

SUSTAINABLE INDIA



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SUSTAINABLE INDIA

A COUNTRY REPORT BY

REVOLVE

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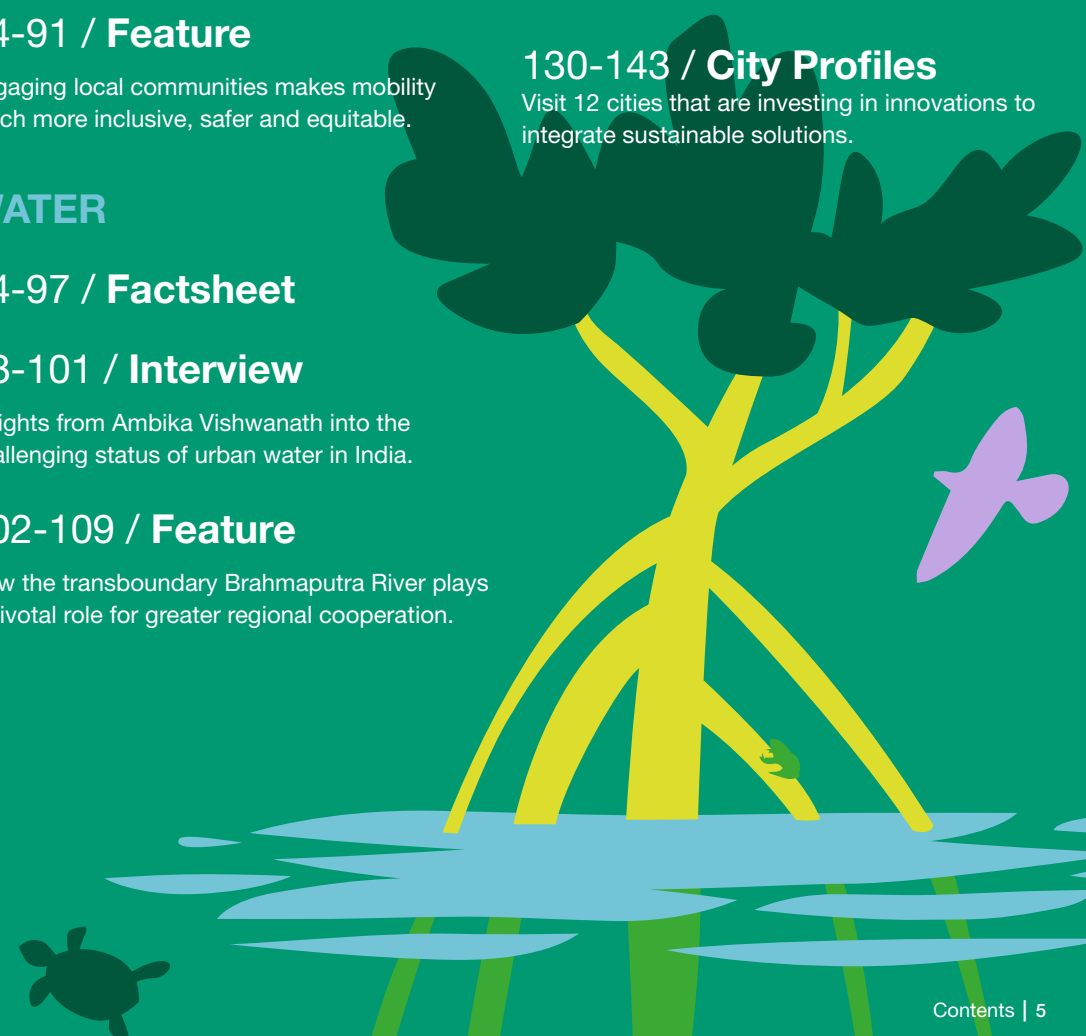
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Going Beyond India's Great *Jugaad*

WRITER: BAHAR DUTT

Jugaad – a creative quick fix – is great but we need more complex solutions when it comes to long-term sustainability.

Bengal Forest Department is supplementing the diet of wild elephants with vegetables to reduce human-elephant conflict.

Twice a day, a truck laden with papaya, potato and cabbage is lowered into a small patch of forests to feed the herd. Human-elephant conflict has existed for a while now and requires long-term measures such as restoring ancient elephant corridors lost to big mining and infrastructure projects, planting trees that are useful to the pachyderms, instead of eucalyptus, and creating early warning systems in the surrounding villages. So why is so much effort going into feeding the wild elephants at this time of the year?

As we probe further, we find that the 10th board exams are on, the penultimate exam for students, and so a quick fix solution is to stuff the pachyderms with easy food to ensure they will

not attack students walking to their exam center. This is the great Indian *jugaad*.

While 'jugaad' spells innovation and therefore denotes a feeling of creativity and hope, it also means a quick fix, leading to helplessness. Environmental problems are 'wicked' problems with complex solutions, which is why jugaad can only take us so far. Take the problem of air pollution in the national capital region. We do not have a long-term solution so in the interim, we deploy thousands of trucks to mist-spray the city's hot pollution points with water. This may temporarily control dust particles, but we need more radical interventions, shifting to cleaner fuels, reducing solid waste and providing farmers with alternatives to crop burning.

We need to move from the 'jugaad' mindset to more long-term interventions that will be multi-sectoral. Fortuitously, in climate change we see various actors coming together from the state, to the central government, to corporations, to think tanks. But when it comes to issues related to biodiversity, pollution or even sustainability, this multi-sectoral collaboration is still missing.

When I was asked to write the opening editorial for this India Report, I was pleasantly surprised by the range of issues covered. In this report, there is a case presented for building homes out of mud and another on the health of an ecosystem based on the number of otters found there! Nothing can be more inspiring than individual stories from ordinary people from Mumbai working on green issues to spur you into action.

Environmentalism now has many niche subjects from water conservation to energy, mobility and just transitions. As we evaluate our work for the planet, perhaps there should be only one yardstick by which we measure our actions – how can we maintain the diversity of life in all its forms from species, to genetics, to ecosystem levels? A healthy ecosystem will have a ripple effect on the planet and our well-being. Whether we work on climate action, or water conservation or sustainability, this should be the one action guiding us onwards. I hope you enjoy this issue, no matter which shade of green you support. ●

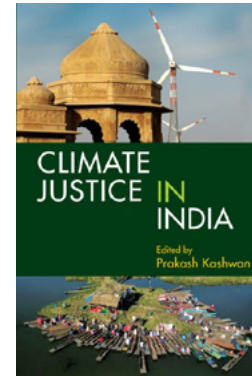


Climate Action and Climate Justice in India

WRITER
DR. PRAKASH KASHWAN

India's ongoing climate action and transition to renewable energies is deeply intertwined with entrenched social, economic and political inequalities.

01



This article draws exclusively from Climate Justice in India (Cambridge: Cambridge University Press, 2023) edited by Prakash Kashwan. Access the book for more details related to references, bibliography and developments around the core arguments put forward here.

India's arguments for international climate justice are well-rehearsed. The country has contributed 3% of the accumulated stock of greenhouse gas (GHG) emissions responsible for the current climate crisis. Various global indices rank India among most climate vulnerable countries, making it a legitimate claimant to a share of the loss and damage funds agreed upon at COP27 in Sharm el-Sheikh. India's claims may be a lower priority compared to smaller island states and more vulnerable countries, especially on the African continent. Irrespective of whether loss and damage funds are available to India, it must tackle climate impacts at home. India is home to the largest population of poor people and is one of the most unequal countries in the world today. According to the World Inequality Report 2022, the wealthiest 1% of Indians own 33% of the wealth in the country, while the bottom 50% own a mere 5.9% of its wealth. The conjunction of extremely high climate vulnerability with extreme inequality makes India a hotspot of climate injustice, with tens of millions of people displaced by floods annually, and hundreds of deaths because of heatwaves and lightning. The enormous disruptions to poor people's lives due to disasters linked to climate change are hardly covered in the national press because Indian media lacks representation from socially and politically marginalized groups and classes. This may also be the reason why India has had very few debates on climate injustice brewing within the country; the press and large swaths of the climate advocacy community continue to focus

on international injustices that India correctly emphasizes in international negotiations. In Climate Justice in India, the contributors and I examine how India's ongoing climate action efforts and energy transition intersects with deeply entrenched and multifaceted inequalities. Multilateral development agencies and international philanthropies

The lower-middle class and income-poor urban residents that are often substantively excluded from urban climate plans also fuel India's vast informal urban economies.

have played a major role in the development of India's urban climate adaptation, risk reduction and resilience-building efforts. Eric Chu and Kavya Michael's analysis of these developments show that despite Indian leaders identifying local development priorities as the main entry point for urban climate mitigation and adaptation, market actors often assume control of these opportunities, leading to the exclusion of much of India's urban population. The lower-middle class and income-poor urban residents that are often substantively excluded from urban climate plans also fuel India's vast informal urban economies. Part of this exclusion has to do with the centralization of decision-making within urban local government bodies, as elected ward representatives and residents are rarely consulted in urban policy-making.

The legacies of a centralized governance system also affect India's much-anticipated transition to renewable energy. K. Rahul and Parth Bhatia examine 28 solar energy policies at the state level in India for their potential to create a more just and democratic electricity system. Their analysis shows



02

Hotspots of inequality coincide with high emissions areas, with the poorest people suffering the worst consequences of air and water pollution.

that while policies do target some under-served communities, they fail to recognize their specific electricity needs, including a lack of integration across sectors, which is crucial for the transition to work for low-income neighborhoods. More importantly, India's current energy transition plans seek to replace the large and centralized legacy grid system, which risks reproducing existing inequities in India's modern renewable energy infrastructure. Another important aspect of India's just energy transition relates to an estimated 3.6 million people employed either directly or indirectly in the coal mining (80%) and power sectors (20%) in 159 districts in India. Most people employed in the sector work under non-unionized, exploitative and environmentally-hazardous conditions that are commonplace in India's coal industry. Vasudha Chhotray's field research in Jharkhand and Chhattisgarh shows that in the Indian context, just transition requires challenging the well-entrenched political and economic regimes of coal extraction

and engaging the local and regional social justice movements. Various aspects of India's just transition are shaped by the gross political and economic inequalities that have also shaped India's emissions over the past 25 years. Haimanti Bhattacharya's research shows that the relationship between carbon emissions from fossil fuels and inequality in consumption expenditures at the state level has undergone a major transformation since the onset of the economic reforms following 1991. While higher-level consumption inequality at the state level meant lower emissions in the pre-1991 period, now the most unequal states are among the largest emitters. This suggests that hotspots of inequality coincide with high emissions areas, with the poorest people suffering the worst consequences of air and water pollution. These findings imply that instead of seeing economic development and climate mitigation as conflicting goals, the pursuit of more inclusive economic development is intrinsically connected to climate

justice. Approaches that include tactics like carbon taxes targeted at the wealthiest population would advance both climate action and climate justice.

Arpitha Kodiveri and Rishiraj researched India's national and state climate action plans to investigate how they incorporate considerations of social justice via a discussion of economic inequality, class, caste, tribe and gender. Even though the national and state climate action plans acknowledge socially rooted vulnerabilities, they fail to incorporate any substantive strategies to address these intersectional vulnerabilities. Addressing caste, gender, ethnicity and religious inequalities will be crucial in responding to the climate crisis. Vaishnavi Behl and Prakash Kashwan show how the intersections of gender, caste and class-based inequalities shape access to clean drinking water in the Garhwal Himalayas and Gujarat. They show that these are not just deeply embedded socio-cultural features, but they permeate climate

adaptation and resilience interventions implemented by multilateral donor agencies and well-known non-governmental organizations (NGOs). The climate crisis is exacerbating grave inequalities in the access to basic amenities, such as clean drinking water, sanitation and the burden of an extremely poor sanitation infrastructure borne by India's Dalits – the 'low caste' communities that make up almost all of India's poorly paid and ill-equipped sanitation workers. Hundreds die every year because of the toxic fumes sanitation workers inhale while manually unclogging and cleaning the sewer-holes. Considering the wide-ranging effects of caste-based oppressions, Srilata Sirkar issues a call to emphasize caste justice in India's climate action. Echoing similar demands about attending to questions of racial justice in the United States and building on recent work conducted in India, Sirkar asserts that caste justice is climate justice and India's climate movement needs to be an anti-caste movement. Such a vision offers an important point of departure for redrawing India's policies, programs and strategies that are sorely lacking in advocating for the rights of women, minorities, indigenous peoples and the poor.

India's youth climate movement has begun to shine light on these inequalities, especially via their advocacy for the rights of Adivasis and other marginalized groups that are intimately connected

Caste justice is climate justice and India's climate movement needs to be an anti-caste movement.

to India's recent weakening of its environmental regulatory framework. Yet, as Kashwan's analysis of three of the most prominent Indian environmental movements – the Silent Valley, Chipko (Hug The Trees), and Narmada Bachao (Save River Narmada) – shows, today's youth leaders will need to actively guard against the middle-class dominance of India's nascent climate movement. Some state governments are taking specific measures to address these inequalities. Ashlesha Khadse and Kavita Srinivasan apply the lens of intersectional agrarian justice to analyze the state-level policy and programmatic initiatives meant to promote agroecology, with an emphasis on securing women

farmers' land rights in the states of Tamil Nadu and Kerala. These interventions show that a hybrid approach that integrates the goal of securing women's land rights with the state-led efforts to promote agroecology interventions promises to advance women's empowerment, food sovereignty and the broader goals of climate action and climate justice in India. New research shows that by 2030, an estimated 160 to 200 million Indians could be exposed to a lethal heat waves every year, and more than 30 million Indians could face job losses due to increased heat stresses. Under these conditions, climate justice will emerge as the single most important concern for India's

policy-makers. New cooling infrastructure may be necessary, but will not be sufficient. Building new systems of public consultation and governance holds the key to the success of Indian efforts to address the climate crisis. ●

01 Construction worker.
Source: Darshan Gavali / Unsplash

02 Poverty, Chennai.
Source: Karthikeyan K / Unsplash

03 Wind farm behind historical temple, Jaisalmer, Rajasthan.
Source: Ilya Yakubovich / Unsplash



Map of India

This map denotes some of the interesting and forward-looking efforts taken by states in these sectors



Circular

UTTAR PRADESH

Waste to Energy Plant, Varanasi – The plant will have a waste segregation facility of 600- 800 TPD of Municipal Solid Waste.

MEGHALAYA

Tura Project: India's first waste fuel plant – The 35-metric tonne pilot plant waste-to-energy plant will convert all waste except recyclables into fuel briquettes that can then be used as a replacement for coal & charcoal.



Ecosystems

HARYANA

Biodiversity Park and Restoration and Rejuvenation of lakes – ecological restoration of 420 acres of biodiversity + Rejuvenation of Damdama lake, which is one of Haryana's largest lakes.

HIMACHAL PRADESH

Project Seedball Bombing – Over 1.1 million seed balls distributed. Around 3-4 lakh trees are expected to grow in the coming years in the areas covered under the project.

ASSAM

Trees Outside Forests in India (TOFI) Programme – The program will rapidly expand the forest cover, improve the resilience of farming systems and augment farmers' revenue.

KERALA

The project will support all 93 Urban Local Bodies (ULBs) across 14 districts in Kerala in improving access to efficient and reliable delivery of solid waste management (SWM).

ORISSA

Project Dolphin (2020) – Helped Chilika lake, Asia's largest brackish water body, in tripling the population of the Irrawaddy dolphins. Project also helped benefit over 200,000 fishermen living in 132 villages.

SIKKIM

GEF-GOI-UNDP SECURE – Himalaya project. Annual budget for 22-23 approved. Project has so far strengthened management of Khangchendzonga National Park & Shingba Rhododendron Sanctuary, supported zero-waste model in and around Yuksom.

TRIPURA

Haora River Front Development Project – Aimed to improve the river bank, river bed protection, construction of in-situ Nalla wastewater treatment plants; and development of a horticulture project along the fertile river bank to promote organic farming in the city of Agartala.

MADHYA PRADESH

Project Cheetah – The central government "re-introduced" 8 African cheetahs in Sept 2022 – five females and three males and 12 more in 2023 -- at Kuno National Park, to develop healthy meta-populations in India that allow the cheetah to execute its functional role as a top predator.



Energy

LADAKH

Solar Photovoltaic Plant 1.5 MW – Solar power project was set up under the 'Make In India' initiative at Leh IAF station to provide sustainable energy.

UTTARAKHAND

1000 solar-powered villages – Will improve the reliability and quality of power supply, and boost rural income, education, health services and employment opportunities.

ARUNACHAL PRADESH

2,880-megawatt (MW) Dibang hydropower project – The project is expected to bring green energy generation and flood moderation in the downstream areas of Arunachal Pradesh and Assam.

JHARKHAND

Solar Power Plants – 1. Garhwa - 2. Palamu - 3. Simdega 4. Deogar - Four solar power projects of 20 MW each will take the installed renewable power capacity of Jharkhand to 450 MWs.

TAMIL NADU

Restoration of Pallikaranai Marshland in Chennai – ₹ 816 crore project to restore This freshwater marsh and partly saline wetland which serves as an aquatic buffer of the flood-prone Chennai and Chengalpattu districts. The diverse ecosystem of the marshland supports 115 bird species, ten mammals, 21 reptiles, ten amphibians, 46 fish, nine molluscs, five crustaceans, and seven butterfly species.

RAJASTHAN

Wind-Solar Power Plant – Completion of wind-solar power plant, in Jaisalmer which consists of 600 MW solar and 150 MW wind plants. Reportedly India's first wind and solar hybrid power generation plant.

GUJARAT

India's first solar powered village – In Modhera more than 1,300 rooftop solar panels installed on residential and government buildings, supply residents with electricity at no cost.

TELANGANA

Villages supported by solar power – The government is promoting and allotting solar units for 300 mandals in the first phase of its project. Each mandal will receive 30 solar units.

Mobility

WEST BENGAL

Hooghly ferries to go green – The zero-emission electric ferry will be powered by a liquid-cooled energy storage solution and have solar panels mounted on the roof.

GOA

Mopa Airport – Built on sustainability themed infrastructure with green buildings, solar power plant, water harvesting, sewage treatment plant, recycling facilities, LED lights on runway and more.

MAHARASHTRA

BEST Buses run on Clean Energy –The buses have moved from coal based thermal energy to solar in order to charge its fleet of 386 buses, and are now slated to run on 100% clean energy.

KARNATAKA

Common Mobility App – Bangalore Metro Rail Corporation Ltd will develop an app through which commuters can book all modes of transport through one single application, without the hassle of multiple payments.

Water

JAMMU & KASHMIR

Project Jeevika Udhampur – Aimed at enhancing livelihood for small farmers by providing irrigation and conservation of water.

PUNJAB

Solar-Based Water Supply –first of its kind solar-based water supply project 150 metre deep tube-wells will be installed, adding to 25000 litres capacity water tanks that have been constructed to provide piped water supply to every household in Jagrawan-Muradpur & Talwara villages.

MIZORAM

Green-Ag Project – Aimed to ensure 49 million Carbon dioxide equivalent (CO₂eq) sequestered or reduced through sustainable land use and agricultural practices in 1.8 million hectares (ha) of land.

MANIPUR

Loktak Lake Preservation – The government of Manipur launched a hydraulic excavator, to preserve the deteriorating lake.

NAGALAND

Water Harvesting Structure – Constructed to provide easy access for collection of rainwater and create a permanent structure for selling local goods by households in and around the village of Piphema.

BIHAR

Store, treat, and supply floodwaters of the river Ganga – Will supply the treated floodwater the river receives during the monsoon months, to various cities. It will help people of Rajgir and Gaya to get drinking water.

DAMAN & DIU AND DADRA & NAGAR HAVELI

Desalination Plants – Plan is being set for floating desalination plants on marine waters, across India's coastline to meet the target of supplying clean piped water to every household by 2040, with the initial plan to set up plants in the Union Territory.

LAKSHADWEEP ISLANDS

Desalination plant – OTEC (Ocean Thermal Energy Conversion) powered desalination plant is the first of its kind in the world as it generates drinking water from sea water using indigenous technology using green energy and environmentally friendly processes.

ANDAMAN AND NICOBAR ISLANDS

Flat Bay Water Supply Scheme – Planned as a long-term project for sustainable water supply to Port Blair Municipal Area as well as the adjoining areas of Mithakhari, Chouldari and Namunagar.



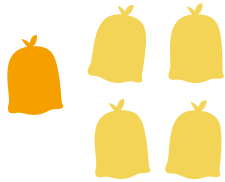


Circular

Fast Facts

India generates 53 million tons of waste annually, equivalent to 150,000 tons per day (estimates by the Ministry of Environment, Forest and Climate Change). **However, independent studies project waste generation to be five times more than what authorities claim.**

Source: 2020 research paper by CSE. CLEAN IT RIGHT: DUMPSITE MANAGEMENT IN INDIA



In 2019-20, 3.46 million TPA of plastic waste was produced. Only 1.58 million TPA was recycled and 0.16 million TPA was co-processed in cement kilns.

Source: Down To Earth Article: Parliamentary Digest (August 8, 2022): India generates plastic wastes of 3.46 million tonnes



In 2019-20, India generated 1,014,961 tons of e-waste from 21 categories of electrical and electronic equipment (EEE). India is the world's third-biggest e-waste generator, producing over 3.23 million metric tons of e-waste per year, behind the USA and China.

Source: Report of the virtual conference E-Waste Management in India: Circular Economy 25th August 2021

India's textile waste makes up 8.5% of the world's total. **Only 59% of India's textile waste goes back into the textile industry through reuse and recycling**, and only a small amount goes back into the global supply chain.

Source: Fashion For Good Article: Wealth in Waste: India's Potential to Lead Circular Textile Sourcing, 2022



India is the twelfth-largest marine trash contributor and will be the fifth largest by 2025. The Meghna-Brahmaputra-Ganges river system discharges almost 73,000 tonnes of plastic trash into the oceans each year, making it the 6th most polluted river system.

Source: Down To Earth Article: Parliamentary Digest (August 8, 2022): India generates plastic wastes of 3.46 million tonnes

Indian households waste 50 kilograms of food per person per year or 68,760,163 tons a year. According to the UN Environment Program's Food Waste Report index in 2021, in India, **40% of the food is wasted**, which is equivalent to Rs. 92,000 crore a year.

Source: Easter Mirror Article: Food Wastage in India: A Concern, 2022



Government Policies

The Ministry of Environment, Forest and Climate Change has notified the Guidelines on Extended Producers Responsibility on plastic packaging under Plastic Waste Management Rules, 2016. The guidelines on extended producer responsibility coupled with prohibition of identified single use plastic items, which have low utility and high littering potential, with effect from 1 July 2022.

Source: Ministry of Environment, Forest and Climate Change

In 2014, Swachh Bharat Mission-Urban (SBM-U) promoted the circular economy in municipal solid and liquid waste at the national, state, and city levels. The Mission's 3R (reduce, reuse, recycle) approach has increased urban India's solid waste treatment capacity from 18% in 2014 to 68% in 2021 (including recycling).

Source: Guidelines for Swachh Bharat Mission-Urban, Ministry of Housing and Urban Affairs

Swachh Sagar Surakshit Sagar campaign aimed to remove approximately 15,000 tons of waste from 75 beaches in 75 days.

Source: Niti Aayog, Lifestyle for Environment Brochure

The Swachh Bharat Unnat Bharat Abhiyan, set up under the Prime Minister's Science, Technology & Innovation Advisory Council, is an initiative that will leverage global technological capabilities to create socio-economic benefits for 1.3 billion Indians by addressing the issues of waste disposal, deteriorating air quality and increasing pollution of water bodies.

Source: <https://www.investindia.gov.in/waste-to-wealth>

Challenges

With rising urban population and changing lifestyles, India is estimated to generate 165 million tons of trash by 2030 and 436 million by 2050. The 2014, Planning Commission research stated that **over 80% of India's trash is dumped in filthy dump yards, causing health and environmental problems.**

Source: Satpal Singh, "Solid Waste Management in Urban India: Imperatives for Improvement," *ORF Occasional Paper No. 283*, November 2020, Observer Research Foundation.



Urban India generates 1,30,000–1,50,000 metric tonne (MT) of municipal solid waste daily. This equates to roughly 330–550 grammes per urban resident. This amounts to 50 million metric tonnes each year, and if trends continue, it will reach 125 million by 2031.

Source: Niti Aayog Report: WASTE-WISE CITIES Best practices in municipal solid waste management, 2021

The rate of wet waste processing is also dismal, which also highlights the low rate of segregation of waste. About 75,000 TPD of wet waste is being generated daily, of which only 68% is being processed, leaving a gap of 32%.

Source: Report: Circular Economy in Municipal Solid and Liquid Waste, 2021

Plastic recycling in India is extremely low with **only 12% of plastic waste generated in 2019-20 being recycled, while 20% was burned.** The remaining 68% of plastic waste likely ends up in dumpsites and landfills, contaminating land, air, soil, and water and contributing to GHGs through methane.

Source: CSE Report: The Plastic Life-Cycle, 2022



Opportunities



Adoption of a circular economy in India will result in yearly benefits of \$624 billion by 2050 and a **44% reduction in greenhouse gas emissions.** In 2019, the metal recycling sector alone employed nearly 1.75 million people, contributing 2 percent of GDP.

Source: Article: Can India Generate 1.4 Crore Jobs By Investing In The Circular Economy?

India has dedicated waste management rules and mechanisms to process different categories of waste. There is government data on different categories of waste generated and recycling units. The opportunity lies in strictly implementing the rules by creating a circular economy with huge potential to create 1.4 crore jobs for unskilled/semi-skilled population and major consumer behaviour changes.

Source: Vakilssearch article (Feb 13, 2023): Can India Generate 1.4 Crore Jobs By Investing In The Circular Economy?

Plastic can be recycled 7-9 times before becoming unrecyclable*. Every tonne of recycled plastic saves 3.8 barrels of oil. One kg of plastic can be converted to 750 ml of gasoline in India. Roads can be made from shredded plastic. For example, in 2002, Chennai's Jambulingam Street was India's first plastic road and The National Rural Road Development Agency built 7,500 km of plastic-waste roads in 2015-16.

Source: Fact Sheet on Plastic Waste in India, TERI

Circularity in dry waste management can help India meet its GHG emissions targets faster. If "refill" bottle designs and models were implemented to all cosmetics, personal care, and house cleaning bottles, packaging and transport reductions would reduce GHG emissions by 80–85% compared to single-use bottles.

Source: Report: Circular Economy in Municipal Solid and Liquid Waste, 2021



There are many homegrown rooted methods of recycling and sustainability which can be adopted and led by traditional Indian lifestyle. Across the country clayware is commonly used on streets and in public to serve food - biodegradable utensils (sal tree leaves), and tea in claypots (kulhad).

Source: Niti Aayog, Lifestyle for Environment Brochure

Moving Towards Circularity in India's Building Sector



ASHISH RAKHEJA
MANAGING PARTNER, AEON CONSULTANTS

Across India, developers and planners are balancing ambitious decarbonization goals with rapid urbanization demands.

India's construction industry is growing in tandem with increasing urbanization. While several elements already exist to ensure this sector is on the way towards net-zero, more needs to be done. We spoke to Ashish Rakheja, Managing Partner at AEON Consultants to understand India's journey, what has worked and what is still left to be done.

India has ambitious climate change goals and development targets. What are some of the ways the building industry can achieve net-zero emissions in India?

Most of the Global North has committed to be carbon neutral much before India. Given our

construction practices and the projected scale of construction over the next few decades, there is a lot to be done for achieving the goal of a Carbon Neutral India, but to say 2070 is ambitious? No, I think it is a reasonable target as climate change is real and India has a lot to lose if we do not increase the pace for adopting environment friendly practices.

The next 5-to-7 years are all about capacity building. You cannot just turn a switch and say that tomorrow morning you will become carbon neutral. There is a lot of learning to be done, and we will need that time to have the rules, regulations & policies

in place for India to get there. As a developing country, India has an advantage: to learn from the journeys of Western countries, so that we are able to adapt faster.

What are the advantages and opportunities for India around net-zero infrastructure?

We have three prominent rating systems in India for green buildings. Over 12 billion square feet of buildings in India have either adopted or committed to green practices. This comes from the fact that we had two decades to introduce efficient and sustainable product offerings, given the reality of resource scarcity.

You cannot just turn a switch and say that tomorrow morning you will become carbon neutral.



In India, we were able to plan better, as the green building movement started in 2000. This coincided with our construction boom, and large numbers of our new buildings are inherently green. In the last 20 years, we have been able to build this into the DNA, and architects, engineers, products and practices have evolved accordingly. The adoption of high-efficiency equipment and products like air conditioners, heat pumps and LEDs are all entrenched in our new buildings. This also helps to contribute toward the goal of carbon neutrality

by 2070, and India can be seen as an example of building responsibly.

Every building is mandated by the Codes to put in a rainwater harvesting system. For the new larger developments, there needs to be an acceptance amongst developers to explore water conservation practices, adopt sewage recycling & adopt rainwater storage to reduce dependence on municipal infrastructure. For example, some of India's prominent hill stations like Shimla report

acute water scarcity in summer, yet it rains one or two times every month. Is it not possible then for us to capture that water and store it? These practices can make many of our cities solve the problem of water scarcity which is also a shift towards reducing carbon footprints.

What is the role of buyers and the tenants in the net-zero conversation?

For the past two decades, India's green building movement has followed a top-down approach. Both

designers and developers have become aware of the benefits of sustainable development. However, the same is not true for the user.

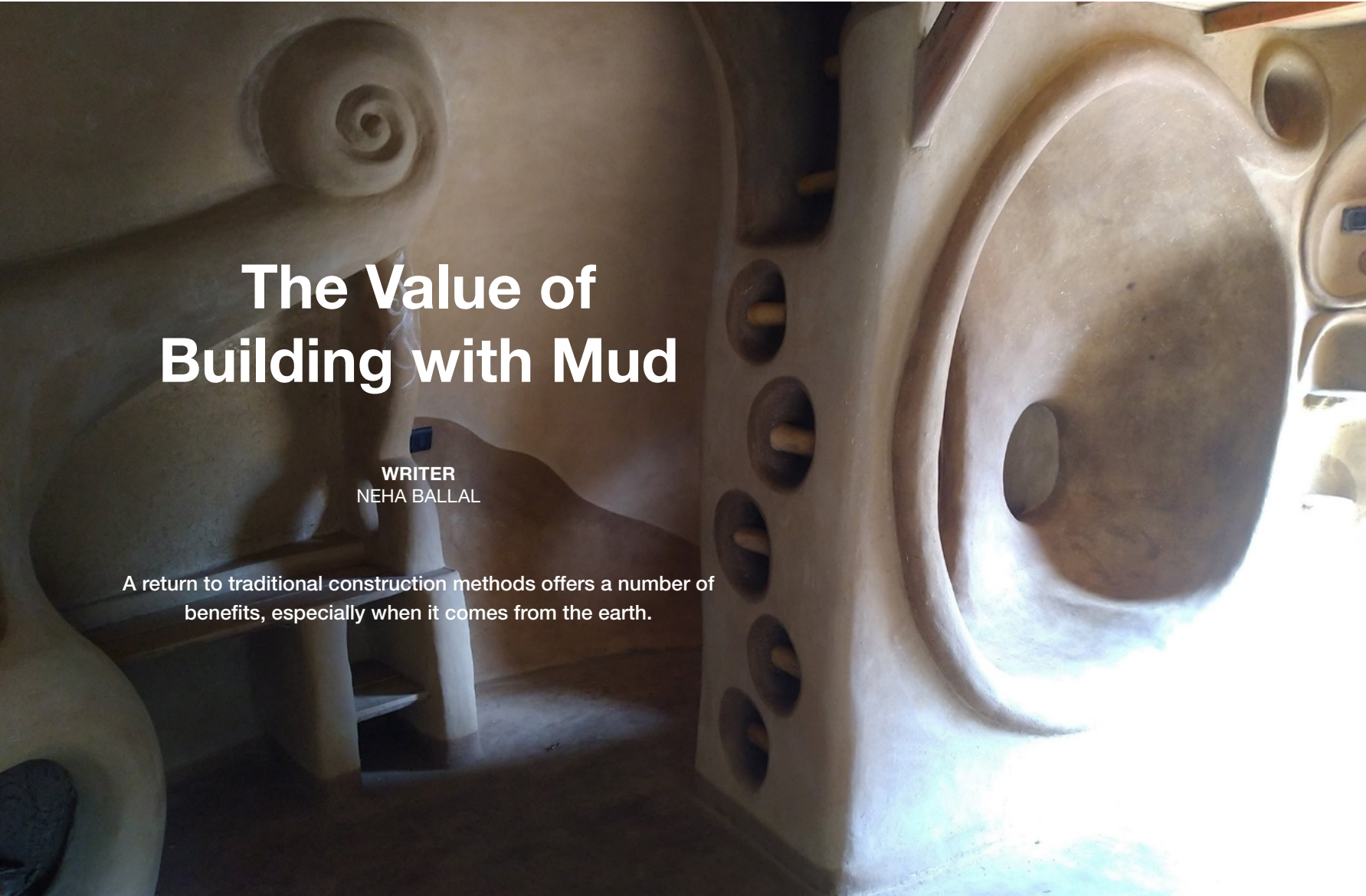
Most Indian states offer incentives for green building. At the owner and developer level, there is a sense of pride as well as incentives to build green. As a result, most building owners in India don't want to construct a building with a low sustainability rating. The general public, however, has not been made aware of the benefits of turning net-zero, and this low level of awareness needs to change. If average families at home don't understand the importance of conservation, then the price India will pay for becoming carbon neutral will be very high. If users do not adopt sustainable practices, the environmental footprint of our buildings will be large. The bottom-up approach is still missing in India in the two decades of the green building movement. In the next decade, this should be inherent to our approach. What is the interaction between traditional sustainability and current technology in India, and what is your sense of the industry going forward.

India has been fortunate because our practice of conservation is built into spiritual books, and we need to combine tradition with technology. For example, India overall gets over 300 days of sunlight, and the green building trend has brought back the practice of bringing sunlight into our buildings. As a result, one can cut down on artificial light, which can significantly bring down energy consumption. ●



01 Building in construction, Bangalore. Source: Parth Savani / Unsplash

02 Modern coworking offices, New Delhi. Source: myHQ Workspaces / Unsplash



The Value of Building with Mud

WRITER
NEHA BALLAL

A return to traditional construction methods offers a number of benefits, especially when it comes from the earth.

01

Mud versus cement is a modern-day debate in India, where age-old traditionally sustainable materials and methods of construction have been replaced by cement in the name of growth and efficiency. As a diverse country with numerous cultures and beliefs, India is home to many construction techniques as well. Most of them use local materials, some of which have lasted

centuries. However, these methods seem to be slowly giving way to more modern techniques that are not always suitable across the varying landscape of the country. Traditional construction techniques are being lost to strong and easy-to-use cement, which has found its way into the construction industry over the last century and seems to be here to stay.

Cement is being used in every corner of the country without consideration for the surrounding temperature or climatic conditions. Southern India is an amalgamation of hot, humid, dry and cold temperatures. The west coast experiences more than five months of heavy monsoons, while the east coast is often submerged in just one month of monsoon. The coastal regions are humid while

Adapting to the climate

Traditionally, laterite stone was available in abundance on the western coast of southern India, and was usable for strong, porous walls of a reddish hue, plastered with a mixture of clay and lime, which enabled breathability throughout. During heavy rains, the sloping, clay-tiled roofs ensured

Plastering with natural materials is effective in adapting to climate conditions while generating very little construction waste: everything is biodegradable or reusable.

the interior is dry and hot. In between, we have small mountains and hills with a cool climate throughout the year. In northern India, we have the Himalayas on the eastern end and the Thar Desert to the western. Considering this, one material like cement should not be used for construction in all these climates. The traditional methods used in these areas should be respected and revived.

water did not stay stagnant or seep into the walls, while also making repairs easy. This technique was effective in adapting to the climatic conditions while generating very little construction waste. Everything was biodegradable or reusable.

But now, clay tiles and mud and stone walls are considered weak. The mud-plastered traditional houses are considered *kuccha* (raw or weak) houses, and the newer cement-plastered houses are considered *pucca* (strong) houses. This differentiation was even taught in schools, ensuring that children understood the importance of growing up and building a strong cement house. This plays a major part in changing the mindset of most Indians. People who owned traditional houses which were more than 50 or 100 years old would save up and raze the old '*kuccha* house' for a strong, modern cement one.

Soon, all the laterite walls were plastered with cement, stripping them of their porosity and breathability. Over the last decade, the laterite stone walls were replaced by fire brick walls, which led to more pollution as the kilns manufacturing these bricks are considered one of the most polluting plants in the construction industry. Sloping roofs gave way to flat reinforced cement concrete (RCC) roofs, which are stronger and cannot be damaged by falling coconuts or monkeys.

During heavy monsoons, water does not drain off the flat roofs as easily, and most houses now have seepage problems. In summer, RCC roofs absorb heat, making the flat-roofed houses unbearably hot. As a result, people have started putting a sloping galvanized iron sheet roof over their flat terraces to ensure water flows down in the rainy season, and there is no direct heat on the roof in summer. Some households use these iron sheets directly to avoid problems caused by flat roofs, but these sheets also absorb heat and create an unbearable environment inside the house.

The Himalayan Belt of North India

In the higher Himalayas, characterized by cold snowy weather and heavy monsoon, locally-available slate stone and wood were used in traditional methods of construction to create breathable and easily replaceable sloping roofs. Walls were made with dry stone masonry and then plastered with local clay. This ensured proper thermal insulation, so the houses remained warm in the cold winters, especially when a fire was

lit inside the house. Wide, decorative windows and doors ensured sunlight reached every nook of the house and allowed people to interact with their neighbors.

However, by 2023, cement found its way even into some of the remotest villages. People carry heavy sacks of cement on their backs, on pick-up trucks or mules, and proudly build cement houses. Come winter, most of them head to the kitchen – the one room which usually still has mud plaster – to sleep, as cement walls in the rest of the house retain little to no heat.



01 Decorative shelving in mud.

Source: Neha Ballal

02 House in Udupi.

Source: Neha Ballal

03 Inside a mud house.

Source: Ayush Goyal / Beyond The Wall

04 Mud house.

Source: Neha Ballal

05 Auroville Matrimandir.

Source: Mrinal Rai / Unsplash

My mud home in the Himalayas

To demonstrate the benefits of traditional buildings, in 2022, I built my own mud home in the remote Himalayan village of Wan, in the state of Uttarakhand. Wan is a beautiful village located at an altitude of 8,000 feet above sea-level and is the last village accessible by road in that region. Beyond Wan, the mighty Himalayas take over.

To build the foundation, I used the traditional dry stone masonry technique where stone pieces are laid one on top of the other without the use of cement or mud plaster. For the walls, I used a method called 'earthbag' or 'super adobe' construction. Here, we reuse empty discarded sacks of cement, fill them with the mud, stone or soil

available on-site (I used soil and stones that had fallen from landslides across the village), and build thick, strong walls. As the layers of sacks went up, villagers passing by stopped to see, both out of curiosity and some skepticism regarding the durability of such a construction.

When the walls reached the required height, it was time for me to start plastering them with mud. Typically, water and clay are used as a plaster coat, but such a plaster would crack easily when stuck to the plastic sacks. Instead, I used cob, a mixture of clay, straw and the local soil (in this case, black soil) in a specific proportion which ensures the plaster sticks to the wall. Unlike simple clay plaster, cob, due to the stickiness of the clay, the fineness of the soil and the binding property of small pieces of straw, is held together and sticks firmly on the wall.

The process of making cob is similar to traditional wine-making in that we mix the materials with our feet. Everyone wanted to jump in and mix the cob, an activity that took a couple of weeks. The village children would help me make the mud plaster in the morning before they left for school, after which I would apply the plaster for the rest of the day. Even the adults joined in too.

Soon, the walls were plastered, the roof was up and the villagers who used to pass by started stepping in to see the house. Everyone was amazed. One local man asked me if he could rent it for the winter because it was so warm and cozy inside. These are the advantages of the traditional methods that have been replaced by modern cement houses. I am glad that because of my attempt to build a small cottage, one remote village in the

Himalayas now knows the advantages of these traditional methods.

A return to traditional building

People are slowly realizing the disadvantages of cement after more than three decades of it being a part of almost every house in India. While traditional houses have lasted 70 to 100 years, the new cement houses last 30 to 40 years, and most of them develop seepages and cracks.

After the lifecycle of a house is completed, the construction waste of cement houses ends up in landfills, most of which are not segregated - the



03

The village children would help me make the mud plaster in the morning before they left for school, after which I would apply the plaster for the rest of the day. Even the adults joined in.

rusted iron rebars are mostly never taken off the cement slabs and thus do not degrade easily, causing more pollution. In Mumbai, redevelopment is rife, as most of the apartments built over 40 years ago have reached the end of their lifespan. Across the city, three to four-story buildings are being demolished and replaced by high-rises. All of the demolition waste ends up in a landfill in the nearby villages or in the ocean, creating not only an eyesore but also increased pollution.

Several organizations in India are supporting and spearheading the move towards sustainable methods of construction that draw on traditional building techniques.

The experimental township of Auroville started in 1968 near the southern Indian city of Puducherry. In Auroville, they have experimented with various traditional types of construction, mixing them with modern amenities while also conducting workshops to teach people about the techniques.

In the bustling city of Bengaluru, alongside the high-rise buildings, a company called Total Environment is building sustainable high-rises. They are taking small steps like using exposed hollow brick for the exteriors (avoiding cement, plaster and paint), stone flooring and integrating garden spaces even on the upper floors.

In a small town in Tamil Nadu is Thannal – an organization that builds mud houses and regularly conducts educational workshops. In a small village near Nainital in northern India, an organization called Geeli Mitti developed on an acre of farmland and focuses on creating awareness through workshops. They have a number of mud homes on the property which also have living roofs, causing them to blend into the landscape. They believe that unless you put your hands in the mud and understand its benefits and complications, you cannot build a mud home. The Indian National Trust for Art and Cultural Heritage, another NGO founded early in the 1860s, has been working on conserving



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heritage across India and has chapters for several cities with dedicated people working towards the conservation of traditional construction methods.

Companies like Earthblocks in Bangalore are mass-producing compressed stabilized earth blocks, which are essentially mud bricks, and can be used in construction just like regular fired bricks, making it easier to build a sustainable house.

Slowly but surely people are now choosing a breathable, long-lasting home that is comfortable to live in and looks appealing. Most of them start with farmhouses, and other homes that are away from the main city as sourcing high-quality materials in urban areas is a challenge. But the movement is underway, and while heading back to mud construction might be costlier in the beginning, it will provide sustainable, long-term benefits.

From being built with natural materials available locally to eventually degrading back into the same soil it came from, these houses depict the circle of life in its fullest. ●

I am glad that because of my attempt to build a small cottage, one remote village in the Himalayas now knows the advantages of these traditional methods.



Ecosystems

Fast Facts

As of 2021 the **total forest cover** in India is 7,13,789 km², which is **21.71% of the geographical area of the country**. The forest cover has increased by 1,540 square kilometer between ISFR 2019 and ISFR 2021 assessment.

Source: India State of Forest Report (ISFR) 2021

21.71%
INDIA'S FOREST COVER

Mangrove cover in the country is about 5,000 km² which is 0.15% of the country's total geographical area.

Sundarban, spread over nearly 10,000 km², located in Bay of Bengal is the world's largest single patch of Mangrove Forests. It is known for its wide range of fauna, including 260 bird species, the Bengal tiger and other threatened species such as the estuarine crocodile and the Indian python.)

Source: India State of Forest Report (ISFR), 2021, Chapter 3.

India had ten critically endangered species and seven vulnerable species in 2021-2022.

Critically Endangered Species:

1. Hump-backed Mahseer
2. Malabar Civet
3. Rameshwaram ornamental tarantula
4. Peacock Tarantula
5. Bengal Florican
6. Great Indian bustard
7. Gharial
8. Sumatran Rhino. This is the smallest of all rhino species.
9. Oriental white-backed vultures
10. white-bellied heron

Vulnerable Species:

1. Great Hornbill
2. Muger Crocodile
3. Sarus Crane
4. Olive Ridley Turtle
5. Snow Leopard
6. Indian Flapshell Turtle
7. Dugong

Source: The IUCN Red List of Threatened Species

According to the World Air Quality Report, India was home to 63 of the 100 most polluted cities in 2021, with New Delhi named as the capital with the worst air quality in the world.

As of 2022, India is home to five members of the big cat species: the Bengal tiger, Asiatic lion, Indian leopard, snow leopard, and Indo-Chinese clouded leopard.

The number of tigers in India climbed to 3,167, tracing an increase from 2006 to 2018, where numbers almost doubled to 2,967 according to the latest tiger census released by Prime Minister Narendra Modi (April 9, 2023) on the country celebrating 50 years of its tiger conservation project.)

Source: The Indu article (April 9, 2023): India's tiger population tops 3,000 shows census

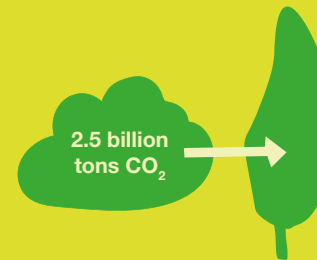
As of June 2021, India has 18 biosphere reserves.

In 2021, India had 75 sites designated as Wetlands of International Importance (Ramsar Sites), with a surface area of 1,326,677 hectares, which makes up 10% of the total wetland area of the country. Ramsar sites help develop and maintain an international network of wetlands, which are important for the conservation of global biological diversity. The certification brings visibility to ecologically-sensitive wetlands and helps in conservation.

Government Policies

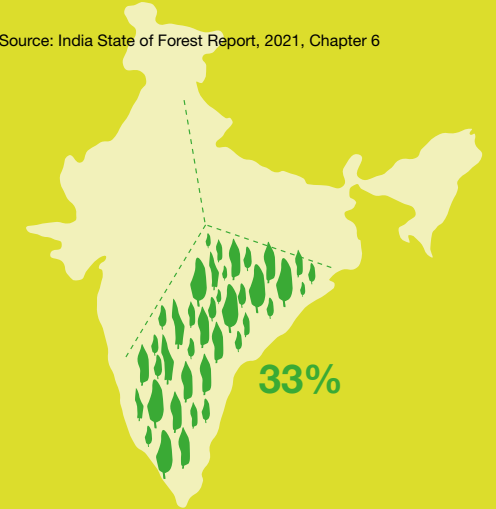
According to India's updated Nationally Determined Contribution under the Paris Agreement, India has committed to creating an additional carbon sink of 2.5 to 3.0 billion tons of CO₂ through additional forest and tree cover by 2030.

Source: India's Updated First Nationally Determined Contribution Under Paris Agreement



The National Forest Policy 1988 mandates that 33% of the total geographical area in India should be under forest or tree cover.

Source: India State of Forest Report, 2021, Chapter 6



India's National Clean Air Program aims to reduce emissions of particulate matter by 30% by 2024.

Source: Ministry of Housing & Urban Affairs



India is amongst the first members to legislate and implement the Convention on Biological Diversity (CBD) domestically, which is the parent convention of the Global Biodiversity Framework (GBF) and its 30x30 target.

The Biological Diversity Act (BDA), 2002 serves as an umbrella legislation in India for protecting the country's biological resources.

Sources: The Biological Diversity Act, 2002 and "Reinforcing India's existing legal frameworks to implement the Global Biodiversity Framework". July 2023. Priyanka Bhide, Namrata Kabra

Challenges

Noise pollution: **As per WHO estimates in India, there are approximately 63 million people who are suffering from significant hearing loss; this places the estimated prevalence at 6.3% in the Indian population.**

Source: National Program for the Prevention and Control of Deafness

A 2018 Central Pollution Control Board report quantified noise levels of all the six largest Indian metro cities as exceeding 80 decibels

Forests' carbon stock can help mitigate or exacerbate climate change as it is a system that has the capacity to store and release carbon.

(According to an analysis of the India State of Forest Report (ISFR) 2021, in the two years between 2019 and 2021, the quality of India's forests deteriorated across 15,183 km² as forests were either chopped down or thinned out.)

(The land under forest area has grown by just 1,540 sq km over 2019, according to the report.)

Climate Change: In the summer of 2022, the India Meteorological Department's observing stations reported temperatures between 45°C (113°F) and 50°C (122 °F). This followed a heatwave at the end of April and early May, at which temperatures reached 43-46 °C.

“Heatwaves have multiple and cascading impacts not just on human health, but also on ecosystems, agriculture, water and energy supplies and key sectors of the economy”- WMO Secretary-General Prof. Petteri Taalas

Source: World Meteorological Organisation

As of 2022, India is the world's second-most polluted country. **Air pollution shortens the average Indian life expectancy by 6.3 years, relative to World Health Organization guidelines.**

(132 cities, an increase from 102 cities since 2019 when the National Clean Air Programme was launched, have pollution levels below national standards.)

Source: <https://aqil.epic.uchicago.edu/country-spotlight/india>

Opportunities

To improve long-term air quality, the Indian Government launched the National Clean Air Program (NCAP) in early 2019. As of 2021 the NCAP is active in 132 Indian cities, and city-level Clean Air Plans (CAPs) are being developed and mitigation measures implemented with the goal of reducing ambient particulate matter concentrations.

India as part of the Bonn Challenge at COP15, committed to restoring 13 million hectares of degraded forests by 2020, and an additional 8 million hectares by 2030. This was enhanced to 26 million hectares in 2019.

Source: Ministry of Environment, Forest and Climate Change

In 2021, the forest carbon stock was estimated at 7,204 million tons. There is an increase of 79.4 million tonnes in carbon stock of the country as compared to the last assessment of 2019. The annual increase is 39.7 million tonnes, which is 145.6 million tonnes CO₂eq.

Source: Ministry of Environment, Forest and Climate Change Press Release: Carbon stock in India increases by 79.4 million tonnes, 2023

Mangrove Forests grow along the coast, especially in river deltas. These plants can grow in a mix of saline and freshwater. They grow in muddy areas covered with silt that the rivers have brought down. The mangrove trees have breathing roots that emerge from the mud banks.



Mangrove cover in the country has increased by 54 km² (1.10%) as compared to the previous assessment.

Source: India State of Forest Report 2021

India joined the Mangrove Alliance for Climate in November 2022 to help the integration of mangrove conservation alongside the Reducing Emissions from Deforestation and Forest Degradation (REDD+) programs for carbon sequestering.

India is among the first five countries to join the MAC, at the 27th session of the Conference of the Parties (COP27).

Source: News articles

The Unseen Polluter



SUMAIRA ABDULALI
FOUNDER, AWAAZ FOUNDATION

Noise pollution is hidden and rarely measured, yet increasingly harmful to the environment.

When does sound become noise?

According to the World Health Organization, India is one of the noisiest countries in the world and hearing loss is prevalent. This was acknowledged by our former Minister of Health, Harsh Vardhan, who is himself an ENT doctor.

How does noise pollution impact people of different economic groups?

I have been recording noise levels in Mumbai since 2003. Initially, people called noise pollution an elitist ‘Western’ concept. However, when I started tracking complaints, many came from economically weaker communities. I have often

heard from people working for daily wages that they cannot sleep and therefore cannot work. I have heard someone threaten suicide because they can’t stand the noise.

Can you tell us about your advocacy journey and experiences interacting with citizens?

When I began gathering data in Mumbai, no government agency was measuring noise. Now, the government has shifted policy and is measuring noise on a large scale. The pollution control board partnered with me to measure festival noise. As a result, firecrackers from Sivakasi, Tamil Nadu, which are distributed across the country, have reduced decibel levels from 140+, and this year

were all within the permissible decibel levels. From a 100% violation in 2008 and 2010, this year there was zero violation.

Awareness, enforcement, and action, however, are completely different things. At first, no awareness of this issue existed at all. However, over the last 19 years this has changed, and today almost everyone is aware that noise is harmful. This can be seen in the nature and number of complaints. Earlier, people would think, “I am very sensitive, it’s just me who’s being impacted,” but when you start getting hundreds of such calls, then you have data too. As I work independently and don’t have enforcement mechanisms at my disposal, I advise these individuals to complain to the police control room. This they have done in such large numbers that in 2020, noise pollution complaints were the second-largest environmental crime in Maharashtra. You need that critical mass of complaints to initiate behavioral and societal change. I think we are getting there.

We talk of world-class buildings, we want to become a world-class city with world-class standards, but we don’t enforce those standards in the building phase, which is going to last at least 20 more years given the volume and scale of the projects in Mumbai alone.



A builder will say they are helping grow the city. Government will say infrastructure is required for the city's betterment. A person bursting a firecracker wants their child to experience the joys of their childhood.

Despite this construction noise has been on the rise; we are told that 40% of Mumbai is going to be broken and reconstructed. Construction causes a huge amount of noise pollution. Levels of enforcement differ, and you're likely to hear from people that construction noise can't be helped. We talk of world-class buildings, we want to become a world-class city with world-class standards, but we don't enforce those standards in the building phase, which is going to last at least 20 more years more given the volume and scale of the projects in Mumbai alone.

What are some of the challenges to reducing noise pollution?

Several of the mitigation measures require money. The question is how much we want to invest in changing, in educating people and using our technological capabilities (noise barriers, better construction equipment) to move forward.

There is consensus that noise is damaging to health, but the easy thing to do is carry on the way you are. People make excuses, which translate into a larger discourse on culture and religion. There are multiple sides to every equation. A builder will say they are helping grow the city. Government will say infrastructure is required for the city's betterment. A person bursting a firecracker wants their child to experience the joys of their childhood.

How does noise affect the ecosystem at large?

For the very first time, the UN has acknowledged that noise is a serious health hazard affecting all species, not just humans. Anyone who has a pet can tell you what happens when there are firecrackers - how dogs hide and get lost. The same effect has been documented for many other species. We know that many animals are terrified of loud noises because their hearing is different and more acute. We also know through a study, which was conducted in the UK quite recently, that across species, noise has very harmful effects. Birds abandon their nests and animals abandon their young ones because of noise. They even found that caterpillar heartbeats speed up when they are exposed to noise. We know that marine mammals are severely impacted by noise, that it disrupts dolphins' and whales' habitats.

What measures can people take to reduce noise pollution? Could you share examples of initiatives or awareness programs to help people gain more agency?

Mindset and social change of any kind takes time. Last year, one of the largest masjids (mosques) in Mumbai announced development of an app to conduct azaans (prayers) online, which shows a huge advance. There have been Navratri (public dance) festivals held using headphones instead of loudspeakers. The media has played a role in increasing awareness. We have partnered with newspapers on campaigns in the field where volunteers explain to people why they should not honk.

Through an initiative across municipal schools, the government of Maharashtra, has created more awareness amongst children. In 2018, they declared a "no honking" year, and partnered with us and the auto rickshaw union on an awareness campaign. A special rickshaw with 150 disabled old fashioned blow horns drove around the city with the message "Mumbai honks 18 million times an hour" on the top.

An organization called The National Environmental Engineering Research Institute (NEERI) has developed a free app called noise tracker to measure sound using your phone. The Mumbai police have accepted this app for making official complaints. We have recently partnered with the traffic police to release a booklet informing citizens what they can do.

I am also very hopeful that younger people who are more environmentally conscious than my generation are going to do these things, across the board. ●

01 Dense traffic, Mumbai.
Source: Hiki Liu / Unsplash

02 The HornVrat rickshaw.
Source: Awaaz Foundation





Connecting Culture and Ecology in the Nilgiri Biosphere Reserve

WRITERS
DR. ANITA VARGHESE & DIVYA KILIKAR

A rich ecosystem in southern India shows the effects of climate change, growing urbanization and lack of ecological sensitivity.

01

Alexander von Humboldt (1769-1859) wrote the first texts of 'biogeography' which meticulously described the geography of plants along a mountain in South America, showing how several factors like altitude, humidity and temperature influence biodiversity. Had Humboldt traversed India's Nilgiri Mountains, he would have found the perfect example

to describe his theory of interconnectedness. Today we also understand that cultural practices play an important role in shaping landscapes: pastoralists set low grade fires to maintain grasslands; rotational agriculture results in forest clearings for human settlements; riverbanks are rerouted to hold and divert excess water.

However, in the Nilgiris over a span of 200 years, development in the form of roads, tunneled mountains, dams, reservoirs and monoculture plantations have hastened a loss of biodiversity which has far-reaching impacts on people and wildlife. While many communities may have adapted by learning new skills, this has not been the case for

Rather than acknowledging their potential as custodians of their ecosystems, people's dependence on natural resources is perceived as the root of biodiversity loss.

indigenous communities who hold on to the last threads of an ancient connection to the landscape. Sightings of wildlife like gaur, bears and elephants moving through human settlements and tea plantations foraging for trash are becoming increasingly common. Are they searching for old routes of migration? Are they attempting to connect to a landscape they no longer recognize?

Preserving a bio-cultural hotspot

In 1986, a large contiguous region of the Western Ghats, spreading across the states of Tamil Nadu, Karnataka and Kerala, was declared the Nilgiri Biosphere Reserve (NBR) in recognition of its rich biodiversity, which includes a number of rare, threatened and endangered species. This mountain

range, along with the entire stretch of the Western Ghats, is older than the Himalayas and has several plants and animals that are similar in origin. Seventy-five percent of the reserve is under the protected area network of tiger reserves, national parks and reserved forests, which have the highest level of state protection. The NBR is also India's first reserve under the UNESCO's Man and Biosphere Program, in recognition of the high cultural diversity that coexists alongside the rich biodiversity. Thirty distinct indigenous groups and several local communities with unique languages and cultural practices are first dwellers of this ancient land.

To the south-west of the NBR, for example, in a stretch of lower elevation evergreen forests which were declared the Karimpuzha Wildlife Sanctuary, endangered lion-tailed macaques roam free, swinging through the canopy. Also living in these forests are the *Kattunayaka*, *Paniya* and *Cholanayaka* indigenous people, for whom the forest is an important provider of livelihoods. Whether providing fish, honey or plant resources,

the forest is a safety net that ensures their nutrition and supports their incomes and lifestyles. While traditional models of co-existence with nature are practiced amongst indigenous people, these lifestyles are threatened by rapid, unchecked development, a lack of consultation and inclusion in policy-making and climate change-related environmental disasters.

In 1993, Keystone Foundation, an eco-development non-profit based in the Nilgiris, began its initial study

of honey collection and traditional bee-keeping methods. Three decades later, Keystone's relationship with indigenous communities has evolved into several collaborations. These are all working towards the goal of sustainable development in an ecologically sensitive mountain range. From reviving native beekeeping among indigenous youth to facilitating trainings on organic farming to setting up thousands of native kitchen gardens, the bees inspired us to further our mission of enhancing indigenous quality of life and the environment.

The restoration of a biosphere

Since the end of the British Raj era (1757-1947), conservation and development have been seen as mutually exclusive, a colonial perspective that has persisted in the form of policy and decision-making. Rather than acknowledging their potential as custodians of their ecosystems, people's dependence on natural resources is perceived as the root of biodiversity loss. Protected areas have been designed to reduce access to the resources

Their language, food, knowledge and belief systems are intricately linked to the grassland, the land of their sacred buffalo and ancestors. One cannot exist without the other.



indigenous people have managed sustainably, leaving them alienated and impoverished.

One unique habitat of the Nilgiris is the Shola-grassland mosaic, evergreen forests and grasslands up to 2,600 meters above sea level. Lodged within the mountains, they are sheltered from the high-speed winds of this altitude. From the 1800s to mid-1900s, timber-based industry facilitated the cultivation of trees like acacia and eucalyptus in Shola areas. The persistent spreading of these trees remains a significant threat to the remaining grasslands. Loss of grasslands is beyond habitat degradation. For the Toda, an indigenous pastoralist

community, life itself is threatened. Their language, food, knowledge and belief systems are intricately linked to the land of their sacred buffalo and ancestors. One cannot exist without the other.

Keystone Foundation is at the frontline of ecosystem restoration efforts in the Nilgiris, engaging children and adults in restoring patches of degraded habitats. Many of our restoration sites are public spaces in schools, tea factories, government buildings, hill wetlands and stream banks. The nurseries at Keystone's centers in the NBR raise native plant species, of which several are endangered, culturally significant and in need of conservation action.



03



04

Rethinking development for a mountain

A few plateaus in the NBR, including Wayanad, Nilambur, Sigur and Ooty, have become areas of settled agriculture where tea and vegetable plantations flourish. Townships were developed and populations have increased in the last 200 years, giving rise to famous tourist destinations like Ooty and Coonoor. Road signs announce a 'plastic-free Nilgiris' as you enter the touristy hill town of Ooty, in Tamil Nadu. While the bustling restaurants and shops have switched from plastic to paper or cloth, managing solid waste remains a daunting task. Unregulated growth of these townships in response to burgeoning tourism means open gutters and sewers flow freely into mountain streams and infrastructure competes for space along mountainsides. Annually, Ooty receives up to 2.4 million tourists from across India. Despite being called the 'Queen of the Hills,' Ooty is certainly not treated like one.

It is in traditional knowledge that community identities are rooted, and so are the answers to improving the stewardship of a biosphere.



05

Development is restricted by low-quality infrastructure unsuitable for a mountain stressed by seasonal population fluctuations. The mountain roads, which started as single paths more than a century ago, are now two-way traffic-choked roads, with no regulations about the kind of vehicles that can enter the district. Today, with expanding human settlements changing the landscape, wildlife movements are affected and increasing incidence of negative human-wildlife interactions are becoming difficult for forest departments and local communities to manage.

Drawing from the experiences of locals in Kotagiri and surrounding areas, Keystone's Biodiversity Conservation Team tracks roadkill, records wildlife movement, monitors negative interactions and works closely with the forest department to close gaps in wildlife rescue and rehabilitation efforts.

Preserving traditional ecological knowledge

In the mid-elevation forests on the eastern side of the Nilgiris, trees and steep cliffs are home to one of India's native bees, *Apis dorsata*, which migrates to the mountains to build their nests for the summer, returning to the plains during the monsoons. These 'giant' bees are followed by the indigenous people. The Kurumba honey hunters know the bees' behavior and ecology like no others. Changes in flower patterns due to erratic weather affect bee migrations. Honey collection is less reliable than it used to be, and while it has implications for the livelihoods of the Kurumbas, little is known about its effects on honeybee lifecycles.

Traditional knowledge that was relied upon for centuries and passed down carefully needs recalibration. As daily wages and restrictions on forests access increase, indigenous people are moving away from traditional ways of living and knowing. With this shift, we are quickly losing valuable knowledge on the ecology of lesser-known species like honeybees and other insects. A comprehensive documentation of the flora of the NBR has been an ongoing effort at Keystone Foundation for 15 years. Our pictorial guides to the regional flora are a compendium of scientific and traditional knowledge and have become a resource for the community youth who have not had the opportunity to learn from their elders. It is imperative to document both traditional knowledge and the conditions that are causing its erosion. It is in this knowledge that community identities are rooted, and so are the answers to improving the stewardship of a biosphere.

Response to natural disasters and epidemics

Since 2018, we have seen a spate of unpredictable and extreme weather events such as flash floods and landslides. According to the Vulnerability Atlas of India, published by India's Ministry of Housing and Urban Poverty Alleviation, the Nilgiris district is categorized as having a high-hazard risk from landslides. The Nilgiris receives high precipitation during both the south-west and north-east

monsoons. The lateritic soils of the area, plus historic changes in land use, and the loss of drainage networks create more vulnerability in the face of such precipitation patterns.

In response, the Keystone Foundation has added a disaster management component. This required much of the normal work to be temporarily halted and every team member was involved on the ground to meet the needs of the community, from providing rations to facilitating medical services. Disaster mitigation is now an integral part of our work, with efforts including strengthening riverbanks against floods, promotion of climate-resilient crops, setting up weather stations and training community members to monitor and predict weather events. ●

Conserving Nilgiris Mountains

Innovation towards building the resilience of a mountain and its people, both stressed by unregulated development and environmental disasters, will be an enduring quest of Keystone Foundation. Our work ties into ongoing global conversations on sustainable development, climate justice and fair means of reducing the vulnerability of millions of communities who are equal custodians and stewards of the land. The brunt of climate change events is shouldered by indigenous communities who live in ecologically fragile areas. It is high time we involve native people in the stewardship of their landscapes so with their innate wisdom they may continue to rebuild the connections the rest of the world seems to have lost. The NBR beckons us to listen and learn while constantly reminding us to reconnect and rebuild our relationship with the larger biosphere – our only home.

- 01 Nilgiris landscape.
Source: Keystone Foundation
- 02 Diversity of native grains during the Using Diversity Food Festival in Hassanur.
Source: Keystone Foundation
- 03 Longwood Shola, Kotagiri.
Source: Keystone Foundation
- 04 Adhimalai - woman packing wild forest honey- traditional livelihoods.
Source: Keystone Foundation
- 05 Apis florea.
Source: Keystone Foundation



Energy

Fast Facts

As of April 2023, **solar and wind power represents over 87.5% of all renewable energy generated in India** (excluding large hydro power projects). 63.7% when including large hydro power projects).

Source: Ministry of Power, Government of India



India is the second-largest coal producer and consumer, and its coal demand is expected to peak by 2030.

Source: Reforms & Achievements of Ministry of Coal since 2014

India is ranked #3 globally in renewable energy generation. As of April 2023, India's renewable energy sources have an installed generation capacity of 125.7GW (excluding large hydro power). This represents 30.2% of the country's total generation capacity (or 172.5 GW including large hydro power representing 41.4% of total generation capacity).

Source: Ministry of Power:

India's total installed energy capacity as of 30/04/2023 stood at 4,16,910 MW, out of which **coal represents 49% of all the generated energy.**

Source: Ministry of Power, Government of India

India produces the world's cheapest solar power as of 2019.

Source: International Renewable Energy Agency



Ten times larger: India's renewable energy sector could potentially employ around one million people by 2030, which would be ten times more than the existing workforce.

Source: NRDC

India is the world's third largest emitter of greenhouse gases (GHGs), after China and the US.

Source: Carbon Brief

Over a period of 25 years, India has managed to lower the weighted average cost of its installed onshore wind projects by 75%. This is the largest cost reduction in the world.

Source: Irena Renewable Power Generation Costs in 2021

As of 2021, India employs more than 863,000 people in the renewable energy sector.

Source: International Renewable Energy Agency

 10,000 people



Government Policies

India set an ambitious target of reaching 175 GW of installed capacity from renewable energy sources by the year 2022, which includes 100 GW of solar and 60 GW of wind power capacity. This target was however not met. The total installed capacity on 31 December 2022 stood at 120.9 GW (this does not include large hydro power projects).

Source: India Times article (March 21, 2023): India misses RE capacity target due to low solar rooftop, wind energy project installations: Parliamentary panel

To achieve this target, the Ministry of New and Renewable Energy introduced a National Wind-Solar Hybrid Policy in order to provide a framework for the promotion of large grid-connected wind-solar PV hybrid systems. The policy also aims to encourage new technologies involving hybrid operation of wind and solar plants.

Source: National Wind-Solar Hybrid Policy 2018

In February 2022, India announced its Green Hydrogen Policy, designed to set up and stimulate the growth of a homegrown green hydrogen industry and transform India into a green hydrogen hub.

Source: Ministry of Power, Government of India

Challenges

India's annual green finance was approximately \$44 billion in 2020. This represents only one-fourth of the financing needed to meet its net-zero target. While the government is committed to green energy, the lack of strong green finance regulations, updated data and consistent green energy policy are but a few causes of this financial shortfall.

Source: Landscape of Green Finance in India Supported by India's green investment flows in FY 2019-20, Climate Policy Initiative Report 2022

India has a high dependency of imported oil. This import dependency is due to the lack of indigenous availability of crude oil needed to fuel India's vast industry and transport sectors. Reducing these imports without a viable alternative fuel in place would harm India's economic growth as it hampers its ability to conduct trade. Until fully operational Green Hydrogen and EV industries are established, India's dependency on imported oil will remain.

Source: International Energy Agency - IEA India Energy Outlook 2021

India lacks a national carbon tax. As a result, it remains financially beneficial to remain in the fossil fuel sector, as the cost is borne by the consumer rather than the producer. This actively impedes India's efforts to invest in cleaner fuel alternatives.

In 2021, India still offered 9x more subsidies to fossil fuels than to clean energy. This approach makes a range of fossil fuel sectors difficult to abate as government benefits remain lucrative and counter India's sustainable development goals.

Source: OECD

Fossil fuels (and electricity) amount to 99% of all energy revenues in India. Of this, oil and gas alone amount to the lion's share of the revenue. Making up for these revenues from alternative energy sources will remain a struggle for the government, as India switches to renewable energies.

Source: Report: Mapping India's Energy Policy 2022: Aligning support and revenues with a net-zero future

Opportunities

At COP26 in Glasgow, India announced a target of **increasing its renewable energy capacity to 500 GW and to meet 50% of India's energy needs by 2030**. The government's commitment is intensifying efforts from various high-emitting industries to lower their carbon footprint, such as the power and transport sectors, as well as the steel and cement industries, that are being encouraged to decarbonize.

Source: Ministry of Environment, Forest and Climate Change, India's Stand at COP-26

The establishment of a domestic green hydrogen industry could lead to savings on energy import of up to \$358 billion and could enable India to abate 3.6 gigatons of CO₂ emissions cumulatively between 2020 and 2050.

Source: Niti Aayog - Harnessing Green Hydrogen Opportunities for Deep Decarbonisation in India, June 2022

India produces some of the world's cheapest solar and wind power and has an established low-cost renewable energy industry. This gives India an advantage in generating low-cost renewable energy and makes green hydrogen the most competitive form of hydrogen in the long run.

Source: Report: Harnessing Green Hydrogen Opportunities for Deep Decarbonisation in India



INTERVIEW

Ensuring India's Clean Energy Transition is Just



RAGHUNATH ANANT MASHELKAR

CHAIRMAN, RELIANCE NEW ENERGY COUNCIL, PRESIDENT, PUNE INTERNATIONAL CENTRE,
CHAIRMAN, IFOREST

Developing economies walk a fine line between transitioning to clean energy and ensuring equitability.

There is a pressing need for clean energy systems in India and across the globe, but must they come at the cost of equitable access and grave implications for vulnerable and stressed communities? Dr. Raghunath Anant Mashelkar explains the importance of centering equity in the transition to clean energy in India.

Could you explain the concept of 'Just Transitions' and how it relates to the context of India?

The concept of Just Transition is linked to the energy transition that is being propelled by climate change. There is an urgent need to decarbonize our economies and move away from fossil fuels. Such a transition must not only be environmentally friendly, but also just and equitable to workers and regions that have been reliant on fossil fuels for several decades.

The first formal recognition of Just Transition was in the Paris Agreement in 2015. At COP27 in Sharm El-Sheikh, Just Transition emerged again as an important agenda item, brought into the spotlight by the \$20 billion Just Energy Transition Partnership (JETP) that was struck between Indonesia and G7 countries at the Group of 20 meeting in Bali for a "just" phase-down of coal use in the country.

Just Transition is complex for developing countries like India, which have high growth trajectories, high fossil fuel dependence, a large informal workforce and vulnerable populations.

01 View of Vizag Adani Coal Handling Terminal, Andhra Pradesh, India.
Source: Vizag Explore / Unsplash



A just transition must not only be environmentally friendly, but also just and equitable to workers and regions which have been reliant on fossil fuels for several decades.

Economic diversification through opportunities for renewable energy and green manufacturing will improve India's human and resource potential.

What are the challenges to balancing India's scientific, industrial and social needs?

India has embarked on an ambitious journey to achieve net-zero emissions by 2070. Several goals will contribute to realizing this, including installing 500 gigawatts of renewable energy by 2030 and meeting 50% of the country's electricity requirement through renewables in the same timeframe.

The few key challenges which loom large for India include:

Energy security: The challenge is to ensure India's development trajectory is not affected.

Informal workers: Unlike the Global North, India presents a labour challenge as millions of workers are engaged informally and without any social security or safety nets.

Balanced development within India: The challenge will be to ensure the transition is not detrimental to the coal mining states. The transition should allow these areas to develop like other parts of the country.

Science-based decision-making: Just Transition will require investments in vast science and social science knowledge resources.

Green industry: Moving away from fossil fuels will require large private sector investments in green fuels and industries.

Dependence on foreign countries for minerals: India's energy transition will require large quantities of critical minerals used in solar Photovoltaic (PV), batteries and other green technologies.

What are the opportunities?

The key opportunity is overall development, across various Indian states, to ensure inclusive growth and improve livelihoods in the fossil fuel manufacturing regions. Economic diversification through opportunities for renewable energy and green manufacturing will improve India's human and resource potential.

Another opportunity will be to harness the renewable energy potential of those regions, which are not perceived as rich regions in the renewable energy space. There is potential for renewable energy and green manufacturing in coal states. Investments in green technologies will improve energy security and boost local jobs and social infrastructure.

How can talent and technology help India become a leader in Just Transition?

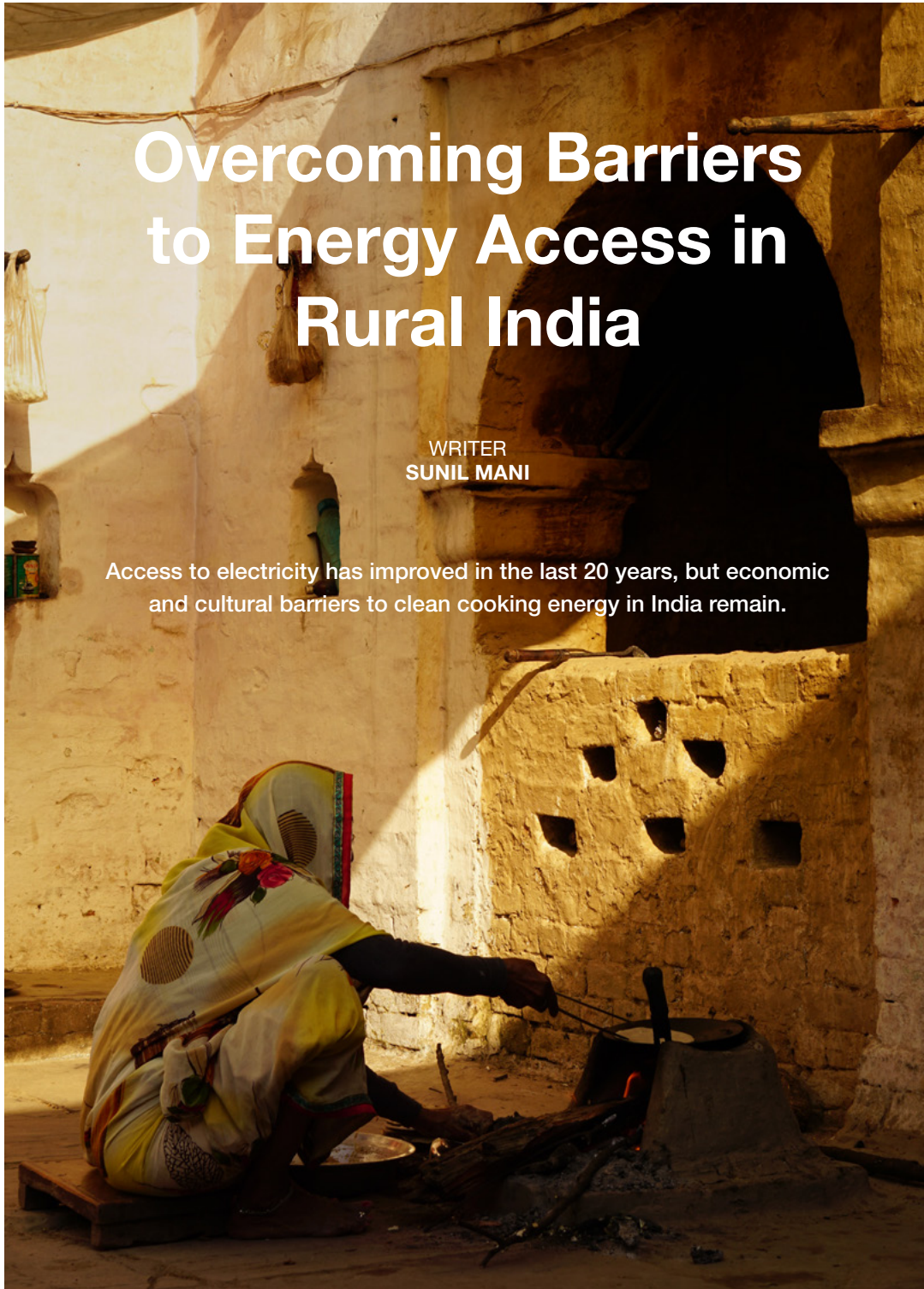
The Mission Innovation Hydrogen Valley Platform was developed under the Mission Innovation Challenge 8 (IC8): 'Renewable and Clean Hydrogen,' and the Department of Science and Technology is spearheading the development of Hydrogen Valley Platforms in India. The Pune Knowledge Cluster, of which I am the chairman, organized a meeting to discuss the 'vision-setting for Hydrogen Valley in

the State of Maharashtra,' where several small and medium industries and research and development institutions participated.

The Council of Scientific and Industrial Research (CSIR) recently showcased the first 'invented and made in India' hydrogen fuel cell-powered bus. This was achieved through a public private partnership initiative: the New Millennium Indian Technology Leadership Initiative launched in 2000 when I was the Director General of CSIR. Models like this – national public private partnerships focused on new technologies – need to be reimaged to deliver the next generation of solutions. ●

02 Wind turbines on the coast, Kanyakumari, Tamil Nadu, India.
Source: Sunny Tank / Unsplash





Overcoming Barriers to Energy Access in Rural India

WRITER
SUNIL MANI

Access to electricity has improved in the last 20 years, but economic and cultural barriers to clean cooking energy in India remain.

01

In the last decades, India has witnessed unprecedented improvements in household energy access. Since 2001, the government has expanded access to electricity and brought nearly 800 million Indians out of darkness. In the seven years between 2016 and 2023, the Indian government provided clean cooking energy solutions in the form of liquefied petroleum gas (LPG) connections to more than 95 million Indian families.

Even though these fast-paced developments brought India significantly closer to achieving the milestone of universal access to modern energy solutions, it is also important to understand the extent to which this has translated into uninterrupted last-mile energy access to every corner of India. Sensing the need to develop a more nuanced understanding of energy, the Council on Energy, Environment and Water (CEEW) conducted the India Residential Energy Survey (IRES) 2020, a nationally-representative household survey, across 21 Indian states that together account for 97% of the population. The IRES 2020 covered various dimensions of electricity and cooking energy-use in households. The following findings revealed a lot about India as the subcontinent advances with its energy transition.

Getting closer to universal electricity access

Is every home wired?

India has made considerable progress toward household electrification, with nearly 97% of households having access to electricity in 2020 in comparison to only 56% in 2000. However, the survey revealed that 2.4% of Indian households remain unelectrified, most of them concentrated in rural northern and eastern states of Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana and Bihar. The majority of these unelectrified households are multi-dimensionally poor and cite their inability to afford electricity as the reason for not having a grid connection.

97% of Indian households had access to electricity in 2020 in comparison to only 56% in 2000.

Source: CEEW.

01 A woman cooking on Fatehpur, Uttar Pradesh, India
Source: Shruti Singh / Unsplash

How many hours do the wires carry electricity supply every day?

An average Indian household now receives more than 20 hours of power supply every day, with Delhi, Kerala and Gujarat receiving just over 23 hours of supply in both urban and rural areas. However, despite significant improvements, households in Uttar Pradesh, Jharkhand, Haryana, Assam and Bihar face long power outages, with rural households still facing six or more hours of outages a day.

How reliable is the power supply?

Three out of every four households surveyed reported that they still face unanticipated power outages. Two-thirds of rural and two-fifths of urban households face outages at least once a day, with Uttar Pradesh, Jharkhand, Assam, Bihar, and Haryana having the highest frequency and duration of outages. One-third of households also faced at least one of three supply quality issues: long blackouts, low voltages or appliance damage due to voltage fluctuations.

Steps to reach 24/7 electricity for all

One cannot discuss the Indian power story without discussing the dismal state of electricity distribution companies, which are in severe financial distress. More than half of public distribution companies had aggregate technical and commercial (AT&C) losses of over 20% in the 2020–21 fiscal year. Such high losses affect the distribution company's ability to provide high-quality 24/7 power. A crucial reason behind the companies' poor financial condition is the revenue shortages arising from lower electricity tariffs and an inefficient billing and payment collection system, which leads to lower recovery of electricity charges from the consumers.

To facilitate adequate mechanisms to collect charges from electricity consumers, the government launched the Revamped Distribution Sector Scheme (RDSS) in 2022. The RDSS aims to reduce AT&C losses to 12–15% by 2025 and replace 250 million conventional electricity meters with smart prepaid meters by 2026. Smart prepaid meters will ensure advance payment from consumers to distribution companies for electricity consumption, eliminating meter-reading and billing-related issues,

as well as automatic disconnection in case a bill is unpaid. Smart meters have the potential to improve revenue, which can then be invested in improving power supply infrastructure. Improved revenue will also go a long way in improving distribution companies' ability to provide reliable, 24/7 power to all and create capacity for supporting disadvantaged consumers with subsidies.

Both the India's central and state governments should explore the idea of an ultra-low lifeline tariff, say ₹2 (or €0.023) per unit of electricity consumed, for households that are unable to afford the minimum basic electricity consumption. Implementing such an electricity tariff (for marginal households with monthly

electricity consumption of less than 30 or 50 units) at the national level would help poorer households sustain a minimum level of electricity consumption without getting disconnected from the grid.

Transitioning to clean cooking in India

Burning solid fuels, or biomass, to cook in poorly-ventilated homes exposes families, particularly women and children, to indoor air pollution. India has made remarkable progress over the past decade to address this and replace traditional solid

cooking fuels with clean cooking options, primarily liquefied petroleum gas. This was done through the Pradhan Mantri Ujjwala Yojana (PMUY) scheme, launched in May 2016. Under the first phase of the PMUY program, the government distributed LPG connections to more than 80 million poor and socially disadvantaged families at subsidised costs, significantly increasing the share of LPG users in the country from 28.5% in 2011 to 71% in 2020. The health benefits of this were estimated to be

02 Power lines over tea field in Kerala, India.
Source: Afanur Rashid / Unsplash

2/3 of rural and 2/5 of urban households still face electricity outages at least once a day.

Source: CEEW



around 150,000 premature deaths avoided in 2019. It also helped India progress on several of the United Nations' Sustainable Development Goals (SDGs), including SDG 3: Good health and well-being, SDG 5: Gender equality, SDG 7: Affordable and clean energy, SDG 13: Climate change, and SDG 15: Life on land/forest degradation.

However, as of March 2020, even though 85% of Indian households had access to LPG, nearly half of them, mostly in rural India, continued to use it alongside polluting solid fuels. Less than half of households in eastern and central Indian states such as Jharkhand, Bihar, Madhya Pradesh, West Bengal and Odisha, use cooking gas as their primary fuel.

India needs to overcome several gaps including affordability, lack of timely LPG refills, easily available, free biomass (such as fire wood, cow dung and agricultural residue that is burned for cooking purposes) and cultural preferences for biomass-cooked food, to ensure a universal and sustained transition to clean cooking fuels.

While 85% of Indian households had access to liquified petroleum gas in March 2020, but nearly half of them, mostly in rural India, continued to use it alongside polluting solid fuels.

Source: CEEW

Overcoming the affordability barrier

The price of domestic LPG refills (14.2 kg per cylinder) in India has almost doubled from less than ₹600 (€6.76) in November 2020 to around ₹1,100 (€12.39) in December 2022. At the current refill price of domestic LPG, transitioning to its exclusive use would require an average rural Indian household to spend 13% of its overall monthly expenditure on cooking energy needs. This is significantly higher than the actual reported spending of 4.9% of monthly expenses on cooking energy needs in March 2020.

In order to address the affordability barrier, the government announced a targeted subsidy of ₹200 (€2.25) per 14.2 kg cylinder for up to 12 refills every year for 90 million PMUY beneficiaries in May 2022. However, even after this subsidy, an average rural household will still have to spend more than 10% of its monthly income on LPG refills in order to transition to its exclusive use. There is a need to provide higher subsidies per refill, and the government can start by targeting households exhibiting low LPG consumption over time.

Financing the higher subsidies amidst the pandemic-induced economic crisis is another challenge, especially because the entire budget for LPG subsidies comes from the Ministry of Petroleum and Natural Gas (MoPNG). Roping in other governmental and non-governmental entities to contribute to India's LPG subsidy basket will reduce the burden on MoPNG and allow higher subsidies. For instance, if any philanthropic organisation interested in maternal health wanted to subsidise LPG consumption for pregnant women and new mothers in a specific area for a specific time period, the government should facilitate the receipt of such funding.



03

Availability barrier

The Council on Environment, Energy and Water found that in rural India, only 54% of the LPG-users receive home delivery for their LPG refills. LPG distributors often complain that doorstep delivery in villages is not financially viable. For households that do not get home delivery, members have to travel an average distance of 4.9 km per way in rural areas to get their cylinders refilled. Thus, many consumers cannot easily travel to the distributor gas agency to pick up a cylinder and transport it back home.

Currently, the LPG distributors receive a flat commission of ₹64.84 (€0.73) to provide home delivery of each LPG refill. However, the LPG distributors' commission per refill delivery should be calculated based on the cost of service provision and cylinder sales per month. We may also consider a decentralised LPG delivery system at the village level and loop in self-help groups and common service centres.

Easy availability of solid biomass fuels

Because biomass is available for free in rural India, any amount of subsidy for LPG may be ineffective in promoting its sustained consumption. The 2020 India Residential Energy Survey found that about 14% of rural households in India rely exclusively on free biomass, while another 50% collect biomass to supplement clean fuels. In such cases, we need to pilot initiatives to promote decentralised biomass processing units that manufacture briquettes and pellets for industrial and commercial establishments using locally-available biomass. Besides putting a monetary value to locally-available biomass, this could also create income opportunities for households currently gathering it for free.

04 A fire pit using biomass for cooking.
Source: Anshu A / Unsplash



After subsidies, an average rural household will still have to spend more than 10% of its monthly income on LPG refills in order to transition to its exclusive use.

Source: CEEW.

04 LPG vendor
Source: CEEW

04

The most important barrier facing India is the unaffordability of modern energy sources to sustain consumption.

Source: CEEW

Awareness barrier

In India, a preference for food cooked on traditional chulhas is a critical barrier to clean cooking options. In order to address such gaps, the MoPNG organises village-level LPG ‘panchayats’ or group meetings, to generate awareness about the ill effects of continued reliance on solid fuels for cooking. These panchayats also allow LPG consumers to share their experiences with one another.

Most participants in LPG panchayats are women, but the decision to purchase an LPG refill lies with the male members in most Indian homes. Therefore, LPG awareness campaigns need to target both men and women. We also need to test various other types of behaviour change communication strategies to determine the right type of messaging.

Are we there yet?

India has shown remarkable progress in both electricity and cooking energy access over the last decades due to the government’s efforts to improve energy access. But the country is yet to achieve “access to affordable, reliable, sustainable and modern energy for all,” as defined in the UN SDG 7.

The absence of nationally representative data that could enable a comprehensive and periodic assessment of households’ energy choices has also been a persistent concern. Periodically tracking our progress (through surveys like IRES) and solving emerging issues are needed to realise SDG 7.

The most important barrier facing India is the unaffordability of modern energy sources to sustain consumption. We need to enhance rural incomes

by integrating energy access programs with broader social assistance and rural development programs (such as MGNREGA and state rural livelihood missions) to address the affordability barrier. Further, as the Global South is struggling with the affordability barrier, developed countries should provide finance to developing nations to ensure they are able to fulfil their energy access targets. With the Group of 20 Presidency for 2023, India has a great opportunity to revitalize global commitments to the energy transition and spearhead the collective voice of developing nations. ●



Mobility

Fast Facts

Rail travel is the most commonly used mode of public transport in India, transporting 3.5 billion passengers in 2021-2022. The pre-COVID number of transported passengers stood at 8.4 billion passengers in 2018-19, a figure that the rail travel sector has yet to return to.

Indian Railways employs 1.4 million employees directly and several times larger the number indirectly through forward and backward linkages.

Source: Indian Railways Vision 2020

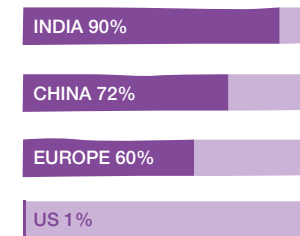
Road transport, both passenger and freight, accounts for 92% of CO₂ emissions from the transport sector.

Source: Report: Transforming Trucking in India Pathways to Zero-Emission Truck Deployment



As of March 2023, Indian Railways has achieved 90% electrification of its total broad-gauge rail network, on track to achieve 100% electrification before year end.

Source: Central Organization for Railway Electrification, March 2023



70% of all commercial cars, 30% of private cars, 40% of buses, and 80% of two-wheeler (2W) and three-wheeler (3W) sales expected to be electric by 2030.

Source: Climate Policy Initiative - Landscape of Green Finance in India Supported by India's green investment flows in FY 2019-20

COMMERCIAL CARS



PRIVATE CARS



BUSES



TWO-WHEELERS AND THREE-WHEELERS



As of 2019-20, India has the world's third-largest rail network comprised of 68,043 km of rail tracks.

Source: Ministry of Railways - Indian Railways Year Book 2021-2022

India has the world's second-largest road network, with 6.4 million km of roads throughout the country (as of November 2022).

Source: Year End Review- 2022 : Ministry of Road Transport and Highways

Government Policies

In 2013, the Department of Heavy Industry introduced a roadmap for faster manufacturing and adoption of EVs in India called the National Electric Mobility Mission Plan 2020 (NEMMP).

The policy framework is split under two schemes called FAME I and FAME II (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India).

FAME I

Announced in 2015, it aimed to promote and encourage the manufacture of electric and hybrid vehicle technology. It was implemented with four focus areas – demand creation, technology platform, pilot projects, and charging infrastructure.

Source: Ministry of Heavy Industry and Public Enterprises - FAME 1

FAME II

Launched in 2019 for an initial period of three years, the scheme was later extended to 31 March 2024.

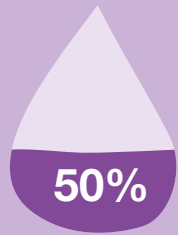
The scheme's outlay is to be used to incentives demand for EVs by way of upfront subsidies and the development of charging infrastructure. The scheme focuses on supporting electrification of public and shared transportation.

Source: Ministry of Heavy Industry and Public Enterprises - FAME 2

Challenges

The transport sector alone accounts for **50% of total oil consumption in India**. And with road transport accounting for 92% of all transport emissions (excl. international aviation and shipping), it remains a major contributor to India's air pollution.

Source: CEEW The Council - India Transport Energy Outlook 2022

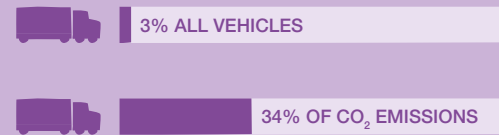


EV Charging Infrastructure: The uptake of EVs is directly linked to the availability and access to Public Charging Stations. India's EV adoption is restrained by a lack of this crucial charging infrastructure. As of March 2023, only 6586 Public Charging Stations are operational across India. This figure remains inadequate to incentivise consumers to switch to electric vehicles.

Source: Ministry of Heavy Industries- Press release: 6586 operational Public EV Charging Stations in India, March 2023

Trucks represent only 3% of all vehicles on India's roads, yet they contribute 34% of CO₂ emissions from the transport sector. One of the major viable carbon-free solution for long-distance and heavy duty transport (trucks) is green hydrogen.

Source: Report: Transforming Trucking in India Pathways to Zero-Emission Truck Deployment



Indian Railways are aiming for 100% electrification by end of 2023. As of March 2023, 100% electrification has been completed in 14 states & UTs including Haryana, Uttarakhand, Meghalaya, and Uttar Pradesh.

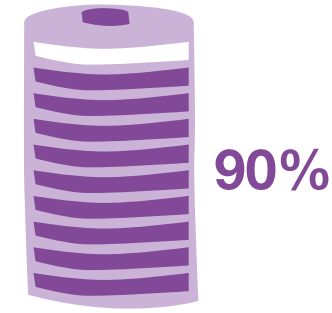
Source: Financial Express article (February 7, 2023): Indian Railways inches closer to 100% Electrification: A remarkable feat! Impact and current status

But 64.5% of electricity generated in India still comes from fossil fuels. For this to become a truly net-zero form of transport, it must be electrified by renewable energy, which is only expected to be achieved in full through solar energy by 2030.

Opportunities

Recycling batteries is both an economical and sustainable solution for meeting the rising demand in lithium-ion batteries. Up to 90% of lithium, cobalt, nickel, manganese and graphite is recoverable and could create great opportunities for India's circular economy.

Source: Lithium-Ion Battery (LiB) Manufacturing Landscape in India, Jan 2022, JMK Research



UP TO 90% OF LITHIUM, COBALT, NICKEL, MANGANESE AND GRAPHITE IS RECOVERABLE

Subsidies for electric vehicles and renewable energy has doubled compared to FY21, at INR 2358 Cr in FY22, as a result of a clear policy framework and incentives. However, India's schemes and incentives relating to green energy have been short-term.

Source: The Times of India article (Dec 20, 2022): Subsidies for EVs in India increased 160%, reached record high of Rs 2,358 crore in FY22: IISD report

For electric vehicle uptake to continue, the government must continue to provide support by way of subsidies, public finance, public sector undertaking and inclusion of priority sector lending of the electric vehicle sector.

Source: Mapping India's Energy Policy 2022: Aligning support and revenues with a net-zero future

Under the second phase of the "FAME India Scheme" (FAME II), the government of India has sanctioned a total 7432 public fast charging stations across the country, substantially increasing India's true electric mobility preparedness.

The availability of charging infrastructure and the uptake of electric vehicles are intrinsically linked. If the government remains committed to the rapid deployment of electric charging infrastructure, electric cars could account for 30% of sales in 2030 and 75% by 2050.

Source: Report, India Transport Energy Outlook, 2022



On Affordable and Inclusive Mobility in India



AISHWARYA RAMAN
EXECUTIVE DIRECTOR, OMI FOUNDATION

India's urbanization planning lacks accessible and inclusive mobility options, but there are hopeful solutions ahead.

What main challenges face the mobility sector in India?

Cities occupy only 3% of the nation's land but contribute 60% of the gross domestic product (GDP). It is here that the role of mobility gains significance. The way cities design, construct and sustain mobility solutions can play an immense role in easing growing challenges associated with unfettered motorisation.

The total number of registered vehicles in India crossed 295.8 million in 2018-19, a near three-times increase from the 115 million registered in 2008-09. The share of buses has declined from 11% around 1947 to a 0.7% in 2019.

The unchecked growth of motor vehicles is inconsistent with how India truly travels. Over 60% of India's non-agrarian population uses non-motorised transport modes like cycling, public transport like buses and intermediate public transport like taxis and auto-rickshaws for their commutes.

The OMI Foundation has been advocating to prioritize studying and supporting the mobility needs of everyone, especially women. Women often travel with dependents, take trips of varying lengths and utilize multiple modes of transport through different legs of the journey. Studies by the OMI Foundation also found that women have lower access to assets such as personal motor vehicles. Women are not the only community whose needs go unaddressed. Both physical and digital mobility infrastructure must work for all, including people with disabilities, the elderly, LGBTQIA+, children and individuals from low-resource households.

What are key aspects of the current mobility environment in terms of accessibility and inclusivity?

Inclusive mobility is safe, accessible, reliable and affordable. It is estimated that India has more than 180 million people living with a disability. By overlooking the needs of people with disabilities, cities render mobility solutions impractical and exclusionary for a significant proportion of the population.

The way cities design, construct and sustain mobility solutions can play an immense role in easing growing challenges associated with unfettered motorisation.



Through surveys, focused group discussions and interviews, OMI studied the travel experiences of people with disabilities in 2019 and 2020. People with disabilities often travel independently but are constrained by the inaccessible environment. Travelling to and from the mode of transit and getting on and off the vehicle are more challenging than the in-transit experience itself. Inadequate training of mobility staff also adversely affects the travel experience.

Women with disabilities face gender-based violence in addition to the general inaccessibility. Payment methods, whether digital or cash-based, are also varyingly inaccessible to persons with disabilities. The Centre for Science and Environment found in a 2019 study that the Delhi metro is the second most expensive metro service in the world.

How can mobility be more inclusive and accessible? What are areas of intervention?

Considerations of inclusive mobility should be a part of the success criteria in the design, implementation, monitoring and evaluation stages. Mainstreaming the travel patterns of disadvantaged communities starts with data collection. India must mandate gathering of up-to-date mobility data, and mobility surveys must include respondents from varying income groups and occupations.

Inclusive mobility is safe, accessible, reliable and affordable.

We must standardize accessibility for physical and digital infrastructure across the trip chain. India should specify universal accessibility as essential criteria for procurement of goods. We should introduce fiscal incentives for accessible mobility, encouraging the industry to invest in the development and production of accessible solutions.

Another opportunity exists in the form of government offering free or subsidized access to public transport for underserved populations. The OMI Foundation has conceptualised the award-winning

‘Digital Mobility Subsidy’, a tech-powered subsidy delivery solution, to overcome the limitations of the current model. The winner of the UN-India and National Institute of Urban Affairs Smart Solutions and Inclusive Cities Award 2022, this recognition is a testimony to the potential of technology to improve the affordability and accessibility of mobility systems in India. ●

01 Auto rickshaws and bus, Mumbai.
Source: Atharva Tulsi / Unsplash

02 Busy street, Pink City Jaipur.
Source: Rifath Photoripey / Unsplash





People x Projects: Engaging Local Communities

WRITERS
TARUN SHARMA & YUTIKA VORA

When it comes to mobility planning, input from local residents is key to addressing community needs.

Being part of the process creates a sense of agency and belonging throughout the life of the project.

from various groups who argued that the project would lead to the loss of trees, displacement of people, and destruction of heritage structures. Namma Bengaluru, a citizen-led movement, organized protests against the project and used social media to spread awareness. Their sustained advocacy led to the project being scrapped by the government in March 2017, which was seen as a victory for citizens and sustainable urban development in Bangalore.

Why Engage?

01 The Great Walk of Athens is an ambitious project which was designed to create a pedestrian pathway through ancient archeological sites of central Athens along a car-free route and eventually create “the most beautiful walk in Europe.” The Great Walk planned a pilot phase of banning traffic across a zone of central Athens, but the pilot had to be rolled back for multiple reasons, including significant public opposition. The project continues to face public opposition as the local residents do not identify with its objectives and find it both expensive and a cause of gentrification of the area.

History has shown that involving citizens in the planning process is essential for sustainable urban mobility. Citizen involvement has sometimes resulted in projects being cancelled or modified. For example, from the 1950s through 1970s, citizens across cities in the United States opposed the construction of highways due to their negative effects on urban life in a movement known as ‘freeway

revolts’. This opposition was fueled by grassroots movements and motivated by a disagreement with the top-down decision-making process used by the highway authorities which hardly involved any citizens. As a result of this opposition, highway construction was halted in several major cities. All these efforts ultimately led to the creation of the National Historic Preservation Act of 1966.

There are few similar examples in India. However, compared to United States, the corollary of non-involved citizens and the resulting discontent is still true. We have a number of similar projects, the most iconic of which being the Steel Flyover protests in Bangalore, which symbolized the discontent of non-involved citizens. The proposed 6.7 km long elevated corridor faced strong opposition

Many such public responses to mobility-related projects have led to their failure. Evidence suggests that when mobility projects – especially those which are planned as large-scale interventions – are implemented quickly with little or no public input, citizens are dissatisfied with the results. Alternatively, including community voices in planning mobility solutions creates a feeling of ownership amongst citizens for the potential solutions. Being part of the process creates a sense of agency and belonging throughout the life of the project. In the absence of participation, citizens may not trust the process and the projects, which often leads to resistance and/or unsuccessful implementation. Failure and scrapping of the Bus Rapid Transport (BRT) corridor in Delhi was a prime example of this lack of involvement of people during the planning process. The BRT was accused of causing congestion and delays, leading to an inadequate ridership and revenue. Moreover, poor planning, inadequate infrastructure, and lack of public participation in the decision-making process were also cited as reasons for the project’s failure.

Involvement of people in mobility planning also adds local expertise and knowledge into the projects. External experts and consultants may not always



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External experts and consultants may not always be aware of the local issues and community priorities.

be aware of the local issues and community priorities. For example, the monorail in Mumbai has not been able to attract as many riders as expected because of poorly planned stations and routes

which did not consider more closely the needs of the communities along the line.

Involving stakeholders can also lead to more cost-effective solutions and projects. Many current approaches in policy planning which emphasize involving a larger number of stakeholders (through use of technology, for example) are premised on the assumption that cost efficiencies can be achieved by receiving inputs from citizens. In July 2021, Kochi Metropolitan Transport Authority launched Open Kochi as an open mobility network for integration of various urban transport modes with input from citizens as well as other stakeholders through a digital mobility platform.

There are several other initiatives that are being adopted to incorporate the needs of citizens in mobility planning, keeping in mind the many benefits of community engagement. Cities are undertaking ‘Walking and Cycling Assessments’ to understand the existing conditions and needs of pedestrians and cyclists to propose short-term and long-term solutions. Some cities are also trying to understand citizen needs for improving first and last mile connectivity of metro services through feeder bus services.

Another example is the City Investments to Innovate, Integrate and Sustain (CITIIS) program, which is jointly supported by Ministry of Housing

- 01 Sleeper train car, Dod Ballapur, Bangalore.
Source: Prakash Sahoo / Unsplash
- 02 Mumbai monorail.
Source: Ashwin Kumar / Wikimedia
- 03 Daily market, Charminar, Hyderabad.
Source: Arihant Daga / Unsplash



‘Invited’ and ‘Created’ Spaces for Citizen Engagement

Citizen engagement has gained traction and visibility in India, as communities and governments seek to address a range of complex challenges and opportunities. Several initiatives and platforms have emerged to facilitate this process, including digital tools and social media as well as inclusion of civil society organizations in policy-making processes. However, effective citizen engagement and stakeholder participation still faces challenges in India, including the need to build capacity and trust among diverse groups, and to address power imbalances and other barriers to participation.

At Nagrika, we have been studying this engagement and have found that while there have been attempts, they are not institutionalized. We identified two types of spaces that engage citizens: ‘invited’ spaces, which are initiated by authorities or institutions; and ‘created’ spaces, which are self-organized by non-governmental organizations, community groups and others to address self-defined issues. Very few cities in India have been using ward committees, a decentralised ‘invited space’ comprising of an elected representative from the ward along with citizens where ward-level plans and projects can be worked on collaboratively. However more recently, there have been some urban programs which have formal invited spaces for citizen engagement. The CITIIS program and the Swachh Survekshan ranking system, which annually ranks Indian cities on parameters of cleanliness and sanitation are some such examples of invited spaces. In 2022, Swachh Survekshan collected feedback from over 11.4 million citizens in 4,355 cities on their awareness of Swachhta app (official app to post feedback on civic related issues); waste segregation, Swachh Survekshan survey, and waste recycling. An example of a created space is when citizens in Mysuru came together to protest a ropeway project that was leading to the felling of trees. It resulted in the ropeway project being

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and Urban Affairs (MoHUA), the Agence Française de Développement (AFD) and the European Union (EU). With a budget of 100 million euros, CITIIS is being coordinated and managed by the Program Management Unit (PMU) at the National Institute of Urban Affairs (NIUA) in New Delhi. CITIIS was launched in 2018 to provide financial and technical assistance to 12 selected cities in India for sustainable urban development. The selected projects will improve sustainable mobility, increase the amount of public open spaces, implement technology to improve e-governance and drive social and organizational innovation in low-income settlements. The program combines financial assistance through loans and technical

assistance through grants to the selected cities. This assistance focuses on strengthening institutions by committing resources to systematic planning (maturation phase) before implementation, by developing results-based monitoring frameworks and by adopting technology for program monitoring. As an integral component of the Program Design, it includes a plan for engaging stakeholders in the design phase, which includes identifying and interacting with relevant stakeholders. CITIIS provides fundings to different urban projects such as river front development, green mobility corridors, ‘smart’ schools among others.



GROUPS DRIVING PARTICIPATION
FORMS OF PARTICIPATION

Source: Nagrika

canceled. The graphic below illustrates some of these spaces.

Even though such spaces exist for citizen engagement through the constitution, community-based organizations or projects initiated by city government, representation of citizens in key decision-making for cities has remained limited. Community-based organizations have a long history of facilitating citizen participation in local decision-making, but they do not have decision-making power themselves. The Smart City Mission had focused on public participation for various mobility-related interventions through a variety of mediums, including online platforms and citizen committees, but has faced challenges in terms of citizen awareness and trust. Citizens are also generally not aware of existing and potential opportunities for participation and of the platforms where their voices can be heard.

Making a move, together

As India continues to urbanize at a rapid pace, involving citizens in the planning and decision-making process for urban mobility projects has become crucial. Though there are examples of mobility projects in India that demonstrate the negative consequences of not involving citizens, studies on the benefits of successful citizen engagement are limited in the Indian context. Despite an increase in citizen participation in mobility projects, a thorough analysis of the pros and cons of different engagement approaches is yet to be conducted, and the effectiveness of such measures is an area in need of further investigation. Furthermore, citizens are often not made aware of the potential ways they can benefit from providing input, and there is a lack of clear calls to action for their engagement.

Many challenges remain in effectively engaging citizens in these projects. A deeper analysis of the various approaches and tools used for citizen engagement, as well as the role of technology,

can enhance participation. Technology has played a significant role in shifting citizen engagement from passive feedback to active participation. For example, small and medium-sized cities in India, which make up most of the urban population, have been more active in using online spaces for civic engagement than larger metropolitan cities. Most often, citizen consultations are limited to the beginning of a project and not sustained throughout its life-cycle. Similarly, only smaller scale projects or limited aspects of larger projects witness any kind of engagement. The graphic below showcases some of the projects and initiatives which saw some form of citizen engagement.

Governments rarely seek feedback from citizens before (and definitely after) implementing a policy or program. To address this issue, governments could seek regular input from citizens throughout the project life-cycle, while citizen groups could hold implementing agencies accountable at later stages of the programs. This could become a two-way road. By allowing time for community members to become familiar with interventions and encouraging them to give input, they feel empowered to help shape their local environments, and valuable public money can be saved by creating sustainable mobility solutions that citizens will use. ●

Mobility Programs Assessed for Citizen Engagement

Projects/Initiatives	Area	Project Goal
Street Design with People	Pune	Making neighbourhoods more walkable and livable.
Streets for People Challenge	Pan India	Creating flagship walking initiatives in cities, which focus on placemaking and liveability.
Gandhi Bazar Pedestrianization	Bengaluru	To improve infrastructure and make it socio-culturally vibrant as well as economically efficient.
Sustainable Mobility Accords (SUMA)	Karnataka	To promote sustainable modes of transport and support communities
India Cycles for Change	Pan India	Amping up the cycling infrastructure of cities.
City Investments to Innovate, Integrate and Sustain (CITIIS)	Pan India	Implement technological solutions for better service delivery through a participatory approach.
TenderSURE	Bengaluru	To use multi agency single tender model for comprehensive and better standards of design.
Open Street Days	Bengaluru Pune	Pedestrianization of streets for 1 day and conduction public events.
Yulu and You	Bengaluru	Gaining insights from customers and community building.
Uber Petitions	Mumbai	Influence decision making through mass petitions.

Table: Citizen Engagement Efforts in Indian Mobility Programs (2022).
Source: Nagrika



Water

Fast Facts

More than 60 per cent of India's total irrigation is now groundwater-fed. About 85 per cent of rural drinking water supply relies on groundwater sources.

Source: The Week article (August 21, 2022): India uses more groundwater than US and China combined

India is the largest user of groundwater with a fourth of the total global withdrawal. Indian cities cater to about 48 per cent of its water supply from groundwater.

India Today article (Mar 29, 2021): India's urban water crisis: Cities at risk of running out of water

With an annual extraction of 244.92 billion cubic metres (in 2020), India uses more groundwater than the US and China combined.

Source: The week article (August 21, 2022): India uses more groundwater than US and China combined

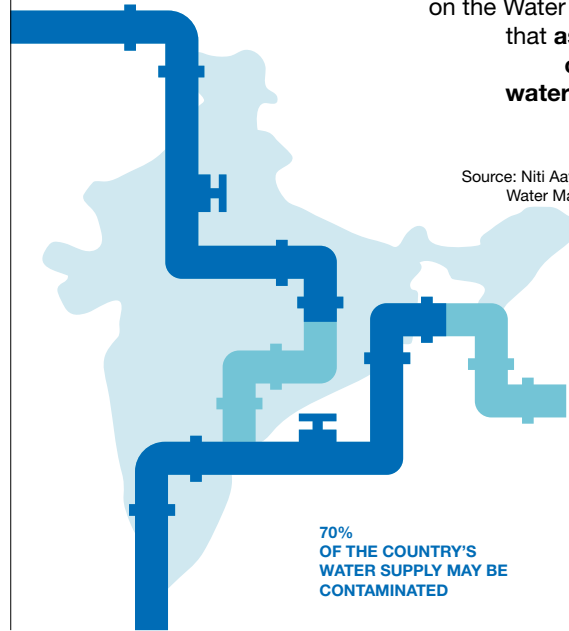
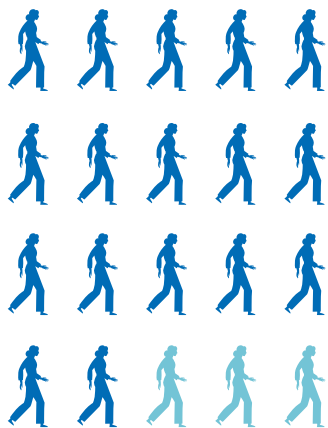
India is expected to be the most severely affected as the global urban population facing water scarcity is projected to increase from 933 million in 2016 to 1.7-2.4 billion people in 2050.

Source: United Nations World Water Development Report 2023: partnerships and cooperation for water

It is estimated that in 20 years about 60% of all India's aquifers will be in a critical condition.

(2012) Roughly 85% of India's residents depend on groundwater for both drinking and irrigation

Source: The World Bank article (March 6, 2012): India Groundwater: a Valuable but Diminishing Resource



A 2018 government report on the Water Index estimates that **as much as 70% of the country's water supply may be contaminated.**

Source: Niti Aayog Report: "Composite Water Management Index", 2018

70% OF THE COUNTRY'S WATER SUPPLY MAY BE CONTAMINATED

Government Policies

India's Constitution envisages the right to **clean and healthy water for all citizens as a fundamental right.**

The Atal Mission for Rejuvenation and Urban Transformation (AMRUT 2.0) is a **mission for providing basic amenities for a better quality of life.**

It includes Urban Water Supply, Sewage and Sanitation, Rejuvenation and Recharge of Water Bodies.

India's Master Plan for Artificial Recharge to Groundwater 2020 aims to tackle the twin hazards of declining recharge zones and the resulting deterioration of groundwater quality.

There is an urgent need to augment the groundwater resources through management interventions.

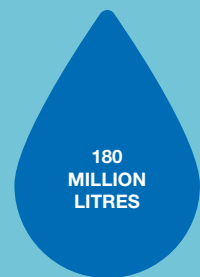
Jal Jeevan Mission (JJM) – Har Ghar Jal aims at **providing potable water** in adequate quantity and of prescribed quality on regular and long-term basis **to every rural household through tap water connection by 2024.**

Challenges



According to the data presented by the Ministry of Jal Shakti, Water availability and its distribution are serious concerns in India. In 2019, out of 19.35 Crore rural households, only 3.23 Crore (16.72%) had access to tap water.

Water infrastructure is at the heart of the problem. Poor maintenance, inadequate recycling, lack of funds for retrofits and replacements, and contamination or depletion of water sources continue to be major impediments.



For example, Bengaluru lost 1 million litres of water every day for six months as a result of the city's failure to act quickly enough to fix a water pipeline break.

Source: Newsclick article(12 Feb 2022): Over 10 Crore Rural Households do not Have Tap Water Supply

Greywater refers to domestic wastewater generated in households or office buildings from streams without fecal contamination.

Source: wikipedia

Rapid urbanisation, rising population, industrial growth and development are burgeoning the demand for water, making cities susceptible to grave water risk in the future.



Recycling and reusing wastewater is another challenge that adds to the water stress.

Out of a total of 72,4 MLD (million litres per day) sewage generated every day, only 20,2 MLD is treated.

Source: Central Pollution Control Board (CPCB) Report, 2021



Opportunities

Groundwater is the water present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. About 30 percent of all readily available freshwater in the world is groundwater.

Source: wikipedia

Rainwater harvesting as a source of fresh water is still unexplored in India, despite mandatory regulations.

An area of 11.23 Lakh sq.km has been identified for artificial recharge, which could help alleviate water stress.

Source: Master Plan for Artificial Recharge to Groundwater in India- 2020, CGWB

India can benefit from digital water infrastructure by reducing non-revenue water and finding leaks early. Utilities can also better regulate water-use patterns through metering and monitoring.

Pune is set to become the country's first city to use smart static water metres in line with the nation's Smart City Mission.

Protecting natural habitats like wetlands and peatlands prevents water scarcity.

These naturally cleansing ecosystems operate as carbon sinks to regulate global temperature.

In 2022 India added 11 more **Ramsar wetland sites**, totalling 75 which cover an area of 13,26, 677 ha of the country.

Source: Ministry of Environment, Forest and Climate Change

Many Indian start-ups have developed technologies to remediate groundwater, such as Uravu Labs, Fluid Robotics, and DrinkWell. **Solar water purification, UV technology, TERAFIL, etc. seem to be the way forward for water purification.**

Water scarcity (closely related to water stress or water crisis) is the lack of fresh water resources to meet the standard water demand. There are two types of water scarcity: physical water scarcity and economic water scarcity.

Source: Wikipedia

Recycling grey water could also bolster India's water resources. Despite 50–70% of freshwater being converted to greywater in Indian households, only 5% of India's greywater is recycled.

Source: The Indu article (March 20, 2020): Every drop count: why grey water recycling is a must

Kurak Jagir, a village in the Karnal district of Haryana, is an example of a successful approach using pond-based greywater management.

Source: DownToEarth article (23 November 2021): Managing greywater: A Haryana village shows the way

Water sources

surface water: water collecting on the ground or in a stream, river, lake, or wetlands

groundwater: water found underground in the cracks and spaces in soil, sand and rock

water recycling: water reuse reclaims water from a variety of sources then treats and reuses it for purposes such as agriculture and irrigation, potable water supplies, groundwater replenishment, industrial processes, and environmental restoration.

atmospheric water: water present in the atmosphere either as a solid (snow, hail), liquid (rain) or gas (fog, mist).

(Canada.ca, EPA - US)

The Status of Urban Water in India



AMBIKA VISHWANATH
CO-FOUNDER & DIRECTOR, KUBERNEIN INITIATIVE

REVOLVE asks its Strategic Partner, Kubernein Initiative, for insights into the dynamics around the value of water in India.

What is the nexus between urban water & climate change?

India, the world's fastest-growing economy, is the second largest urban community with a 2.3% yearly increase since 2017. One of the fastest-growing populations in the world, India will soon have one of the youngest demographics. Issues related to water stress and security are rising rapidly, where availability, quality, and reliability are key challenges. Climate and water are inextricably linked and as the gap between supply and demand widens, climate change will further deepen India's water woes. The Global Climate Risk Index 2021 places India as the seventh most vulnerable nation to weather-related disasters (storms, floods, heatwaves, etc.), many exacerbated by climate change.

India is experiencing and continues to experience repercussions from climate change in the form of shifts in precipitation, droughts, temperature increases, sea level rise, tropical cyclones, and the Himalayan ecology. All of this will be felt most acutely in Indian cities, the forefront of India's economic growth potential.

What are the key challenges affecting urban water in India?

Challenges are numerous in a vast country like India, including – lack of access to clean water, supply-demand mismatches, rising demand from fast-growing urban spaces, pollution and exploitation, insufficient infrastructure and governance systems, and many more. Urban India is also one of the highest extractors of groundwater, with over 70% on average across

cities. Many of these challenges are being addressed, through central government mandates and missions and through city municipalities – largely aimed at improving access, increasing wastewater management, and better quality control and campaigns to catch the rain and save water. State and local governments are also designing climate action plans. However, as good as many of these plans are, they are only likely to take the country so far in solving the many stages of a water crisis due to the disconnected nature of the plans and policies and the lack of integration with other aspects of governance. In many cases, last-mile implementation is lacking, as is the missing question of gender.

Urban India is also one of the highest extractors of groundwater, with over 70% on average across cities.



What is the potential for change?

There is an incredible push from all sectors across the country to understand the water challenges and solve them going forward. I've been working on water in various capacities for over 15 years and it's great to see that both in India and globally there are more concentrated efforts. The March 2023 UN Water Conference is a testimony to that. However, many efforts are incredibly siloed and lack an understanding of both long-term effects and ancillary risks they might have. For example, while we need to focus efforts on bringing water to the 60% population that has had little to no access, we also need to think about safeguarding the resources and introducing methods of circularity in use and re-use. 11 out of 15 major river basins are likely to experience water stress by 2025, we still have no clear idea of how that will interact with bringing piped water to all by 2024. There is also a paucity of research on the intersection between water and our growth ambition. Indian cities are among some of the fastest-growing cities in the world and major drivers of economic growth; many of them are also extremely water stressed. Research by Kubernein shows that this will affect key industries such as automobiles, fashion, paper, and others. Without a more holistic approach, the potential for change is limited.

1 out of 15 major river basins are likely to experience water stress by 2025.



What are some of your takeaways from the historic 2023 UN Water Conference?

Held after a gap of over 40 years, the UN Water Conference 2023 was historic in many ways. It brought together people from all aspects of 'water', conservation, access, technology, management, scientists, engineers, policy-makers, researchers, and many others. Historic because, it is not a regular event, but also because perhaps for the first time in the 'water world' there were conversations on multiple intersections – from climate to smart development to inclusion and gender to the rights and responsibility of all involved. Granted there were many failings to the event and those of us who have worked in this space know the science and the arguments, but it was important to reiterate key issues surrounding water especially given the number of people there who worked in related fields but did not always consider the relationship with water and their sector. There were many discussions, plenaries, and side events on various aspects of inclusion with voices from

varied groups and marginalized communities from around the world, which are essential going forward, as they underscore not only diverse experience but also the knowledge in dealing with water stress that can be useful.

What are the pathways ahead for policy-making and citizen involvement?

How we perceive the future of water and related risks needs to evolve. The complexity of the interconnected nature of future ecological risk with socio-economic risk needs to be better understood and subsequently brought into governance plans and policies. This cannot be done in isolation by governments and institutions; there needs to be deeper engagement with civil society actors and practitioners as well as robust citizen action. The current approach that uses linear reasoning to build forecasts in understanding water stress needs to break open with mapping and analysis that is comprehensive and inclusive and ultimately integrated into the long-term vision

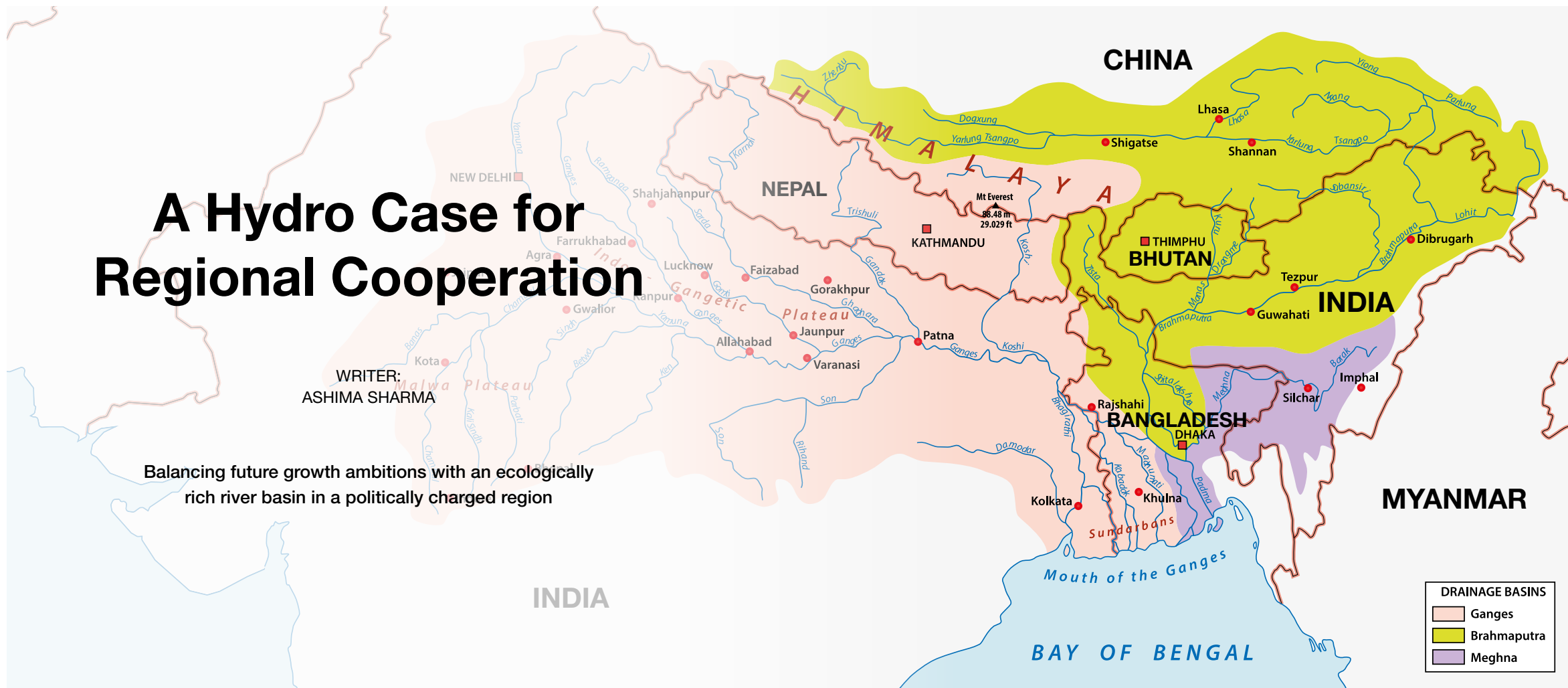
of cities. Studies by NIUA, the National Institute of Urban Affairs, a semi-autonomous body under the Ministry of Housing, show that poor planning and management of cities will cost Indian cities between \$2.6 billion and \$13 billion every year. A better understanding of these issues will aid our water story and growth potential. Communities and vulnerable stakeholders play a significant role when it comes to understanding management issues and activities related to urban water. Working relationships need to be established between municipalities, the government, and organizations both in the private and not private sector; which exists in India to a certain extent though not as widespread across the country as it can be. ●

- 01 Woman carrying water home, Jaipur. Source: Rifath Photoripey / Unsplash
- 02 Refilling bottles at a public water pump, New Delhi. Source: Patrick Beznoska / Unsplash

A Hydro Case for Regional Cooperation

WRITER:
ASHIMA SHARMA

Balancing future growth ambitions with an ecologically rich river basin in a politically charged region



Each year hundreds of people inhabiting the Brahmaputra River basin become silent witnesses to the loss of their homes. Annual flooding erodes swathes of land, the currents carry river islands, home to riverine communities, displacing land with water. There have been 25 major floods in Assam since 1950. With the increasing rate of floods and channel change over the years, traditional flood adaptation practices in riverine communities are becoming prone to failure. Their houses, crops, land use, and use of natural resources are based on traditional ecological knowledge which aids

in mitigating the adverse effects of flooding. This knowledge, however, is now being challenged by the increasing unpredictability of the river's flow.

There is a fundamental flaw in the so-called technocratic purely engineering approach to understanding a river. It strips the river of its living entity and treats it as a pipe of water that can be bent, broken, and joined again. The nature of the Brahmaputra basin is unique – its braided characteristic makes the river prone to frequent channel migration and excessive siltation downstream, causing the river

to flood each year and bringing fertility to the land. However, changing and erratic rainfall patterns coupled with artificial building activities have affected the lives and agrarian livelihoods of thousands of people that the Brahmaputra sustains.

Water is now a subject of geostrategic concern for countries across the world. The rhetoric of the third world war being one for water may not be far from reality. Whether it may be a dispute over the Nile Basin, Euphrates-Tigris Basin, or a human-nature conflict as a result of unchecked development – the

center of it all is water. As Asian countries gravitate towards achieving carbon neutrality goals, many, including China have redoubled efforts on harnessing hydropower as a driver of growth. Cradled in the Himalayas, the Brahmaputra is a transboundary river flowing downstream of China through Tibet, north-eastern India, and Bangladesh. Forming part of the world's most densely populated river basin, the Ganga-Brahmaputra-Meghna basin is yet to be studied in its entirety to ensure sustainable livelihoods.

As a lower riparian neighbor, India has repeatedly urged China to ensure that the interests of downstream states are not harmed by activities upstream. With respect to the Brahmaputra River, India signed an agreement with China in 2002, that provides sharing of hydrological data and cooperation in flood management. However, beyond data sharing during the monsoon period, there is no formal treaty between India and China regarding the Brahmaputra waters. Beyond existing activities on the river, China is planning to build the world's biggest hydroelectric dam over the Yarlung Tsangpo (as the Brahmaputra is known in China) river in Tibet near the Arunachal Pradesh

border. The dam which is said to have 'no parallel in history' has drawn criticism from human rights groups, environmentalists as well as neighboring countries. For years, the fear of China controlling and diverting the water in its territory has raised concerns for both downstream neighbors, India and Bangladesh. The flash flood of June 2000 in Yigong (a tributary of the Tsangpo) presents a classic example of how a hydroclimatic disaster triggered in the upstream Tibet region affected Arunachal Pradesh and Assam in India the most. Given the susceptibility of the Himalayan region to climate change, the risk of such disasters affecting downstream regions and communities increases

multifold, and the absence of a formal treaty on water sharing between the Asian giants adds to geopolitical concerns.

Inclusive hydro-diplomacy, a community approach

Policy-makers in both India and China, continue to defend the dam projects in their respective countries as run-of-river hydroelectricity generation projects. This approach diverts a part of the river to run past the electricity-generating turbines. The waters then

flow back to join the river, claiming no loss to the total water flow and quantity. Seemingly harmless, the dam causes two problems downstream:

Firstly, dams prevent the movement of silt that fertilizes the floodplains of the Ganga-Brahmaputra-Meghna. Water flowing down the young, rocky, and crumbly Himalayas brings food for the fish and fresh soil for the communities downstream. These small rocks, however, are a menace to the turbines because they damage the blades. Further, holding back sediment and silt flowing down results in sand from riverbeds being exposed, leaving behind a sandy infertile desert when the river changes course. A change in the quality of the water due to reduced silt will have long-term effects on agricultural output affecting the food security of the region. Environmentalists have long fought for a part of the river to continue to flow to maintain 'minimum environmental flow'.



01 Combined catchment areas of the Ganges, Brahmaputra and Meghna rivers
Source: Rainer Lesniewski / Shutterstock
02 Yarlung Tsangpo River
Source: Ryan Kilpatrick / Flickr

There have been 25 major floods in Assam since 1950.

Secondly, passing water through turbines requires the curbing of the pulse of the river. The farmers downstream are dependent on the water pulses to catch fish. Research on two of the world's largest run-of-river hydropower dams (Jirau and Santo Antônio, Brazil) on the Madeira River document how downstream aquatic organisms and river-dependent populations suffer the slow demise of biodiversity with alteration in frequency, magnitude, duration, timing, and rate of change of natural flow regimes.

The Brahmaputra River's precarious state has led to the development of policies and legal frameworks to regulate the river's use and management within riparian nations. How do we move beyond emotive politics to save the river? Communities that inhabit islands and banks of the Brahmaputra encounter numerous challenges each year - their traditional adaptations along with scientific interventions may be the answer to the river's survival. A chang ghor,

for instance, is a house on stilts that the Mishing tribe from Assam have traditionally built to survive the Brahmaputra floods each year. Within the house, there are other flood adaptations like food and grain storage on bamboo shelves built closer to the ceiling. From livelihoods that are reliant on agriculture to folk traditions, the centrality of which is water, there is an inherent sense of consciousness in the communities that encounter natural disasters that are integral to their lives. The idea of water diplomacy must be altered to reimagine how the river is viewed in its entirety. River sharing fosters the development of cooperative water management systems, encouraging joint efforts in monitoring, maintaining, and protecting shared rivers and their ecosystems. By emphasizing sustainable practices and ecological preservation, countries can collectively ensure the long-term viability of their shared water resources, reducing the likelihood of conflicts rooted in environmental degradation.



03



04

Hydro-political relations and the way forward

Our trust with the Brahmaputra does not end in India but in Bangladesh. Like China, India has also engaged in hydropower projects in Arunachal Pradesh along the Brahmaputra as a part of larger economic and development goals. Expected to start construction in 2025, the Tawang II dam on the Tawangchu River in Arunachal Pradesh has been proposed as an 800MW hydropower project. Given that India and Bangladesh share 547 transboundary rivers, Bangladesh can and has in the past demanded fair and equitable water sharing and multilateral agreements from India.

One of the significant treaties between India and Bangladesh includes the Ganges Water Sharing Treaty, also known as the Farakka Agreement, signed in 1996. This treaty regulates the distribution of the Ganges River's water during the dry season, ensuring that both countries receive a fair share of the water.

India and Bangladesh share 547 transboundary rivers.



05

Another Mahakali Treaty signed in 1996, focuses on the utilization of water resources for irrigation and hydropower generation, while also addressing flood control measures.

The 38th Joint Rivers Commission of India and Bangladesh in 2022 addressed the needs of irrigation downstream, availability of drinking water, and the sharing of waters in the Teesta (a right-bank tributary of the Brahmaputra). As the case in run-of-river project claims of China to India, a succession of 30 proposed, operational and non-operational dams are located on the Teesta in India. Bangladesh's concerns are similar, from

disrupting the flow regime, arresting sediments, and loss of fisheries. India's way to accede to the fears in Bangladesh is by supplying electricity to Bangladesh from one of the projects.

The overarching threat is that of mass displacement and ecological damage, leading to unpredictable human concerns and security risks. It is at such a junction that a greater synthesis of scientific methods and traditional practices needs to intersect, to build sustainable livelihoods and resilience among local communities. While bureaucracy tows its old pathways of navigating treatise and MoUs, the problem of hydro-diplomacy remains unresolved

unless the local tribal communities, the farmers, the fisherfolk, and the gender scape of river-inhabiting communities are not constituents of diplomacy dialogues. Similarly, the question of sustainability remains unresolved until each country only looks at the river as a part of what's contained within its borders. The hydro-hegemony of upper riparian countries calls for hydro diplomacy to be an active player in policies around the transboundary river and water sharing.

Transboundary river diplomacy offers several avenues for preventing conflicts and promoting peaceful resolutions. It encourages countries to establish

platforms for dialogue and negotiation, where they can address concerns, share information, and discuss the equitable distribution of water resources. Through such diplomatic channels, countries can build trust, strengthen relationships, and develop frameworks for resolving potential conflicts that may arise from water scarcity or disputes surrounding over-usage in order to encourage shared access to this precious natural resource. ●

- 03 Chang ghor
Source: ICIMOD Kathmandu / Flickr
- 04 House surrounded by water after a flood, Barpeta, Assam.
Source: Vincenzo Cassano / Unsplash
- 05 The Dholra-Sadiya Bridge spans the Lohit River, a major tributary of the Brahmaputra
Source: Akhil Verma / Unsplash

An aerial photograph of a wide, greenish-brown river. A large, light-colored sandbar or island is visible in the center, with a narrow channel of water flowing through it. A large flock of birds, likely waterfowl, is flying in a V-shape across the river. The sky is a clear, pale blue.

IEWS

Brahmaputra's Journey Through Assam

A PHOTO ESSAY BY **ROUNDGLASS SUSTAIN**
PHOTOGRAPHY BY **DHRITIMAN MUKHERJEE**

As the river Brahmaputra flows through Assam, it forms an indispensable relationship with all that it touches and sustains.

Pulitzer prize-winning writer Paul Salopek said rivers were “the biographers of landscape”. They are also storytellers and shapers of destiny. They bring with them tales of the lands they flow through, the people living on them, and the creatures — big and small — whose fates are inextricably tied to the moods and changing courses of the river. Rivers bless the lands they flow through with prosperity and fertility, but sometimes they rage and cause destruction and despair.

One such mighty river is the Brahmaputra, which covers a journey of about 2,897 kilometers across three countries. En route, it travels through an expansive terrain — snow-capped peaks, barren Tibetan plateaus, rocky riverbeds, humid plains, dense rainforests, and a mangrove delta that opens out to the sea. The river originates in the Himalayan mountain range in China (Tibet), over 5,300 meters above sea level. Here the river is known as Yarlung Zangbo, Jiang and Pinyin. From China (Tibet), it enters India through Arunachal Pradesh, but only expands and grows wide once it arrives in Assam. It then changes course to join the Ganges in Bangladesh, where it is known as the Jamuna and Meghna, where it forms the largest delta in the world before merging into the Bay of Bengal. Along its course, the river transforms the lives of all the people and places it flows through.

Brahmaputra’s floodplains change form annually every monsoon. While the flooding of the Brahmaputra is essential to the ecosystem, it also causes large-scale disruption and displacement. “A river changing course is natural and healthy. A lot is said about the Brahmaputra overflowing in the monsoon causing floods. These floods rejuvenate the grasslands around the river. The damage it causes occurs because we have built roads and houses in what is essentially the course of the river. That’s our fault, not the river’s,” says photographer Dhritiman Mukherjee, who first photographed the river in Assam in 2004, and has two books to his name on the subject.

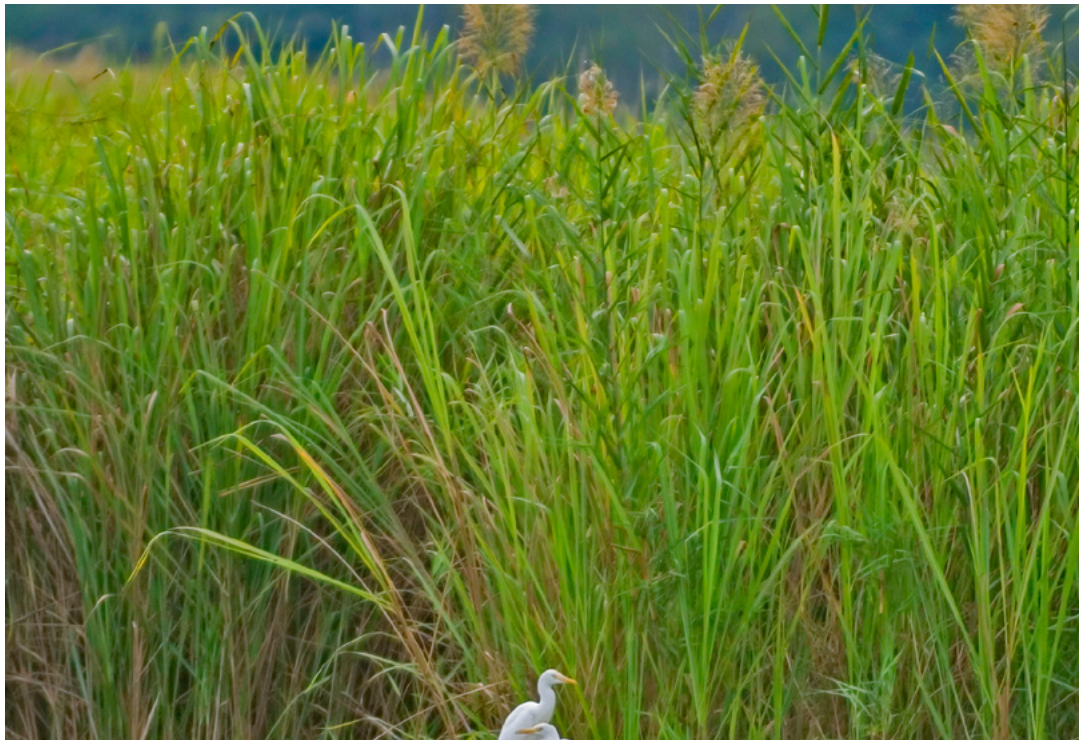


The Brahmaputra makes one of its most interesting journeys in Assam. The river divides the state into two halves, also creating a distinct north and south bank. The tributaries of the north bank descend from high mountains, and travel through rocky terrain, over boulders and pebbles. On the south, it has a flatter trail with deep meandering turns. The Brahmaputra also flows through and is instrumental in the creation of over six wildlife havens in the state.

The river enters Assam from Daying Ering Memorial Wildlife Sanctuary in Arunachal Pradesh, forming north and south banks. Orang National Park, which lies on its north bank and towards the center of the state, is the oldest game reserves demarcated by the British in 1915. It is the only stronghold of the one-horned rhinoceros (pictured below) in the north of the river. The swampy, wooded forest with tall trees and grasslands is also home to leopards, elephants, tigers, barking deer, and a large variety of birds.

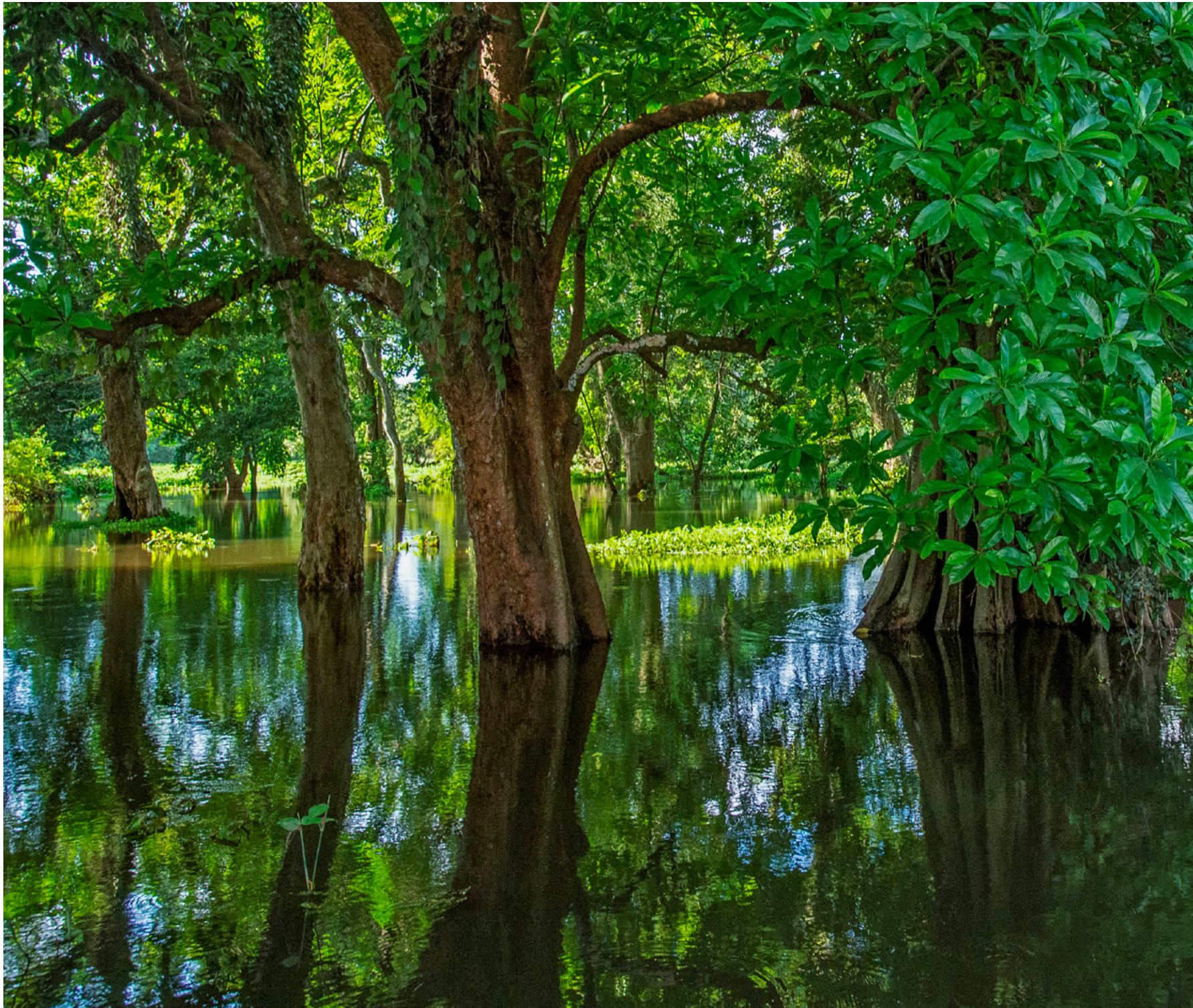
On the south bank of the Brahmaputra are the Dibru-Saikhowa National Park (top right), Kaziranga National Park, Pobitora National Park, and the Laokhowa and Burhachapori wildlife sanctuaries. Very rich in biodiversity, Dibru-Saikhowa is one of two places in India which is home to feral horses (the other being Point Calimere Wildlife and Bird Sanctuary in Tamil Nadu).

The Burmese python (*Python bivittatus*) (pictured bottom right), Indian cobra (*Naja naja*) and Indian rock python (*Python molurus*) are found in the forests but are hard to spot. However, Mukherjee managed to photograph this Burmese python during the forest department's rescue and release operations.



Dominated by grasslands, the Burhachapori Wildlife Sanctuary has a healthy population of the Bengal tiger. This sanctuary was on the verge of losing its flagship species — the rhino, buffalo, and tiger — because of poaching and political unrest. Until 1983, there were about 50-60 rhinos here. But at the peak of the Assam Agitation, a political movement, it is believed that 40-50 rhinos were killed or chased away. The Indian Rhino Vision 2020, a conservation program launched in 2005, has been translocating rhinos from Kaziranga and Pobitora to Burhachapori and has revived the rhino population here. The river and its banks connect neighboring national parks and acts as a natural corridor for tigers. “Tigers are often seen moving from Kaziranga to Burachapori, or even to the Orang National Park,” says Mukherjee. These tiger pugmarks are sign of safe movement, and hope.





Life along an ever-changing river poses as many challenges as blessings. Brahmaputra rises during the monsoon and submerges more than two-thirds of life around it every year, including the famous Kaziranga National Park (pictured left). In Kaziranga animals like rhinos cross over to the higher grounds of Karbi-Anglong to escape the floods, but a national highway and tea estates along the route get in the way. Several unable to cross over perish in the floods.

Along its course, the Brahmaputra splits and meets again, resulting in several river islands across the state. These river islands are also called *chaporis*. The largest inhabited river island in the world — Majuli — is also created by the Brahmaputra in Assam. If the river does not change course for a few years, these islands are covered in tall grass and short trees, with swathes of soil that is trapped between their roots — giving birth to a dynamic forest.

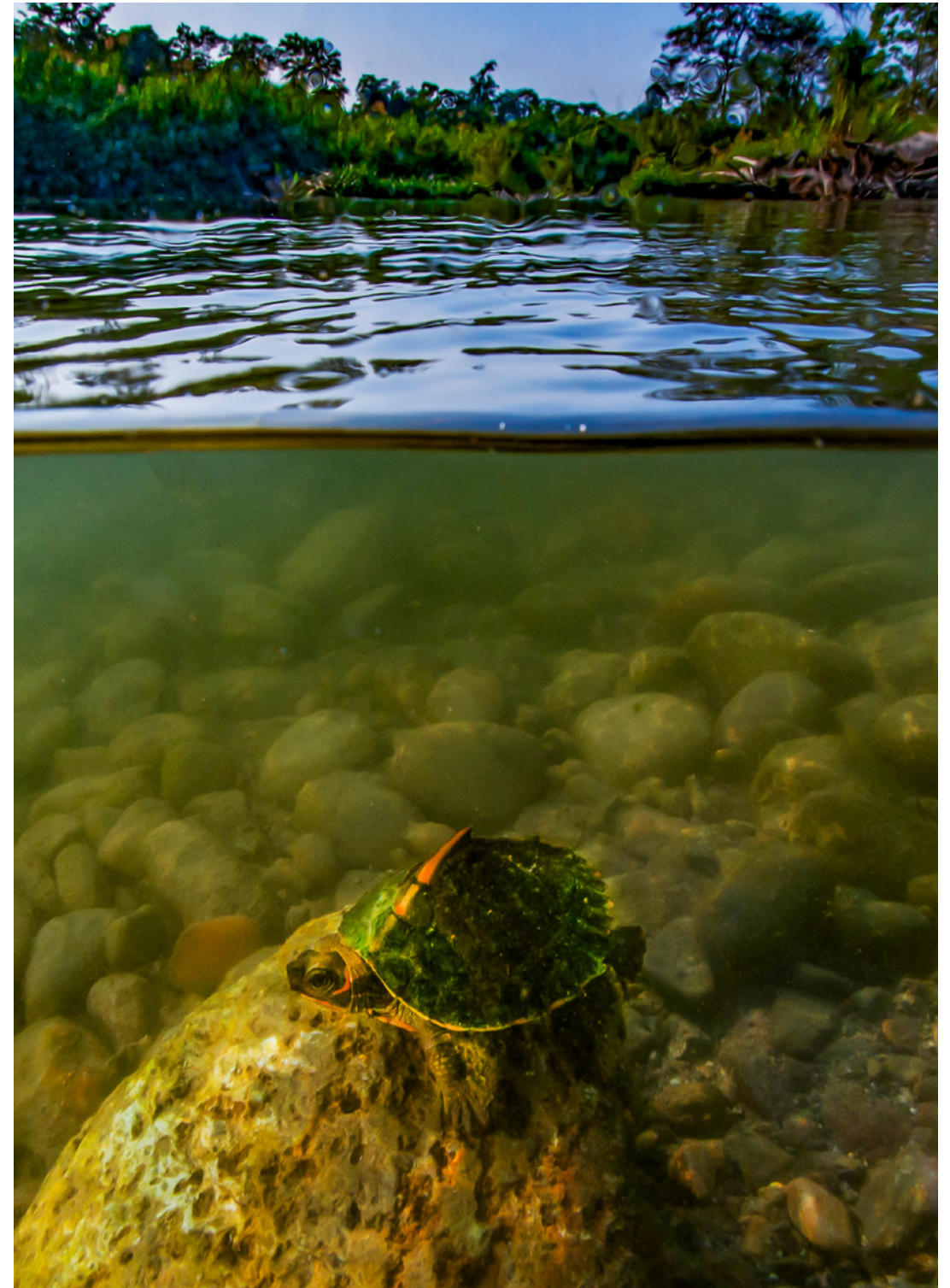


The grasslands of Brahmaputra are home to some endemic species of birds and wild animals. It harbors one of the healthiest populations of the greater one-horned rhinoceros. Wild water buffaloes, Asian elephants and Bengal tigers are the other large mammals that inhabit the grasslands. They are also home to the only known population of eastern swamp deer. The critically engendered pygmy hog can also be found here.

Dibru-Saikhowa National Park and Kaziranga National Park together comprise about 500 species of birds. These include the endemic and endangered marsh babbler and the Manipur bush quail, which was last seen in 1935 but there has been no photographic evidence of the bird recorded since then. The black-breasted parrot bill (*Paradoxornis flavirostris*) (pictured below) is a rare bird found only in tall grasslands along the Brahmaputra.



The Assam roofed turtle (*Pangshura sylhetensis*) (pictured right) is one of the 21 species of turtles found here. The turtle gets its name from the spiked vertebral keel on its back, that makes it look like an Assamese roof. Other species of turtles include the yellow tortoise, Asian brown tortoise, narrow-headed softshell turtle, keeled box turtle and three-striped roofed turtle. The river is home to the only wild population of the critically endangered black softshell turtle.





Communities along the banks of the river and its adjoining districts rely heavily on it for their means of livelihood and resources. Main professions include fishing, farming, and riverine transport. In the Brahmaputra river system, 126 species of fish have been recorded out of which 41 species are commercially important.



Freshwater fish like catfish (pictured bottom left), and carp are mostly commercially traded. There is also the case of unchecked fishing where stray incidents of fishing on canals and streams have been observed. In 2017, rising water pollution followed by increasing muddiness, or turbidity, resulted in the decline of the number of fish caught in Guwahati. Other human-induced threats such as construction of dams and use of motorboats for transportation further affect the health of the river.

Several communities and tribes live by the river or have inhabited the river islands. These include the Deori, Sonowal, Kachari, and Mishing (also called Miri) tribes. The Mishing (below) consider Subansiri, a tributary of the Brahmaputra, as their place of origin. Fishing continues to be the main activity of this riparian tribe. Over the years, they have moved on from using traditional tools of fishing such as *chalon* — a type of handmade bamboo sieve used to capture fish — to readymade hand and fishing nets. “They often catch the fish between their toes and fish it out with their hands. They spend hours immersed in water to fish,” says Mukherjee.



Brahmaputra's changing course causes a great deal of erosion in the already dynamic riparian floodplains. New hydroelectric projects like the 2,880 megawatts Dibang hydropower project in Arunachal Pradesh and the building of innumerable dams, will further stress and disrupt the river's journey. The Brahmaputra is the only source of sustenance and livelihood for many. And it needs our protection.



This photo essay first appeared as “A River that Carves a World: Brahmaputra’s Journey through Assam” (14 Dec 2022) in RoundGlass Sustain. RoundGlass Sustain is a not-for-profit telling stories of India’s natural world to create awareness, document science, and support conservation.

roundglass



CITIIS PROFILES

City Investments To Innovate, Integrate and Sustain

CITIIS, or the City Investments to Innovate, Integrate and Sustain, is a sub-component of the Government of India's Smart Cities Mission. It is a joint program of the Ministry of Housing and Urban Affairs, Agence Française de Développement (AFD), the European Union (EU), and the National Institute of Urban Affairs (NIUA).

The program is assisting 12 cities in India, which were selected through a rigorous challenge process to develop capacities and implement innovative and sustainable urban infrastructure projects.

The projects are driven by the four values at the core of the program:

- 1. Relevance and Feasibility:** The projects are appropriate, viable and achievable, in line with local constraints, strengths and opportunities.
- 2. Excellence in Sustainable Urban Development:** The projects include actions that contribute to social inclusion, environmental resilience, and project sustainability.
- 3. Innovation and Integration:** The projects are designed to make use of technology for creating innovative processes or assets.
- 4. Participatory Approaches:** The projects value and demonstrate co-operation between stakeholders and address the needs of beneficiaries.

CITIIS
City Investments To Innovate, Integrate and Sustain



Agartala

Haora Riverfront Development

Agartala is the capital of the Indian state of Tripura and is the second-largest city in northeast India. Situated on the banks of the Haora River, the city shares its western border with Bangladesh. The “Haora Riverfront Development” project aims to develop a total area of 16.94 acres along the Haora River. This will include green open spaces of 11.26 acres and 2000 meters of walking pathways with 700 meters of bicycle lanes. The area around the river will also include recreational spaces like parks, playgrounds, and commercial markets. Additionally, it aims to improve the water quality in the Haora River by implementing in-situ wastewater treatment. To address the annual monsoonal flooding of the Haora river and mitigate the flood impacts on the population living along the river, strengthening of the embankments using nature-based solutions is an integral part of the project. The project is being developed with the view that the riverfront should be easily accessed by the people, thereby improving the relationship between the river and the citizens of Agartala.

“Haora River Front Development Project in Agartala being implemented under CITIIS is a textbook example of inclusive, resilient & sustainable urban green open space development that addresses recurrent floods, restores biodiversity, and provides for livelihood generation of the stakeholders, especially women.” — Dr. Shailesh Kumar Yadav, IAS, CEO, Agartala Smart City Limited

Project Cost: € 11.64 million
CITIIS Grant: € 6 million

Work in Progress Gabion Wall as a nature-based solution for strengthening the embankment of the River. Photo: Vidhya Mohankumar, CITIIS Domestic Expert for Agartala

Amaravati

Basic Infrastructure Development in Low-Income Settlements in Amaravati City

Amaravati is a city that lies between the Vijayawada and Guntur districts of Andhra Pradesh. The project “Basic Infrastructure Development in Low-Income Settlements in Amaravati City” is building 15 e-health subcenters and wellness centers, 17 model Anganwadi centers, and doing holistic upgradation of 14 primary schools across 25 urban villages of Amaravati. The e-health centers are aimed at enabling patients in remote areas to consult doctors through telemedicine and accessible infrastructure. The Anganwadi centers will be equipped with basic facilities, segregated spaces, a dedicated outdoor play facility, and a consultation room for women. The schools will be upgraded to include Buildings as Learning Aid elements, child-friendly infrastructure, and improved furniture. Currently, these 25 urban villages do not have adequate facilities for women and children. The CITIIS project will provide them with these facilities to include child-friendly and universally accessible infrastructure in the form of better toilets and ramps.

Project Cost: € 16.31 million
CITIIS Grant: € 9.4 million

Interiors of the Anganwadi Centre in Amaravati. Photo: Amaravati Smart and Sustainable City Corporation Limited





Amritsar

Rejuvenation of Auto Rickshaws in Amritsar through Holistic Interventions (RAAHI)

Amritsar is Punjab's second-largest city, as well as a major transportation hub. The RAAHI project aims to promote the use of e-autos for last-mile connectivity and provide holistic "green public transport" facility, which can enable a modal shift from private vehicles to public transport. The project falls under the larger pan-city proposal focusing on traffic and mobility and aims to formalize the Intermediate Public transportation sector through the formation of the Amritsar City Auto Rickshaw Drivers Co-operative Society, replace old diesel auto-rickshaws with e-autos and improve social livelihood opportunities for female members of the drivers' families by providing free-of-cost skill development courses and develop e-auto charging stations.

"The project falls under one of the key thematic interventions of the Smart City Proposal (Self Sustainable Transportation & Environment) and one of the primary objectives of providing green mobility by promoting non-fossil fuel-based vehicles." — Mr. Sandeep Rishi, Municipal Commissioner, Amritsar Municipal Corporation and Chief Executive Officer, Amritsar Smart City Limited

Project Cost: € 12.27 million
CITIIS Grant: € 9.41 million

One of the beneficiaries of the RAAHI Project taking passengers from Amritsar Railway Station to their destination. Photo: Amritsar Smart City Limited

Bhubaneswar

B-Active (Bhubaneswar Active)

Bhubaneswar Smart City Limited is undertaking the revitalization of open spaces and creation of green and blue corridors in the city to make public spaces the center of social interaction and activity. The project entails interventions at the physical, policy, and public participation levels and covers the following assets:

A) Water Assets - The project involves rejuvenation of natural streams to create dynamic public spaces, which would connect water and the city through place-making interventions

B) Parks and Open Spaces - Parks on Demand (PoD) are being revamped is being done to develop vibrant spaces that will allow inclusive play and social interaction and cohesion amongst citizens.

C) Sports and Playgrounds - School playgrounds are being revamped under the project with the intent to promote healthy living by making sports facilities accessible for everyone.

"The development of school playgrounds with facilities like volleyball, badminton, football, kho-kho, kabaddi, and cricket courts is a significant step toward making Bhubaneswar more livable, sustainable, and inclusive." — Mr. Vijay Amruta Kulange, CEO, Bhubaneswar Smart City Limited

Project Cost: € 3.2 million
CITIIS Grant: € 0.93 million

Bhubaneswar Placemaking aims to develop and modify connections leading to parks, schools and offices. Photo: Bhubaneswar Smart City Limited (BSCL)





Chennai

Model & SMART Corporation Schools

This project aims to create an enriching, interesting, and fun-filled learning environment in schools, where experimental and experiential learning is encouraged, and logical thinking is fostered. In the process, a much-needed facelift and repositioning of 'The Chennai School' (420 schools within the management of Greater Chennai Corporation) have been planned which in the long run will nudge citizens to alter their perception and preference positively towards the GCC-run/managed schools. The project has identified interventions required in the areas of physical and digital infrastructure, teacher training and skill upgradation, smart pedagogy, extra-curricular activities and soft skills, strengthening institutions, and collaborating with industry, academia, and NGOs. This project is also a novel attempt to improve the lives of low-income households, by providing an improved and elevated education experience for children.

“The project seeks to improve varied aspects of learning by improving physical infrastructure, providing smart pedagogy, technically sound, and technologically equipped digital classrooms.”
 — Ms. Sharanya Ari, IAS, Deputy Commissioner (Education), Greater Chennai Corporation

Project Cost: € 11.21 million
CITIIS Grant: € 8.9 million

Activity room in one of the developed class rooms. Photo: Greater Chennai Corporation/Chennai Smart City Limited

Dehradun

Child-Friendly City Project

Dehradun aims to become a more child-friendly city by encouraging the use of public transportation and establishing safer pedestrian routes. Many streets in Dehradun lack raised walkways, such as footpaths and sidewalks. The existing walkways are narrow and hence most people walk on the roads. This results in blocked passageways and safety concerns due to drivers' behavior. Additionally, as India motorizes, the sheer number and speed of vehicles increasingly challenge people walking and cycling. On-street vehicle parking has increasingly become problematic as well. Thus, this project presents an opportunity to provide safe walkways and calm traffic to improve the safety of school children crossing the streets. The project proposes an emphasis on specific interventions centered on schools, such as amenities, vending zones, medians, curb extensions, and traffic calming measures.

“The true beauty of a street lies in its sustainable design.” — Ms. Sonika Meena, IAS, CEO, Dehradun Smart City Limited

Project Cost: € 6.82 million
CITIIS Grant: € 5.46 million

Tactical Urbanism exercise focusing on safe and interactive pedestrian ways for children undertaken in Dehradun. Photo: Dehradun Smart City Limited





Hubballi-Dharwad

Green Mobility Corridor

The Unkal Nala and its tributaries form the largest drainage system in Hubballi city. The Unkal Nala starts from the overflow weir of the Unkal Lake, which was the main source of drinking water for Hubballi Dharwad and irrigation for the surrounding farmlands during the early 1960s. The Unkal Nala forms the spine with 90% of the population crossing it at least twice a day, particularly people residing beside the Nala banks.

This project focuses on the transformation of the Unkal Nala, the 9.25-kilometer-long drainage channel in the city, from a mere stormwater drain to a developed, holistic space for the community. This corridor development also provides an opportunity for connecting the green corridor project to the major roads in the city passing through this Nala, where non-motorized transport corridors are also being developed as part of other missions/programs. This effort would create a network of non-motorized transport corridors and thus, promote sustainable mobility in the city to a larger extent.

“GMC is a testament to our smart and sustainable future and the citizens are already excited to witness the positive impact of the project on the city’s liveability and environmental well-being.” — Ms. Priyanga M., Managing Director, Hubballi-Dharwad Smart City Limited

Project Cost: € 15.29 million
CITIIS Grant: € 9.41 million

Entrance gate of the Green Mobility Corridor with citizens / beneficiaries using the Corridor. Photo: Akanksha Laroija

Kochi

E-Health Solution

The healthcare system in Kochi is being used by 50% of the urban population in the city. Under the “E-Health Solution” project, a centralized digital information database and management system is being created. For this purpose, 32 hospitals were selected for integrating the healthcare data of patients. The project includes upgrading the IT infrastructure, components like cables, devices like monitors, laptops, tabs, Wi-Fi, and internet in hospitals and integrating them with the e-health software so that the data is centralized and easily accessible by the hospitals. This project aims to develop an IT-enabled integrated framework to ensure that the public healthcare system is affordable and accessible to the people. As a part of the system, the collected health data of the patient will be mapped to their Unique Health IDs. A central repository of public health data will thus be formed, and this will reduce the out-of-pocket costs for the patients and prevent delays in treatment due to repeated testing required otherwise. It also aims to prepare the city with health infrastructure and enable the government to take steps towards mitigation during a pandemic/epidemic.

“When a patient registers under e health , their health details can be accessed and updated by the hospital, which makes consultation and diagnosis easier and accurate. E-health also allows people to book an appointment with the doctor, which can eliminate long queues and overcrowding at hospital. The CITIIS e-Health project has proved to be a successful venture.” — Mr. Shanavas S, IAS Former CEO, Cochin Smart Mission Limited

Project Cost: € 2.25 million
CITIIS Grant: € 1.7 million

Unique Health ID Registration kiosk. Photo: Cochin Smart Mission Limited





Puducherry

Our Neighbourhood Is Your Neighbourhood Too: A Participatory Planning Approach

The Puducherry CITIIS project “Our Neighbourhood Is Your Neighbourhood Too” intends to provide solutions oriented towards the development and up-gradation of housing, improvement of access to basic services and infrastructure, enhancement of livelihood infrastructure and employment opportunities through skilling in low-income settlements, through an intensive citizen engagement and outreach program.

The city has identified concerns regarding the exclusion of low-income groups from economic opportunities, poor quality social and physical infrastructure, and a need for basic community facilities like roads, street lights, and parks in low-income settlements. The CITIIS project will also address the need for affordable housing by developing new housing and retrofitting existing low-income housing complexes.

“CITIIS Program is improving the living conditions in 22 slum settlements in Puducherry by developing housing for slum dwellers, enhancing the social & community infrastructures and developing livelihood infrastructures.” —Dr. D. Manikandan, IAS, Chief Executive Officer, Puducherry Smart City Development Limited

Project Cost: € 11.73 million
CITIIS Grant: € 9.4 million

New housing complex being constructed at Puducherry under the CITIIS project. Photo: Puducherry Smart City Development Limited

Surat

‘Wild Valley Biodiversity Park’- Rejuvenation of Existing Wastelands along Kankara Creek

The project aims to rejuvenate the existing wasteland of Kankara Creek through a range of activities. Under this project, a biodiversity park for preserving flora and fauna will be developed and the wasteland will be made accessible to the public by developing it into a usable public space through the CITIIS grant. The major need for the project arises from the requirement to prevent water pollution, reduce waterlogging in the soil, and create a clean environment for people on the banks of the Kankara Creek. Moreover, the deteriorating biodiversity of this region has raised a very strong need to preserve different types of biodiversity-based species and improve the eco-aqua environment for marine biodiversity. As part of this project, 212 acres of land will be planted with approximately 600,000 plants of 85 types of native species on both sides of Kankara Creek on a stretch of approximately 13 km. Additionally, a recreational space consisting of 9 km of walking trails and 9 km of cycling tracks will also be prepared.

“This project will establish an enduring legacy of biodiversity conservation that will not only benefit our city but also inspire other cities across India.” — Ms. Swati Desai, Chief Executive Officer, Surat Smart City Development Limited

Project Cost: € 16.37 million
CITIIS Grant: € 9.41 million

Pilot Project at Recreational Park (Zone A), Surat. Photo: Surat Smart City Development Limited (SSCDL)





Ujjain

Mahakal Rudrasagar Integrated Development Approach – Phase II (MRIDA-II)

Ujjain is one of the oldest living cities in the world. Located on the bank of river Kshipra, is known for the Shri Mahakaleshwar Temple, one of the 12 Jyotirlingas (shrines considered to be the most sacred abodes of Lord Shiva). Under the CITIIS project of ‘Mahakal Rudrasagar Integrated Development Approach – Phase II (MRIDA-II)’, Ujjain is developing public spaces around the holy Shri Mahakaleshwar Temple and Ram Ghat. This is being achieved through conservation and adaptive reuse of the historic Maharajwada Complex, creating safe pedestrian access pathways and resting areas around the temple, upgrading public infrastructure and creating amenities for the convenience of pilgrims and visitors. A sub-surface parking and vendor zone near the temple area to decongest traffic is also being developed. Revitalisation of the Rudrasagar Lake is being undertaken through dredging of the lake, segregation of storm water and sewage, and remediation of the water through application of nature-based solutions, thus aiming improvement of the quality of the water and the micro-climate of the city. Under the project, 185,000 sq.m. of the Rudrasagar Lake is being improved through bioremediation, and 33,500 sq.m. of public space is being developed.

“The MRIDA-II project is a harmonious blend of tradition and sustainability shaping Ujjain’s vibrant future for generations to come.” — Mr. Ashish Kumar Pathak, CEO, Ujjain Smart City Limited

Project Cost: € 17.69 million
CITIIS Grant: € 9.4 million

The Mahakaleshwar Dwar, ancient gateway to the Shri Mahakaleshwar temple. Photo: Ujjain Smart City Limited (USCL)

Visakhapatnam

Social Inclusion through modernising public schools as SMART Campus

The Greater Visakhapatnam Municipal Corporation (GVMC) has laid specific emphasis on upgrading the social infrastructure in the city. The “Social Inclusion through Modernizing Public Schools as Smart Campus” project is upgrading 40 schools out of the 147 in the city, with the aim of building child-friendly and universally accessible physical infrastructure. Under this project, innovative methods of teaching will be adopted through the design of the schools like introducing Building as a Learning Aid (BaLA) elements in classrooms. The project will also create a more inclusive and enabling learning environment for students by utilising outdoor spaces and retrofitting existing infrastructure. This includes landscaping, developing sports facilities outside schools and refurbishment of existing sports grounds. Safety and health of the children will also be enhanced by refurbishing existing toilet blocks and enhancing site furniture.

“The proposed project of renovating the existing schools into 21st century learning would certainly provide quality education to economically marginalized communities and will also serve as an example of how infrastructural improvements can improve educational quality. The proposed project sub-components, as they are small in terms of spatial extent, are meant to create a positive social impact and positive aesthetic appeal.” — Mr. Saikant Verma, MD & CEO, GVSCCL

Project Cost: € 7.65 million
CITIIS Grant: € 6.1 million

Students using the play area facilities at the pilot school. Photo: Greater Vishakhapatnam Smart City Corporation Limited



Notes

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