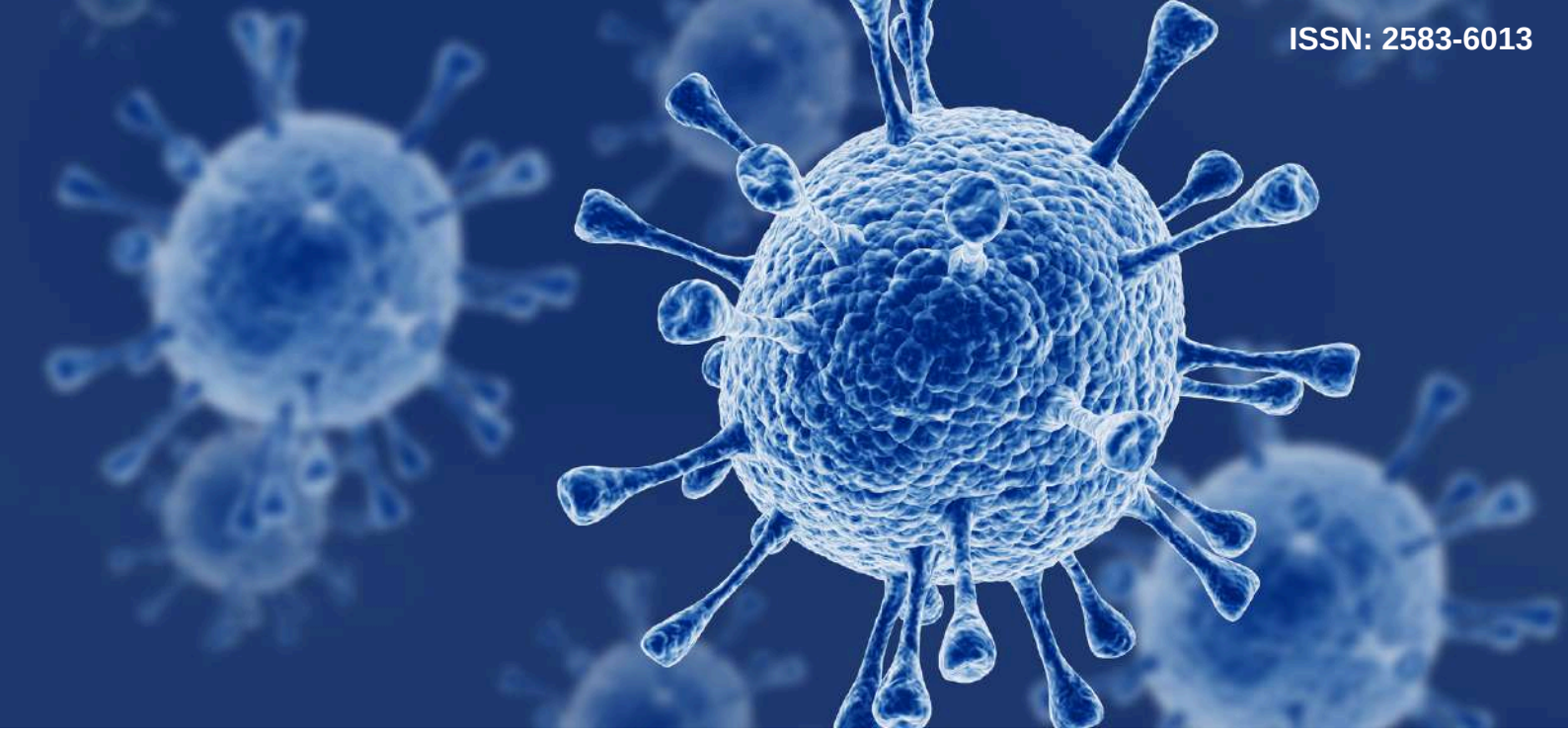

WHEN WEATHER SHAPES DISEASE RISK IN CENTRAL CHINA

-Ankur Goel
Director, Copper Cross Solutions

In recent years, scientists and public health experts have been paying closer attention to the ways in which weather and climate affect human health. Beyond the obvious dangers of heatwaves or floods, there is a quieter but equally pressing concern: how subtle changes in temperature, pressure, and sunlight can influence the spread of infectious diseases. One disease that illustrates this hidden connection is Severe Fever with Thrombocytopenia Syndrome (SFTS), a tick-borne viral illness first identified in China in 2009.

SFTS, caused by a novel bunyavirus, can trigger high fever, gastrointestinal problems, and dangerously low platelet counts. In some cases, it proves fatal, which is why the World Health Organization classifies it as a priority for research and emergency preparedness. The virus is transmitted primarily through the bite of Haemaphysalis longicornis, a tick species common in East Asia. Farmers and residents of hilly, wooded regions are most at risk, but the ripple effects of outbreaks concern the entire community.

A recent decade-long study in Xinyang, Henan Province, provides fascinating insight into how short-term shifts in weather influence the appearance of new cases. By tracking more than 6,600 confirmed patients between 2013 and 2023 and pairing these records with detailed meteorological data, researchers discovered that certain combinations of temperature, pressure, wind, and sunshine can predict an increased risk of infection. Their findings shed light on the delicate balance between humans, ticks, and the environment and underscore how even modest climate variations can tip the scales in favor of disease.

The silent march of a tick-borne virus

SFTS does not spread evenly throughout the year. In Xinyang, cases surge from April to June, when spring turns into early summer, and then taper off by October. This seasonal rhythm coincides with the activity cycles of ticks, which thrive in warm, humid habitats. However, the researchers wanted to know whether more immediate weather patterns spanning days or weeks rather than entire seasons could also be

influencing outbreaks. To test this, they used sophisticated statistical models that could capture non-linear relationships and time-lagged effects. In simple terms, they asked: if the weather changes today, will it affect the number of SFTS cases reported tomorrow, next week, or two weeks later? The results confirmed that the disease is sensitive to short-term meteorological shifts.

Temperature's double-edged role

Of all the weather factors considered, temperature emerged as the strongest driver of SFTS incidence. When daily averages hovered between 18 and 23°C, the risk of new cases was highest. Below this range, tick activity is suppressed, as colder conditions push them into dormancy. Above this range, both the ticks and the virus they carry struggle to survive, reducing the likelihood of transmission.

This creates a "Goldilocks zone" for disease spread conditions that are just right for ticks to feed, reproduce, and transmit the virus to humans and animals. For residents of Xinyang and similar regions, this means that even slight warming trends in spring can herald a spike in infections within days. The danger is particularly pronounced because many of the affected are elderly farmers who spend long hours outdoors, increasing their exposure.

Pressure, wind, and sunlight in the mix

Temperature was not the only weather element with an influence. The study found that SFTS risk rose when atmospheric pressure fell into a specific window between 1,006 and 1,017 hPa. Although the biological mechanisms are still being explored, scientists believe that lower pressure may extend tick survival and encourage feeding activity, indirectly heightening the chance of human infection.

Wind offered another intriguing clue. Normally, one might expect that strong winds would disperse ticks or limit their ability to attach to hosts. Yet the data showed that extremely high wind speeds above 11.6 meters per second correlated with a higher short-term risk of SFTS. The effect was modest and may depend on local geography, but it suggests that extreme gusts could alter tick-host contact patterns in unexpected ways. Sunshine duration also played a role. Days with more than nine hours of bright sunlight were linked to increased disease risk. Extended daylight encourages both ticks and their animal hosts, such as rodents and livestock, to remain active for longer periods, creating more opportunities for viral transmission. For human populations, longer sunny days also translate into extended time outdoors in fields and farms, further raising exposure.

Curiously, relative humidity, often a key factor for vector survival, showed no significant short-term effect in this particular study. This contrasts with findings in other provinces, highlighting how regional geography and microclimates can alter the disease-weather relationship.

Lessons from a decade of data

Between 2013 and 2023, the city of Xinyang recorded 6,601 cases of SFTS. Most patients were over 60 years old, and women outnumbered men. The data painted a vivid picture of how localized and persistent the disease has become in central China. Peaks in 2015 and 2016 highlighted years of especially favorable conditions for ticks, while the gradual year-to-year variability showed how climate variability influences epidemic intensity.

The research did more than confirm suspicions about weather's role. By using models that account for delayed effects where today's weather influences case counts days later the scientists could map out "lag windows" of risk. For example, a warm spell in May could lead to a noticeable surge in cases within the following week. These lag effects are crucial for designing early warning systems.

What this means for public health

Understanding the weather–disease connection is not just an academic exercise. For health authorities, it opens the door to practical strategies. By integrating temperature, pressure, and sunlight data into surveillance systems, officials can issue timely alerts when conditions are ripe for outbreaks. Farmers and rural residents could then be advised to take precautions, such as wearing protective clothing, avoiding high-risk outdoor activities

during peak hours, and checking for ticks after working in fields.

Hospitals and local clinics could also benefit from weather-linked forecasting. Knowing when to expect a surge in SFTS patients allows them to allocate resources, prepare diagnostic kits, and ensure adequate staffing. In regions where the disease is endemic, such preparedness can make the difference between a contained outbreak and a public health crisis.

On a broader scale, the findings underscore the importance of climate change adaptation. As warming trends shift temperature and pressure patterns across East Asia, the “Goldilocks zone” for ticks may expand into new territories. Areas that previously reported few cases could find themselves facing fresh outbreaks. Continuous monitoring, combined with public education, will be vital to staying ahead of this moving target.

A global reminder

While SFTS (Severe Fever with Thrombocytopenia Syndrome) is currently concentrated in East Asia, with confirmed cases in China, Japan, South Korea, and Vietnam, the implications of its study extend far beyond the region. Many infectious diseases including malaria, dengue, chikungunya, and Lyme disease exhibit similar sensitivity to short-term weather fluctuations. Temperature swings, unexpected rainfall, or shifts in humidity can dramatically influence vector populations, viral replication, and human exposure patterns. As climate variability intensifies due to global warming, these subtle environmental drivers of disease risk are poised to become even more critical to understand and anticipate.

The Xinyang study in central China provides a valuable template for such research. By combining long-term patient data with high-resolution meteorological records, and analyzing them through sophisticated models that capture non-linear, delayed, and threshold effects, researchers were able to reveal the nuanced ways weather interacts with disease emergence. For example, the study demonstrated that short bursts of warmer temperatures followed by dry spells can amplify tick activity, increasing the likelihood of SFTS transmission to humans. This methodological framework can be adapted in other geographic and epidemiological contexts, allowing countries to anticipate outbreaks of climate-sensitive diseases and implement timely preventive measures. The story of SFTS underscores our profound interconnectedness with the environment. To most people, a sudden gust of wind, an unseasonably sunny week, or a drop in atmospheric pressure may seem inconsequential. Yet for the ticks carrying the SFTS virus, these subtle changes determine whether they survive, reproduce, or decline. And the consequences cascade: fluctuations in tick populations directly influence the exposure risk for farmers tending their fields, families in rural villages, and healthcare workers managing outbreaks. In this way, environmental changes ripple through ecosystems and societies alike.

As climate change reshapes weather patterns, the link between meteorology and disease becomes increasingly urgent. Protecting communities from SFTS and similar threats requires an integrated approach combining medical interventions, environmental awareness, adaptive farming, and public health planning. Predictive weather-disease models can inform residents when to take protective measures, such as using tick repellents or avoiding high-risk areas.

For the residents of Xinyang, each spring brings more than crops and blossoms it brings heightened vigilance against a microscopic enemy. Their experience shows how human health is deeply connected to ecological systems. The story of SFTS serves as a reminder that environmental stewardship and public health are inseparable, and understanding these hidden links is essential in a world of accelerating climate variability.

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ANTARCTICA IS WARMING AND WHY THE COLDEST PLACE ON EARTH MATTERS TO ALL OF US

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When we think of Antarctica, we imagine endless fields of ice, bone-chilling winds, and penguins waddling across a frozen wilderness. For decades, this vast continent has been seen as a timeless frozen desert untouched and unchanging. But recent research tells a different story: Antarctica is warming, and its future is tied directly to ours.

A new scientific study led by researchers from the Chinese Academy of Meteorological Sciences and international collaborators has revealed clear signs of rising temperatures across Antarctica from 1980 to 2023. By combining multiple advanced climate datasets, the scientists were able to cut through uncertainties that often cloud Antarctic research. Their findings leave little room for doubt: Antarctica is heating up, and the consequences ripple across the planet.

Why Antarctica Matters to the World

Antarctica may seem distant, but its ice sheet is a cornerstone of Earth's climate system. It holds about 60% of the world's fresh water, locked in ice up to 4.8 kilometers thick.

If all this ice melted, sea levels could rise by more than 50 meters an unimaginable scenario, but even small losses already spell trouble for coastal cities.

The Southern Ocean surrounding Antarctica regulates global climate by absorbing carbon dioxide and heat. It drives major ocean currents that affect rainfall in Africa, monsoons in Asia, and storms in the Americas. In short, what happens in Antarctica does not stay in Antarctica.

What the New Research Found

The scientists analyzed five state-of-the-art reanalysis datasets essentially climate "time machines" that combine satellite observations, weather models, and historical records to build a complete picture of past conditions. By comparing them, the team created an ensemble average that is more reliable than any single dataset.

Here's what they discovered:

- The Antarctic continent warmed significantly from 1980 to 2023, at an average rate of 0.12°C per decade. That may sound small,

but over decades it adds up and polar regions amplify warming more than elsewhere.

- The warming is uneven. East Antarctica and the Antarctic Peninsula warmed the most, while parts of West Antarctica showed smaller or even no significant changes.
- The surrounding seas tell a different story. While the continent warmed, the Antarctic Ocean cooled overall during this period, especially between 1980 and 2016. This reflects changes in sea ice, which expanded slightly before collapsing dramatically after 2016.
- The early 2000s marked a shift. Before then, warming in some regions was more pronounced; afterward, dynamic changes in wind and ocean patterns partly masked the warming in West Antarctica and the Peninsula. Yet beneath these shifts, the long-term trend remains clear.

The Tug of War: Thermodynamics vs. Dynamics

One of the most fascinating aspects of the study is how it untangles the forces driving Antarctic climate change. The researchers separated two main processes:

1. Thermodynamic processes: These are changes linked to heat such as warming oceans, shrinking sea ice, and altered land surfaces. They add energy to the system, driving warming.
2. Dynamic processes: These involve shifts in winds and atmospheric circulation, like the Southern Annular Mode, which can temporarily cool or warm different regions by pushing air masses around.

The results are striking. Thermodynamic processes alone would have caused about 0.22°C of warming per decade across Antarctica. But dynamic processes counteracted some of that, leading to a cooling effect of about –0.10°C per decade. In other words, Antarctica would be warming much faster if not for shifting wind patterns.

This tug of war explains regional differences:

In East Antarctica, thermodynamics (warming oceans and land changes) dominate, while wind patterns partly cancel out the effect.

In West Antarctica and the Peninsula, atmospheric dynamics play a bigger role, amplifying or suppressing warming depending on the season and decade.

The Seasons of Change

Not all months are created equal in Antarctica. The study found strong seasonal patterns:

- The spring months (September–November) warmed the fastest, at about 0.27°C per decade. This is especially concerning, because spring warming can accelerate ice melt and disrupt ecosystems just as wildlife prepares for breeding and migration.
- Summers, autumns, and winters also warmed, but less consistently.
- Meanwhile, the Antarctic Ocean cooled in all seasons, with the sharpest drop in winter (–0.34°C per decade).

This unusual ocean cooling is linked to shifting sea ice patterns. For years, Antarctic sea ice seemed to resist the global trend, even growing slightly. But since 2016, ice extent has plunged to record lows, a worrying sign of instability.

Why This Matters for All of Us

The Antarctic story is not just about penguins or glaciers, it's about humanity's shared future. Rising temperatures in Antarctica can:

- Accelerate sea level rise: Melting ice sheets in West Antarctica and the Peninsula are among the largest contributors to current sea level rise. Cities like Mumbai, New York, and Jakarta stand in the path of higher seas.
- Disrupt global weather: The Southern Ocean drives the "conveyor belt" of global ocean circulation. Disturbances here can alter rainfall patterns, worsen droughts, and intensify storms thousands of kilometers away.
- Threaten ecosystems: From krill—the foundation of the Antarctic food web to emperor penguins, species are already feeling the stress of shifting sea ice and changing waters. Their fate is tied to the delicate balance of temperature and ice.

Perhaps most importantly, the warming trend in Antarctica is a warning light for the planet. For years, scientists wondered if Antarctica might remain insulated from global warming thanks to

its remoteness and strong wind systems. This new research shows that is no longer the case.

Hope in Understanding

The study also provides hope: by understanding how different processes interact, scientists can improve predictions. Knowing that thermodynamic warming is being partly masked by atmospheric dynamics means that future warming could accelerate once those dynamics shift again. This foresight gives policymakers and communities time to prepare.

Already, international collaborations like the Paris Agreement and efforts to protect the Southern Ocean are steps in the right direction. But the Antarctic findings underline the urgency of reducing greenhouse gas emissions. Without action, the frozen continent will continue to thaw and with it, our global safety net.

What Can Individuals Do?

It's easy to feel powerless when thinking about Antarctica a place so distant, vast, and extreme that it seems removed from our daily lives. But in reality, the choices we make every day ripple outward, shaping the future of even the most remote regions of our planet. Awareness is the first step, but action is what creates change. Here are some meaningful ways individuals can contribute:

- Reduce energy use: Small lifestyle changes add up. Switching to energy-efficient appliances, choosing public transport or carpooling, and cutting unnecessary electricity use directly lower carbon emissions. Even something as simple as turning off unused lights or setting air conditioners a few degrees higher makes a measurable difference when multiplied across millions of households.

Support climate-friendly policies: Real impact comes when communities demand systemic change. Citizens can push leaders to invest in renewable energy, strengthen carbon reduction goals, and fund international climate research. Policy decisions today will determine how rapidly we transition away from fossil fuels and how prepared we are for climate-related challenges tomorrow.

- Stay informed and spread awareness: Antarctica's role in regulating Earth's climate is often underappreciated. By sharing credible information through conversations, social media, or classrooms individuals can help bridge the gap between distant scientific findings and everyday understanding. The more people grasp what is at stake, the louder and stronger the call for collective action becomes.
- Protect oceans: Oceans connect us all. Reducing single-use plastics, supporting sustainable seafood choices, and advocating for marine protected areas all contribute to healthier marine ecosystems. These actions indirectly safeguard Antarctica as well, since its unique biodiversity is tightly linked to the global ocean system.

Antarctica is often called the "last wilderness" a place that serves as Earth's natural laboratory, climate archive, and planetary air-conditioner all at once. New research shows that this wilderness is changing far faster than expected. Its melting glaciers, shifting winds, and warming seas are sending us a clear warning: climate change is no longer a distant threat; it is a present reality, leaving fingerprints at the ends of the Earth.

For people thousands of miles away, Antarctica's icy silence may seem remote. Yet it is, in truth, the echo chamber of our planet's health. What happens there reverberates everywhere, shaping coastlines, altering weather patterns, and influencing the stability of societies. Rising sea levels, stronger storms, and shifting rainfall are already tied to changes in the Antarctic system.

The Antarctic story is not only about science; it is also about responsibility. It reminds us that we are stewards of a fragile system that stretches beyond borders and generations. The ice may look eternal, but it is not. Our window for meaningful action is narrow and closing. The choices we make today will determine whether Antarctica remains a frozen sanctuary or becomes a symbol of what we failed to protect.

E20 ETHANOL BLENDING IN INDIA: PROMISE, PITFALLS, AND THE ROAD AHEAD

-Kamaldeep
Freelance Writer

Introduction

In our previous editions, we emphasized ethanol blending as a powerful strategy to combat climate change while transforming sugar industry by-products into valuable fuel. We also outlined a roadmap for authorities to make this transition feasible. Today, that vision has advanced significantly: the government has achieved 20% ethanol blending (E20) ahead of the original 2030 target. As Petroleum Minister Hardeep Singh Puri noted, India has already reached this milestone in the current Ethanol Supply Year[1]. However, practical implementation is never without challenges. Recent reports and consumer feedback indicate that using E20 in non-compliant vehicles is leading to mechanical issues, reduced fuel efficiency, and growing public concern. This article examines the policies that enabled India to reach 20% blending, the effects of E20 fuel on end users, and the environmental and economic implications of this transition while exploring pathways for a smoother shift toward a truly sustainable fuel future.

How India Reached 20% Ethanol Blending

India's achievement of 20% ethanol blending is not accidental; it is the result of a carefully phased policy framework and coordinated action across ministries, industries, and states. Over the past five years, the government has accelerated reforms under the Ethanol Blended Petrol (EBP) Programme, addressing supply bottlenecks, expanding feedstock flexibility, and incentivizing infrastructure investments.

1. Ethanol Blending Roadmap (2020–2025)

In 2021, the government released the Roadmap for Ethanol Blending in India (2020–25), uncovering a strategic roadmap to secure the E20 goal by 2025–26 five years ahead of the initial 2030 timeline. Milestones included phased rollouts of E10 by April 2022 and E20 by April 2025, alongside expansion of ethanol-compatible vehicles and feedstock diversification[2].

2. Scaling Production and Feedstock Diversification

To counter seasonal molasses supply issues, policymakers approved the use of alternate

feedstocks like maize, surplus rice, and damaged grains. Incentives such as interest subvention and financial support to distilleries enabled a sharp upswing in ethanol processing capacity. By mid-2025, blending had climbed steadily from just 1.5% in 2014 to 20%, a thirteen-fold increase in a decade[3].

3. Procurement Reforms & Stable Pricing

Oil Marketing Companies (OMCs) were encouraged to sign long-term offtake agreements with distillers, providing price stability. Differential pricing for ethanol based on feedstock value encouraged non-molasses production, enabling more equitable regional participation and reliable supply[4].

4. Ethanol Blended Petrol Programme Expansion

Blending targets were steadily raised from E10 in 2022, to approximately 18.4% by March 2025, culminating in nationwide E20 implementation in mid-2025. This push was reinforced by compulsory blending mandates for OMCs and targeted infrastructure expansion[5].

5. Infrastructure & Logistics Enhancement

Recognizing that distilleries alone aren't enough, the government invested in ethanol storage tanks, pipeline integration, and blending terminals. This infrastructure backbone was essential for seamless, pan-India distribution of E20[6].

6. Realizing Socio-Economic & Environmental Gains

By July 2025, Ethanol Supply Year data revealed massive gains:

- Ethanol output jumped from 38 crore litres in 2014 to 661.1 crore litres.
- Foreign exchange savings: ~₹1.36 lakh crore.
- Pumping up rural economy: ₹1.18 lakh crore paid to farmers; ₹1.96 lakh crore to distilleries.
- CO_2 emission reduction: ~698 lakh tonnes.

Furthermore, NITI Aayog estimates that, under the EBP from 2014–15 to early 2025, India saved ~₹1.44 lakh crore in forex, avoided 245 lakh tonnes of crude oil, and cut CO_2 emissions by 736 lakh tonnes equivalent to planting 30 crore trees[7].

Impact of E20 Fuel on Non-Compliant Engines and Consumers

While the achievement of 20% ethanol blending (E20) marks a significant policy milestone, its rollout has exposed crucial challenges at the consumer level. Most vehicles on Indian roads today especially those manufactured before April 2023 are not fully E20-compliant. Vehicles built post-April 2023 are generally designed to handle E20, but older models may still be at risk[8].

Practical evidence supports this: an For instance, a survey by LocalCircles across 37,000 respondents nationwide found that:

·28% of petrol vehicle owners whose vehicles were purchased in 2022 or earlier reported unusual wear and tear since the E20 rollout.

·Two in three reported reduced fuel efficiency.

52% said they would support E20 only if it were optional and priced at least 20% lower than current fuel prices[9].

These findings are backed by industry manufacturers. A spokesperson for SIAM (Society of Indian Automobile Manufacturers) acknowledged a 2–4% drop in mileage with E20 in non-compliant vehicles but noted it poses no safety risk[10].

These findings make one thing clear: while India has achieved its blending milestone, a large share of the existing vehicle fleet is still not ready for E20. The rapid rollout, without adequate preparation for older vehicles, risks eroding public trust. To bridge this gap, India will need a carefully managed transition through phased implementation, retrofitting solutions, and clear communication with consumers before the full benefits of ethanol blending can be realized.

The growing unease has already spilled into public debate and legal forums. In September 2025, a petition challenging the nationwide rollout of E20 was brought before the Supreme Court. However, the Court dismissed the case, upholding the government's blending programme and signaling strong institutional backing for the policy despite consumer pushback[11].

This judgment underscores the government's determination to stay the course, even as practical difficulties remain unresolved.

Environmental and Economic Implications of E20

While India's E20 rollout brings policy triumphs at the national level, its practical implications involve deeper ecological and structural considerations that go beyond consumer-level technical issues.

1. Water Footprint and Resource Stress

Sugarcane, the primary feedstock for ethanol, is exceptionally water-intensive. NITI Aayog reports that producing just 1 liter of ethanol requires about 2,860 liters of water(https://www.context.news/just-transition/in-data-indias-biofuel-plans-threaten-land-and-water?). In water-stressed regions like Maharashtra, where sugarcane dominates agriculture, this places enormous strain on groundwater and irrigation infrastructure. Without sustainable farming practices such as drip irrigation, water stress could worsen in the pursuit of ethanol goals[12][13].

2. State-Wise Capacity Disparities

Ethanol production capacity is heavily concentrated in a few states. As of mid-2025:

- Maharashtra leads with 396 crore liters
- Uttar Pradesh follows at 331 crore liters
- Karnataka at 270 crore liters

The national total stands at 1,822 crore liters, supported by 499 distilleries[14].

This regional concentration risks bottlenecks and inequitable access to ethanol. States lagging in capacity may struggle to meet blending targets without investing in infrastructure or relying on inter-state supply chains.

3. Food–Fuel Trade-offs and Land Use

Scaling ethanol production, particularly from grains, raises concerns about competition with food production. While diversification extends supply sources, it must be managed carefully to avoid inflating food prices or exacerbating shortages especially during poor harvest years.

4. Macro vs. Micro Economics

At the macro level, ethanol blending supports foreign exchange savings and climate goals. Yet, for individual consumers—especially those with older, non-E20-compliant vehicles—this policy can introduce unforeseen costs in maintenance or fuel use. Without mitigation measures, the transition may feel unjust despite systemic benefits.

Way Forward: Ensuring a Smooth Transition to E20

While India's achievement of 20% ethanol blending is commendable, ensuring a just and sustainable transition requires careful attention to both policy and implementation challenges. Key measures include:

1. **Phased Rollouts:** Implement E20 gradually, prioritizing regions with more E20-ready vehicles and robust ethanol supply.
2. **Vehicle Compliance & Retrofitting :** Promote E20-compatible vehicles and provide retrofitting or labeling for older models.
3. **Infrastructure Expansion**: Develop stora ge, blending depots, and pipelines; diversify production geographically.
4. **Public Awareness & Incentives :** Highlight E20's benefits and offer price or retrofitting incentives.
5. **Sustainable Resource Management** : Optimize water use, encourage alternative feedstocks, and monitor land use.

Conclusion

India's E20 journey marks a major step in energy security, rural support, and emission reduction. While challenges remain for consumers and infrastructure, a phased, well-managed approach with continued innovation can ensure a smooth transition. Properly implemented, E20 can serve as a global model for reducing fossil fuel dependence while supporting farmers and sustainability.

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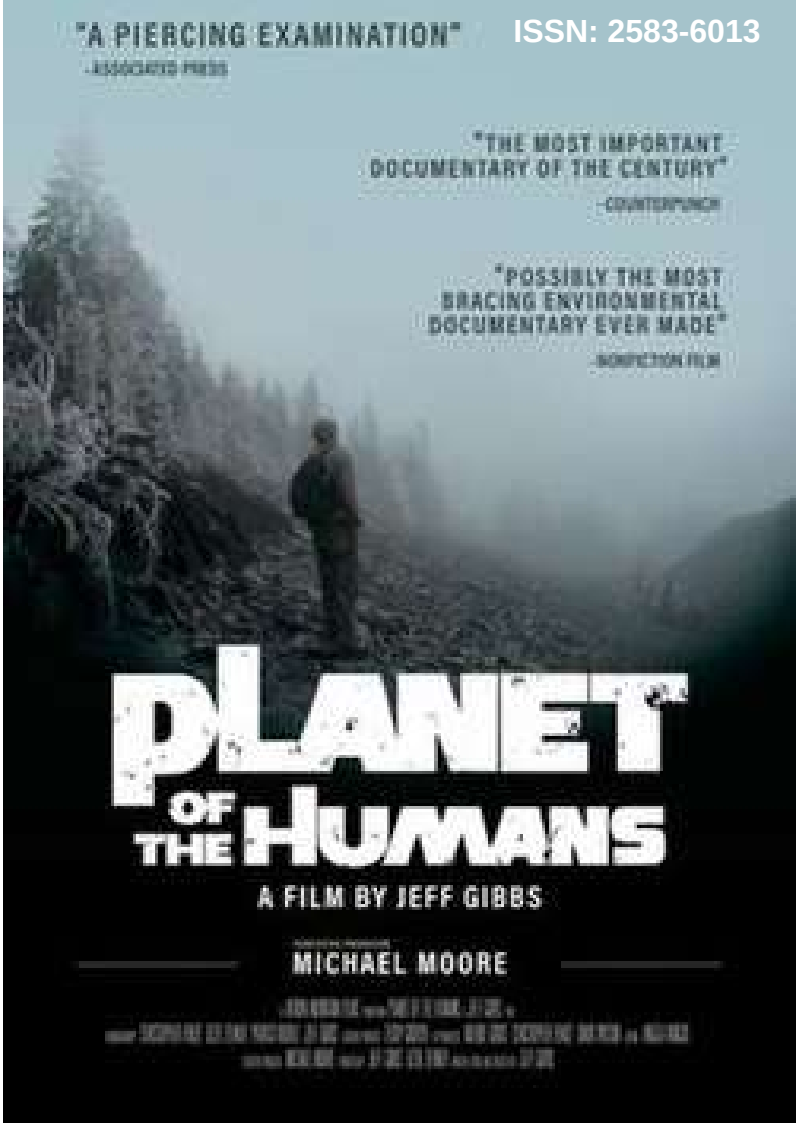
MOVIE RECOMMENDATION

PLANET OF THE HUMANS



Planet of the Humans is a documentary directed by Jeff Gibbs and produced by Michael Moore. It takes a critical look at the renewable energy movement, questioning whether green technologies and corporate-driven solutions are truly sustainable. The film explores themes of overconsumption, population growth, and the limits of "green" progress, sparking debate about humanity's role in driving climate change and the urgent need for deeper systemic change.

PLOT SYNOPSIS

The documentary begins with filmmaker Jeff Gibbs reflecting on his long-time belief in renewable energy as the solution to climate change. He sets out to investigate the green energy movement, only to discover unsettling truths. Through a series of interviews, on-site visits, and archival footage, Gibbs exposes how solar, wind, and biomass technologies are often dependent on fossil fuels, mining, and unsustainable practices.

As the film progresses, it reveals the growing influence of corporate interests in the environmental movement, suggesting that "green capitalism" may be more about profit than genuine ecological survival. Scenes of deforestation for biomass energy, the environmental costs of mining for solar and wind infrastructure, and the hidden reliance on coal and gas challenge the audience's assumptions about clean energy.

The story takes a more sobering turn as Gibbs argues that society's core problem is not just energy sources but overconsumption and unchecked economic growth. The film positions humanity's dependence on endless growth as fundamentally incompatible with a finite planet.

The climax delivers a stark warning: while people cling to the hope that technology alone can save us, the planet continues to deteriorate. The film concludes not with easy solutions but with a call to face uncomfortable truths—if humanity is to survive, we must confront our addiction to growth, consumption, and the illusion of limitless progress.

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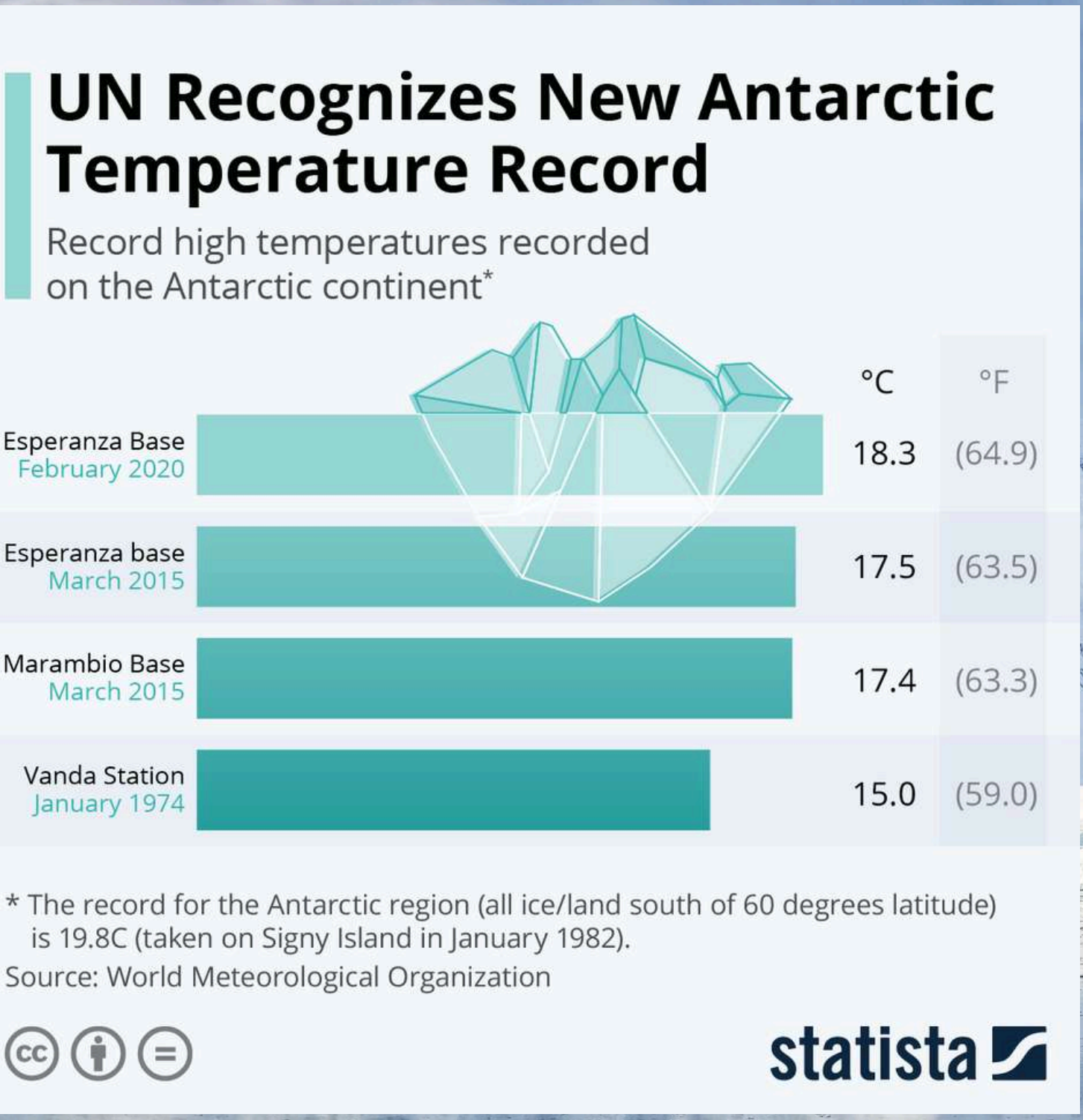

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