SUSTAINABLE INDIA



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SUSTAINABLE INDIA

A COUNTRY REPORT BY

REVOLVE

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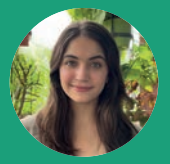
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No City Stands Alone: Reimagining Collaborative Urbanism

WRITER: **GAURAVI LOBO**



The Kallanai, built on the Kaveri, is a 2000-year-old stone diversion dam still in use today. What makes it remarkable is not its age, but its logic. It was built through an integrated understanding of agricultural cycles, community needs, and collective stewardship. It reflected a worldview in which water, land, labour, and governance were inseparable.

Much of that worldview was disrupted. Colonial urban planning reorganised Indian cities around extractive priorities – systems designed to serve select populations rather than entire ecosystems. Post-independence urban development inherited many of these structures, reproducing short-term fixes over integrated approaches.

Today, that legacy is colliding with unprecedented urban pressures. By 2030, India's urban population is expected to reach 600 million and the demand for water is expected to exceed supply by a factor of two; about 57% of Indian districts are at high risk from extreme heat; and cities already generate over 62 million tonnes of waste each year. These pressures compound, collide, and magnify one another.

The shift cannot be merely technical. We need to fundamentally shift ontologies that guide our urban futures. Current models treat cities as sites of resource withdrawal. Labour, land, data, and knowledge flowing outward without reciprocal investment. Instead, collaborative models understand cities as living systems. Extractive models solve for efficiency; collaborative models solve for resilience.

Increasingly, cities cannot afford anything but resilience. The modern world is a single, interconnected urban organism – supply chains cross continents, water scarcity in one region triggers food insecurity in another. Governance failures in one place carry lessons and warnings for others. The idea that any place can address climate, mobility, waste, or water challenges alone is an illusion. Interdependence is no longer a philosophical stance. It is a material condition.

At the Cities of Care Conference, co-hosted by the School of Cities, University of Toronto, IIT Madras, and the UofT India Foundation, this nexus becomes illustrative. Not because of the event itself, but because of the model it represents – scientists, policymakers, community practitioners, and entrepreneurs sitting at the same table. Solutions emerging from dialogue rather than prescription. This is what collaborative urbanism looks like in practice. Kallanai endured because it worked with systems rather than against them. As India approaches an urban century defined by vulnerability and possibility, the lesson is simple: cities thrive only when we treat their systems as interconnected and their people as collaborators rather than subjects.

My work at the UofT India Foundation is shaped by this principle. It is a rejection of traditions that treated the Global South as a site of data but not insight. It insists on reciprocity, on amplifying homegrown innovation, and ensuring that India's urban realities inform global knowledge systems.

The task ahead is not to rebuild ancient models, but to reclaim their intelligence: to replace silos with systems thinking and short-term fixes with long-term resilience. This report is one reminder that we can choose to build systems capable of renewal, not collapse.



Circular



$2 Trillion Potential

India's circular economy could generate over $2 trillion in market value and create 10 million jobs by 2050.

Source: Press Information Bureau



E-Waste = $6 Billion Opportunity

India generates one of the world's largest volumes of e-waste, which could be harnessed as a $6 billion economic opportunity. A stronger recycling ecosystem would not only recover valuable materials but also create jobs and reduce environmental hazards.

Source: The Economic Times



Budget 2025 Push

The Union Budget 2025 has proposed tax rebates for green technologies, subsidies for waste-to-energy projects, and expanded PLI schemes for resource efficiency. These measures aim to boost innovation, cut waste, and align India's economy with its 2047 developed nation vision.

Source: MoneyControl

EU–India FTA Goes Green

The EU-India Free Trade Agreement is integrating circular economy projects to unlock sustainable growth. Supported by €41 million in Horizon Europe funding, the initiative will reduce waste, promote greener value chains, and strengthen EU–India business ties.

Source: The Business Standard

Extended Producer Responsibility (EPR)

India is expanding EPR rules to 10–11 new sectors, requiring producers to manage their products across the full lifecycle. This shift encourages companies to design goods for reuse, recycling, and recovery, replacing the traditional "take, make, dispose" model.

Source: The Economic Times



Solar & Battery Innovation Challenge

The Ministry of New and Renewable Energy (MNRE) has launched a ₹10 crore innovation challenge for startups and R&D institutions. Focused on solar and battery circularity, the initiative will fund solutions for recycling, reuse, and sustainable design innovations in clean energy technologies.

Source: Press Information Bureau

Fast Facts

IIT-Bhilai's Groundbreaking PET Recycling

Researchers at IIT-Bhilai have developed a novel, eco-friendly method to recycle PET plastic using a reusable nano zero-valent iron catalyst.

Source: Press Information Bureau

SBI Boosts Green Finance with €100 Million Pact

The State Bank of India has signed a €100 million deal with the French Development Agency (AFD) to fund green projects. The move will help expand India's climate-friendly investments and support SBI's goal of raising its green loan share to 10% by 2030.

Source: The Hindu

Tax Policy Barrier to Recycling

India's uniform 18% GST on both recycled and virgin materials undermines the competitiveness of recycling. This discourages businesses from entering the formal sector, reduces innovation, and costs the government crores in lost revenue, creating a major roadblock to scaling the circular economy.

Source: Down to Earth

India Proposes Global Cities Coalition for Circularity (C3)

At the 12th Regional 3R & Circular Economy Forum in Jaipur, India proposed launching the Cities Coalition for Circularity (C3), a global digital platform designed to connect cities, academia, and tech innovators to scale circular solutions and accelerate sustainable development across the Asia-Pacific region.

Source: Press Information Bureau

INTERVIEW

Building Climate Resilience Through Gender and Circularity



SURYAPRABHA SADASIVAN
SENIOR VICE PRESIDENT, CHASE ADVISORS

Advancing climate resilience through circular economy models must prioritise women's leadership and equitable participation.

What are the key barriers preventing women, especially in climate-vulnerable regions, from participating in or benefiting from circular economy models?

Women are at the heart of India's circular economy, whether it's composting organic waste, conserving seeds, or collecting and sorting recyclables. Yet, they often find themselves in the lowest-value and least secure parts of the chain.

The first barrier is informality and lack of recognition. In many cities, women make up 40-70% of waste pickers but work without contracts, safety gear, or social protection. That keeps incomes low, often between ₹6,000 and ₹8,000 ($70-90) a month, and their contributions largely invisible in policy discussions.

The second is limited access to assets and markets. Access to credit for equipment like shredders or composters is limited, and finding steady markets for their products is a constant challenge. Public procurement could help, but circular products from women-led enterprises are rarely prioritised.

The third is the skills gap. Women are rarely trained for higher-value work like IT refurbishment, recycled product quality control, or plant operations.

In climate-vulnerable areas, these issues become more acute. Droughts, floods, and degraded resources disrupt livelihoods, making finance scarcer, mobility harder due to care responsibilities, and training opportunities fewer. Yet, when barriers are addressed, impact follows. In Pune, the SWaCH cooperative's 3,800 mostly women members work under municipal contracts with steady pay, safety standards, and formal recognition, proving that inclusive policy and institutional support can turn invisible work into dignified, climate-positive livelihoods.

What policy measures, financing mechanisms, or institutional arrangements could help scale gender-responsive circular initiatives in India?

Advancing climate resilience through circular economy models must prioritise women's leadership and equitable participation.



01

India has a strong policy base for the circular economy, from the Draft National Resource Efficiency Policy to the Swachh Bharat Mission 2.0 and GeM's Womaniya programme, but their potential is limited without coordinated action across stakeholders.

The first opportunity is in policy and contracting. Municipalities can require that women's cooperatives and self-help groups be part of waste management contracts, Extended Producer Responsibility (EPR) systems, and material recovery facility operations.

The second is financing. Institutions like Small Industries Development Bank of India and National Bank for Agriculture and Rural Development can offer blended finance products for women-led circular Micro, Small and Medium Enterprises (MSMEs), combining low-interest loans for equipment with performance-linked grants tied to diversion targets, safety standards, and fair wages.

The third is institutional design. City-level Circular Economy Cells (living labs) can bring together government, industry, and women's collectives to map enterprises, match them to tenders, provide technical assistance, and resolve operational challenges.

These measures work best when accountability is built in. Third-party monitoring of contracts and participatory review platforms where women can directly share feedback with officials ensure that initiatives don't just launch, they scale and sustain impact.

In what ways can circular models enhance the adaptive capacity of women in drought-prone, flood-affected, or degraded-resource regions?

Circular models can do more than reduce waste, they can directly strengthen women's capacity to adapt to climate shocks.



02

01 Women are at the heart of India's circular economy.
Source: Dibakar Roy / Pexels

02 Municipalities can mandate women's cooperatives and self-help groups in waste management, EPR, and recovery facility operations.
Source: Peter Burdon / Unsplash

03 Women can lead in the circular economy- from e-waste refurbishment to bioeconomy skills and green construction.
Source: Nishant Aneja / Pexels



03



04

In Gujarat, the Bhungroo system stores excess monsoon water underground, providing irrigation for up to eight months. Women's groups managing these systems have increased crop yields by 25–40% and collective incomes by ₹15,000–₹20,000 annually.

In Tamil Nadu's Kolli Hills, women-led seed banks conserve over 20 millet varieties, cutting post-disaster recovery time from months to days and reducing input costs by up to 30%.

In Assam, women's self-help groups have turned flood-damaged organic waste into compost, improving soil health for the next planting season and creating extra seasonal income of ₹5,000–₹7,000 per household.

Scaling these models will require structured action. Circular Economy Cells could map climate-vulnerable wards, prioritise women-led enterprises for resilience-focused contracts, and bundle funding from municipal budgets, CSR programmes, and climate adaptation schemes. Standardising resilience indicators, such as recovery time after shocks or income gains from restored resources and tracking them annually would ensure adaptation benefits are measured, valued, and used to shape future investments.

What skills and training are needed to prepare women for leadership in emerging circular economy sectors like e-waste, bioeconomy, or green construction?

High-value opportunities in the circular economy are expanding rapidly, and women should be at the forefront of this growth. In the e-waste sector, skills such as refurbishment, data wiping, and safe dismantling can generate three to four times more value than dismantling for scrap, yet training for women in these areas remains limited. In the bioeconomy, operating biogas plants, ensuring bio-fertiliser quality, and processing biomass are becoming core competencies. In green construction, as more cities enforce construction and demolition waste recycling mandates, skilled operators will be needed to produce recycled aggregates and run recycling plants.

Training on its own isn't enough, it must be linked to market-ready opportunities. Certified women-led teams could be pre-qualified for municipal or EPR contracts, ensuring their skills translate into income and leadership roles. Circular Economy Cells could partner with the Skill Council for Green Jobs, the National Skill Development Corporation, and local institutes to deliver modular, on-site training followed by direct bidding support.

Models like the Skill Impact Bond have shown how public-private partnerships can deliver training that leads to measurable job outcomes. Embedding similar performance-linked models in the circular economy, with gender audits to track contract awards and revenue flows, would ensure women move from being participants in training to leaders in enterprises.

What indicators can help track gender equity in circular economy projects – beyond just participation numbers?

Counting women is only the first step. We also need to measure how their situation has changed. This means tracking median income growth, the share of contract revenue reaching women, and whether their earnings meet living income benchmarks. Leadership is another key metric; the proportion of women in supervisory roles, holding contracts, or influencing procurement decisions.

Safety and benefits must be part of the picture. Are women receiving PPE? Are they covered by social security and maternity benefits? Do they have access to regular health check-ups, safe transport, and childcare facilities? Time saved through closer facilities or reduced travel can also be a valuable measure.

Finally, resilience indicators help link circularity to climate adaptation. These include the speed of recovery after a climate shock, hectares under climate-resilient crops, and households benefiting from systems like Bhungroo or seed banks. Embedding these indicators into municipal surveys, enabling digital reporting on platforms like GeM, and verifying through third-party gender audits – combined with participatory platforms for direct feedback, would make institutions accountable while ensuring women's voices shape both policy and practice.

India’s Circular Shift in Waste and Wastewater

WRITER
DHIRAJ SANTDASANI

India accelerates climate action by transforming waste and wastewater into circular economy engines for urban sustainability.

As we approach the Sustainable Development Goals (SDG) deadline of 2030, the next five years must represent a fifth-gear acceleration of climate action worldwide. For the Global South, the period from 2025 to 2030 will be a defining window to build a strong foundation and rapidly accelerate the on-the-ground delivery of climate action, particularly given the robust ecosystem developed over the past decade.

In India, particularly, the 2015 SDG announcement coincided with a wave of ambitious climate initiatives launched by the newly elected government in 2014. Since then, tremendous strides have been made across various sectors, laying the groundwork for bold, strategic action in the years ahead. Decisive climate planning was renewed during this period, with cities now at the forefront, managing an ever-growing portfolio of climate-related interventions with more support than ever.

While India's climate action has spanned all critical sectors, including energy, transport, industry, agriculture, and forestry, one sector seeing unparalleled attention, growth, and progress is municipal solid waste and wastewater management. This sector accounts for 3.7% of the national greenhouse gas inventory. While this may seem modest at first, deeper investigation reveals the sector's outsized potential impact on emissions, public health, and the overall urban sustainability agenda.

With rising waste generation driven by changing lifestyles and rapid urbanisation, this sector is becoming increasingly critical in India's fight against climate change. Waste sector emissions in India grew at a compound annual growth rate of 4.2% between 2005–2015, as per the Ministry of Housing and Urban Affairs. What's even more critical is that most emissions from the waste sector come in the form of methane, which has 86 times the global warming potential of carbon dioxide over a 20-year timescale. Approximately 15% of India's methane emissions come from the waste sector.

Unlike other sectors, where governance is spread across multiple institutions, cities have direct

01 Waste and wastewater.
Source: Tom Fisk / Pexels

02 India's climate action spans key sectors, but municipal waste and wastewater management is seeing unprecedented focus and progress.
Source: Ajay Kumar Jana / Unsplash

Approximately 15% of India's methane emissions come from the waste sector.



02

control over waste management, making it a priority for climate action that must be addressed with urgency and clarity.

Over the past decade, India has made remarkable progress in this space. In 2014, the Indian government launched two landmark missions: the Swachh Bharat Mission (Urban) and the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), aimed at improving solid waste and wastewater management in cities. At the time, waste processing capacity stood at just 18%, and operational wastewater treatment and access to sewer systems in urban areas were both about 30%. These missions tackled foundational challenges, scaled infrastructure, and accelerated capacity building through a mission-driven approach.

The second phase of these missions, launched in 2021, has further amplified these efforts. Today, India's waste processing capacity has quadrupled. Wastewater treatment and sewer networks have both grown by about 10% in just five years, despite being highly cost- and time-intensive infrastructure projects. Importantly, these advancements go beyond treatment and disposal. They represent a paradigm shift toward recycling, resource recovery, and revenue generation from waste streams, marking a strong transition toward circular economy models.

For example, the Indore Municipal Corporation, having set up Asia's largest bio-compressed natural gas (bio-CNG) plant, processes its organic waste and generates revenue from the bio-CNG produced, used as transport fuel for city buses. The model provides a royalty of $300,000 to the Indore Municipal Corporation. In Surat, the city corporation, in close collaboration with industries, established a wastewater treatment plant to supply industrial-grade water, reducing dependency on groundwater and providing more potable water to households. These examples reflect the true essence of a circular economy, where the approach is to maximise resource use to its highest potential.

A particularly noteworthy development in the circular economy space has been the launch of a dedicated circular economy initiative by India's apex policy think tank, NITI Aayog, laying the foundation for a mission-mode approach toward achieving a circular economy. It sets clear national



03

As per a report published by the Ministry of Housing and Urban Affairs, India has the potential to unlock approximately $3 billion in annual economic value through the adoption of circular economy models in the solid waste and wastewater sectors.

The true key lies in empowering local institutions with the tools, data, and expertise needed to act with clarity and speed.

03 India is increasingly adopting compressed natural gas (CNG) for public transport.
Source: Himanshu Singh / Pexels

04 India's Swachh Survekshan survey tracks city-level cleanliness and waste management efforts nationwide.
Source: Tushar Gidwani / Unsplash

and state-level targets and outlines actionable steps for various sectors and stakeholders to accelerate value-creation from waste. Through a series of detailed sectoral reports covering 11 key areas, the initiative quantified the economic opportunity of circular economy models in India and laid out a clear roadmap for achieving these ambitions. With this, India's intent to close the loop across sectors gained stronger focus and renewed momentum. As per a report published by the Ministry of Housing and Urban Affairs, India has the potential to unlock approximately $3 billion in annual economic value through the adoption of circular economy models in the solid waste and wastewater sectors.

This includes $1.7 billion from municipal solid waste and $1.2 billion from wastewater and sludge. A dedicated investment of $1.2 billion has been committed under the national GOBARdhan scheme to establish 500 new waste processing plants for the generation of bio-CNG, with a target of integrating 5% of India's energy mix by 2028–29.

It is important to note that these efforts have collectively addressed what could have been major roadblocks on India's path to a circular economy. A successful circular economy requires an enabling ecosystem, supportive policies, technical capacity, adequate financing, and robust monitoring. Each of these aspects has been thoughtfully planned in India's waste and wastewater sectors, backed by the strategic use of digital technologies to monitor progress across cities.

Take, for instance, the data infrastructure now in place, the Swachh Survekshan, a nationwide annual cleanliness and waste management survey conducted across all cities, providing a comprehensive record of city-level efforts. Beyond rewarding performance, it enables city, state, and national governments to track progress, assess speed, and identify areas for acceleration. Before 2014, such granular datasets were virtually non-existent, limiting cities' ability to make informed, data-driven decisions. Similarly, under the AMRUT mission, the Ministry has established a centralised mission progress dashboard for wastewater projects. This dashboard captures real-time updates from cities across India, enabling the government to monitor projects in the pipeline, under implementation, or completed. It improves performance tracking, fund utilisation, and project management.



04

Building on a strong foundation of governance, financing, and mission-driven momentum, the delivery of complex infrastructure such as biomethanation plants and sewage treatment facilities continues to advance but often faces execution hurdles at the local level. These hurdles are not always due to lack of intent or funding but often arise from the need for deeper institutional capacity, streamlined coordination, and hands-on technical support within city systems. Access to finance is improving, but the true key lies in empowering local institutions with the tools, data, and expertise needed to act with clarity and speed. This is where organisations like C40 Cities step in, bridging global best practices with local realities, facilitating peer learning, and enabling climate-smart decision-making on the ground.

If India is to power a truly circular future in the waste and wastewater sectors, the focus must now shift from policy to performance, from ambition to acceleration.

The momentum is real, but completing the circle will require staying on course, scaling what works, and bringing every city along the journey.



Ecosystems

India is the 7th most climate-vulnerable country

According to the Economic Survey 2025, India faces major risks to agriculture, water security, and public health due to climate change, making urgent adaptation and resilience measures critical.

Source: India Today



Kerala's 'Rainforest Gardeners' Preserve Over 2,000 Endangered Species

Kerala's Gurukula Botanical Sanctuary, a 32-hectare site in the Western Ghats, safeguards 2,000+ native plant species. Run by local women gardeners, it revives degraded forests and serves as a "Noah's Ark" for conservation.

Source: The Guardian

Indian Government plans a National Green Financing Institution

The Indian government is planning a dedicated institution to pool and channel green capital, helping India achieve its 2070 net-zero target and scale up clean energy at lower financing costs.

Source: The Economic Times



Amazon is funding flamingo conservation in Mumbai

With a $1.2 million pledge, Amazon will restore mangroves and support biodiversity research at Thane Creek, home to one of the world's largest flamingo congregations.

Source: Amazon India



India's protected areas now cover over 1,000 sites

On World Wildlife Day 2025, India highlighted that it has expanded its protected areas to a total of 1,014, safeguarding 5.32% of its land for biodiversity conservation.

Source: Press Information Bureau

Shifting rainfall patterns could cost India 4.5% of GDP by 2030.

More erratic and extreme precipitation events are raising flood risks and reducing productivity, threatening both livelihoods and economic stability.

Source: India Today

The Green India Mission Targets Critical Ecosystems

The revised mission (2021–2030) expands restoration efforts to the Aravallis, Western Ghats, Himalayas, mangroves, and arid northwest regions. By adopting a "micro-ecosystem" approach, it aims to strengthen climate adaptation, reduce land degradation, and enhance carbon sequestration.

Source: The Indian Express

India Hosts 8% of the World's Species

Despite occupying just around 2% of the world's land area, India is home to about 8% of all known species, making it one of the planet's 17 megadiverse countries. It also hosts four internationally recognised biodiversity hotspots: the Himalayas, Western Ghats, Indo-Burma region, and Sundaland (including the Nicobar Islands).

Source: International Union for Conservation of Nature

Climate Change Is Reshaping India's Rivers

Unprecedented floods, glacial lake outbursts, and warming river waters are altering India's freshwater systems. These changes are disrupting aquatic biodiversity, threatening fish-dependent livelihoods, and forcing vulnerable riverine communities to relocate.

Source: India Today

Gujarat Leads India in Mangrove Expansion Under MISHTI

Under the MISHTI scheme (Mangrove Initiative for Shoreline Habitats and Tangible Incomes), Gujarat has cultivated 19,520 hectares of mangroves, including 6,000 in Kutch. The state now ranks second in India, expanding from 397 km^2 in 1991 to 1,175 km^2 in 2021, with a 241 km^2 rise in just two years.

Source: The New Indian Express

INTERVIEW

Sustaining the Himalayas through Community and Innovation



NEHA UPADHYAY

BY BLENDING SOLAR ENERGY, ORGANIC FARMING, AND WOMEN'S LEADERSHIP, NEHA UPADHYAY IS REIMAGINING HOW MOUNTAIN ECOSYSTEMS CAN THRIVE AMID CLIMATE AND ECONOMIC PRESSURES.

Your work with Vishwadeep Trust combines clean energy, organic farming, and women's empowerment in fragile mountain regions. How do you see these elements interlinked to strengthen local ecosystems rather than functioning as separate initiatives?

At Vishwadeep Trust, our approach is deeply holistic. We believe that clean energy, organic farming, and women's empowerment are not separate pillars but interconnected threads that strengthen mountain ecosystems and community resilience. Our vision is to empower tribal communities and women farmers through ecological, organic agriculture and renewable energy access, from cultivation to post-harvest management.

By integrating solar energy solutions with organic farming, we address both environmental and socio-economic challenges. For example, we introduced solar dryers to reduce the perishability of organic produce, extending its shelf life from just two days to nearly two years. This innovation not only minimises post-harvest losses but also reduces women's drudgery, giving them more time to participate in markets and demand fair prices for their produce.

As a female founder, I see this integrated model as a reflection of how women naturally multitask and connect systems, while traditional development approaches often work in silos. Our goal is to strengthen local ecosystems by creating circular, sustainable livelihoods that honour both nature and women's agency.

Introducing solar technology for post-harvest processes has been central to your projects. What challenges and lessons have emerged from implementing renewable energy in isolated Himalayan terrains?

Implementing solar technology in isolated Himalayan terrains has brought both challenges and valuable lessons. One of the primary challenges has been the limited accessibility of raw materials required for manufacturing and maintaining the systems. Additionally, aligning solar-powered post-harvest processes with the timing of the harvest proved difficult first, as farmers would sometimes delay

01 The Himalayas are a vital ecosystem for India and must be protected.
Source: Dhiren Gandhi / Unsplash

Ladakh's ecosystem is one of the most fragile in the world.



01

Takmachik, known as Ladakh's first eco-model village, has become a living example of how traditional wisdom and modern sustainability can coexist.

collection, causing the produce to become too dry or unsuitable for market.

A particularly memorable challenge arose during the early phase of introducing solar dryers. Farmers found that sugar-soaked apricots were causing rust on the metal mesh of the dryers and initially believed the technology itself was faulty. After sending our scientist to investigate, we discovered that the rusting was actually due to the sugar reacting with the metal under heat. We then trained the farmers to avoid dipping apricots in sugar before drying, which not only solved the issue but also led to a healthier, completely sugar-free dried apricot product. The dryers remain protected, and the produce quality has improved significantly.

A key lesson throughout this journey has been the remarkable openness of rural and tribal communities to renewable energy. Once introduced, they have shown great enthusiasm and responsibility in using solar technologies effectively.

On average, a single household using our solar dryer reduces approximately 536 kilograms of greenhouse gas emissions every eight months and saves around 436 kilograms of liquefied petroleum gas emissions through the use of solar cookers. These outcomes demonstrate both environmental and social acceptance, proving that even in the most remote Himalayan regions, renewable energy can thrive when paired with local knowledge and adaptive learning.

Ladakh's ecosystem is extremely delicate and climate-sensitive. How do your interventions like promoting indigenous crops and organic farming help restore ecological balance and support climate resilience?

Ladakh's ecosystem is one of the most fragile in the world. High-altitude, cold-desert conditions mean even small disturbances can have lasting impacts. Our interventions focus on strengthening what already works in harmony with this landscape: indigenous crops, traditional knowledge, and organic farming.

By reintroducing and promoting native, climate-resilient crops such as barley, buckwheat, and apricot, we are restoring local biodiversity and reducing dependency on external seeds and chemical inputs. These crops are naturally adapted to Ladakh's harsh conditions, requiring minimal water and thriving without fertilisers or pesticides.

Organic farming further supports this balance by reviving soil health, encouraging microbial activity, and reducing contamination of glacial meltwater – the primary water source for both humans and wildlife. Composting, bio-fertilisers, and crop rotation are now common practices among our partner farmers, helping the soil regenerate after years of stress.

Beyond the ecological gains, these efforts have created climate resilience at the community level. Indigenous seeds mature faster and withstand erratic temperature shifts, ensuring food security even when weather patterns change. The return to organic and local systems also revives cultural pride and traditional ecological wisdom, making sustainability not just a practice but a way of life.



02 Women engaging in organic farming.
Source: EqualStock / Unsplash

In essence, our approach restores Ladakh's ecological rhythm, honouring its traditional systems while preparing its people to adapt to the challenges of a changing climate.

You've prioritised women farmers in your programmes. How does involving women at every stage, from training to leadership, transform both community resilience and environmental outcomes?

Women have always been the silent custodians of Ladakh's land and biodiversity, yet their contributions have often gone unrecognised. Through our interventions, we have placed women farmers and the Ama Tsogpa (traditional women's groups) at the centre of every stage, from training and production to leadership and decision-making. This inclusive approach has transformed both community resilience and environmental outcomes.

Our data shows that women farmers contribute nearly 3,485 hours of agricultural work each season, compared to 1,212 hours by male farmers. Recognising this immense effort, we designed lightweight, portable, and easy-to-use innovations such as solar dryers, solar cookers, and organic processing units, specifically so that women could operate them comfortably from their homes or village centres. These technologies have reduced women's drudgery by 40%, saving both time and physical strain while improving productivity and income.

Under the Ama Tsogpa, women have revived indigenous seed banks, led organic farming initiatives, and adopted renewable energy for post-harvest processes. Their careful and intuitive management of natural resources has improved soil fertility, reduced water waste, and lowered household emissions. The income generated through these activities is often reinvested into community priorities like children's education, nutrition, and water conservation, creating a cycle of economic empowerment and ecological stewardship.

Our data shows that women farmers contribute nearly 3,485 hours of agricultural work each season, compared to 1,212 hours by male farmers.

Our interventions show that when women lead, sustainability deepens. The Ama Tsogpa model proves that gender empowerment and environmental restoration are inseparable. Together, they are shaping a more resilient, equitable, and climate-conscious Ladakh.

Takmachik has been called Ladakh's first "eco-model village." What key insights from Takmachik could be replicated across other mountain regions in India or globally?

Takmachik, known as Ladakh's first eco-model village, has become a living example of how traditional wisdom and modern sustainability can coexist. The key insight from Takmachik is simple yet profound: villages must not succumb to the pressure of producing more yield at the cost of their ecological balance.

In many Himalayan and mountain communities, the push toward higher productivity often leads to dependence on expensive chemical fertilisers, pesticides, and genetically modified seeds. Takmachik chose a different path. The village is committed to organic and regenerative farming, relying on indigenous seeds, natural composting, and solar-based post-harvest processing. This



03 Solar Panels in an isolated mountainous region.
Source: Alexander Mils / Unsplash+

03





04 Local communities of the region.
Source: Nomad Bikers / Unsplash

05 The beautiful terrain of the Himalayas.
Source: Mona Jain / Unsplash

approach not only preserved soil fertility and biodiversity but also reduced farmers' financial burdens and restored food sovereignty.

The village's success shows that self-reliance and ecological ethics can go hand in hand. Community-led decision-making, women's participation through Ama Tsogpa, and the use of clean energy have created a model of sustainability rooted in cultural identity. The farmers understand that true prosperity lies not in excess yield, but in balance between land, livelihood, and life itself.

The lesson from Takmachik that can be replicated across other mountain regions in India and beyond is clear: protect the integrity of local ecosystems, trust indigenous knowledge, and resist the lure of quick economic gains that damage the environment. Sustainability begins when communities value long-term health over short-term harvests.

As ecosystems across the Himalayas face increasing pressures from tourism, climate change, and migration, what is your long-term vision for sustaining livelihoods while preserving ecological integrity?

My long-term vision for the Himalayas is to create a network of self-sustaining eco-villages that become living models of harmony between people, nature, and livelihoods. As climate change, mass tourism, and migration continue to strain fragile mountain ecosystems, our goal is to show that development and conservation are not opposites – they can reinforce one another when rooted in community and ecology.

We are working toward expanding eco-villages that integrate organic farming, solar technology, and indigenous entrepreneurship. Each eco-village functions as a hub for eco-tourism, where visitors experience authentic Himalayan culture, local food systems, and conservation practices, while revenue directly supports farmers and artisans.

The next phase of our work focuses on building a green economy, developing tribal and women-led industries around climate-resilient crops, herbal products, natural fibres, and solar-dried foods. These value chains not only create dignified local employment but also reduce out-migration and help preserve traditional knowledge.

By linking ecological restoration with income generation, we envision a future where every household becomes a stakeholder in sustainability. In this model, eco-villages evolve into circular, low-carbon economies that regenerate land, empower communities, and safeguard Himalayan heritage for generations to come.

Partnering Nature and Business for Prosperity

WRITER
PRARTHANA BORAH

Ignoring nature is no longer an option for businesses as ecological collapse threatens their survival and profitability.

01

For too long, businesses have operated on the complacent premise that nature is an infinite resource – to be used without consequence. Fertile soil, clean water, pollination, and carbon sequestration are not just ecological functions; they are the backbone of modern economies. Whether construction, agriculture, pharmaceuticals, or energy, industry depends on nature's services – yet these dependencies have been overlooked.

The harsh reality of climate disaster, biodiversity loss, and ecosystem collapse redefines this mindset. The interconnectedness of business and nature is now a critical economic concern, with nature-related risks becoming an integral part of corporate strategy conversations. There is also the realisation that companies failing to recognise this symbiosis can forfeit immense opportunities for resilience, innovation, and growth. The World Bank estimates that by 2030, the collapse of essential ecosystem services – such as wild pollination, marine fisheries, and native forest timber – could wipe out $2.7 trillion from global GDP. The hardest-hit economies will be those least equipped to adapt, with countries like India facing potential GDP declines exceeding 10%.

India has been proactive in integrating nature into business decision-making. The Ministry of Environment, Forest and Climate Change launched the India Business & Biodiversity Initiative (IBBI) in 2014, hosted by Centre of Excellence For Sustainable Development (CII-ITC-CESD), which helps businesses conserve biodiversity and manage ecosystem services sustainably. Companies that join IBBI commit to a 10-point declaration integrating biodiversity values into their business decisions. IBBI's impact is visible across sectors. The tourism industry is designing eco-sensitive resorts that minimise environmental damage, reducing ambient temperatures and cutting energy costs. New-age holiday retreats like SwaSwara, located on the Konkan Coast near Om Beach, are designed for eco-conscious travel. The resort promotes the use of handwoven towels made by local women to engage local communities, reuses wastewater in gardens, composts kitchen waste, and designs opportunities to reconnect with nature through birdwatching and nature retreats. Spice Village in Kerala was built using local materials and native craftsmanship, embodying the traditional wisdom of communities from surrounding mountains. Khem Village in Rajasthan, which calls itself a luxury jungle camp, was established in 1989 by planting indigenous trees and creating small water bodies. This has since converted a vast, open grassland into a natural habitat.

Leading corporations are recognising the intrinsic link between ecological health and long-term business resilience, embedding biodiversity considerations into their core operations.

Tata Steel has demonstrated a strong commitment to biodiversity conservation through a dedicated Biodiversity Policy. The company systematically integrates biodiversity into its operational planning by developing Biodiversity Management Plans (BMPs) or Biodiversity Action Plans (BAPs) across its sites. These plans are developed with baseline assessments, risk analyses, and ecosystem estimations to understand local biodiversity conditions. Tata Steel follows a location-specific, mitigation hierarchy-based approach – avoid, minimise, restore, and offset – to identify, address, and mitigate potential ecological impacts. Through biodiversity studies, ground-truthing, stakeholder engagement, and continuous monitoring, the company actively safeguards ecosystem services while balancing operational needs and community welfare.



02

The World Bank estimates that by 2030, the collapse of essential ecosystem services could wipe out $2.7 trillion from global GDP.

Businesses are increasingly adopting landscape-based strategies that integrate biodiversity conservation with sustainable production, delivering positive outcomes for both nature and society.

Similarly, Corteva Agriscience champions biodiversity and social inclusion through its ambitious initiative aimed at empowering two million women across India's agricultural value chain by 2030. By fostering women-led Farmer Producer Organisations (FPOs) and cooperatives, Corteva facilitates the adoption of climate-smart agricultural practices that enhance soil health, conserve water resources, and promote on-farm biodiversity. This initiative reflects Corteva's commitment to advancing nature-positive solutions while fostering equitable growth and resilience in rural communities.

The Task Force on Nature-related Financial Disclosures (TNFD) leads this shift, challenging businesses to recognise their dependence on nature and take accountability for their environmental footprint. TNFD's 14 key guidelines for environmental impact reporting urge companies to go beyond compliance and integrate nature-positive strategies into their core operations. Globally, with over 600 environmental disclosure frameworks worldwide, transparency in business operations is no longer optional but mandatory. Investors, consumers, and regulators increasingly demand that companies link financial performance to environmental responsibility.

Businesses in India are responding to TNFD. LTI Mindtree, a global technology consulting and digital solutions company, has conducted biodiverse area and water risk assessments using the LEAP approach. The LEAP approach of TNFD is designed to help companies locate and assess dependencies on nature, evaluate risks, and prepare responses. Indian companies like TVS Motor Company, Hindalco Group, ITC Limited, Jindal Stainless, and JSW have disclosed on TNFD in the last year, while others like TCS, Adani Ports, Nestle, UltraTech, and Maruti Suzuki have stated their alignment with TNFD, demonstrating a growing corporate commitment to biodiversity action. Dabur has committed to no net loss to biodiversity by 2050. In India, the leading sectors for TNFD adoption include metals and mining, iron and steel production, software and IT services, automobiles, and water utilities.

Beyond compliance, Indian companies are taking bold steps to preserve and restore nature.

Capacity building of supply chains in nature consciousness is an increasing trend. Companies like Triveni Sugar are embedding supply chain sustainability into their Environmental, Social, and Governance (ESG) strategy by educating farmers on regenerative agricultural practices. Restoration projects like Panasonic Life Solutions India's rehabilitation of degraded land into dense forests using the Miyawaki method (an approach to afforestation developed by Japanese botanist Akira Miyawaki, involving planting a dense mix of native tree species in a small area to develop a self-sustaining, dense forest) by planting 3,800 native trees to restore local biodiversity, are also slowly gaining momentum. Miyawaki is popular for its rapid growth, high density, and biodiversity benefits and is considered a practical solution where natural forests are essential.

These efforts, while commendable, must be rapidly scaled. India stands at a pivotal moment where businesses must take the lead in protecting and restoring nature. Whether through large corporations, SMEs, or sustainable supply chain management, companies have the power and responsibility to embed biodiversity into their core strategies. Companies that recognise nature as a critical business asset will thrive in the coming decades. Now is the time for bold commitments and decisive action. Business and nature are not separate entities; they are deeply intertwined, and their futures depend on each other. The question is no longer whether businesses should invest in nature, but how quickly they can afford to do so before it's too late. ●

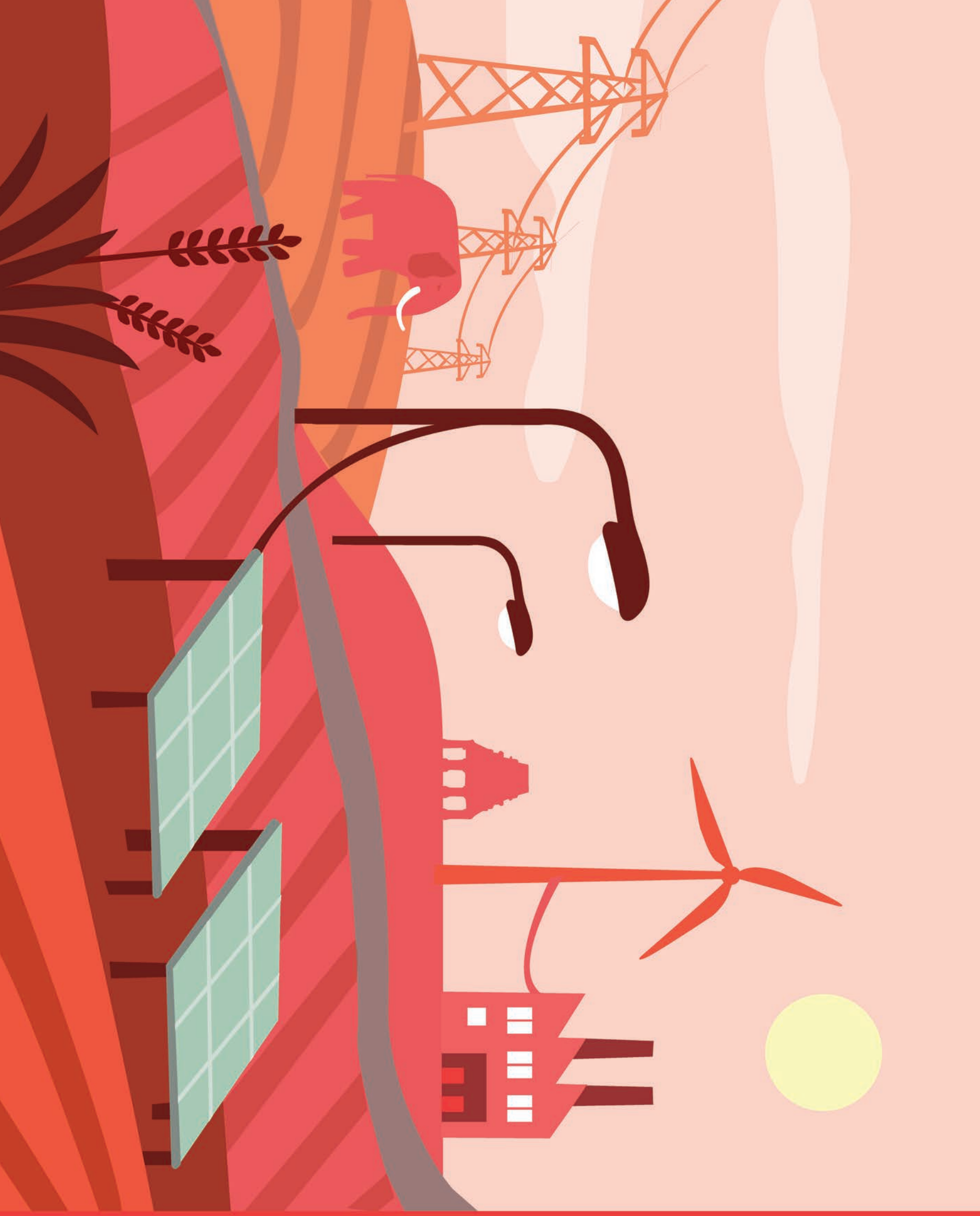
01 Nagarahole forest, Karnataka, India.
Source: gettyimages

02 Corteva's Cultivation of Change: Empowering Women in Agriculture.
Source: Corteva Agriscience.

03 Asian openbill storks
Source: Soumadeep Das / Pexels



03



Energy



PM-Surya Ghar Success

Over 8.5 lakh rooftop solar installations have already been completed – pushing India closer to its 500 GW renewable target by 2030, and 1,800 GW by 2047.

Source: ET Energyworld



Record-Breaking Growth in Renewables

In June 2025, India added 7.3 GW of renewable capacity, a 420% jump from the previous year, led by 5.4 GW of solar additions.

Source: The Economic Times



Rajasthan to Host India's Largest Solar-Wind Hybrid Project

Adani Green Energy is developing India's biggest solar-wind cluster in Rajasthan, secured with a $1.06 billion refinancing deal structured for long-term sustainability.

Source: Livemint

Falling Solar Costs

Solar tariffs have dropped to just ₹2.15/unit in 2025 (from ₹10.95 in 2010), making solar cheaper than coal, even with storage.

Source: The Economic Times



India Doubles Renewables in a Decade

Renewables now make up 12.1% of India's electricity (FY24) – double the 5.96% share in FY15.

Source: Outlook Business

Clean Energy Leads Capacity

As of March 2025, India's renewable capacity hit 220.1 GW, with solar alone contributing 48% (106 GW). Another 143.8 GW is in the pipeline.

Source: ET Energyworld



Investment Magnet

India attracted $11.8 billion in renewable investments in just the first half of 2025, its second-highest half-year record. Solar accounted for 77% of the inflows.

Source: Business Standard

India Becomes the World's 3rd-Largest Solar Power Producer

In 2025, India generated a staggering 108,494 GWh of solar energy, surpassing Japan's 96,459 GWh to claim the third-largest spot globally.

Source: The Economic Times

India Enters UN SDG Top 100 for the First Time

India broke into the Top 100 of the UN SDG Index (Rank 99) in 2025 – its best-ever performance – thanks to gains in clean energy, healthcare, housing, and poverty reduction.

Source: Business Standard



Warning: 2030 Energy Needs May Outpace Renewables

Despite rapid progress, experts warn of a 12% shortfall in meeting energy needs by 2030, risking reliance on fossil fuels unless renewable targets accelerate.

Source: The Hindustan Times

INTERVIEW

Balancing Industry Growth with Stronger Environmental Regulation



SANJEEV KUMAR KANCHAN
DIRECTOR, ESG & INDUSTRY, IFOREST

India's industries face rising pressure to go green, but is compliance practical or performative?

What are the most critical bottlenecks industries face in meeting environmental compliance requirements, and how can regulations evolve to address these?

Rising environmental concerns have led to stricter pollution norms, but industries face significant hurdles in achieving compliance. Many older plants lack the infrastructure to meet today's requirements. Public sector units often cite limited resources to upgrade systems, while Micro, Small and Medium Enterprises (MSMEs) struggle with the high cost of clean technology, making superficial or partial compliance common. In the past, industries relied on data manipulation to appear compliant, but with real-time monitoring, stronger regulators, and vigilant communities, such practices are increasingly untenable.

A critical issue is the reliance on lower-grade fuels and raw materials, chosen for cost and availability, which results in higher emissions and frequent compliance failures. At the same time, industries are burdened with multiple, overlapping reporting systems such as laboratory testing, real-time monitoring, the Business Responsibility and Sustainability Report (BRSR), the Carbon Credit Trading Scheme (CCTS), and green steel disclosures. These fragmented requirements consume resources without adding real value.

The regulatory system itself is complex, with overlapping mandates between central and state agencies, cumbersome clearances, and inconsistent enforcement. Weak institutional capacity-limited manpower, technical expertise, and outdated monitoring systems further undermines compliance credibility. Adding to this, one-size-fits-all norms fail to account for the diversity of India's industrial base, from small outdated units to advanced plants.

To address these bottlenecks, India needs to move beyond conventional systems. Stricter norms must be supported by realistic timelines, sector-specific

The inherent conflict of interest, where companies hire and pay the labs that assess them, makes such systems vulnerable to manipulation.

01 Balancing industry growth with stronger environmental regulation is key to a sustainable future
Source: Pixabay / Pexels



01

Micro, Small and Medium Enterprises (MSMEs) are the backbone of India's manufacturing sector and a vital source of employment.

strategies, and modern, technology-driven compliance mechanisms. Market-based approaches, such as emission trading, can improve efficiency and accountability. Incentives like concessional green finance, tax benefits, and subsidies should support genuine compliance, particularly for MSMEs. Strengthening regulatory institutions with skilled manpower, advanced infrastructure, and streamlined frameworks will be key to building credibility. By making compliance practical, consistent, and verifiable, India can balance industrial growth with its environmental sustainability goals.

How can continuous emissions monitoring (CEMS) and digital tools improve transparency and enforcement in pollution control?

Traditional pollution monitoring in India has long relied on laboratories hired by industries to generate compliance reports. These reports are widely distrusted, often presenting perfect compliance at unrealistically low costs, contradicting on-the-ground inspections, and dismissing public complaints. The inherent conflict of interest, where companies hire and pay the labs that assess them, makes such systems vulnerable to manipulation.

In real-time monitoring or Continuous Emission Monitoring Systems (CEMS/OCEMS), analysers or sensors are installed directly on chimneys to monitor and transmit live data to regulators' servers, eliminating human interference and enabling constant oversight. Beyond minimising manipulation, they allow regulators with limited staff and resources to monitor industries remotely, issue timely alerts, and help industries optimise processes for efficiency and cost savings. Crucially, real-time monitoring establishes the foundation for market-based compliance mechanisms such as emission trading. By quantifying emissions accurately, industries performing better can earn credits, while laggards face financial incentives to improve. This approach has been central to emission trading systems in the USA and Europe for over four decades, proving its effectiveness.

In 2014, India adopted real-time monitoring, but its potential remains underutilised. To maximise benefits, environmental laws must formally recognise real-time data as the legal basis for compliance. Robust quality assurance frameworks, clear



02

protocols and standards, and institutional capacity-building are also essential to ensure reliability.

Real-time monitoring is far more than a compliance tool if implemented correctly and properly. It represents the backbone of credible reporting, smarter and more efficient regulation, and a transition to next-generation environmental governance. By embracing this shift fully, India can move from a culture of manipulated data and superficial compliance to a future of transparency, accountability, and measurable environmental improvement. India has to do a lot to ensure proper implementation of CEMS, in order to achieve credible reporting that supports good compliance enforcement.

What kind of policy or financial support do MSMEs need to invest in clean technologies and meet decarbonisation targets?

Micro, Small and Medium Enterprises (MSMEs) are the backbone of India's manufacturing sector and a vital source of employment. While individually small, their cumulative energy and steam demand is enormous, making them a significant contributor to industrial emissions. Rising energy costs, stricter air pollution norms, and India's climate commitments demand urgent transformation in MSME boiler systems.

iFOREST's study on boilers estimates that MSMEs operate about 45,000 boilers registered under the Indian Boiler Regulations (IBR). Most of these are small, inefficient, over 18 years old on average, and dependent on fossil fuels or biomass, collectively accounting for nearly 7% of India's CO_2 emissions. This excludes lakhs of non-IBR boilers, which remain outside any consolidated database and are largely unchecked for safety, efficiency, and environmental compliance, further compounding the challenge.

A decisive shift is needed towards efficient, low-emission, and alternative technologies such as electric boilers and industrial heat pumps, high-efficiency biomass systems, solar thermal solutions, and Steam-as-a-Service (SaaS) models. The SaaS approach, where community boilers replace numerous small units, can simplify compliance, enable better monitoring, and improve operational efficiency.

There are existing government initiatives such as Assistance in Deploying Energy Efficient Technologies in Industries & Establishments (ADEETIE), Energy Efficiency Financing Platform (EEFP), Credit Linked Capital Subsidy Scheme (CLCSS), Performance-Linked Grant (PLG), and Technology & Quality Upgradation Support Scheme (TEQUP). These remain fragmented, lack clear strategy, and operate without robust accountability. To enable MSMEs to play a stronger role in India's decarbonisation roadmap, a focused, integrated approach is essential. This requires creating a comprehensive boiler database (IBR and non-IBR) with stronger regulatory oversight, introducing regulatory tools and targeted incentives with a time-bound roadmap, and designing tailored financial instruments to support cleaner steam technologies. In parallel, cluster-based steam infrastructure should be promoted with dedicated policy and financial backing to scale SaaS models. Strengthening awareness and capacity-building will also be critical to ensure effective technology adoption and compliance.

MSMEs can thus transform from laggards into frontrunners in India's industrial decarbonisation journey.

To what extent are India's existing emission and effluent standards aligned with global best

02 Reliance on low-grade fuels drives higher emissions and compliance failures.
Source: Johannes Plenio / Pexels

03 MSMEs run thousands of old, inefficient boilers, contributing nearly 7% of India's CO_2 emissions, with many more unregulated and unchecked.
Source: David McElwee / Pexels



03

practices, and where is reform most urgently needed?

Indian environmental standards continue to lag behind global best practices, largely due to technological, institutional, and regulatory gaps. Industries often operate with less advanced technologies and lower-quality raw materials, while pollution control, monitoring, and reporting systems remain weak. Compounding this, many Indian pollution norms have not been revised for over a decade, leaving them outdated and misaligned with global benchmarks.

Similar to the European Best Available Techniques Reference Documents (BREFs), India should develop its own sector-specific BREFs tailored to domestic industrial conditions and raw material realities. These documents can provide the technical basis for progressive and enforceable standards, similar to established practices in the USA, EU, and Japan.

In water pollution control, global approaches take into account the quality of intake water when setting final discharge norms – an element still missing in India's regulatory framework. Similarly, for air quality, the gap with global norms remains stark. India's National Ambient Air Quality Standards (NAAQS) for PM2.5 are set at 40 µg/m³ annually, while WHO guidelines prescribe just 5 µg/m³. While India cannot immediately align with such stringent levels due to its socio-economic constraints, coal dependence, vehicular emissions, and high baseline pollution, a phased tightening of standards is both necessary and feasible. This transition must be supported by industrial modernisation, cleaner energy adoption, and stronger compliance systems.

Key reforms are essential: developing and updating India-specific BREFs; shifting from concentration-based to load-based standards to reflect actual pollution burdens; instituting periodic tightening of norms with broader parameter coverage; and institutionalising real-time monitoring and transparent reporting with robust quality assurance. Together, these measures would modernise India's environmental governance, gradually align standards with global best practices, and ensure cleaner growth without compromising economic competitiveness.



04

What are the risks of ESG becoming a box-ticking exercise for Indian industries, and how can meaningful performance be incentivised?

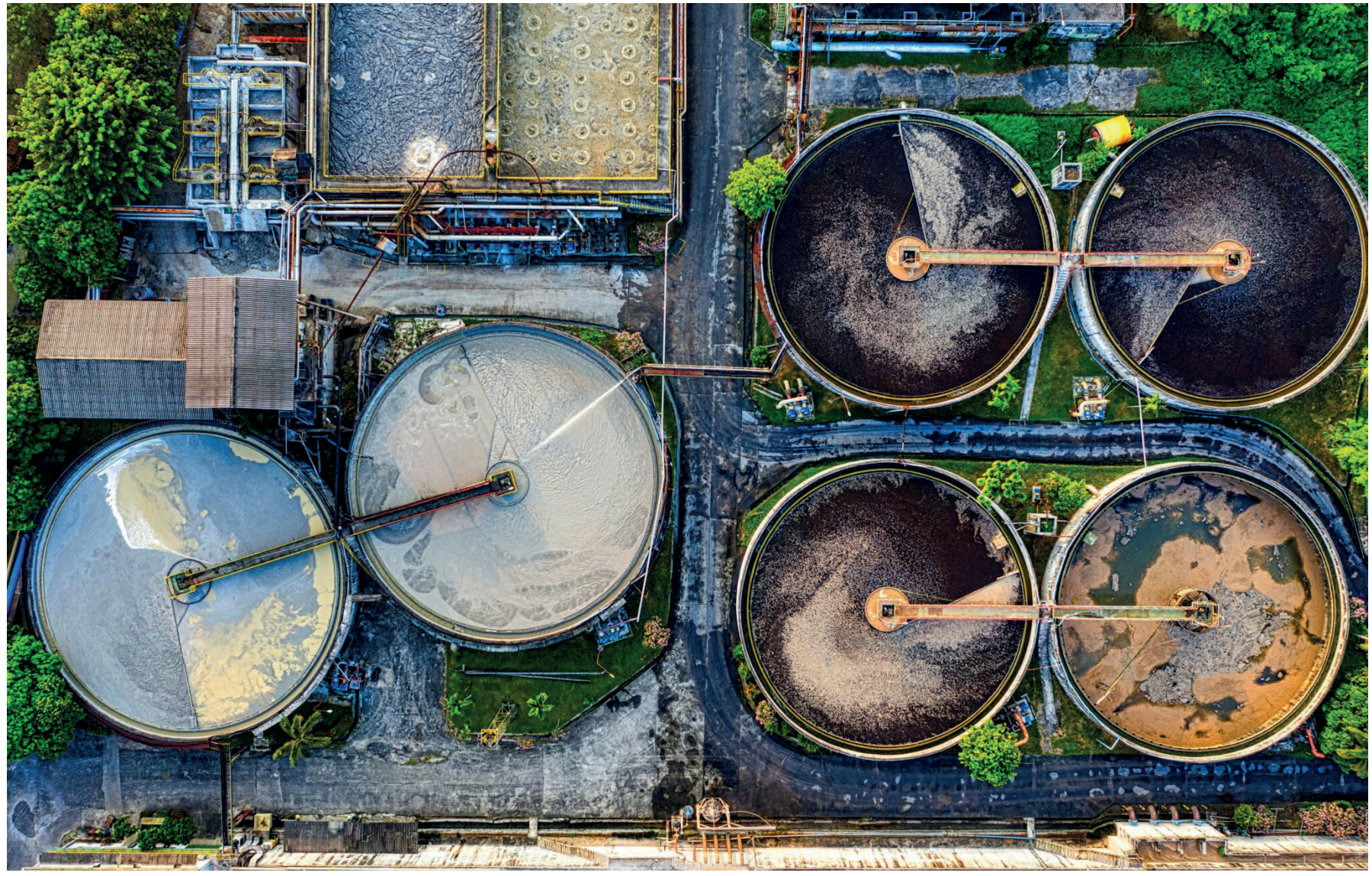
Industries in India disclose ESG performance through both voluntary and mandatory mechanisms such as Business Responsibility and Sustainability Reporting (BRSR), ESG ratings, climate-risk disclosures, CSR compliance, and ESG-linked financing. Ideally, ESG should serve as a tool for self-assessment, helping companies realign priorities, set measurable goals, and create a roadmap for sustainable growth. While a few companies have adopted global best practices, most treat ESG primarily as a compliance exercise to satisfy regulators or investors, rather than embedding it into core business operations.

A worrying trend is the use of ESG reporting for greenwashing.

A worrying trend is the use of ESG reporting for greenwashing, where commitments are overstated or selectively highlighted while real gaps remain hidden. The absence of uniform standards allows firms to choose lenient frameworks, undermining credibility. For MSMEs, ESG is often seen as a financial and administrative burden rather than a strategic opportunity, leading to minimal or superficial compliance. Weak verification mechanisms and the absence of robust third-party audits further reduce the reliability of disclosures. Similarly, ESG ratings suffer from inconsistency, as agencies operate without standardised methodologies.

Since 2021, SEBI has mandated BRSR for the top 1,000 listed companies, introducing a uniform framework that requires extensive data disclosure. However, analysis by iFOREST shows that significant gaps persist – reporting remains inconsistent, information is often incomplete, data verification is limited, and analysis lacks depth.

To ensure ESG translates into meaningful action, India must move toward standardised, sector-specific disclosure norms aligned with global benchmarks, while keeping compliance practical and phased. Financial incentives – such as preferential access to green finance, lower borrowing costs, or tax benefits for verified ESG progress – can encourage genuine performance. Mandatory third-party assurance will be critical to curb misreporting. For MSMEs, targeted capacity building and phased adoption roadmaps are essential. Ultimately, ESG must be integrated into business strategy – driving clean energy use, efficient operations, responsible supply chains, and workforce welfare – rather than remaining a box-ticking exercise.



05

How can ESG metrics be localised to better reflect India-specific environmental challenges like water stress, poor air quality, and land degradation?

For ESG to realise its full potential in India, it must be embedded within the country's broader environmental and sustainable development agenda while aligning with the UN Sustainable Development

04 Stricter pollution standards are key for India's clean future
Source: Yogendra Singh / Pexels

05 Industries must make water efficiency and recycling core ESG goals.
Source: Tom Fisk / Pexels



Land, as a finite and fragile resource, requires sustainable use and protection from degradation, deforestation, and biodiversity loss.

Goals (SDGs). The framework must be contextualised to address India's pressing challenges – water stress, air pollution, land degradation, and carbon emissions – and enable industries to create sector-specific sustainability roadmaps with clear priorities and measurable goals.

Water is perhaps one of the most urgent concerns for India, with 1.4 billion people, it holds only 4% of the world's freshwater, creating acute stress on its resources. For industries, water-use efficiency, wastewater treatment, recycling, and groundwater recharge must become core ESG indicators. Without this, both industrial growth and community water security remain at risk.

Air quality, though often underrepresented in ESG reporting, is equally critical. Many Indian cities rank among the world's most polluted. ESG metrics should therefore extend beyond greenhouse gases to include ambient air quality parameters such as PM2.5, NOx, and SO_2. They must also capture the adoption of cleaner fuels, advanced pollution-control technologies, continuous monitoring, and compliance with national and WHO standards.

06 A boat on a lake, Srinagar.
Source: Amjed Wani / Pexels

Land, as a finite and fragile resource, requires sustainable use and protection from degradation, deforestation, and biodiversity loss. Sectors such as mining, construction, and infrastructure must integrate ESG metrics that mandate land reclamation, biodiversity safeguards, and ecosystem restoration, including no-net-loss commitments.

For credibility and impact, ESG reporting in India must move towards sector-specific, measurable, and verifiable standards aligned with global benchmarks. Independent third-party assurance will be essential to curb greenwashing, while stronger links with green finance – such as bonds, sustainability-linked loans, and tax incentives – can accelerate adoption.

Ultimately, ESG in India must go beyond disclosures. It should serve as a catalyst for cleaner production, responsible resource use, and equitable growth – ensuring that environmental stewardship becomes central to industrial competitiveness.

The Startups Leading India's Climate-Tech Transformation

WRITER
NALIN AGGARWAL

From Coimbatore to Pune, a new generation of startups is driving India's decentralised decarbonisation journey.



01

Turning heads across Indian fields today is the Takavator. With its tangle of exposed pipes, metal funnels, and conveyor belts atop a green trailer, it looks straight out of a mad scientist's lab. But behind its appearance lies a game-changing solution to one of India's most urgent challenges – air pollution caused by stubble burning.

Every autumn, millions of farmers burn their leftover crop residue, releasing a thick blanket of smoke that chokes cities and towns across the country, leading to health problems and respiratory illnesses. Reuters reported in 2023 that stubble burning in the neighbouring states of Punjab and Haryana caused almost 40% of the air pollution in New Delhi, a city that has ranked as the most polluted in the world on the Air Quality Life Index (AQLI) for eight years running.

Tackling this air pollution crisis is Takachar, a Mumbai-based startup and the brain behind Takavator. The team uses circular economy innovation to transform crop residue – materials that would otherwise be burned – into high-value products.

The machinery is cheap, portable, and affordable. It processes crop residues like rice husks into biochar-based soil fertiliser, which can be applied directly to fields improving soil health. Additional products include biofuels and chemicals. By turning agricultural waste into useful commodities, Takachar not only mitigates pollution but also promotes sustainable resource use – closing the loop in the agricultural cycle and driving innovation for a low-carbon economy.

01 Delhi ranks as one of the most polluted cities in the world.
Source: Saakshi Yadav / Pexels

02 Farmer burning crop residue.
Source: Dr Photographer / Pexels

Takachar is part of a rising wave of climate-tech startups tackling India's most pressing challenges – air pollution, climate emissions, water scarcity, and food insecurity – shaping the country's sustainable future.

From workshops in Coimbatore to laboratories in Pune, and accelerators nurturing climate-tech startups nationwide, thousands of entrepreneurs are building technologies that could define India's low-carbon future. Small in size, but transformational in ambition, these startups are driving a transformative shift toward a greener, more resilient India.

India's climate-tech scene now comprises of about 3,000 startups, according to an article published in 2025 by Latitude Media, from registered ventures to actively funded players. IIMA Ventures, an investment firm for innovation in India, reports that between 2014-2024 the climate tech startup ecosystem raised over $3.6 billion USD. India's decarbonisation market alone is projected to be worth $10.3 billion USD by 2032.



From workshops in Coimbatore to laboratories in Pune, and accelerators nurturing climate-tech startups nationwide, thousands of entrepreneurs are building technologies that could define India's low-carbon future.

This vision of a solar-powered Kerala is not a utopian dream but an achievable imperative.

This isn't just about business success but about building the infrastructure for national transformation. Startups serve as crucial bridges between laboratory innovations and market-ready solutions, turning breakthrough technologies into affordable, scalable tools for decarbonisation. They're also employment engines: young companies, not just big ones, generate the fastest job growth in India – essential in a country where millions enter the workforce annually. Perhaps most importantly, they create positive spillovers that benefit society far beyond their immediate commercial impact.

Since 2016, Climate Collective Foundation has worked to strengthen this ecosystem – helping climate tech entrepreneurs navigate the journey from idea to scale, bridging the crucial stages in a startup's journey, known as the "valley of death". To do this, we have developed an ecosystem model comprising accelerator programs (capacity building, mentorship, investor connects, and market access); piloting & deployment platforms for industrial decarbonisation; access to risk capital (grants and syndicated equity); convenings and networking events to bring the ecosystem together; and a vibrant community of over 25,000 committed stakeholders. All this stems from our conviction that ecosystem-building to support climate-tech startups is urgent and essential for India's decarbonisation journey, and equally, ecosystem orchestration assumes greater significance as the market matures.

Current Transformative Trends

India's climate-tech landscape is experiencing transformative trends reshaping how the country approaches its climate challenges. From government-led initiatives to region-specific innovations and groundbreaking sectoral advancements, these trends are not only accelerating India's transition to a low-carbon future but also positioning the nation as a global leader in sustainable solutions.

Here are the key patterns we've observed shaping the future of India's climate-tech ecosystem:

1. Government as catalyst for climate innovation

India's policy framework has evolved from broad startup promotion to targeted climate-tech acceleration. The Indian Government's Production-Linked Incentive (PLI) schemes exemplify this shift – attracting INR45,000 crore in battery manufacturing investments and enabling startups like Ola Electric to scale battery manufacturing and electric vehicle (EV) production.

The National Electric Mobility Mission and the Faster Adoption and Manufacturing of Electric Vehicles in India (FAME) schemes have catalysed an entire ecosystem, while the upcoming deep-tech policy promises dedicated funding for research and development pilots in carbon capture, green hydrogen, and bio-based materials. This integrated approach, where industrial policy, energy transition, and climate goals reinforce one another, has become one of the most powerful enablers of startup growth.

2. Decentralising innovation beyond metros

A striking development in India's startup scene is geographic decentralisation. The Economic Survey of India 2023–24 found that nearly half of all Indian startups now originate from Tier-2 and Tier-3 cities – rapidly growing hubs such as Pune, Jaipur, and Coimbatore. An analysis published by CoreStory India in 2025 indicates that more than 50% of all startups are now based outside major metros, such as Delhi, Mumbai, and Kolkata. The



trend is driven by lower costs, a growing pool of talent, and improved digital infrastructure. While these figures are not specific to any particular sector, it's reasonable to infer that the climate-tech ecosystem also follows this pattern, as innovation follows regional needs and opportunity. This decentralisation not only spreads entrepreneurial activity but also drives locally-rooted solutions addressing region-specific challenges.

Consider Tan90, a Coimbatore-based startup that developed IoT-enabled water management systems specifically for Tamil Nadu's textile clusters, where water scarcity directly threatens industrial operations. Their solution, now scaling across similar industrial belts in Karnataka and Andhra Pradesh, demonstrates how distributed innovation creates spatially equitable decarbonisation – ensuring India's climate transition remains inclusive rather than metro-centric.

3. Sectoral breakthroughs driving change

India's climate-tech landscape now spans seven critical domains, each with solutions that are rapidly maturing and scaling. Industrial decarbonisation is one of the most pressing areas, with startups such as LivNSense deploying AI-driven digital twin platforms that allow factories to monitor operations, optimise processes, and cut emissions in real time across hard-to-abate sectors, such as energy-intensive industries like steel and cement, where decarbonisation is particularly challenging.

In the energy transition space, the challenge lies in ensuring grid reliability as renewable supply grows. Companies like TekUncorked are stepping in with Internet of Things (IoT) sensors and advanced analytics that help utilities detect faults early and integrate clean energy more reliably, reducing energy transmission losses by up to 15%. Mobility solutions are another area of transformation. Startups such as Kazam are building affordable EV charging networks across metros and Tier-2 cities, while Ather Energy has demonstrated that Indian consumers are willing to embrace electric vehicles when infrastructure and economics align.

Circular economy innovations are helping reduce both waste and dependence on fossil fuels. Econscious has pioneered biodegradable, bio-based packaging to replace single-use plastics at scale, while Banyan Nation operates India's largest plastic recycling platform, processing an impressive 30,000 tonnes annually. In parallel, carbon removal technologies are emerging as a vital complement to emissions reduction. String Bio, for example, converts methane emissions into sustainable proteins and chemicals, turning greenhouse gases into valuable products and new revenue streams for industries.

Protecting and restoring natural systems is another frontier. Recognising that ecosystem health underpins climate resilience, startups like NatureDots are applying deep-tech platforms for the restoration of rivers and lakes, reviving biodiversity while also supporting local livelihoods through sustainable ecosystem management. Finally, adaptation and resilience solutions are helping communities and businesses cope with intensifying climate risks. Fasal's AI-powered precision agriculture enables farmers to reduce crop risk, conserve water, and build resilience against extreme weather events, allowing them to adapt proactively rather than reactively.

Together, these innovations form a deepening pipeline that connects directly to India's most urgent emission and resilience challenges, while positioning Indian entrepreneurs at the global frontier of climate technology.

A two-way innovation street

This climate-tech innovation story transcends borders. Indian entrepreneurs bring resourcefulness, market agility, and global ambitions, starting with local affordability constraints then adapting solutions for international markets. The Chennai-based Zerowatt Energy's AI-powered industrial energy optimisation platform is expanding to the United Kingdom, bringing Indian energy intelligence solutions to European manufacturing sectors seeking decarbonisation. While Takachar's solution to the



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stubble burning crisis is now being deployed across Kenya, Uganda, and other developing economies facing similar agricultural waste challenges. They even won the 'Clean Our Air' category in the Earthshot Prize, a prestigious global awards program launched by Prince William to fund innovative solutions to the world's most urgent environmental challenges.

But the learning flows both ways. Europe brings a decade of experience in financing deep-tech ventures, operating blended climate funds, and enforcing industrial decarbonisation standards. The European Innovation Council's climate-tech accelerators and Germany's carbon border adjustment mechanisms offer valuable models for Indian policymakers.

Europe's regional diversity mirrors India's geographically dispersed innovation landscape, making Indian approaches to distributed scaling especially relevant. Joint accelerators, such as the Indo-German Energy Programme's startup initiatives, highlight how bilateral collaboration can amplify impact.

Building the decarbonisation engine

The path forward is complex but increasingly navigable, with systemic barriers that need targeted intervention. Overcoming these challenges requires coordinated efforts across government, industry, and finance to create an environment conducive to innovation and scale. To fully unleash the country's climate-tech startup movement, India must pursue five strategic priorities:

1. **Establish dedicated growth-stage climate funds** with 10-year investment horizons and blended finance structures that can bridge the critical stage between pilot and scale.

2. **Strengthen incubation infrastructure** beyond metros, ensuring Tier-2 and Tier-3 cities have access to world-class validation facilities, technical expertise, and mentorship networks.

3. **Anchor demand systematically** through corporate and public procurement programs that guarantee early market access for breakthrough solutions, following models like Denmark's green procurement requirements.

4. **Harmonise policy frameworks** between central schemes and state programs, creating seamless pathways from ideation through commercialisation without regulatory friction.

5. **Deepen India-EU partnerships** through joint funding mechanisms, shared accelerator programs, and mutual market access agreements that enable startups to scale across both regions simultaneously.

From startup ideation to a decarbonised future

India's climate-tech startups are the building blocks of a decarbonised future – where Delhi's children breathe cleaner air, Mumbai's streets better withstand monsoon floods, and farmers across Rajasthan use AI-powered tools to adapt to water.

With more than 800 active ventures, billions in funding, and globally minded entrepreneurs, India is not just catching up but has a unique, generational opportunity to lead the world's climate transition. These startups are designing tomorrow's solutions today – not only for India's air, water, and energy crises, but for planetary sustainability. Supporting them is more than an economic policy, it's a commitment to a ensuring a liveable, resilient future for generations to come.

03 India's urban climate-tech.
Source: Milin John / Unsplash

04 EV scooter in an Indian neighbourhood.
Source: Ather Energy / Unsplash



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05 An artist's illustration of artificial intelligence (AI). This image depicts how AI could be used in the field of sustainability from biodiversity to climate.
Source: Nidia Dias / Pexels

Mobility





EV Growth

India sold 1.2 million EVs in FY24, reaching 5% market penetration. With supportive policies and expanding infrastructure, India is positioning itself as a global EV hub.

Source: Times of India



Delhi E-Buses

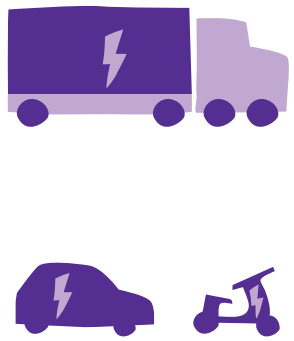
Delhi has deployed 76 electric buses under the DEVI initiative. These are designed to improve last-mile connectivity around metro stations and narrow city routes.

Source: ET Energy World

Green Railways

Indian Railways has secured 7,600+ MW of solar and wind power, including solar at a record-low ₹2.15/kWh. These steps are part of its broader plan to achieve net-zero emissions.

Source: Press Information Bureau



Sustainable Transport Mission

India will launch a Sustainable Transport Mission under its National Action Plan on Climate Change. This marks the first major addition to the plan in over a decade.

Source: Business Standard

Advancing Sustainable Mobility Initiatives

The government is driving sustainable mobility through the PM e-Drive scheme and the PM e-Bus Seva programme. Together, they aim to boost EV adoption and deploy 10,000 electric buses nationwide.

Source: Hindustan Times



Hydrogen Buses

India's first hydrogen fuel cell buses began operating in Leh, Ladakh. The initiative sets a global benchmark for clean transport in extreme, high-altitude terrain.

Source: Times of India



Green Freight

The PM e-Drive scheme offers incentives of up to ₹9.6 lakh per electric truck. It targets the replacement of 5,600 older diesel trucks with cleaner freight vehicles.

Source: The Economic Times

EV Exports

Maruti Suzuki's e-Vitara is India's first global battery EV and will be exported to 100+ countries. With 80% of battery value produced domestically, it strengthens India's clean mobility ecosystem.

Source: Times of India

EV Toll Waivers

Maharashtra now allows full toll exemptions for passenger EVs on major routes like the Samruddhi, Mumbai–Pune, and Sewri–Nhava Sheva expressways. This move under the updated EV policy aims to accelerate electric vehicle adoption and reduce driving costs.

Source: Times of India



City EV Expansion

Bengaluru is set to scale its electric bus fleet dramatically under the PM e-Drive programme, adding 4,500 e-buses to exceed a 10,000-vehicle fleet.

Source: Times of India

How Tax Reforms are Driving the Future of Sustainable Mobility in India





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ECONOMIST, OMI FOUNDATION & LEAD, CENTRE FOR FUTURE MOBILITY, OMI FOUNDATION

As India accelerates towards a greener transport future, the overhaul of its tax structure has become a key policy lever shaping the economics of sustainable mobility.

How have India's tax regimes and related policy tools influenced consumer behaviour, market entry, and the growth of the automotive sector?

India's tax regimes have consistently shaped consumer purchasing decisions and market dynamics in all sectors, and the automotive sector is no exception. In the 1990s, the combined incidence of customs duty, excise, and sales tax often exceeded 60% of a car's base price, suppressing affordability and slowing ownership growth. Policy recalibration in the 2008 Budget, when excise duty on small cars and two-wheelers was reduced from 16% to 12%, immediately stimulated demand in the most price-sensitive segments, signalling the state's use of tax relief as a demand-shaping instrument.

On the supply side, the Automotive Mission Plan 2006-2016 emphasised excise concessions for small vehicles and lower duties on raw materials (from ~7.5%) to catalyse localisation of components and attract global Original Equipment Manufacture (OEM) investment. These measures triggered a wave of compact car launches, greater reliance on domestic suppliers, and sharper competition on price points.

At the dealer level, anticipation of tax relief often led to inventory build-ups or delayed retail sales, underscoring how fiscal signals influence channel behaviour as much as consumer demand. In essence, India's tax and duty instruments have not only generated revenue but have been market-shaping tools, determining what vehicles consumers buy, how manufacturers design and localise, and how quickly new entrants expand.

Beyond being a tax system, how can the Goods and Services Tax (GST) framework function as a strategic lever to shape demand, supply, and the adoption of sustainable mobility solutions?

It isn't a question of being 'beyond' a tax system, rather, it is a matter of informing our perspectives on what a comprehensive tax-system truly entails. Tax systems are multidimensional policy instruments that innately shape supply-chains, consumer demand

In the 1990s, the combined incidence of customs duty, excise, and sales tax often exceeded 60% of a car's base price, suppressing affordability and slowing ownership growth.



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as well as sustainability transitions. Even before the 2025 tax reforms, India's Goods and Services Tax (GST) served as more than a fiscal instrument – it acted as a policy lever to influence demand, supply, and investment in sustainable mobility.

On the demand side, GST differentiation encouraged cleaner vehicle choices. Since July 2019, electric vehicles were taxed at just 5%, compared to 28% plus cess for petrol and diesel cars. This sevenfold gap made EVs more competitive and spurred early adoption, especially in the price-sensitive two- and three- wheeler markets. After the rate cut, electric two-wheeler sales jumped from about 130,000 in FY2020 to over 720,000 in FY2023, even before large-scale subsidies under FAME-II took hold. Similarly, charging infrastructure benefited from a 5% GST rate, reducing capital costs for operators. The nationwide GST system also enabled better policy monitoring by providing granular consumption and tax data. This allowed the government to identify EV adoption clusters, estimate fiscal costs, and calibrate incentives – insights that were impossible under India's earlier fragmented tax regime.

The 2025 GST reforms built on these lessons, shifting from encouragement to system-wide optimisation. By cutting GST on small cars to 18%, maintaining 5% on EVs, and eliminating inverted duty structures, the new framework aligns affordability with industrial incentives. It also complements schemes like PM E-DRIVE and PLI-ACC, linking fiscal policy with manufacturing and infrastructure expansion.

In essence, GST has evolved from a tax collection system into an industrial and behavioural policy tool one that can both steer consumer choice and shape the contours of India's clean mobility transition.

Recent GST rationalisation measures have targeted affordability and manufacturing in the automotive sector. What do you see as the government's intent behind these changes, particularly in promoting EV adoption?

Much like earlier tax interventions that boosted electrification, or nudged localisation, the September 2025 GST rationalisation reflects the state's continued use of fiscal tools to guide industry behaviour. This time, the emphasis is on recalibrating the market structure – ensuring that mass demand is sustained, while also signalling where future

Much like earlier tax interventions that boosted electrification, or nudged localisation, the September 2025 GST rationalisation reflects the state's continued use of fiscal tools to guide industry behaviour.



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investments in technology and manufacturing should flow.

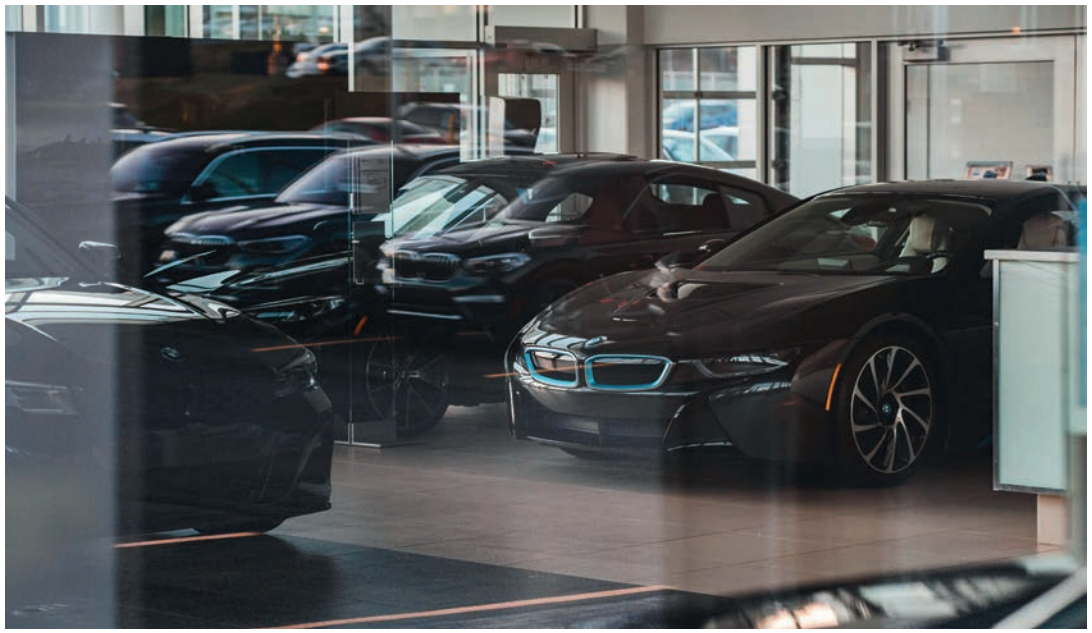
Rates on small petrol, CNG, and diesel cars (under 1,200–1,500 cc and ≤4 metres) were cut from 28% to 18%, effective September 22, 2025. The same reduction – from 28% to 18% – was applied to three-wheelers and buses or larger passenger vehicles, signalling a push for more affordable mobility options across private, shared, and public transport. These measures directly support price-sensitive first-time buyers, ease fleet purchases for ride-hailing and delivery operators, and help lower the cost of public transport while improving fleet electrification economics.

The strongest signal for clean mobility came from fuel-cell motor vehicles, where the GST rate dropped from 12% to 5%, aligning incentives with India's hydrogen roadmap. In contrast, hybrid vehicles with higher engine capacity saw a punitive increase to 40%, discouraging "luxury hybrids" that offer limited environmental benefits.

On the supply side, GST on tractor parts was reduced from 18% to 5%, cutting input costs for rural equipment manufacturing and supporting job-creating localisation.

Taken together, these reforms highlight a deliberate strategy: drive mass affordability (especially in compact cars, 3-wheelers, and buses) while signalling a technology-neutral but sustainability-first tilt – favouring EVs and hydrogen – and disincentivising high-capacity hybrids and luxury segments. The broader direction is towards catalysing volume adoption in clean mobility and building the demand certainty that can anchor investment in domestic EV and component ecosystems.

How are these tax reforms likely to influence different stakeholders – vehicle sales (small cars, EVs, commercial fleets), domestic manufacturing (components, batteries), and the broader EV ecosystem?



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India's recent tax reforms mark a decisive shift in automotive policy by reshaping affordability, manufacturing, and incentivising the path to cleaner mobility. The most visible boost is for small car buyers: cutting GST from 28% to 18% has reduced prices, with major automakers already passing on the benefits. This should revive demand among first-time and middle-class buyers – segments crucial to India's goal of becoming the world's largest vehicle manufacturer by 2030, as outlined by Road Transport and Highways Minister Nitin Gadkari at the International Value Summit 2025. Lower purchase costs are set to expand the consumer base, accelerate production, and stimulate the supply chain.

For electric vehicles, however, the picture is mixed. The 5% GST rate maintains stability, but excluding electric passenger cars from the new PM E-DRIVE scheme (launched in September 2024 to replace FAME-II with a ₹10,900-crore outlay) was a missed opportunity. While the scheme supports two- and three-wheelers, buses, and trucks, electric cars still cost 1.3–1.7 times more than petrol or diesel models. Despite EV car sales rising 93% year-on-year to 15,528 units in July 2025, they form only 4.7% of total passenger sales. Without renewed fiscal incentives, India risks missing its 30% electrification target for 2030.

The reforms favour commercial fleets. Reducing GST to 18% for trucks, buses, and three-wheelers lowers acquisition and operating costs, improving fleet economics and reducing logistics expenses. PM E-DRIVE allocates ₹4,391 crore for 14,028 electric buses and targeted subsidies for electric three-wheelers and ambulances. All of these are measures expected to modernise public transport and electrify freight mobility.

For component makers, a uniform 18% GST rate ends the long-standing inverted duty structure that locked up working capital and delayed refunds. This simplifies compliance, eases liquidity for MSMEs (owed over ₹26,000 crore by large manufacturers) and strengthens local sourcing and supply chain resilience.

01 CNG-fuelled transportation is on the rise in India.
Source: Carolina Avinceta / Unsplash

02 Tax cut on environment-friendly vehicles is leading to a rise in electric vehicles in India.
Source: Chuttersnap / Unsplash

03 Rise in the sales of the automobiles sector.
Source: Erik Mclean / Unsplash

Even with the 2025 GST reforms, several structural frictions continue to slow down the transition to sustainable mobility.

Battery manufacturing remains the weak link. The ₹18,100-crore PLI-ACC scheme has yet to yield commercial output, prompting Budget 2025 to exempt 35 capital goods and key minerals like cobalt and lithium scrap from import duties. Meanwhile, charging infrastructure lags: of 30,000 registered stations, barely half are operational. PM E-DRIVE's ₹2,000-crore plan for 72,300 new chargers is vital to bridge this gap.

The reforms lay a solid fiscal foundation, but India's clean mobility transition will depend on tighter alignment between taxation, infrastructure, and domestic manufacturing – ensuring progress moves in sync across all fronts.

Despite reforms, complexities like Input Tax Credit issues, cost pressures at the component level, and gaps in policy monitoring remain. How do these challenges affect the pace of sustainable mobility adoption?

Even with the 2025 GST reforms, several structural frictions continue to slow down the transition to sustainable mobility.

The first is Input Tax Credit complexity. EVs are taxed at 5%, but key inputs like battery cells and power electronics still attract 18%. This inverted duty structure forces manufacturers to wait months for refunds, tying up as much as 7-8% of turnover in working capital. Fleet leasing companies face an added hurdle – GST law restricts credits on vehicles used for renting or hiring – so they carry a tax cost of 10-12% higher than outright buyers, which directly slows down fleet electrification.

Second, there are component-level cost pressures. While finished EVs benefit from concessional GST, many critical inputs, chargers, BMS, electronics, remain expensive. Domestic MSME suppliers struggle to localise these parts competitively, leaving India's EV value chain import-dependent and delaying investment in gigafactories and advanced manufacturing.

And third, monitoring and evaluation gaps reduce policy effectiveness. When GST on small cars and three-wheelers was cut in 2025, price reductions varied widely across OEMs; some passed the relief on fully, others retained margins. Without digital tagging of EV-related HSN codes and systematic use of GSTN data, policymakers can't track pass-through, localisation, or adoption trends in real time. That makes course corrections slower and leaves investors uncertain about the policy environment.

The combined effect is that adoption becomes slower, costlier, and patchier than intended. Consumers pay more than the policy signal suggests, suppliers hesitate to localise, and investors remain cautious. Unless GST is streamlined to remove these frictions – and complemented by real-time monitoring – India risks falling short of its EV penetration and manufacturing leadership ambitions.

What tax changes or incentives would best help India adopt sustainable mobility, make manufacturing cheaper, and track progress effectively?

India's journey toward sustainable mobility hinges on well-calibrated fiscal policies that make electric vehicles affordable, manufacturing efficient, and progress transparent, using incentives as levers for scale, innovation, and affordability.

A tiered GST structure could make electric vehicles (EVs) more inclusive and fiscally balanced: 0% GST on EVs under ₹15 lakh to accelerate mass adoption, 5% for mid-range models, and 12% for premium EVs. Such calibration would widen access while preserving revenue neutrality. Reviving Section 80EEB of the Income Tax Act, the earlier ₹1.5 lakh income-tax deduction on EV loan interest, would further ease affordability barriers for price-sensitive consumers and sustain retail demand.

On the supply side, India needs to consider cutting input costs to improve liquidity for local businesses. Extending customs duty exemptions, which are currently limited to 35 battery-related capital goods, to include motors, controllers, and power electronics would strengthen domestic manufacturing. Likewise, making the 90% provisional ITC refund permanent or introducing GST credit trading platforms would help MSMEs unlock working capital, a chronic weakness in the auto value chain.



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04 The rise of EV-run scooters in India.
Source: Ather Energy / Unsplash

Battery production remains the largest strategic gap. The ₹18,100-crore PLI-ACC scheme has yet to yield concrete results at appreciable scale, suggesting the need for gradual domestic value addition (25%, 35%, 45%, and 55% over five years) instead of an ambitious 50% requirement upfront. Pairing this with R&D grants and technology transfer support for anodes, cathodes, and electrolytes. This together makes up 36% of total cell cost and the resultant incentives could attract global partnerships. Investments in battery recycling infrastructure would also ease dependence on imported lithium and cobalt.

Infrastructure incentives must scale with production. Doubling the PM E-DRIVE allocation from ₹20 billion to ₹50 billion would fund nationwide charging coverage, ensuring no driver is more than 50 km from a fast charger. Mandating that 30% of installations be in tier-2 and tier-3 cities, along with viability gap funding for battery-swapping, would ensure equitable adoption.

Finally, progress must be measurable. Blockchain-linked battery IDs could track subsidies, recycling, and second-life use, while a unified national charging app would simplify access and payments. Linking central funding to the India Electric Mobility Index (IEMI) would reward high-performing states. Together, these measures would transform GST from a revenue instrument into a strategic driver of clean, affordable, and globally competitive mobility.

How Data Is Accelerating Freight Electrification in India

WRITERS
NAIM KERUWALA & SARIKA CHAKRAVARTY



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India moves about 4.6 billion tonnes of freight each year, creating a transport demand of 2.2 trillion tonne-kilometres at a cost of nearly $115 billion.

E-trucks are decarbonising India's transport sector, with data playing a critical role in debunking technology myths and enabling route optimisation, cost reduction, infrastructure planning, and large-scale adoption. Affordability and quality of life for all citizens should additionally serve as inherent factors of mobility, alongside its intersection with other city systems.

India is witnessing historic growth. Rapid urbanisation, a rising population, expanding e-commerce, and higher incomes are dramatically increasing the demand for goods and services. To keep pace, the road freight sector is projected to grow nearly fourfold by 2050, according to research published in 2022 by The National Institution for Transforming India (NITI Aayog), a government think tank. However, if this surge continues to run on fossil fuels, it will worsen air pollution, deepen public health crises, inflate energy costs, and drive up emissions just as we race to reduce them. Meeting future freight demand with conventional diesel trucks would mean spending over US $1 trillion on crude oil imports by 2050 reports NITI Aayog, an unsustainable economic and environmental burden.

Already responsible for 70% of goods movement and nearly 40% of fuel use, India's road freight sector stands at a pivotal moment. The transition to Zero-Emission Trucks (ZETs) offers a clear path to decarbonisation, cutting emissions while lowering operating costs and achieving India's net-zero goals. With battery costs falling and policy momentum accelerating, the missing link isn't technology but data. By leveraging e-freight data to accelerate adoption and debunk technology myths, India can unlock the economic, environmental, and health benefits of zero-emission trucking.

The Indian government has announced US $60.2 million in incentives for over 5,600 e-trucks, and subsidies of up to $57 per kWh.

Road freight drives the Indian economy

India's freight network is the backbone of its economy and one of its biggest climate challenges. A working paper by the World Bank published in 2018 found that the country moves about 4.6 billion tonnes of freight each year, creating a transport demand of 2.2 trillion tonne-kilometres at a cost of nearly US $115 billion. Trucks dominate this movement carrying over 70% of domestic freight while representing less than 5% of total vehicles.

However, freight trucks are responsible for a disproportionately large share of India's transport emissions. They account for nearly 40% of on-road fuel consumption and roughly half the particulate and NO_x pollution. Transport analysts estimate that under business-as-usual, the number of medium- and heavy-duty trucks on our roads will more than quadruple by 2050. Transport already makes up 13% of India's total energy-related greenhouse gas emissions, according to India's fourth biennial update to the UNFCCC. If current trends continue, India's truck fleet could quadruple by 2050 locking the country into higher emissions, fuel imports, and health costs.

Why electrify and why now?

The case for ZETs is no longer environmental idealism; it's economic pragmatism. According to NITI Aayog, wide-scale Zero- Emission Trucks adoption could help India avoid 3.8 gigatonnes of CO_2 and save about US $140 billion in oil imports by 2050.

The public health case is even stronger. Studies from IIT Kanpur and the International Council on Clean Transportation (ICCT) estimate that accelerated EV adoption could prevent more than 70,000 premature deaths each year by 2040. Communities in freight corridors often already live with asthma, respiratory distress, and constrained daily lives because of dust, smoke, and pollution. Clean-air benefits would be immediate and meaningful.

And yet, electrified freight remains a rounding error in India's logistics sector. Of over 0.83 million trucks sold in 2024, just 6,200 were electric and 95% were small urban vehicles. Only 280 were heavy-duty electric trucks. This gap isn't for lack of will; it's for lack of data. Without reliable, shared information on routes, costs, usage, and demand, no business model can scale.



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01 E-trucks are decarbonising India's transport sector, and data is playing a role in it.
Source: abshky / Pexels

02 Roads act as the backbone of the Indian economy
Source: Atharva Tulsi / Unsplash

03 Transport makes up to 13% of the energy related greenhouse emissions in India.
Source: Ravi Sharma / Unsplash

Building the policy momentum, India is already steering in the right direction with the government having announced $60.2 million in incentives for over 5,600 e-trucks, and subsidies of up to $57 per kWh. The Bharat Zero Emission Trucking (ZET) policy advisory, led by the Office of the Principal Scientific Adviser, calls for tax breaks, low-interest loans, and charging infrastructure along key corridors. Guidelines released by the Union Government recommend fast chargers every 100 km on national highways. And the National Logistics Policy and Unified Logistics Interface Platform are aligning multiple agencies behind a common digital backbone.

Meanwhile, NITI Aayog's e-FAST initiative has aggregated demand commitments for nearly 7,800 ZETs from 16 companies creating a pathway for scaled manufacturing and adoption. Policy frameworks are already aligning with the government identifying ten highway segments for zero-emission truck movement showcasing that the political will exists. These efforts show strong intent. But turning pilot projects into national transformation depends on one missing ingredient: data-driven adoption of electric freight in India.

C40 Cities' Laneshift Programme has begun to show how data can bring this hope within reach. Along the 350-kilometre Bengaluru-Chennai highway, Laneshift is testing long-range electric freight trucks. Early operational data indicate that with sufficient infrastructure and planning, fuel cost savings and emission reductions are large enough to make electric trucks viable for real commercial freight, not just pilots.

Truck manufacturers, logistics firms, state governments, and EV infrastructure providers are now collaborating, learning where charging must be



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How can data drive e-truck adoption?

E-trucks are crucial for India's freight decarbonisation, with data playing a pivotal role in accelerating their adoption. Data, including telematics, operational, and charging information, is vital to speed up their adoption. This data helps to understand battery usage, energy efficiency, and route performance, which is essential for replacing diesel trucks. Charging data further guides the strategic placement of charging stations and maintenance hubs, plan for energy and grid infrastructure enabling efficient nationwide deployment.

Using data on freight movement to see where goods move, where demand centres are, and where routes overlap can help match the right type of electric truck to the right route and duty cycle. It also enables charging stations to be planned where they are actually needed.

placed, understanding where trucks break down or idle, and where demand patterns make or break profitability. Businesses, cities and finance are coming together to accelerate the positive tipping point for zero-emission freight, making the technology more affordable, accessible, and attractive than conventional fossil fuel alternatives showcasing the use of data for building momentum in the industry.

Fleet, charging, route, energy, freight, and policy data are key to driving India's e-freight adoption and operational efficiency. Financing can be structured to favour operators with smaller fleets who today are excluded because the risk is uncertain. And communities living near major freight routes – often low-income or marginalised – can benefit first, because emissions reductions will happen where emissions are worst. Cities can also play a role by utilising "pull" policies to foster market momentum. For electric trucks, this includes leading by example by mandating the electrification of municipal vehicle fleets to generate early demand and build initial charging infrastructure. This initial phase is crucial, as it builds public support before cities introduce "push" policies. These regulatory measures, such as implementing Low Emission Zones (LEZs) or establishing mandates that limit fossil fuel vehicles, make conventional ICE trucks less convenient or unavailable, accelerating the market shift away from old technologies.

With freight electrification, there are broader gains beyond health. Reducing India's reliance on imported diesel strengthens energy security. Lower fuel and maintenance costs will bring down costs of goods, helping low-income communities. Green jobs in charging infrastructure, battery servicing, and EV manufacturing can revive regional economies. While cleaner streets and quieter nights are the improvements people will directly feel.

We need to treat data not as an optional add-on but as an enabler for stakeholder decision-making in India's EV transition.



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Policy frameworks are aligning as the government shows commitment to a future of electric freight.

Demonstrating these data-driven efficiency gains not only debunks technology myths but also encourages private sector participation and scales e-freight adoption beyond pilot projects. This evidence-based data driven approach to electric freight adoption in India contributes to policy making, enables targeted investments, maximises environmental benefits, and accelerates large-scale adoption of zero-emission freight.

When aggregated responsibly, these insights can also help policymakers and utilities anticipate charging demand, optimise grid planning, and prioritise investments in high-impact corridors.

The accelerating transition to electric freight

This is an opportune movement for the transition. Battery costs have dropped substantially. Grid technology is improving. Policy frameworks are aligning as the government shows commitment to a future of electric freight.

When data is leveraged it can power smarter decisions across the ecosystem. Policymakers can plan infrastructure where it's needed most. Financiers can price risk accurately, enabling credit access for small fleet operators, the main drivers of India's road freight. OEMs can optimise for real-world Indian routes, and cities can target emission reduction where the air is dirtiest.

We need to treat data not as an optional add-on but as an enabler for stakeholder decision-making in India's EV transition. Data-driven e-truck adoption is key to achieving India's net-zero goals enabling a cleaner, smarter, and more efficient freight future in India.

04 An EV shift can counter excessive emissions from urban Indian cities.
Source: Lukas Kienzler / Pexels



Water



Clean Water for Chunchuna

Chhattisgarh's Chunchuna village received clean drinking water for the first time since Independence, thanks to the Jal Jeevan Mission. This marks a historic milestone for a remote, Maoist-affected region long deprived of basic services.

Source: Times of India



Yamuna Master Plan

The Centre has drafted a 'Yamuna Master Plan' to tackle Delhi's river pollution crisis, inspired by Gujarat's Sabarmati riverfront project.

Source: India Today

₹9,000 Crore for Water & Sanitation

Delhi has allocated ₹9,000 crore in its 2025–26 budget to modernise water systems. Initiatives include smart metering, GPS-enabled tankers, STP upgrades, and emergency storage for shortages.

Source: Times of India



5,000 Water ATMs for Delhi

Delhi will install 5,000 water dispensing ATMs across the city through a public-private partnership model. These kiosks will serve localities without pipeline connections, reducing reliance on tankers.

Source: Business Standard



Real-Time River Monitoring

Delhi will set up 32 real-time water quality monitoring stations – 10 on the Yamuna River and 22 on drains. Continuous data will support quick interventions for river clean-up.

Source: NDTV

Dhanbad to Build 500 Small Ponds for Water Resilience

Dhanbad district is launching an environmental effort to construct over 500 ponds, each spanning 2–3 acres, situated along roadsides and near water towers. The project aims to boost summer water availability and involve residents in water conservation.

Source: Times of India

80% Rural India Covered

Over 80.9% of rural Indian households – 15.67 crore out of 19.36 crore – now have piped water access at home, a major achievement under the Jal Jeevan Mission.

Source: NDTV



Clean Ganga Mission Showcased as Global Model at Stockholm Water Week

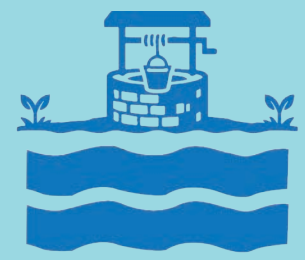
India's ₹40,000 crore Namami Gange Mission was showcased at Stockholm Water Week as a global model for river revival, using solar-powered treatment plants and soil biotechnology to rejuvenate the Ganga.

Source: Times of India

Ken-Betwa: India's First River Link Project

The Ken-Betwa Link Project, launched in October 2024, is India's inaugural river-interlinking scheme. Once completed (by 2030), it will irrigate 10.6 lakh hectares annually and benefit 62 lakh people in drought-prone Bundelkhand.

Source: National Water Development Agency



Atal Bhujal Yojana Empowers Communities

With 77,000+ structures in 7 states, Atal Bhujal Yojana has recharged 2,359 MCM groundwater, India's largest community-led effort.

Source: Press Information Bureau

Tapping Wastewater to Secure India's Water Future



SIDDHARTH DESAI
JT. MANAGING DIRECTOR, KISHOR PUMPS

Scaling wastewater treatment in India is key to unlocking a sustainable water future, reducing scarcity, and protecting public health.

Wastewater treatment is a stated priority under the National Water Mission (NWM)– why does India still treat less than half of its sewage, and what systemic gaps persist?

Research from the World Resource Institute indicates that India will be under severe water stress by the end of the decade. The country's growing population and rapid urbanisation are increasing water demand while generating larger amounts of waste water. To address this, policies like the National Water Mission and the Atal Mission for Rejuvenation and Urban Transformation (AMRUT 2.0) aim to make cities water-secure and self-sufficient, with a large share of urban water needs met through recycling and treating waste water. A process that involves removing contaminants from sewage to make the water safe for reuse or release into the environment, preventing pollution and protecting public health.

However, a 2022 report by the government think tank NITI Aayog revealed that less than a third of urban sewage is treated. Untreated wastewater continues to pollute rivers, lakes, and groundwater, posing serious health risks and harming ecosystems.

Many households still depend on septic tanks that are poorly maintained and often leak untreated waste into drains.

Overcoming the gap in wastewater treatment would unlock a vital water supply while alleviating fresh water pollution. But the current gap goes beyond the lack of Sewage Treatment Plants (STPs). Outdated collection systems, insufficient funding for operations and maintenance, unclear responsibilities, and strained municipal finances hinder progress. Even where treatment plants exist, they are frequently underutilised, poorly connected, or lack the power to operate effectively.

These issues are worsened due to a focus on individual plants rather than the entire system. The lack of oversight leads to illegal discharging and untreated sewage polluting water sources. Smaller towns especially struggle with high infrastructure costs and unclear revenue streams, leaving many treatment units non-functional. Additionally, aging infrastructure that combines stormwater with sewage increases load on the system during heavy rains. Addressing these systemic issues is essential to creating a sustainable, effective sanitation system across India.

Research from the World Resource Institute indicates that India will be under severe water stress by the end of the decade.



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How can policy frameworks better integrate wastewater reuse into national and state water security strategies?

Since water management is primarily a state responsibility, integrating treated wastewater into water security strategies requires strong commitment at the state level. The first step is for states to recognise treated wastewater as a viable water source and set clear reuse targets aligned to AMRUT 2.0, which aims to meet at least 20% of urban water demand and 40% of industrial water demand through water recycling. These goals must be linked to measurable milestones and regular reporting on actual demand met, rather than just capacity installed.

Next, states can mandate the use of recycled water through Recycled Water Purchase Obligations (RWPO), requiring utilities, industries, construction agencies, parks, and new developments to source a portion of their non-potable water needs from treated wastewater. Providing an alternative water source is especially important for industries such as energy production. The World Resource Institute highlights that nearly half of India's thermal power plants – the country's primary energy source – experience water stress, leading to shutdowns and energy shortages. Mandates on wastewater usage could be supported with enforceable contracts and financial incentives, particularly in cases were where tariffs do not fully cover treatment and supply costs.

States need to recognise treated wastewater as a viable water source.

Lastly, India needs to shift from a one-size-fits-all approach to a fit-for-purpose model, where national guidelines clearly define water quality standards for different reuse applications – such as industrial cooling, landscaping, agriculture, groundwater recharge, or environmental flows. Strengthening monitoring and ensuring public transparency will be key to building trust, unlocking demand, and making wastewater fundamental to water security in India.

How can decentralised wastewater treatment systems complement large centralised plants in both urban and rural areas?

Decentralised wastewater treatment (DWWT) systems play a vital role in filling gaps left by large centralised plants, especially in underserved areas. In urban settings, smaller treatment units – such as district-scale, estate, or building-level plants – act like capillaries feeding into the main system. They quickly intercept sewage in low-density or unsewered areas, can be set up rapidly, and later integrated or co-treated with larger plants.

Treating wastewater close to the demand areas – whether for parks, construction sites, industrial cooling, or residential estates – reduces pumping costs and secures reliable water reuse. This also relieves pressure on central systems, making processes more resilient during heavy rains, when water treatment infrastructure is often overloaded.

A practical model is the hub-and-spoke approach: the central plant ensures quality control, sludge management, and monitoring, while local systems handle treatment and discharge into reuse points or the main drain. In rural and small-town areas, simple solutions like soak pits or planted filters, along with regular desludging and faecal sludge treatment, offer effective, low-cost, fit-for-purpose options.

To ensure decentralised sewage treatment systems effectively complement large, centralised plants, cities and state need to divide areas that already have sewage systems from those that depend on local systems. They should also map reuse demand before



02

infrastructure and require buildings to implement dual plumbing systems that separate clean and wastewater. Establishing long-term agreements for operation and maintenance with performance-linked payments, such as consistent treatment quality and reuse will encourage adoption. Tracking progress through citywide monitoring systems ensures accountability and builds confidence in decentralised wastewater treatment options.

How can treated wastewater be positioned as a climate resilience tool, especially in water-scarce regions?

Treated wastewater can be a powerful tool for climate resilience, especially in water-scarce regions of India. Water scarcity is a significant challenge, with many areas facing dwindling surface water sources like rivers and lakes, changing monsoon seasons, and over-extraction of groundwater leading to falling water tables. In such a context, treated wastewater offers a reliable alternative water source for non-potable uses such as irrigation, industrial processes, cooling in power plants, and landscaping. When properly managed and integrated into water planning, it reduces the demand on stressed natural water sources, easing pressure on already overused rivers, lakes, and aquifers.

Embedding treated wastewater use in drought management codes provides a steady, predictable supply of water, even during dry seasons or prolonged drought periods. Practices like groundwater recharge – injecting treated water into underground aquifers – can help store excess water during the

01 Water pollution is a key cause for concern in India.
Source: Brian Yurasits / Unsplash

02 A bridge above the polluted Yamuna river.
Source: Jyotirmoy Gupta / Unsplash



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Decentralised wastewater treatment systems play a vital role in filling gaps left by large centralised plants, especially in underserved areas.

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03 Pollution at Howrah Bridge
Source: Abhyuday Majhi / Unsplash

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Embedding treated wastewater use in drought management codes provides a steady, predictable supply of water, even during dry seasons or prolonged drought periods. Practices like groundwater recharge – injecting treated water into underground aquifers – can help store excess water during the rainy season, ensuring availability during droughts and preventing issues like seawater intrusion, where overextraction of groundwater can lead to seawater contaminating freshwater sources in coastal areas.

The effective use of treated wastewater as a climate resilience tool comes down to what I previously mentioned: creating a fit-for-purpose approach. Treatment levels must match specific uses, whether for irrigation, industrial cooling, or environmental benefits.

If you could prioritise three immediate policy or investment shifts to fast-track sewage treatment and reuse, what would they be?

To my mind, three shifts stand out: move from asset creation to outcome delivery, securing demand for recycled water, and closing the collection gap.

First, we must pay for outcomes, not assets. Grants should be converted into performance-linked payments per verified kilolitre treated and reused, with bonuses for compliance uptime and energy efficiency. Standardising contracts to ensure sustainable funding for operations and maintenance is vital.

Secondly, states should guarantee demand. This can be done through implementing obligations for recycled water use across industrial areas and large developments. Government co-funding of infrastructural needs like upgrading treatment facilities will produce higher-quality recycled water through tertiary treatment, while installing specialised piping systems ensure treated water distribution for uses like irrigation or industrial processes.

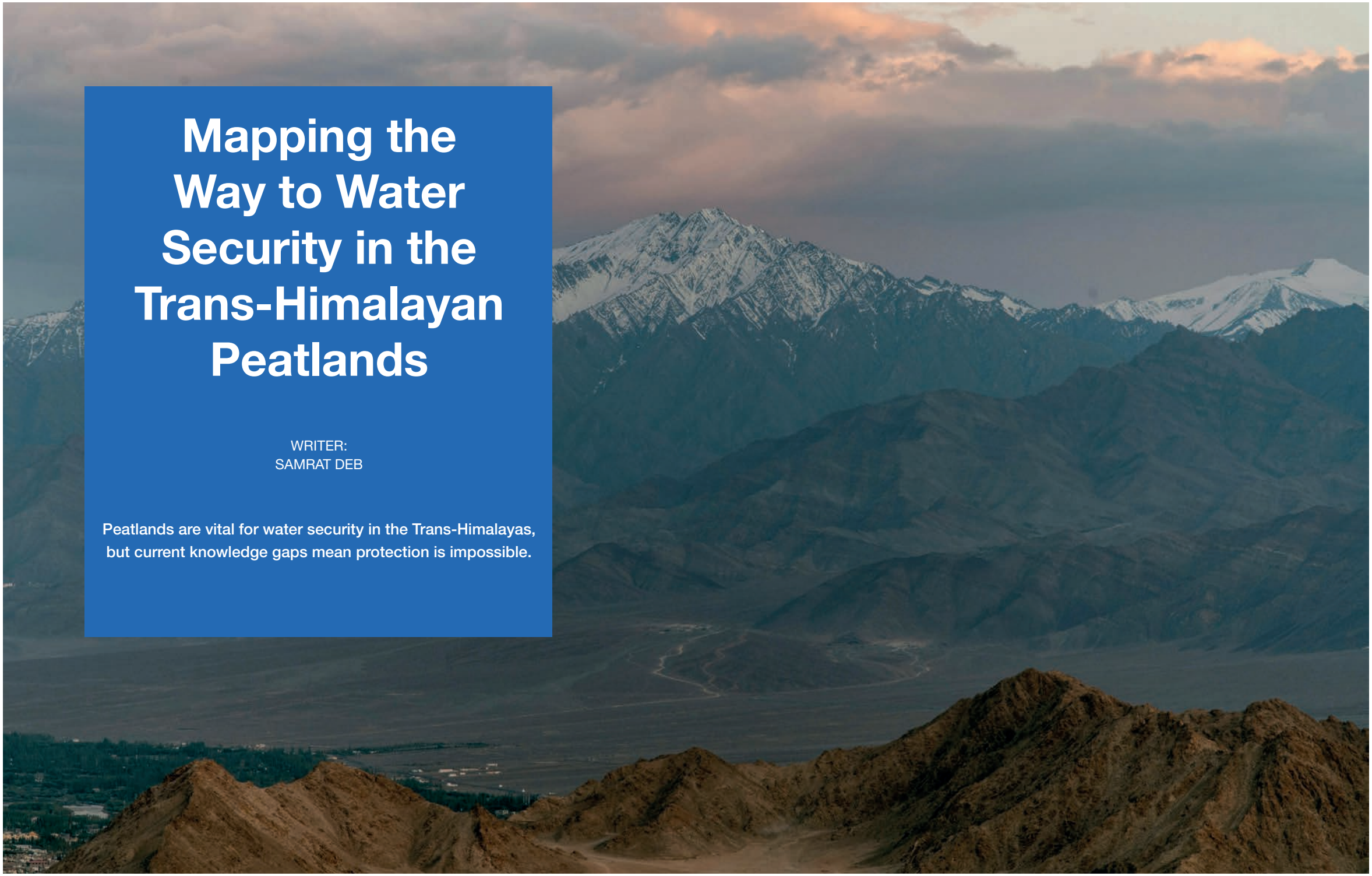
Lastly, expanding the collection wastewater network to ensure citywide sanitation is crucial. This means funding the connection of households to safe sewage systems, preventing untreated sewage discharges into drains and aquifers, and mandating regular desludging with supportive infrastructure like faecal sludge treatment plants or co-treatment bays at city sewage treatment plants. In areas without sewerage, local treatment facilities can be used to treat wastewater close to where it is generated. New rules requiring buildings to have dual plumbing systems will support efficient and safe sewage management.

Implementing these changes will directly support India's policy goals of ensuring sustainable water management and expanding access to safe sanitation for all citizens. By moving towards outcome-based approaches and scaling wastewater reuse, India can make significant progress in achieving water security and building healthy, resilient urban and rural communities. ●

Mapping the Way to Water Security in the Trans-Himalayan Peatlands

WRITER:
SAMRAT DEB

Peatlands are vital for water security in the Trans-Himalayas, but current knowledge gaps mean protection is impossible.



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There's a saying in Ladakhi: "If you have no water, you have no settlement". For the Ladakhi people, who live in the high-altitude Ladakh region of northern India, part of the Trans-Himalaya, ensuring access to water has always defined their survival. This remote and rugged landscape, spanning northern India, Nepal, Tibet, and Pakistan, is characterised by extreme elevation and harsh environments. Communities like the Ladakhi have long relied on meltwater from snow and glaciers to sustain themselves. Yet today, climate change threatens these vital water sources, turning villages into ghost towns and pushing communities to the brink of crisis.

The solution to water resilience might lie in the region's peatlands and high-altitude meadows – natural water reservoirs that could help combat drought. However, these landscape features are poorly studied and are under threat, and their potential for supporting communities in a changing climate remains largely unknown. Mapping them is a crucial step toward developing a better understanding of their potential and ensuring water resilience for the future.

Melting glaciers threaten water supplies

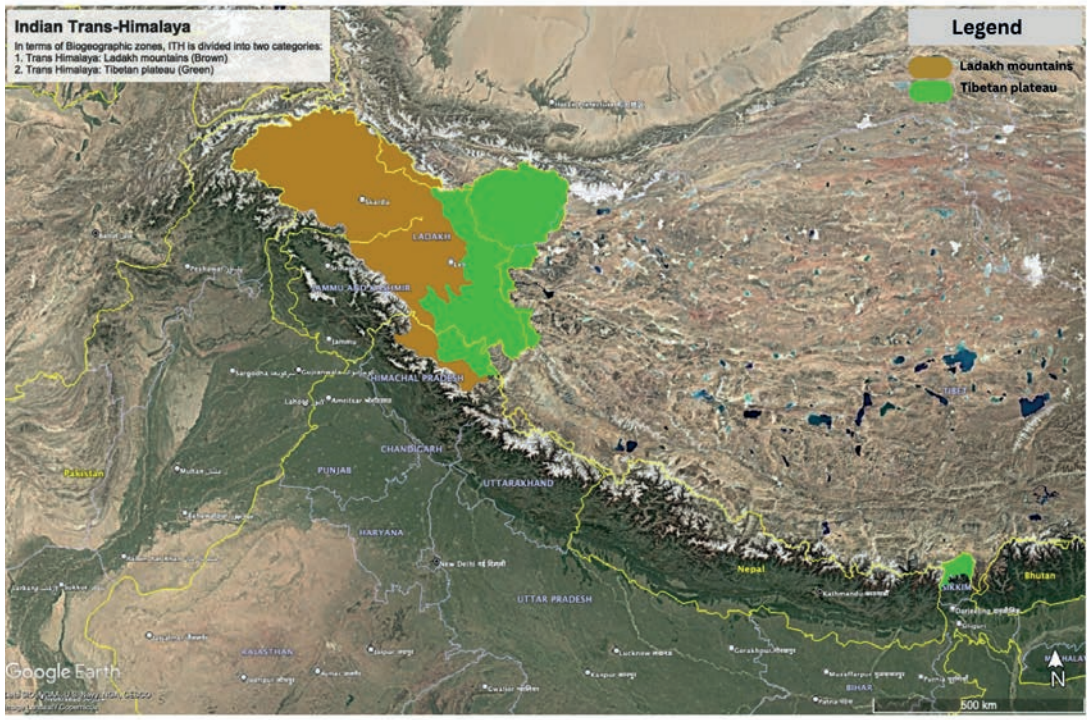
The Indian Trans-Himalaya covers over 184,000 square kilometres – more than 5% of the country's landmass – at elevations ranging from 3,000 to 5,000 metres. These heights experience some of the world's most limited rainfall, with regions like Ladakh receiving only about 100 mm annually – less than a tenth of India's national average of 1,083 mm. UNESCO refers to this area as the "Cold Desert Cultural Landscape". Here, snow melt, glaciers, and wet meadows or peatlands provide vital sources of water for over 330,000 inhabitants, supporting agriculture, daily needs, and livelihoods.

But as glaciers retreat and snowfall patterns shift due to warming temperatures, these natural water sources diminish, severely impacting access to clean water and endangering the very existence of these high-altitude communities.

Satellite analyses of Ladakh, by the South Asia Institute at Heidelburg University, reveal significant changes between 2000 and 2019: winter and spring snow cover decreased, while summer snow slightly increased – indicating a change in snowfall timing and intensity. These changes disrupt the snowpack accumulation vital for water storage in the Trans-Himalayan region. In addition to changes in the snowfall pattern, long-standing glaciers in the region have been retreating rapidly.

The Chhota Shigri glacier in Himachal Pradesh, a 9-kilometre-long valley glacier that feeds the

"If you have no water, you have no settlement".



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Chandra River, is the longest continuously monitored glacier in the Himalayas. Its ongoing ice loss reflects reduced snow and ice accumulation during winter months, highlighting the impacts of changing climate patterns. Similarly, long-term studies have documented the retreat of the Baga Shigri glacier, which, according to research published in Physical Geography in 2017, receded approximately 1.1 kilometres between 1965 and 2014 – roughly the length of two football fields.

As these glaciers continue to shrink at an accelerated rate, downstream water flows are projected to peak by mid-century before gradually declining each year. This pattern suggests that regions relying on glacial melt for their water supply will experience severe flooding until 2050, only to be followed by prolonged periods of droughts. The outlook is troubling for both communities and ecosystems that depend on glacial water, facing an uncertain and increasingly challenging future.

While the Indian government is aware of the current situation in the region and is implementing short-term measures to provide water to local communities living in the Trans-Himalayas, greater emphasis should be placed on long-term, nature-based solutions that can effectively store water and improve community resilience.

Nature's finest water reservoirs

One promising natural solution to the water crisis in the Trans-Himalayan region is the protection and restoration of peatlands and high-altitude wet meadows. Globally these water-logged ecosystems are vital, with peatlands storing around 10% of the world's freshwater, according to the Natural Conservancy, and acting as essential water buffers. Composed of undecomposed organic matter, peatlands feature large pores that enable them to absorb and retain substantial volumes of water. Many peatlands worldwide, including those in the Himalayas, are characterised by Sphagnum moss, which can hold up to 20 times its dry weight in water. A preliminary study published in January 2025 by GIZ India in collaboration with Wetlands International South Asia and the Indian Ministry of Environment, Forest and Climate Change, estimates that peatlands cover approximately 260,000 hectares in the Indian Himalayas.

Once water is stored in peatlands, it is gradually released into streams, helping to prevent sudden floods and maintain a steady flow throughout the year. During dry periods, peatlands serve as critical water reservoirs, buffering the impacts of droughts and ensuring a more reliable water supply. Research published in the Journal of Hydrology in 2023 on the Andes of South America from a landscape similar to the Trans-Himalaya show that peat-forming bofedales, a type of high-altitude wetland, can provide as much as 98% of the water flowing into rivers and streams during the dry season. This "sponge effect", absorbing and releasing water, underscores the vital role that peatlands play in providing a natural hydrological buffer and maintaining water availability during dry periods.

In arid, high-altitude regions like the Trans-Himalayas where snowmelt is the primary water source, peatlands function as natural flow regulators. They store winter and spring snowmelt and release it slowly during late spring and summer – crucial times for the survival of villages in the region. As climate change causes earlier snowmelt and reduces overall snowfall, peatlands could help delay water runoff and extend water availability, aiding communities in coping with increasingly brief and unpredictable periods of water supply.

Beyond their water-regulating functions, peatlands play a significant role in carbon storage. According to the *Global Peatlands Assessment: The State of the World's Peatlands* by the UN Environment Programme, despite only covering about 3% of Earth´s surface, peatlands store almost a third of the world's carbon. Peatlands provide critical biodiversity habitat for various species and support local livelihoods through grazing. However, although they are highly significant, peatlands remain understudied and undervalued, research published in the Journal of the Society for Conservation Biology in



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01 Ladakh, India.
Source: Julia Wolk / Pexels

02 Map of the Indian Trans-Himalaya region.
Source: Samrat Deb

03 Peatlands in Chushul Valley, Ladakh.
Source: Samrat Deb

04 Settlement of Nomadic Changpa community in Ladakh peatlands.
Source: Samrat Deb

Peatlands store around 10% of the world's freshwater.



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05 Livestock grazing in peatlands in Ladakh
Source: Samrat Deb

2025 demonstrates that only 17% of the world's peatlands fall under protection.

In India, there's a significant knowledge gap about the extent and locations of peatlands, with only 1% of India's peatlands officially mapped. How can we effectively protect and manage ecosystems when we lack fundamental information about their location and extent?

Currently, only 17% of the world's peatlands fall under protection.

Overcoming the knowledge gap

As part of the Alexander von Humboldt Foundation's International Climate Protection Fellowship, my research involves demarcating and mapping high-altitude peatlands in the Trans-Himalayas to explore the correlation of peatlands with the water availability. By doing so, I aim to develop a better understanding of the existing synergies between these ecosystems and local water flow. This knowledge can inform conservation strategies, ensuring that peatlands are effectively protected and integrated into water management policies to strengthen climate resilience and support sustainable development in the region.

The mapping process involves examining remote sensing and GIS-based datasets combined with ground truthing – visiting and physically verifying the data. However, because of the geopolitical uncertainty of the region and very limited research in the past, there is significant data unavailability in the region. To address this challenge, the research focuses on gathering community knowledge along with high-tech modelling and satellite datasets to overcome data gaps in the region.

In the Trans-Himalayan region, my initial findings indicate that peatlands are widespread particularly in areas where groundwater emerges. Mapping indicates that their distribution is largely influenced by topographic features – such as valley bottoms and gentle slopes – as well as climate. These areas are also essential for controlling the sources of rivers and streams. Protecting these zones would help maintain a steady flow of water, ensuring it remains available for communities and ecosystems.

An additional urgency to protecting peatlands is that when they become degraded or dried, they release large amounts of CO_2 – research published in Nature Climate Change in 2021 estimates that drying peatlands could release an additional 860 million tonnes of CO_2 into the atmosphere each year – significantly contributing to climate change. Therefore, to achieve broader climate, water, and biodiversity goals it is essential to accurately assess the extent and ecological health of peatlands in areas such as the Trans-Himalayas. This understanding will be key to developing national strategies focused on conserving healthy peatlands and restoring those that are degraded.

Mapping is the fundamental first step to ensure that peatlands are recognised and integrated into India's broader conservation strategies. By understanding the location and function of peatlands – and their role in regulating snowmelt within the fragile environment of the Trans-Himalayas – we not only move towards protecting an essential ecosystem, but we help safeguard community resilience by protecting the foundation of any mountain settlement: water. ●

VIEWS

Weaving a Circular Future

PHOTOGRAPHY BY **BHAAVYA GOENKA**



The fashion and manufacturing industry is the world's second-largest consumer of water. From fibre cultivation and mechanised spinning to dyeing, weaving, and packaging, water use is constant at every stage. Even after purchase, garments continue their impact through frequent washing – often releasing inorganic microfibres into waterways. This ongoing strain has sparked a growing reckoning within the industry: how can fashion shed its extractive legacy and embrace practices that minimise environmental harm and restore value to people and the planet?

In response to fashion's environmental toll, many brands are rethinking their approach – shifting from linear, consumption-driven models to ones rooted in ethics, sustainability, and long-term responsibility. This includes building meaningful partnerships with artisans, weavers, and factory workers – recognising them not as peripheral labour, but as essential stakeholders whose knowledge and craft shape the industry.

One brand helping redefine this new model is IRO IRO, a Jaipur-based circular design collective founded by Bhaavya Goenka. Each year, it creates collections from textile waste, blending indigenous craft with innovative upcycling. By centring artisans as creative and economic partners, IRO IRO fosters fair wages, prevents rural migration, and brings quality not just to the products – but to the lives behind them. Their versatile, multi-functional designs offer long-term value to consumers while embedding sustainability into every thread.

As IRO IRO continues its research, *aakh (Calotropis gigantea)* is proving its potential – not just as a fabric, but as a fibre of resilience. With support from public bodies like the Ministry of Textiles, projects like this hint at a wider revival of native fibres, community-led production, and truly circular fashion.

01 The warp threads.

02 Weaver, Hari Narayan ji, adjusting the warp threads.

03 Waste collected for upcycling. In just three years, IRO IRO has transformed 10 tonnes of waste into textiles, preventing 200 tonnes of CO_2 emissions, and creating jobs for artisans near Jaipur.

04 IRO IRO collaborates with studios across Asia, including Calico (Japan), Matter Prints (Singapore), Doodlage (India), The Summer House (India), and The House of MG (India), to upcycle textile waste into functional design for fashion, interiors, and more.



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05 Sorting waste by hand. Local artisans play a key role in the circular chain, from waste collection to fabric creation.

06 Weaving waste at the factory.

07 Quality check at IRO IRO. Circularity is woven into every step of the design process. The goal isn't scale, but shared prosperity across the value chain.

08 IRO IRO is reviving aakh (Calotropis gigantea), an indigenous plant fibre, once lost to colonial-era industrialisation. It grows on arid land without irrigation, making it a low-impact alternative to cotton.

09 Rajesh ji with yarn at the loom: Aakh thrives in both dry and moist climates, offering new opportunities for decentralised, rural textile production. If Aakh were to be reintroduced into the Indian context, it would certainly present new opportunities for everyone involved in the textile sector.

10 Savita Devi spinning yarn in Govindgarh: In this Rajasthani village, an experimental value chain is taking root – training households in fibre collection, yarn processing, and handloom weaving.

11 The Endeavour dress and pants. Crafted from upcycled, handwoven khadi and waste yarns from Khamir (an NGO in Gujarat), each piece like this one carries legacy, lightness, and the unique wrinkles of Indian seersucker.

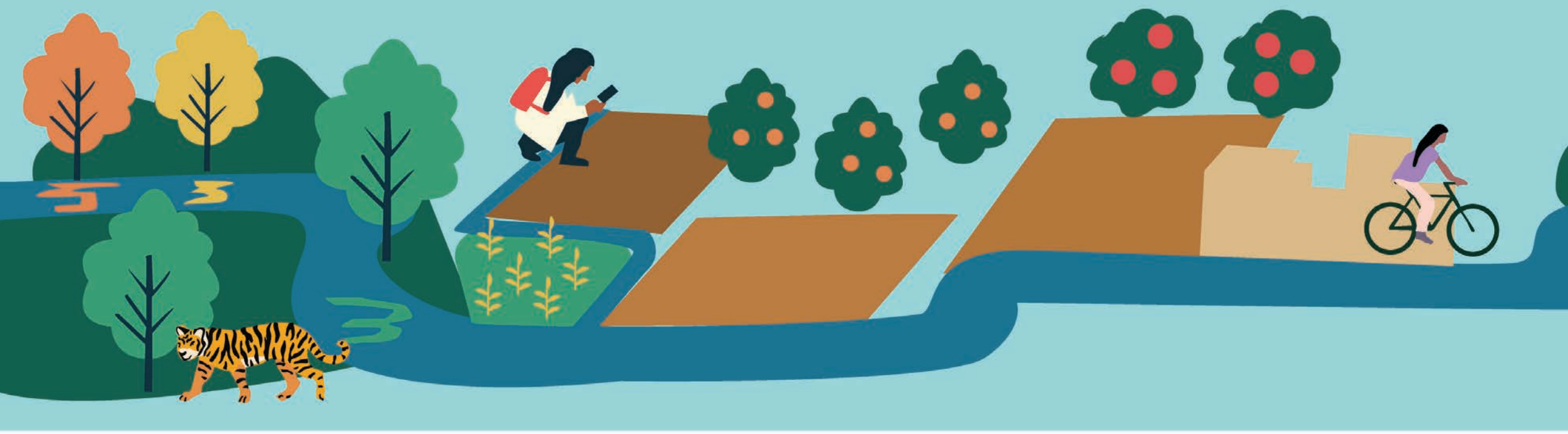
8 MISSIONS | **INDIA'S CLIMATE GOALS** | **HOW DO THESE MISSIONS CONNECT?**

The Missions Leading India's Climate Future

WRITER
SHREYA JAIN

India's climate future hinges not on isolated missions, but on their collective, coordinated power.





When India launched the National Action Plan on Climate Change in 2008, it recognised something crucial: climate change is not a single crisis but a web of interconnected ones. The eight National Missions – solar energy, energy efficiency, sustainable habitats, water, the Himalayan ecosystem, sustainable agriculture, the Green India Mission, and strategic knowledge – were never meant to stand alone. We still chase them as separate agendas, like parallel roads that never meet. But in truth, they form a single chain, and the chain is only as strong as its weakest link.

Ignore the Himalayas, and every other mission falters.

Consider the National Solar Mission. Its benefits extend far beyond clean power. Solar irrigation reduces farmers' dependence on diesel pumps, linking directly to the Mission on Sustainable Agriculture. Rooftop solar strengthens urban energy resilience, complementing the Mission on Sustainable Habitat. Without these overlaps, solar would remain just a power project; with them, it becomes a driver of water efficiency, urban resilience, and rural stability.

The National Mission on Enhanced Energy Efficiency tells the same story. It slashes waste across industries and households, but its ripple effects extend into land and forests. Lower energy demand reduces the pressure for new coal mines, indirectly serving the goals of the Green India Mission. Protecting and expanding forest cover, in turn, feeds back into efficiency by moderating local temperatures, reducing cooling demand, and storing carbon. The missions are not separate; they are feedback loops.

Water binds nearly everything. The National Water Mission is the silent backbone of agriculture, cities, and the energy sector. Without water efficiency, solar power cannot scale in dry regions, agriculture collapses under erratic rainfall, and sustainable habitats become pipe dreams. Protecting water also means protecting its source – the Himalayas. The Mission for Sustaining the Himalayan Ecosystem is not just about snow and glaciers. It is about securing the rivers that feed millions, stabilising agriculture, enabling hydropower, and conserving biodiversity. Ignore the Himalayas, and every other mission falters.

Meanwhile, the Green India Mission extends well beyond afforestation. Forests are natural allies of agriculture, water recharge, biodiversity, and even urban cooling. They are as much a climate technology as solar panels and LEDs, as their benefits extend to every other mission.

The National Mission on Strategic Knowledge for Climate Change sits at the heart of India's climate response. Only with sound data, modelling, and research can the country avoid a fragmented approach and build a truly integrated, interconnected strategy.

The problem lies not in the design but in the execution. Each mission is typically tied to a separate ministry, with its own targets and silos. But climate systems do not respect bureaucratic boundaries. To succeed, India must invest in integration, including joint planning, pooled funding, and governance structures that enable the missions to communicate effectively with one another.

India's climate response will not be measured by isolated targets such as added solar capacity or the number of trees planted – its success hinges on whether all eight missions move in step, reinforcing one another to build true resilience.



8 MISSIONS | INDIA'S CLIMATE GOALS | # 1 NATIONAL SOLAR MISSION

India's Solar Mission Reaches a Turning Point

WRITER
SHREYA JAIN

India's solar mission is transforming the nation's energy landscape, unlocking new opportunities for growth, innovation, and sustainable development.





The Jawaharlal Nehru National Solar Mission (JNNSM) has been one of the most ambitious clean energy initiatives globally. Launched in 2010 with a modest target of 20 GW of solar capacity by 2022, the mission was drastically scaled up in 2015 to aim for 100 GW, signaling not just a technological shift, but a reimagining of India's energy future. Fifteen years later, the mission is delivering both promise and pressure, standing at the intersection of energy security, climate responsibility, and developmental equity.

As of March 2025, India's total renewable energy capacity has reached 220.1 GW, with solar alone contributing 105.6 GW, nearly 48% of the renewable mix.

As of March 2025, India's total renewable energy capacity has reached 220.1 GW, with solar alone contributing 105.6 GW, nearly 48% of the renewable mix. Another 143.8 GW is in the pipeline, indicating strong momentum. This extraordinary progress positions India as a global leader in solar deployment, backed by competitive tariffs, strong policy signals, and a growing appetite for energy security.

These efforts are reflected in India's recent rise to 99th place in the 2025 Sustainable Development Report, up from 109th the previous year. The report notes significant gains in clean energy adoption, poverty reduction, and health outcomes. Solar energy has played a central role in driving this progress, not only by cutting emissions, but also by improving energy access, reducing rural dependency on diesel generators, and powering thousands of health clinics, schools, and livelihoods across the country. Yet, the solar journey is far from complete.

India's large-scale solar parks have flourished, particularly in states like Rajasthan, Gujarat, and Madhya Pradesh. But rooftop solar, which was intended to make up 40% of the 100 GW solar target, continues to lag, hindered by discom resistance, lack of financing options, and unclear net metering regulations. Without reform in the distribution sector, decentralised solar cannot fulfil its promise of democratised, consumer-led energy generation.

Another major challenge is domestic manufacturing. Despite policy support through the Production Linked Incentive (PLI) scheme and basic customs duties on imports, India remains heavily dependent on imported solar modules – primarily from China. This creates strategic vulnerabilities, especially as global supply chains become more fragmented and competitive.

Moreover, integration into the grid is becoming a bottleneck. As solar and wind increase their share of installed capacity, managing intermittency, ensuring a round-the-clock power supply, and investing in battery storage and flexible transmission infrastructure will become crucial. Without these, the mismatch between capacity and actual generation will persist, undermining India's energy transition.

India's solar mission has never been only about technology, it is about transformation. Its success lies not just in gigawatts installed, but in how equitably the benefits are shared, how sustainably the systems are built, and how effectively clean energy supports economic development.

To truly power a just and resilient future, the next phase of India's solar story must go beyond capacity additions. It must integrate innovation, empower consumers, strengthen domestic value chains, and reform institutions to achieve these goals. If India can accomplish that, the National Solar Mission will not just be a milestone in its energy journey; it will be a model for sustainable development globally. ●

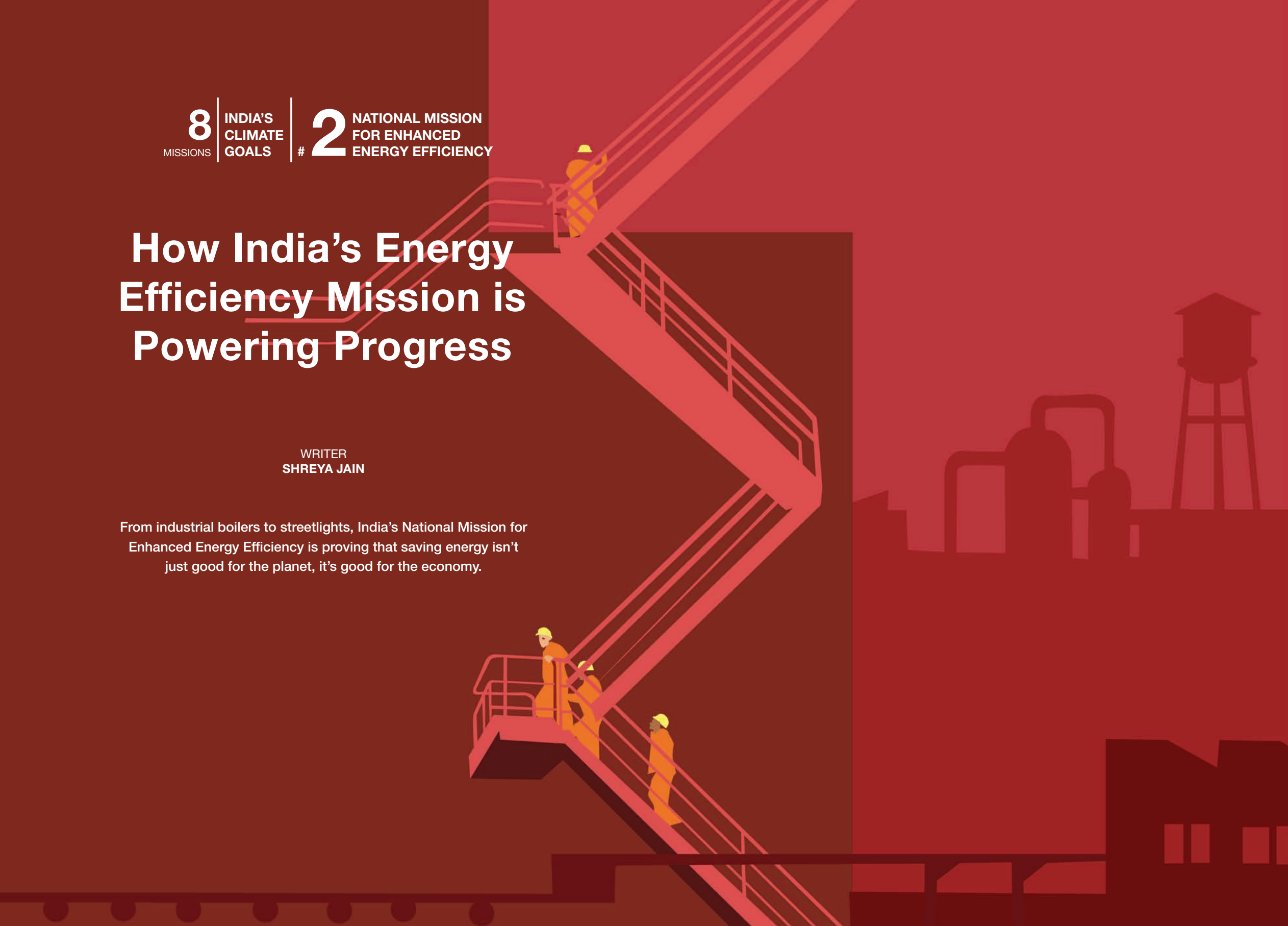


8 MISSIONS | INDIA'S CLIMATE GOALS | # 2 NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY

How India's Energy Efficiency Mission is Powering Progress

WRITER
SHREYA JAIN

From industrial boilers to streetlights, India's National Mission for Enhanced Energy Efficiency is proving that saving energy isn't just good for the planet, it's good for the economy.





India's clean energy discourse is dominated by large-scale renewable energy projects: solar parks, wind farms, and hydroelectric capacity additions. While such initiatives are critical, they overshadow a quieter but equally transformative force: the National Mission for Enhanced Energy Efficiency (NMEEE).

Launched in 2010 under the National Action Plan on Climate Change, the NMEEE offers a compelling lesson in how to decouple economic growth from rising energy demand. It doesn't rely on building additional power generation capacity; instead, it maximises the value of the energy we already produce. In doing so, it addresses one of the most cost-effective and immediate pathways to emissions reduction.

India's clean energy discourse is dominated by large-scale renewable energy projects.

At the centre of the mission lies the Perform, Achieve and Trade (PAT) scheme, which sets energy efficiency targets for energy-intensive industries. Facilities that surpass their targets earn tradable Energy Saving Certificates, creating a market incentive for efficiency. This is not merely compliance, it is a competitive advantage.

Complementing this is the Market Transformation for Energy Efficiency (MTEE) programme, which has dramatically increased the adoption of efficient appliances through market interventions. The most striking example is the widespread deployment of LED lighting, achieved through bulk procurement strategies that reduced costs by over 85%, making the technology accessible to millions of households and significantly reducing national electricity demand.

Financing remains a long-standing challenge for energy efficiency projects, which often face perceived risks despite strong returns. NMEEE addresses this through the Energy Efficiency Financing Platform (EEFP) and the Framework for Energy Efficient Economic Development (FEED), both designed to mobilise capital by mitigating investment barriers and providing risk-sharing mechanisms.

The impact is measurable. These initiatives have collectively avoided millions of tonnes of CO_2 emissions, reduced energy import dependence, and generated substantial cost savings for both industry and consumers. Yet, despite such outcomes, energy efficiency remains underrepresented in the public and policy narrative.

This imbalance must be corrected. If India is to achieve its net-zero goal by 2070, the NMEEE should be expanded to emerging sectors such as data centres, electric mobility, and urban real estate. Leveraging advanced technologies – artificial intelligence, IoT, and real-time monitoring – can ensure that energy savings are sustained and scalable.

In policy, energy efficiency is not a peripheral measure; it is a core pillar of a resilient, low-carbon economy. The NMEEE's success demonstrates that efficiency is the "first fuel" – cleaner, faster to deploy, and more economical than most alternatives. For India, placing it at the forefront of national energy strategy is not simply desirable; it is imperative.

Financing remains a long-standing challenge for energy efficiency projects.

8 MISSIONS | INDIA'S CLIMATE GOALS | # 3 NATIONAL MISSION ON SUSTAINED HABITAT

Building Sustainable Habitats for India's Future

WRITER
SHREYA JAIN

India's cities face mounting pressures. The National Mission on Sustainable Habitat aims to steer them towards sustainable, resilient growth.





India's cities are at a critical turning point, balancing economic growth alongside worsening air pollution, waste pressures, floods, and heatwaves. Against this backdrop, the National Mission on Sustainable Habitat (NMSH), launched under the National Action Plan on Climate Change (NAPCC), was envisioned as a framework to make our urban centres climate-resilient, resource-efficient, and livable.

At its core, NMSH focuses on three key pillars: enhancing energy efficiency in buildings, managing solid waste and promoting recycling, and advocating for sustainable urban transportation. These are not just technical objectives; they are existential imperatives for a country where 600 million people will live in cities by 2036. Energy-efficient buildings can significantly reduce emissions and electricity demand, sustainable transportation can decrease dependence on fossil fuels, and robust waste management systems can prevent health crises. The vision is sound. The challenge is scale and urgency.

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Cities such as Pune and Indore have reduced their reliance on landfills by investing in decentralised waste management and public participation. Metro networks in Kochi and Ahmedabad, alongside electric bus fleets in cities like Nagpur, are shifting mobility towards low-carbon options. Energy-efficient design is no longer a niche idea; it is being applied in affordable housing and public infrastructure.

Crucially, NMSH has embedded sustainability principles into larger flagship programmes, including the Smart Cities Mission and Atal Mission for Rejuvenation and Urban Transformation (AMRUT). This has ensured that climate resilience is not a standalone goal but part of mainstream urban planning.

Yet, for all its promise, the mission has yet to deliver transformation at the speed cities require. Enforcement of building codes, such as the Energy Conservation Building Code (ECBC), remains uneven, particularly in fast-growing Tier 2 and Tier 3 cities. Waste segregation at source is still the exception rather than the norm, and urban transport investments too often prioritise road expansion over integrated public transit.

To realise its potential, NMSH will need to evolve in three ways. First, turn guidelines into mandates by linking compliance with building codes, waste rules, and transportation plans to municipal approvals and funding. Second, mobilise dedicated financing, from green bonds to municipal bonds, to help cities invest in energy-efficient infrastructure without overburdening budgets. Third, place citizens at the centre, recognising that sustainable cities are built not only with concrete and policy, but also with public participation and behavioural change.

The mission's framework is adaptable, allowing for local solutions such as rainwater harvesting in water-stressed cities, heat-reflective materials in hot zones, and nature-based flood management in coastal areas. This flexibility is its strength, but only if backed by strong monitoring, data transparency, and the political will to act.

Urbanisation is inevitable; whether it becomes an environmental liability or a model for sustainable growth depends on choices made today. The National Mission on Sustainable Habitat offers a foundation, but its success will hinge on turning good intentions into consistent, enforceable, and well-funded action. The future of India's cities may well depend on it. ●

8 MISSIONS | INDIA'S CLIMATE GOALS | # 4 NATIONAL WATER MISSION

Building Water Resilience through the National Water Mission

WRITER
SHREYA JAIN

India's worsening water crisis demands that the National Water Mission urgently rethink its strategy.





Water is arguably India's most undervalued and overstressed resource. As the country confronts deepening water insecurity, the National Water Mission (NWM), launched in 2011 under the National Action Plan on Climate Change, remains one of the few policy instruments explicitly focused on long-term water sustainability. With its central aim of improving water use efficiency by 20%, the Mission set out with a clear mandate. Yet, more than a decade later, the mission has seen uneven progress, limited results, and has not lived up to its full potential.

Water is arguably India's most undervalued and overstressed resource.

The National Water Mission mainly focuses on technical solutions and improving efficiency. It promotes things like water audits, micro-irrigation, rainwater harvesting, and sustainable farming through campaigns like "Sahi Fasal." While these steps are important, they only address part of the problem. India's water crisis goes much deeper. It's also about political and economic challenges, poor coordination between central and state governments, weak institutions, and the lack of a clear, long-term plan.

Take agriculture, which consumes nearly 80% of India's freshwater. While NWM promotes water-efficient irrigation and better crop choices, the country's current subsidy regime, especially for power and fertiliser, continues to encourage overextraction of groundwater and cultivation of water-intensive crops like paddy and sugarcane even in semi-arid regions. Punjab and Haryana grow paddy not because it makes climatic sense, but because the policy ecosystem rewards it. The Mission's behavioural nudges are no match for structural economic incentives. Unless NWM is backed by bold reforms in Minimum Support Prices, procurement policies, and energy pricing, its goals will remain out of reach.

Urban water management presents another challenge. The NWM advocates water-sensitive urban design, wastewater reuse, and leakage reduction, but most Indian cities continue to struggle with inadequate infrastructure. While over 72,000 million litres of sewage is generated daily, only 28% is treated, with the remaining 72% largely released untreated into rivers, lakes, and other water bodies. Moreover, governance of urban water remains divided between multiple municipal, state, and parastatal agencies, often working at cross-purposes. While the Mission encourages convergence with Smart Cities and AMRUT schemes, such integration remains weak and unaccountable.

Perhaps the most significant gap in the National Water Mission is its silence on ecological sustainability. India's rivers are dying, wetlands are vanishing, and groundwater tables are collapsing. The Mission does little to connect water use with the ecosystems that sustain it. A future-ready water mission must embed river basin planning, aquifer recharge, and ecosystem restoration at its core. Water should not only be conserved for use, but it must also be allowed to flow for the health of the environment.

The Mission's strengths lie in its recognition of water as a cross-sectoral issue and in its attempt to mainstream efficiency. But efficiency alone cannot solve a problem rooted in inequality, mismanagement, and environmental neglect. What India needs is not just a mission, but a movement. One that aligns agricultural reform, urban planning, ecological restoration, and digital governance under a shared vision of water security.

The National Water Mission can be that starting point. But to truly deliver water resilience for India's 1.4 billion people, it must evolve from a siloed scheme into a transformative, whole-of-government approach. ●



8 MISSIONS | INDIA'S CLIMATE GOALS | # 5 NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM

National Mission for Sustaining the Himalayan Ecosystem for a Resilient Future

WRITER
SHREYA JAIN

The Himalayas are vital to India's climate resilience, water security, and cultural heritage, and strengthening the National Mission for Sustaining the Himalayan Ecosystem is key to protecting these landscapes and the communities that rely on them.





The Himalayas are often called the "Third Pole" because they hold vast amounts of snow and ice and are the source of major rivers like the Ganga and Brahmaputra. They support millions of people, unique plants and animals, and play a crucial role in maintaining a stable climate. But today, this fragile region is under serious threat. Glaciers are melting faster, rainfall patterns are changing, and floods and landslides are becoming more frequent. To protect this vital ecosystem, India launched the National Mission for Sustaining the Himalayan Eco-system (NMSHE) as part of its national climate strategy.

The Himalayas are often called the "Third Pole" because they hold vast amounts of snow and ice and are the source of major rivers like the Ganga and Brahmaputra.

NMSHE was conceived with an ambitious, long-term vision: to build a knowledge-based and adaptive framework for sustaining the Himalayan ecosystem, spanning 11 Indian states. It aimed to enhance understanding of climate impacts, support sustainable development of mountain communities, and conserve biodiversity and water resources. From monitoring glaciers and permafrost to studying traditional knowledge systems, it promised an integrated scientific and community-oriented approach.

However, the mission's progress has been slow and scattered. While it laid the groundwork for research through nodal institutions like the GB Pant Institute and state climate cells, the translation of this knowledge into policy and community resilience remains limited. Institutional silos, funding constraints, and a lack of real-time data sharing between central and state agencies have hindered its effectiveness. Recent disasters, including cloudbursts in Uttarakhand, floods in Sikkim, and the melting of the Chorabari glacier that triggered the 2013 Kedarnath tragedy, underscore the urgency of building a dynamic and decentralised early warning and climate adaptation system.

One of the mission's key mandates was to evolve strategies for sustainable tourism, urbanisation, and hydropower in the fragile region. But in reality, unregulated development has continued. Roads cut hastily through mountains, dams constructed without adequate ecological assessments, and booming tourist footfall, all increase landslide and flood vulnerability.

In this context, there is a pressing need to strengthen NMSHE through better coordination with state governments, integration with district-level climate action plans, and collaboration with ongoing scientific efforts. For instance, the CryoSCOPE project, co-funded by the European Union and the Indian Ministry of Earth Sciences, brings together 19 partners across eight countries to study cryospheric changes in the Himalayas, including institutions such as IIT Madras, IIT Roorkee, and the University of Kashmir. Going forward, the mission must move from passive data collection to proactive climate risk reduction. This includes developing glacier lake outburst flood (GLOF) prediction models, mapping permafrost zones, and empowering local panchayats with climate-resilient practices. Integrating indigenous knowledge, such as traditional water harvesting or sustainable grazing, is not only respectful but also necessary for context-specific adaptation.

India's Himalayan states are on the frontline of climate change. Strengthening the National Mission for Sustaining the Himalayan Eco-system is not just an ecological imperative; it is a national one. As the world edges closer to dangerous tipping points, our ability to protect the Himalayas will be a litmus test for climate leadership in the Global South. ●



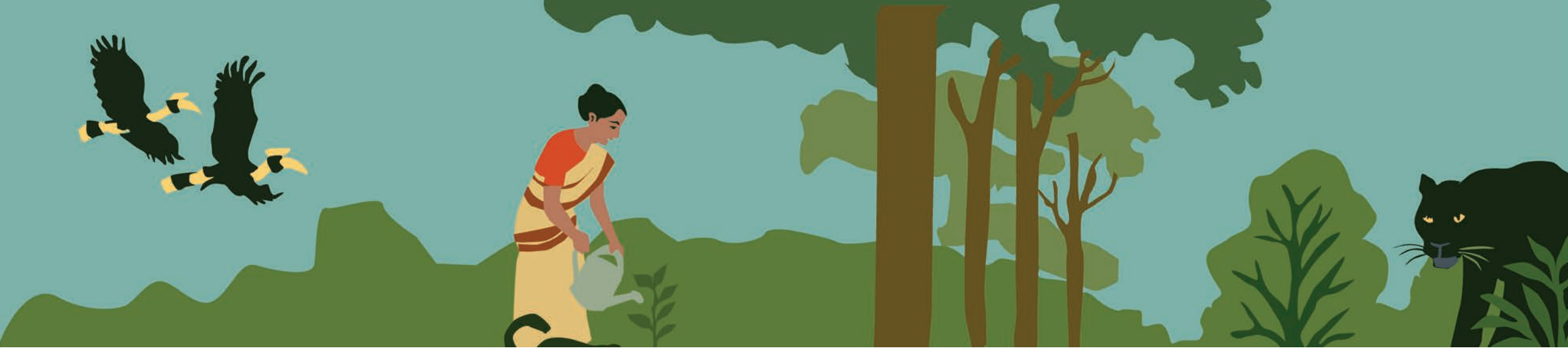
8 MISSIONS | INDIA'S CLIMATE GOALS | # 6 NATIONAL MISSION FOR A GREEN INDIA

Sustaining and Growing India's Green Mission

WRITER
SHREYA JAIN

The National Mission for a Green India offers hope to regenerate landscapes, empower communities, and secure a greener future.





When India launched the National Mission for a Green India (GIM) in 2014, under the framework of the National Action Plan on Climate Change, it reflected an ambitious recognition: forests are not just the lungs of the planet, but are also critical in mitigating climate change, protecting biodiversity, and securing livelihoods.

The Mission set an ambitious goal: to expand forest and tree cover by 5 million hectares while restoring the quality of an additional 5 million hectares. Ten years on, the results highlight a familiar problem: big green promises often fall short due to poor co-ordination, limited funding, and competing agendas.

While India's forest cover has increased in recent years, much of this growth is attributed to single-species plantations, such as eucalyptus and acacia.

The GIM attempts to reimagine afforestation beyond the narrow lens of tree planting. It aspires to integrate ecosystem restoration, biodiversity conservation, and community participation into forest management. This is significant in a country where nearly 300 million people depend directly on forests for fuel, fodder, food, and income. By acknowledging the links between climate adaptation and rural livelihoods, the Mission positions local communities as stakeholders rather than bystanders in the ecological regeneration process.

Yet, the progress so far has been underwhelming. The Mission was initially allocated a budget of ₹46,000 crore, but actual releases have been only a fraction of that. According to official data, less than 30% of the approved funds have been utilised, and many states continue to lag in project execution.

Another challenge is the focus on quantity over quality. While India's forest cover has increased in recent years, much of this growth is attributed to single-species plantations, such as eucalyptus and acacia. These plants may absorb carbon in the short term, but add little to biodiversity, water conservation, or soil health. For GIM to truly live up to its name, it must prioritise healthy, diverse ecosystems over just adding more hectares.

Community participation, though central on paper, remains patchy on the ground. Joint Forest Management Committees were meant to empower local stakeholders, but in practice, many operate without meaningful decision-making power or financial transparency. For tribal and forest-dependent communities, whose traditional knowledge is invaluable, exclusion not only breeds mistrust but also undermines the sustainability of afforestation efforts. Genuine decentralisation, giving Gram Sabhas a more decisive say in design, monitoring, and benefit-sharing, is essential if the Mission is to succeed.

India has also pledged to create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent by 2030 as part of its Nationally Determined Contributions (NDCs) under the Paris Agreement. Meeting this target is impossible without large-scale, scientifically guided, and socially inclusive afforestation. Moreover, forests are frontline defenses against climate extremes – heatwaves, floods, and droughts – that are already intensifying across the country. Strengthening GIM is therefore not a luxury, but a necessity for both climate resilience and rural livelihoods.

What then is the way forward? First, financing must be secured, whether through increased budgetary allocation, convergence with schemes like CAMPA (Compensatory Afforestation Fund), or innovative instruments such as green bonds. Second, monitoring frameworks should shift from simply measuring tree cover to assessing ecological health – species diversity, soil fertility, and water retention. Third, the Mission must adopt a planning approach that integrates forests, farmlands, and water systems, rather than treating them in silos. And finally, institutional reforms are needed to devolve, absolute authority to local communities while ensuring accountability in the use of funds and outcomes.

The National Mission for a Green India was conceived as more than an afforestation programme. It was envisioned as an ecological transformation. Its slow progress underscores the gap between intent and execution. But with climate risks mounting and India's development ambitions intensifying, the Mission's relevance has only grown sharper. Given the proper support and community ownership, the Mission can go beyond planting trees to shaping a resilient, inclusive, and sustainable India. ●

8 MISSIONS | INDIA'S CLIMATE GOALS | # 7 NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE

Building Climate Resilient Farms Through Sustainable Agriculture

WRITER
SHREYA JAIN

India's National Mission for Sustainable Agriculture offers a pathway to strengthen farming systems against rising climate risks.





India's agriculture is under growing strain from a rapidly changing climate. Heatwaves arrive earlier each year, monsoon patterns have become unpredictable, and floods and droughts often strike the same region within months. Soil fertility is declining in many states because of long-term chemical dependence, and groundwater levels continue to fall in major food-producing districts. Farmers today face growing risks, higher input costs and increasing uncertainty about their harvests and incomes. These problems are no longer one-off shocks. They have become the new normal, and they call for a complete rethink of how India manages its land, water and crops.

Climate resilience cannot be achieved through single interventions, but requires coordinated improvements in soils, water management, cropping systems, and rural livelihoods.

The National Mission for Sustainable Agriculture (NMSA) was created in response to these growing challenges. It seeks to build agricultural systems that can withstand climate stress while improving long-term productivity. The mission promotes practices that conserve resources, reduce vulnerability, and support holistic farm development. Its design acknowledges that climate resilience cannot be achieved through single interventions, but requires coordinated improvements in soils, water management, cropping systems, and rural livelihoods.

At the heart of the NMSA are four core pillars that together aim to build resilience in a changing climate. The first is soil health, which involves restoring organic matter, improving nutrient balance and reducing chemical dependence. Improving soil fertility is key to ensuring stable yields and food security. The second pillar is water use efficiency. With groundwater levels falling across many states, micro irrigation and water saving technologies are crucial for producing more food with less water.

The third pillar, agroforestry, integrates trees into farming systems, helping stabilise soils, diversify incomes and create natural buffers against extreme weather. The fourth is climate smart agriculture, which promotes drought tolerant seeds, improved crop varieties and integrated farming systems that spread risk and strengthen resilience.

Despite presenting a strong framework, the mission faces persistent challenges. Adoption of sustainable practices remains uneven, especially among small farmers who cannot afford the risks or upfront costs of new technologies. Extension services are often limited, leaving farmers without clear guidance on climate-smart methods. Coordination across soil, water, and agriculture departments is weak, even though resilience requires them to work together. Funding constraints also limit the mission's reach, particularly in climate-vulnerable districts.

Even so, the opportunities are substantial. Investments in renewable energy, rural connectivity, and climate adaptation are creating new tools and support systems for farmers. Mobile advisories and remote sensing now offer real time weather and soil information. Demand for sustainably grown food is increasing. States such as Andhra Pradesh, Sikkim, and Himachal Pradesh show that large-scale transitions to organic or low-input farming are possible when policies, training, and incentives align.

If strengthened and adequately funded, the National Mission for Sustainable Agriculture can help India shift from input-intensive farming to systems that regenerate soils, conserve water, and equip farmers as frontline climate actors. The mission offers a clear pathway; the task now is to deliver it with consistency and ambition. ●



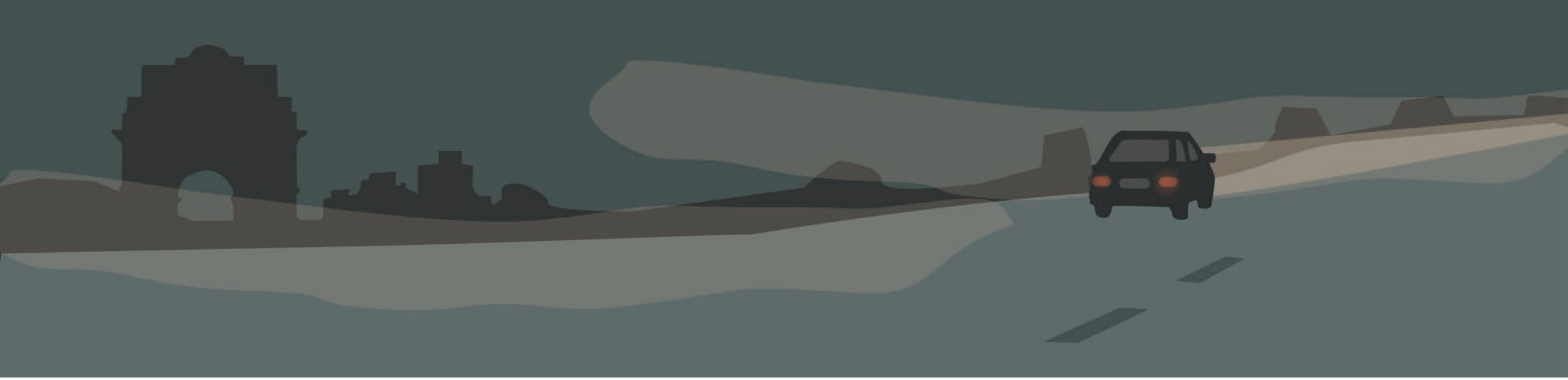
8 MISSIONS | INDIA'S CLIMATE GOALS | # 8 NATIONAL MISSION FOR STRATEGIC KNOWLEDGE ON CLIMATE CHANGE

Why India's Climate Intelligence Mission Needs a Modern Upgrade

WRITER
SHREYA JAIN

India's National Mission on Strategic Knowledge for Climate Change lays important groundwork for addressing the climate crisis – but it needs key updates to fulfil its potential.





India is facing growing climate risks. Heatwaves are becoming more frequent, monsoon patterns are shifting, water systems are under pressure, and rapidly expanding cities are becoming more vulnerable to extreme weather. These changes affect agriculture, public health, energy demand, and infrastructure. As India continues to develop, the need for reliable climate information and long-term planning is more urgent than ever. Preparing for climate change is not only about responding to emergencies, it is about understanding future risks and acting early.

Preparing for climate change is not only about responding to emergencies, it is about understanding future risks and acting early.

The National Mission on Strategic Knowledge for Climate Change (NMSKCC) is central to this effort. Created under the National Action Plan on Climate Change in 2010 and updated in 2022, the mission aims to strengthen the scientific foundations of India's climate response. Its goals include expanding climate research, improving observation networks, building accessible data systems, and encouraging collaboration between researchers, governments, and industry. Above all, the mission recognises that India's climate challenges require India-specific knowledge. Generic global models cannot fully capture the behaviour of the Indian monsoon, the sensitivity of Himalayan ecosystems, or the pressures on fast growing cities.

Over time, the mission has helped widen the scope of climate research and strengthen the country's scientific capabilities. Institutions such as the Indian Institutes of Technology (IITs), the Indian Institute of Science (IISc), the National Centre for Medium Range Weather Forecasting (NCMRWF), and the Indian Institute of Tropical Meteorology (IITM) have contributed to climate trend analysis, model development, and early warning systems. The mission has supported vulnerability mapping, improvements in observation infrastructure, and training programmes that prepare the next generation of climate scientists. These efforts form an essential base for a climate-ready India.

However, the mission also faces challenges that limit its impact. Climate data in India is still scattered across many agencies, making it difficult for users to find and combine information. State governments, municipal bodies and smaller industries often lack simple tools that translate scientific knowledge into practical decisions. Coordination between research and policy varies across sectors, and funding cycles are not always long enough to support advanced modelling or multi-year research programmes.

These challenges can be turned into opportunities for the next phase of the mission. Three priorities stand out.

First, India can create a unified national climate data platform that brings together historic records, current observations, socioeconomic indicators, and future climate scenarios. A shared platform would help planners, researchers and businesses work with consistent and high-quality information.

Second, the mission can enable deeper interdisciplinary collaboration. Climate change affects water, health, infrastructure, agriculture, and finance, and meaningful solutions will come from research teams that connect these domains. India already has strong scientific institutions, and the mission can bring them together more effectively.

Third, the mission can focus on converting scientific insights into decision tools. Whether designing resilient cities, planning power systems or supporting farmers, users need accessible and sector specific climate information.

The NMSKCC represents India's commitment to building climate intelligence. By improving data access, supporting collaboration, and turning research into real world guidance, the mission can help India manage risk and strengthen resilience. Its promise lies not only in understanding a changing climate but in helping the country navigate that change with confidence. ●







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