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EARTH MATTERS

Subscriber's copy VOLUME 16 | ISSUE 11 | February 2024

WORLD SUSTAINABLE DEVELOPMENT SUMMIT 2024

LEADERSHIP FOR SUSTAINABLE DEVELOPMENT AND CLIMATE JUSTICE

WSDS SPECIAL ISSUE

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TerraGreen

TerraGreen is India's most respected monthly magazine dedicated to informing and enlightening its readers on issues of environment, energy, and sustainable development. Launched in 2004, *TerraGreen* has made an indelible impression on the minds of readers, both in India and across the world. Today, it enjoys a readership of over 40,000 and a subscriber base of close to 10,000.

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The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
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EDITORIAL

> This special edition of *TerraGreen* covers a wide range of contributions including but not limited to climate-related aspects to adaptations, energy transition, sustainable development, and COP28.

We continue to grapple with complex and interconnected challenges in achieving sustainable development , requiring collective efforts to create a sustainable and equitable future. We value the significance of leadership that plays a pivotal role in driving change which necessitates inclusivity, resilience, adaptability, and creativity. Recognizing the critical role of leadership in achieving sustainable development and operationalising climate action, the 23rd edition of TERI's flagship event, the World Sustainable Development Summit (WSDS) focused on 'Leadership for Sustainable Development and Climate Justice'. Distinguished leaders, policymakers, and experts from international organizations, government, business & industries, research & academia, civil society convened to deliberate on the progress we have made so far, multifarious issues, nuances and the path ahead towards the shared goal of realizing sustainable development and climate justice .

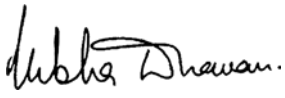
The Hon'ble Prime Minister, Shri Narendra Modi, highlighted in his message that the WSDS has evolved into a pre-eminent platform to foster dialogue, collaboration, and action on sustainability and combating climate change. We were also enlightened by the inspiring address of the Hon'ble Vice President of India, Shri Jagdeep Dhankhar, who articulated that climate justice should guide the efforts against climate change, considering its disproportionate impact on the most-vulnerable communities.

Shri Dhankhar highlighted India's leading role in global environmental protection and climate justice initiatives. The Hon'ble Minister of Environment, Forest and Climate Change Shri Bhupender Yadav in his address noted that India is committed to both fighting climate change and ensuring climate justice. Such profound articulations by our leaders had set the tone and created contours of the collective discourse during the flagship event.

The cover story in this Special Issue on 'Leadership For Sustainable Development And Climate Justice' underscores the assumption that leadership plays a pivotal role in pushing for a green and just world in achieving sustainable development or fighting for climate justice. With nations lagging far behind in meeting climate goals, only a sustained push through climate leadership can bring us closer to achieving our targets for 2030 and 2050. We possess the technology and resources necessary to combat climate change; therefore, we must intensify our efforts before it becomes too late.

The articles showcase research and provide insights to drive action and design futuristic strategies. There are opinion pieces on leadership for sustainable development and climate justice in a conflict-ridden world which are insightful and essentially provide inputs for a deeper reflection. Some of the opinion pieces are portrayed in the form of 'innovation showcase' that include any innovative initiative, or technology that organizations in the sustainability sphere are implementing/promoting. Such narratives and practices may trigger further research, collaborative decision-making, and timely action.

Happy reading!



Vibha Dhawan
Director-General, TERI

Reading 'TERI analysis' included in the January 2024 issue was an eye-opening experience. It skillfully detailed the reasons that in order to attain the overarching ESG targets, the government must consider making exceptions in competition laws to facilitate effective ESG-related collaborations. The 'feature' article talked about National Saffron Mission that government launched with the aim to rejuvenate saffron cultivation. However, the Mission is yet to suitably address the issues of the saffron farmers in Kashmir valley as they heavily rely on natural rainfall for irrigation, resulting in decreased production. The declining production in recent years has been forcing farmers to shift to other crops. 'Special report' of the issue was focused on Atal Setu. This 22-kilometre-long engineering marvel stands as a symbol of progress and development, while also prioritizing environmental sustainability.

Colonel Ashwani Bhardwaj
Bengaluru, Karnataka

The new-year edition of TerraGreen has continued to be reliable as its predecessors. The article that confirms Norway as Europe's greenest country was a delight to read. I came to know through another article that details Londoners are also investing in rooftop solar PVs for harnessing renewable energy. The section on 'climate change' established that climate change is not limited to the physical aspects, it has a profound influence on mental stress, especially amongst the teens. I did find 'sand alert' under the 'cover story' to be very encouraging and relevant in the context of a developing country as ours. The author rightly pointed out the repercussions of dredging, if carried out unplanned.

Mridula Sharma
Kota, Rajasthan

TerraGreen January's most engaging article, as per me, is 'Innovative Direct Seeding Device'. Development of aerial seed-dispensing device could initiate a revolution in agriculture, especially, rice cultivation. Marut's patented technology not only opens avenues for rural employment but also encourages the establishment of community health centres, facilitated by farmer producer organizations, and women self-help groups. The piece of writing on 'Every Can Counts' initiative is a true knowledge enhancer. The initiative stands as the foremost programme for promoting drink can recycling across Europe and beyond. Its mission is to inspire, encourage, and empower consumers to actively participate in recycling their drink cans, whether at home, in the office, or on the go—from parks, festivals, and sporting events to schools and universities.

Shruti Sharma
Bhopal

Published by Dr Vibha Dhawan on behalf of The Energy and Resources Institute, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003. Editor-in-chief Dr Ajay Mathur

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ACT4EARTH MANIFESTO

The 23rd edition of the World Sustainable Development Summit brought together global leaders and stakeholders to discuss the imperatives of 'Leadership for Sustainable Development and Climate Justice.'

Climate justice needs to be the north star to guide sustainable development.

Polycrisis demands polycentric leadership on integrating sustainable development, protecting nature, enhancing resilience, promoting sustainable consumption, driving energy transitions, and strengthening climate actions.

It is to this end, to nudge action, raise ambition, encourage dialogue, and bring like-minded people together that a 10-point *Act4Earth Manifesto* has been formulated.

We hereby pledge to Act for Earth by:

1. Formulating people- and nature-centric approaches for holistic well-being of both humanity and the natural world.
2. Integrating sustainable development through policy innovations such as green budgeting and sustainable public procurement that provide the right policy and market signals.
3. Critically examining existing norms and frameworks which guide climate policies and global governance processes.
4. Internationalizing and internalizing sustainable consumption and environmentally sensitive lifestyles.
5. Advocating for bridging the financing gap in areas of adaptation, capacity building, and innovations.
6. Accelerating efforts to address the energy trilemma through partnerships and navigating the geopolitical landscape.
7. Amplifying the voices of the most vulnerable communities and foster leadership at the local, national, and global levels.
8. Incorporating diverse perspectives and lived experiences of women in climate action and sustainable development.
9. Nudging business leadership and environment stewardship for integrating environment and sustainable development considerations in business models across value chains.
10. Encouraging young people to be catalysts for change for inter-generational and intra-generational equity.

India's Road Map to COP33

Keeping the Momentum on Climate Leadership

Article penned by **Meera Gopal** addresses and explains India's position, commitment, and contribution towards constructive discussions on climate change, especially in the context of the Global South. The text also highlights, despite having the lowest per capita emissions among G20 nations, India led the charge in adopting significant climate initiatives during its G20 presidency. With the proposal to host COP33 in 2028, it is certain that India will continue to lead on climate action through pragmatic internationalism to find multilateral solutions in an increasingly polarized world.

The year 2023 was a watershed moment for India—with the G20 presidency and the Clean Energy Ministerial. The country has been actively positioning itself as a leader of the Global South—which became the driver of the G20 success—with India delivering a consensus-based communique despite all contrary predictions. India's engagement leading up to 28th meeting of the Conference of Parties (COP28), in tandem with its G20 priorities, focused on climate finance as a key issue, with targeted engagement on issues such as the new collective quantified goal (post-2025 climate finance goal). At the Leaders' Summit, Prime Minister Narendra Modi highlighted India's early achievement of the emissions' intensity reduction targets and proposed hosting COP33 in 2028, when the next Global Stocktake is scheduled to take place. Internationally, thus, India has emerged as a unique leader, bridging the Global North and the Global South, experts have attributed it to India's four cooperation tracks on multilateral, minilateral, trilateral, and bilateral levels (Xavier and Nachiappan 2023).

However, domestically, things are more challenging. Despite being ranked seventh on the Climate Change Performance Index which evaluates climate policies of countries, it was found that India needs to strengthen the implementation of its climate policies and make them more effective. India, thus, faces a dichotomy—of pursuing a leadership role at a global stage and perpetuating a fragmented system of climate governance with weak implementation. Three key areas where India outshined rest of the developing countries in pushing for stronger climate commitments have been discussed next.

Prime Minister Narendra Modi at the opening session of the high-level segment of COP28 Source AP/PTI

Taking Forward the G20 Victories

Despite having the lowest per capita emissions among G20 nations, India led the charge in adopting significant climate initiatives during its presidency. Notable achievements included commitments to triple renewable energy capacity, double energy efficiency, and bolster funding for climate disaster responses. Key minilateral initiatives, such as the Global Alliance on Biofuels with Brazil and the United States, and the India–Middle East–Europe connectivity partnership, were launched. India's innovative domestic solutions were also highlighted at these forums, setting an example for other developing countries. Crucially, an expert group, co-convened by economists N.K. Singh and Larry Summers, proposed

a road map for reforming multilateral development banks to improve climate finance. India's responsibility extends to ensuring the effective realization of the Delhi Declaration, in collaboration with the next G20 presidencies of Brazil and South Africa. This commitment was underscored by hosting significant events like the G20 Virtual Summit and the 2nd Voice of the Global South Summit in November 2023, focusing on the Declaration's implementation. At this critical juncture, the G20's leadership troika of developing nations—India, Brazil, and South Africa—holds a unique chance to champion vital issues such as financial reform, inclusive development, and climate finance.

Enhancing Cooperation via Bilateral and Mini-lateral Engagements

India's efforts in forging robust bilateral climate cooperation ties are noteworthy, involving most G7 countries and significantly bolstering its global climate strategy. Recent engagements with Middle Eastern nations, including the United Arab Emirates and Saudi Arabia, on green hydrogen and renewable energy initiatives, have further strengthened India's negotiating position. These partnerships hold potential for representing and leveraging the needs of other developing nations in the region including Pakistan, Bangladesh, Nepal, and Sri Lanka. Additionally, India has addressed concerns of developing countries in minilateral settings like the Quad. Hosting the Quad Leaders' Summit this year, there is immense opportunity to steer discussions on climate. The Quad has already made climate a priority area of focus with initiatives like the Clean Energy Supply Chains (launched in 2023) and efforts to enhance access to early-warning systems and climate data through Q-CHAMP (Climate Change Mitigation and Adaptation Package). India's unique position in the Quad, alongside three developed nations, enables it to underscore inefficiencies in global climate governance, especially around finance and capacity building.

Showcasing Domestic Solutions for Global Challenges

Domestically, India is a front-runner in climate solutions, notably in developing green hydrogen. The ₹19,744 crore Green Hydrogen Mission aims to cut fossil fuel imports by ₹1 lakh crore and reduce CO_2 emissions by nearly 50 million metric tonnes (MMT) annually by 2030. Such government initiatives boost investor confidence, attracting finance towards alternative fuels. India's success in renewable energy generation is also noteworthy. Country's ongoing fast-paced efforts to operationalize its domestic carbon market is a signifier of the significant potential to serve as a model for other developing countries to replicate similar mechanisms which are internationally aligned, at the same time, further and protect their domestic interests. Efforts such as Mission LiFE, addressing unsustainable consumption, have led to innovative policies like the Green Credits Programme, incentivizing eco-friendly practices among individuals, communities, and industries.

Challenges Persist…

To consolidate India's leadership role, it needs to look within the two main challenges. First, institutionally, India's climate policies, while robust, suffer from fragmentation, reducing their effectiveness. For instance, Apex Committee, formed in 2020 to oversee the Paris Agreement's implementation,

has met infrequently, focusing mainly on COP planning and inter-ministerial coordination. Empowered under the Environment (Protection) Act, 1986, this committee has significant authority, including setting environmental standards and coordinating state-level actions, crucial for a diverse nation like India. However, its potential remains underutilized, primarily restricted to United Nations Framework Convention on Climate Change (UNFCCC) submission planning. Thus, it could take proactive steps to ensure standards for greenhouse gases (GHGs), implementing a national-level carbon budget, etc. Additionally, the Committee also has the power to issue directions, including closure, prohibition, or regulation of any industry, operation, or process, thus, possesses enormous powers to issue directions on climate proofing, issuing binding targets for industrial sector, etc.

Experts describe India's climate policy as "climate nodes spread across government, stitched together by relatively weak and unstable cross-ministerial coordination and strategy bodies" (Pillai and Dubash 2021). Recommendations to address this gap include expanding institutional capacity within the government by having more climate expertise in key ministries such as the Ministry of External Affairs, and appointing a Prime Minister's special envoy for climate cooperation to bridge the gap between international negotiations and domestic policy implementation (Xavier and Nachiappan 2023).

Second, transitioning away from coal presents another major challenge. As a significant coal producer, India risks-stranded assets, unemployment, and energy insecurity with a rapid coal phase-down, this has naturally been the justification for the pushback against language on rapid coal phasedown at the recently concluded COP28. A just and planned transition, therefore, is vital. With about 3.6 million people dependent on coal, states like Jharkhand are developing just transition strategies. This includes retraining workers and decarbonizing sectors like Indian Railways, integral to the coal economy. However, given the governance structure, the states do not have much power or the capacity to address this colossal challenge. Thus, there is a need for concerted efforts on working with the states to ensure an effective transition pathway.

Nonetheless, transitioning to a low-carbon, green growth pathway to a net-zero economy will ultimately have economic co-benefits. Analysis by ASPI's High Level Commission on Getting Asia to Net Zero finds that achieving

net-zero emissions by 2070 could boost India's economy by as much as 4.7% above projected baseline growth in GDP terms by 2036 — worth a total of USD371billion—with long-run effects still maintaining 3.5% growth above baseline by 2060 (ASPI 2023). India could thus become a role model for developing countries, balancing development and climate challenges.

Road Map to COP33

India continues to lead on decoupling emissions reduction and economic growth, thus making a low-carbon development pathway feasible. India's third National Communication (NC) to the UNFCCC, reveals that that between 2005 and 2019, India's GDP grew at a CAGR of 7%, while emissions increased only by 4%. It also reiterates that India met its Nationally Determined Contribution (NDC) emission intensity target 11 years early, although there's debate about the need for more ambitious absolute emission goals.

However, to sustain this role, India must strengthen its domestic framework, setting higher climate goals and showcasing that ambitious targets are achievable, particularly with international support in finance, technology, and capacity building. This approach will not only enhance India's global credibility and influence but also inspire other nations to follow the suit. India's achievements, largely realized with domestic resources, underscore the possibility of attaining more ambitious goals.

Recommendations include that India must continue to focus on triangular arrangements, serving as a bridging power between the Global North and the South. India's four 'cooperation tracks', serve as a blueprint for other developing nations, demonstrating the effectiveness of innovative policies, technological advancements, and domestic financial strategies in driving climate action. With the proposal to host COP33 in 2028, it is certain that India will continue to lead on climate action through pragmatic internationalism to find multilateral solutions in an increasingly polarized world.

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Meera Gopal, Senior Program Officer, Climate, Asia Society Policy Institute

COP 28: Fractured World, Fragile Future

New Era for International Cooperation: Can India Bridge the Climate Divide and Orchestrate Action?

Article contributed by **Ripu Bhanjan Singh** gives an overview of how India can become the architect of a collaborative climate action blueprint—one that inspires the entire world. The author establishes with apt examples how India can realize its potential of being a global leader in mitigating climate change. India's bold proposal to host COP33 in 2028 isn't just a promise, it's a power play. It's a chance to rebuild trust, not just with the world, but especially with the Global South. This is a monumental opportunity for developing nations to join forces with India and shift the narrative from pledges to tangible results.

COP28 Advancing International Cooperation

The perfect storm surrounding recently concluded COP28 has underscored the paramount significance of international cooperation for several factors. Foremost, Al Jaber's dual role and his downplaying of fossil fuels' role in climate change have eroded trust amongst the stakeholders including both state and non-state actors. This fractured landscape makes it harder to forge collective action. To counter this, international cooperation is vital in amplifying scientific consensus, promoting transparency in climate data and reporting, and holding powerful actors accountable for their greenwashing tactics. Secondly, the existing North–South divide in terms of climate responsibility, vulnerability, and financing has been further exacerbated. While the Climate Loss and Damage Fund (LDF) operationalization is a welcoming step, it took 30 years. Parked at the World Bank raises concerns over historic conditionalities and bureaucracy that have plagued the Bank's efficiency. Third, developing countries have raised concerns about overprotective policies that limit access to meaningful technology transfer and intellectual property (IP) rights. This requires a collaborative approach that transcends finger-pointing and blame. Fourth, harnessing diverse perspectives and building collective resilience. Climate change is a complex, global challenge requiring diverse expertise and innovative solutions. No single country or entity has all the answers. International cooperation fosters knowledge-sharing, technology transfer, and collaborative research, developing more effective approaches. Finally, in light of the urgency of the climate crisis that demands unwavering commitment and escalating ambition, international cooperation is an essential tool for maintaining momentum and pressure for accountability on past promises and future ambitions.

Promising India

While the conference had its fair share of developments, India emerged as a bright spot. Prime Minister Modi lauded India setting an example of balancing ecology and economy before the world; contributing under 4% to global carbon emissions despite being home to 17% of the world population; and being one of those few economies of the world on course to meet Nationally Determined Contribution (NDC) targets. India went into COP28 bubbling with unparalleled momentum of championing itself as the voice of the Global South with a particular focus on the citizen-centric approach to combat climate change. India consistently advocated for the needs and concerns of developing countries, emphasizing their disproportionate vulnerability to climate impacts, climate justice, and climate finance despite lower historical emissions. This resonated with many developing nations who often feel unheard in climate discussions. Moreover, India's position was communicated well during the G20 presidency and the Voice of the Global South summit, both of which India hosted in 2023. India utilized these platforms to articulate and promote its willingness to serve as a bridge between the Global North and Global South. India is decisively hinting towards a new era of international collaboration, presenting itself as a hub to co-develop green technologies and a magnet for climate finance, accelerating global climate action. Hence, it was a

no surprise when Prime Minister Modi proposed to host the COP33 in 2028 in India. India is well-positioned to play the role of an orchestrator.

COP33: a monumental opportunity

India's bold proposal to host COP33 in 2028 isn't just a promise, it's a power play. It's a chance to rebuild trust, not just with the world, but especially with the Global South. This is a monumental opportunity for developing nations to join forces with India and shift the narrative from pledges to tangible results. India can be the architect of a collaborative climate action blueprint unlike any before, one that inspires the entire world.

Leading the world towards a successful COP33 demands more than just ambition. India needs an ace up its sleeve: a multi-pronged strategy that harnesses the collective power of diverse stakeholders. This global collaborative force—a symphony of think tanks, researchers, civil society, private sector, citizens, indigenous communities, sub-national and local governments— will be India's backbone in its role as convenor and secretariat. This approach is crucial for a variety of reasons, some of the notable ones have been briefed here:

Synergy of expertise: Each stakeholder brings unique expertise and perspectives. Combined, they form a powerful knowledge bank to inform 'surgical briefings' for policymakers—precise, evidence-based insights that drive well-informed climate action priorities.

Leveraging existing strengths: India already boasts cutting-edge research capabilities and experienced international relations experts. Combining this with the global collaborative force creates a powerhouse presidency.

Amplifying India's impact: Pooling all resources—domestic and international—allows India to maximize its diplomatic footprint. Platforms like BRICS, G20, QUAD, and others become potent tools for forging strategic partnerships and amplifying its voice.

Building a comprehensive strategy: By facilitating dialogues with diverse voices, including civil society, businesses, and indigenous communities, India ensures that its global climate action strategy is inclusive, responsible, and addresses the needs of all.

Spotlighting climate action

India's strategy for COP33 should be anchored along the following crucial pillars:

Pillar #1: Equitable and inclusive climate action: At the heart of the COP33 strategy, India must champion a deliberate and equitable approach to climate action, ensuring fair access to resources, opportunities, and participation in decision-making processes for all stakeholders. This emphasis is particularly crucial for indigenous communities and developing nations.

Pillar #2: Enhanced access to climate finance: India should advocate a robust stance to develop innovative financial solutions aimed at addressing the substantial funding gap for climate action. At the outset this pillar should entail the status of climate finance disbursed versus past pledges (USD100 billion annually); followed by exploring blended finance; unlocking climate markets; and dept-for-climate swaps amongst others.

Pillar #3: Robust reporting and knowledge management: The global community has long procrastinated on effectively measuring and transparently reporting on past commitments. India can play a pivotal role in creating clear, standardized, and accessible systems to track progress in global climate action. This involves ensuring data accuracy, evaluating effectiveness, and facilitating shared learning among nations.

Pillar #4: Clear communication strategy: This strategic component aims to eliminate jargon and ambiguity in climate reporting and communication. The overarching objective is to ensure that climate data is accessible and comprehensible for a diverse audience, ranging from policymakers to the general public. The pillar encompasses the creation of accessible glossaries and dictionaries; storytelling and visualization; and the active promotion of multilingual communication.

Pillar #5: Technology transfer, research, and innovation: Recognizing the imperative for developing countries to acquire the essential technologies and expertise to address climate change, India should proactively facilitate purposeful knowledge-sharing sessions with stakeholder groups. This involves the creation of diverse platforms for intentional collaboration, the enhancement of technical capacity, support for critical research, innovation, and development initiatives, and the backing for customized, locally relevant solutions.

This is not just about India leading the world. It's about the world, in all its diversity, collaborating for a sustainable future. The COP33 can be the stage where this symphony plays out, with India as the conductor, orchestrating a harmonious movement towards a healthier planet. ■

Ripu Bhanjan Singh, Strategy Consultant, Swaniti Global

Leadership for Sustainable Development and Climate Justice

This article penned by **Dr Vibha Dhawan** gives us an opportunity to both assess and analyse the ground we have covered towards realization of sustainable development. The author has opined—our efforts towards climate mitigation and adaptation should be viewed by keeping climate justice at the centre. Not only developed countries, but also the developing counterparts, need to take measures to move away from fossil fuel usage and find ways to adopt sustainable ways of energy consumption. Investment in a circular economy is equally crucial for developing countries as we need to shift our focus from financial gains to environmental gains.

Gulmarg, this winter, wore a forlorn look. The swathes of snow seeped into its lush green slopes, were not there. In its place lies bare the expanse of brown, sandy landscapes with a smattering of white at best. The neighbouring states of Himachal Pradesh and Uttarakhand have faced a similar fate. Attributed to the El Nino effect and climate change, this unusual dry winter spell has severely hit tourism in these hilly states, sparking serious concerns of water shortage.

Such weather disruptions are becoming increasingly frequent, portending long-term shifts in weather patterns and temperatures. These disturbances are tell-tale signs of a bleak future; a looming climate crisis that can destroy humankind.

The world has been making efforts to overcome this catastrophe through policies that encourage environmental awareness. Pursuing climate justice and sustainable development, therefore, becomes an integral part of any strategy for a healthier planet. Since the implementation of Sustainable Development Goals (SDGs) and climate action come down to the national strategy and plan, a robust relationship between leadership, sustainable development and climate justice can prove to be a game-changer.

Embracing Sustainability

Sustainable development in simpler terms can be explained as a process which is tailored to meet the needs and demands of the present without hampering the social, environmental, and personal health of the future. Contrary to its ideals, the world today is grappling with the Frankenstein effect of technology. Human greed for rapid development and instant return on investment has left us on the brink of a dystopian climate future.

In the world caught up in a swirl of incessant chaos, sustainable practices present hope of course correction by accelerating the 2030 Agenda for Sustainable Development and its SDGs.

The 17 SDGs, a unifying framework for achieving sustainable development

world over, are complex and interlinked in nature. The framework expands the understanding of sustainable development beyond the limited ambit of environment. It calls for building a resilient, just, and inclusive society that promotes the well-being of the present and future generations and creates equal opportunities for all.

For a country like India, sustainability gains deeper relevance due to its growing population and rapid urbanization. The effects of environmental degradation are more pronounced in the Indian cities, forcing people to view the Goals with more seriousness.

A recent survey revealed that an alarming 60% of residents in Delhi and Mumbai are contemplating moving to other cities due to the escalating air pollution crisis. The time has come to move away from profit making, and a quick return of investment to building experiences for the present and future generations. We must shift the focus from financial gains to environmental gains. Sustainability must be considered a lifestyle choice that is integrated in our daily chores and routines. This will take time, and a collective, persistent effort at global, local, and personal level to fight the unique challenges we face today.

Conflict Situations and Backsliding of SDGs

What was named the 'Decade of Action' by the United Nations had a rather ominous beginning. The onset of COVID 19 caused heavy loss of lives, and deepened the socio-economic crisis of countries, especially the low-income and least-developed countries. The pandemic severely weakened the ability of several countries to achieve their SDGs, posing a great danger to the gains made.

Additionally, the prevailing conflict situation has left the world battered, causing incredible suffering, and impacting the local and global sustainable goals. The global spillover of Russia–Ukraine War hit the global supply change, shook European security and interdependent global economy, which was already struggling to find feet due to the raging pandemic. As per a report, the number of people suffering from severe food insecurity jumped by more than 200 million between 2019 and 2021.

Like the rest of the world, the Indian economy too suffered the brunt of the war with Indian currency hitting a multiple all time low against the US dollar in 2022, and fuel prices soaring to cause massive deterioration in the trade balance as merchandise imports hit record monthly highs.

The ongoing Israel–Palestine War threatens to worsen the crisis. An October 2023, Bloomberg report feared the war could disrupt the world economy and plunge it into recession. Together, the COVID-19, the post-COVID inflation, and the ongoing conflict situations have pegged back the progress of SDGs, particularly SDG16 (Peace, Justice, and Strong Institutions).

The statistics also reveal the achievement of SDGs by 2030 is in a deep peril. As per UN release in July 2023 only 12% of SDG targets are on track following a preliminary assessment of roughly 140 targets for which data is available.

"…At present, 37 out of the 69 world's poorest countries are in debt distress or at high risk, hampering their ability to accelerate action on the SDGs. More than 108 million people as of December 2022 were forcibly displaced from their homes and there was a steep rise to conflict-related civilian deaths with over 50% surge in 2022, fuelled by the war in Ukraine."

India too is trailing in fulfilling more than 50% of indicators under the SDGs, according to a study published in *The Lancet* journal on February 20, 2023.

However, with seven years to go, not all is lost. According to the *SDGs Report 2023: Special Edition,* "there has been progress in some areas—800 million people have been connected to electricity between 2015 and 2021, 146 countries already met or are on track to meeting the under-5 mortality target and effective HIV treatment has cut global AIDS-related deaths by 52% since 2010," the release added.

As India and the world accelerate the efforts to get these goals back on track, it is critical for world leaders to renew their commitment and design policies and programmes around the SDGs.

Climate Justice: Time for the Developed World to Step Up

The year 2023 was officially declared the warmest year on record. As per European Union's climate service, "unprecedented global temperatures from June onwards led 2023 to become the warmest year on record—overtaking by a large margin 2016, the previous warmest year."

This breach, although temporary, has raised concerns of coming years becoming hotter, and the possibility of this becoming a long-term phenomenon. Nearly 200 countries had agreed in Paris in 2015 to try and limit warming levels to 1.5 degrees to avoid the worst effects of global warming. The current trends, however, reveal we are way off the mark.

This latest revelation has come shortly after the conclusion of COP28 Summit, where countries agreed to 'transition away from fossil fuels', the leading cause of global warming. While the language of the text was criticized to be weak, it is seen as a move in positive direction due to the progress in the areas of renewable power.

It will not be wrong to say the world is in the middle of a climate crisis which has turned out to be far more catastrophic than what was predicted. Sadly, the consequences of climate change are often borne by the most vulnerable, drawing focus to the concept of climate justice.

As the world deals with unpredictable weather patterns, rising sea levels, forest fires, loss of biodiversity, and rising temperatures, climate justice becomes imperative as much as any other social or economic justice.

Research has shown the world's 46 LDCs, home to about 1.1 billion people, have contributed minimally to CO_2 emissions. In 2019 they accounted for less than 4% of total world greenhouse gas (GHG) emissions. Yet over the last 50 years, 69% of worldwide deaths caused by climate-related disasters occurred in LDCs.

Our efforts towards climate mitigation and adaptation should be viewed by keeping climate justice at its centre. It

was wonderfully demonstrated by the small Pacific island of Vanuatu who last year succeeded in persuading the UN General Assembly to ask the world's highest international court to rule on the obligations of countries to address climate change.

The nation of 320,000 people has been at the receiving end of climate change-driven natural disasters. Vanuatu is a classic example in showing how climate change has varied implications for countries despite not making equal contribution to the problem.

Likewise, India, the second-most populous country, is among the top ten countries who are significantly vulnerable to climate change and its injustice. Data reveals India's per capita GHG emissions to be far below the world average.

It puts out a compelling argument about developed countries taking moral responsibility for helping the developing countries, and for acceptance of common but differentiated responsibility as a global principle.

Climate finance is, therefore, crucial to supporting mitigation and adaptation actions. While operationalizing the Loss and Damage Fund at the recent climate summit in UAE is a step in the right direction, more clarity is needed about its functioning, resource management, and sustainability. More such initiatives are needed to fast-track climate recovery.

Developing countries, too, need to take measures to move away from fossil fuel usage and find ways to adopt sustainable ways of energy consumption. Investment in a circular economy is equally crucial for developing countries. Importantly, the focus should be on green development, in promoting initiatives such as green credits and green alternatives that do not hinder economic growth.

Leadership that Prioritizes Climate Action

Whether it is in achieving sustainable development or fighting for climate justice, leadership plays a pivotal role in pushing for a green and just world.

Be it from the governments, business houses, industries, organizations, or local communities, we need leaders who recognize the prevailing climate emergency and prioritize its addressal.

The role of an environmental, social

and governance (ESG) programme is critical in ensuring accountability and the implementation of systems and processes to manage a company's impact, such as its carbon footprint besides taking a stock of how it treats its employees, suppliers, and other stakeholders. It is an essential performance indicator that helps in contributing to a business' sustainability efforts and pitches it for long-term success.

As per a recent study, the number of companies appointing chief sustainability officers jumped threefold in 2021 year-on-year. A survey of PwC of 1640 companies across 62 countries showed there is an increasing demand for such dedicated positions in corporate houses to tackle ESG challenges. This growing shift from Return of Investment to Return of Experience should be taken note of.

Not long ago, it was believed that government and institution policies must provide incentive-based solutions towards climate action. The cost of actions was measured against the benefits of avoided costs of climate degradation in the future. This economic understanding of climate change is now replaced by a more refined thinking. Economies understand the need to take smart actions which can not only mitigate climate change but also increase efficiency and drive new technology. Such actions can stimulate growth, push investment, generate employment, and help build healthier economies.

Take for example the various initiatives of putting up solar panels on rooftops to power our homes and businesses with green electricity. The Indian government also provides various incentives and subsidies to encourage the use of solar rooftops. Recently, the government increased the benchmark central financial assistance for the residential sector under the rooftop solar programme to give a push to the projects and cover the higher cost of solar panels.

Additionally, we can also draft policies where such subsidy-based incentives and environmental-friendly action be changed into models that can generate revenue and lessen the burden on customers.

Customers installing a solar panel can be waived off money for a few years by the government in return for using part of the electricity produced from the rooftop. In that way, one can still get a benefit of 50% and the remaining 50% can go to the government to repay their investment. Thus, there should be policies of this kind that do not hurt the customers and help in advancing sustainability.

Also, establishing a just and equitable world is a prerequisite for combating the effects of climate change. For instance, there is a lack of equilibrium in solar PV manufacturing costs across regions. Production costs exhibit significant disparities across various components and geographic locations. Module costs vary from as low as USD0.24/W in China to USD0.33/W in Europe.

To ensure a diverse and resilient supply chain, the international community must embrace India's call during its G20 presidency of 'One Family, One Earth, One Future'. Unless the world takes collective action and rises above individual, national, or regional gains, climate justice will remain a mere feel-good theory.

Youth leadership too needs to be recognized. Various youth climate groups across the world are voicing their concerns for climate change and connecting with local communities. They must be supported and guided in their passion to better the current situation.

In the words of the newly elected chair of the Intergovernmental Panel on Climate Change (IPCC), Jim Skea, "climate change, unequivocally caused by human activities, is already upon us." We, therefore, need leaders who are willing to take ambitious climate action that is targeted, reasonable, and importantly people centric.

Recognizing the role of leadership in achieving sustainable development and climate action, the 23rd edition of TERI's flagship event the World Sustainable Development Summit, picked its umbrella theme as 'Leadership for Sustainable Development and Climate Justice', where distinguished leaders, policymakers, and experts converged to discuss the way forward.

With nations far behind in meeting climate goals, only a sustained push through climate leadership can take us closer to our climate goals in 2030 and 2050. We have the technology and resources to fight the battle against climate change; we should ramp things up before it gets too late. ■

Dr Vibha Dhawan, Director General, TERI

Pioneering Climate Finance in India

Through this article, **Manish Chourasia**, has shed light on the significance of climate finance to reduce repercussions associated with climate change. India's plans on mitigating climate change are facing limitations, largely due to the insufficient capacity of the involved institutions. This has created a void in sector's understanding, hindering the flow of channelled capital into the sector. The author has explained how Tata Group has been instrumental in mainstreaming the renewable energy sector and is working to make the emerging cleantech segments more attractive. The organization is focused on its chosen sectors and markets, working with partners to channelize necessary expertise, capital and realize India's climate goals.

The Global Climate Dilemma

Discussions around 1.5°C threshold temperature, global warming, and climate events have dominated news headlines in the last decade. The urgency and severity of these issues are undeniable, yet global emissions have surged due to intensified economic activities over the last three decades. According to the National Aeronautics and Space Administration (NASA), the Earth has already undergone a temperature rise of 0.89°C from pre-1900 levels until 2022, leaving a very small scope before we face irreversible consequences.

The challenge is not macroeconomic in nature. The global annual savings at the end of 2021 were about USD27.30 trillion, which is about 4–5 times higher than the funds required to fight climate change. While most of these savings are in developed countries, the requirement of funds is in developing countries because they are the ones who will grow at a much higher rate and their carbon intensity of the gross domestic product (GDP) will be higher going forward. For encouraging sustainable development, capital flow needs to happen from Global North to Global South.

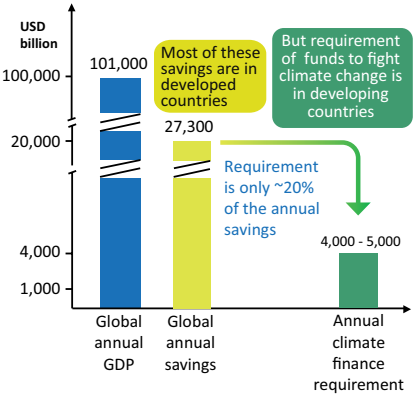


Figure 1 *Funds required for climate finance versus global savings Sources World Bank, Energy Transitions Commission (ETC)*

Traditionally, climate finance has been perceived as a public sector endeavour on a global scale. Globally, a diverse class of investors are eager to contribute towards the war against global warming, but they require credible local platforms to effectively channelize funds. India's ambitious plans, however, faced limitations due to the insufficient capacity of such institutions to match the agility, innovation, and profound understanding required. A significant void existed in sector understanding, hindering the flow of channelled capital into the sector.

Tata Capital's Role in Cleantech Finance Space

Tata Capital Limited (TCL), the flagship financial services company of the Tata Group, has been instrumental in this space. TCL's Cleantech Finance arm, formerly known as Tata Cleantech Capital Limited (TCCL), has established itself as that ideal intermediary to connect global climate funds with Indian climate projects and companies. Climate finance was traditionally seen as a public sector initiative. However, TCL

Figure 2 *Achievements TCL's Cleantech Finance arm*

has successfully made it more appealing for increased capital participation. Over the last six years, TCL's Cleantech Finance arm has consistently maintained a return on assets (ROA) of around 3%, attracting numerous lenders to join in the cleantech sector. The company's Cleantech Finance division has disbursed more than double of its total portfolio (disbursed ₹273.6 billion and a portfolio of ₹108.4 billion as of September 2023), setting a framework for other players to enter in the segment.

TCL has successfully steered climate financing through its Cleantech Financing arm by mainstreaming the cleantech sector through private capital by delivering tailored solutions during the early stages of development. As of September 2023, over 400 projects have been sanctioned in cleantech segment for a cumulative capacity of more than 16 GW of renewable energy projects. This has resulted in abatement of more than 25 million tonnes of carbon emissions.

TCL takes pride in its commitment to take calls to fund nascent technologies

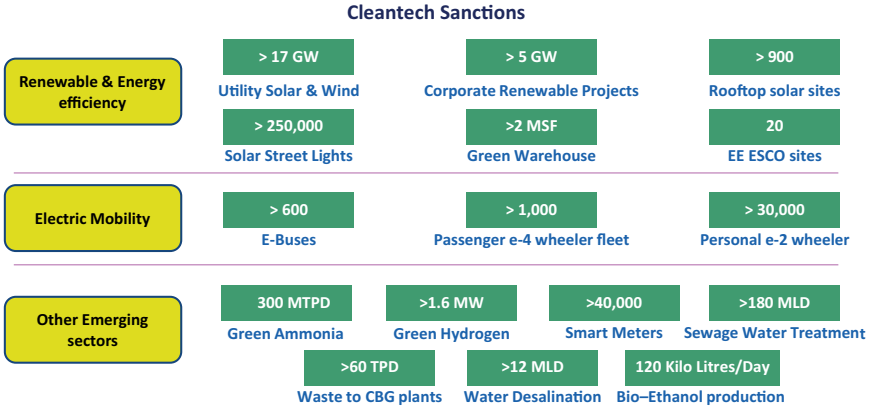


Figure 3 *Mainstreaming activities of TCL's Cleantech Finance arm*

to mainstream them, which may not be appealing to traditional banks and financial institutions. It is working aggressively to develop markets for emerging sectors such as solar rooftop, waste to biogas, electric mobility, green hydrogen, green ammonia, biofuels and water treatment.

TCL has taken efforts to develop in-depth understanding of the rapidly evolving sectors encompassing technical, commercial, regulatory, contractual, and E&S aspects. A dedicated research vertical was established to enhance this understanding, coupled with the implementation of a robust risk diligence, and monitoring framework for complex transactions and efficient asset management. The company has integrated E&S assessment into every

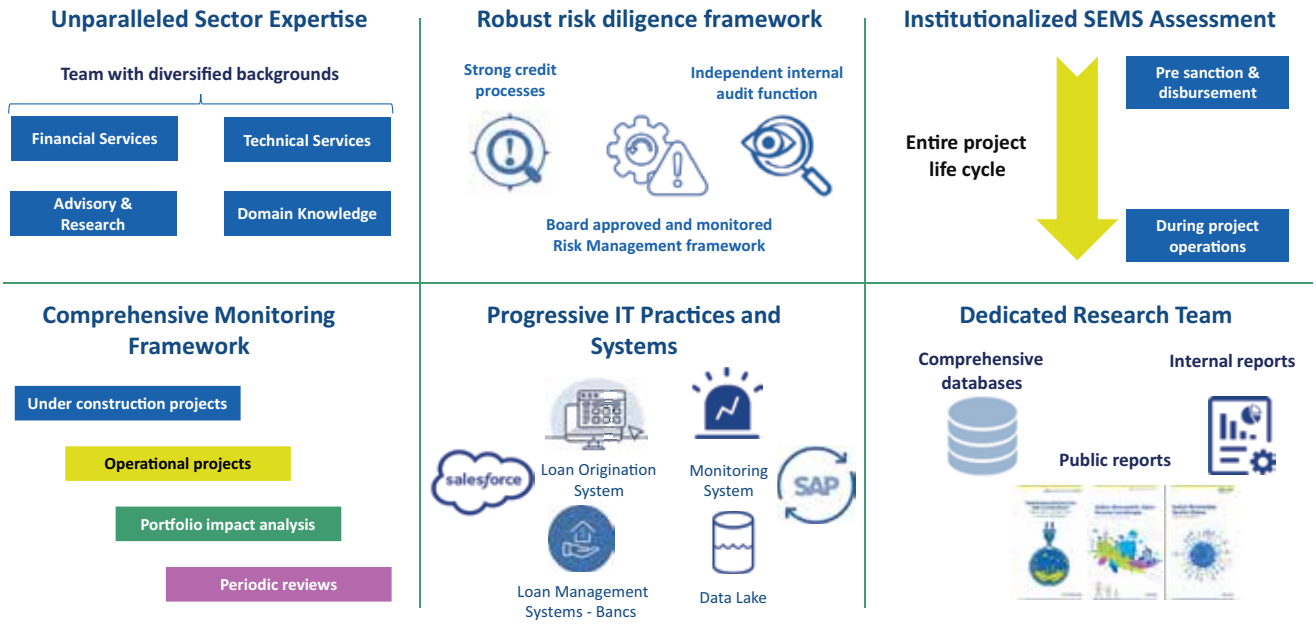


Figure 4 *Key differentiators of TCL's Cleantech Finance arm*

project appraisal process. TCL has progressively embraced cutting-edge technologies for making its business digital-friendly and competitive. The company's recruitment strategy involved bringing in experts not only from financial services but also the renewable industry, forming a specialized research team with unparalleled segment expertise. To benefit the industry and attract investors, the company has created a knowledge-sharing platform. This involves publication of reports, white papers, and collaborative reports with industry bodies, along with hosting webinars to disseminate valuable insights.

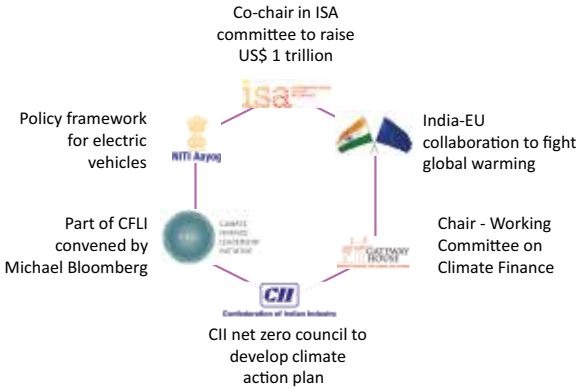
From the outset, the company embraced a collaborative strategy with investors, clients, and regulators. It has entered into notable partnerships with reputed Indian institutions such as Indian Renewable Energy Development Agency Limited (IREDA), Energy Efficiency Services Limited (EESL), and Bureau of Energy Efficiency (BEE). Furthermore, the company stands as the sole private sector institution in India to secure a-USD100 million line of credit facility, from the Green Climate Fund (GCF), to finance rooftop solar projects in India.

In addition, TCCL was the first private sector climate finance institution and first Indian financial institution to be inducted into the Green Bank Network. The company has also expanded its offering in financial and cleantech advisory services. Over the years, the company has been proud to work not only with leading multilaterals such as the World Bank, IFC, ADB, GIZ and DFID, large Asian multilaterals but also with leading corporate institutions. TCL's instrumental efforts have been recognized globally and the organization has won several accolades for its devotion to cleantech financing. The company has also contributed as a

Green bank network

First Private Sector Climate Finance Institution in the Green Banking Network

Part of Marquee committee



Awards and Recognition

Enterprises in the renewable energy space, 2021

Top Financing Institutions for
- *RE financing 2020,*
- *EV Transit 2022*
- *RE & EE 2021 & 2022*

Best renewable energy financer, 2019

101 top-most influential BFSI leaders
- *2019*
- *2020*

Figure 5 *External recognition for stellar effort*

knowledge partner by becoming a part of marquee committees for promotion and support of climate finance.

Climate Opportunities in India

India has huge untapped potential in cleantech sector with numerous emerging technologies gaining prominence. A diverse group of global investors has already allocated substantial funds to India, totalling USD80 billion over the past seven years. The total investment needed for the next seven years is 12 to 18 times higher than the amount already invested. This underscores an immense growth opportunity within the cleantech space in India.

However, this huge fund requirement makes up ~40% of the current total assets of all commercial banks in India. Given the magnitude, relying solely on the public sector is impractical, necessitating private sector investment. Moreover, developing countries face a significant challenge as green technologies require higher capital, making investments often prohibitive. Additionally, the higher cost of capital in these countries renders green investments costlier. Even if India can raise low-cost international capital, all savings get neutralized by the high cost of hedging. Moreover, for tenures larger than the average maturity of over 10 years, the hedging market itself is non-existent, leaving projects exposed to currency risk in medium to long term. A de-risking mechanism is another

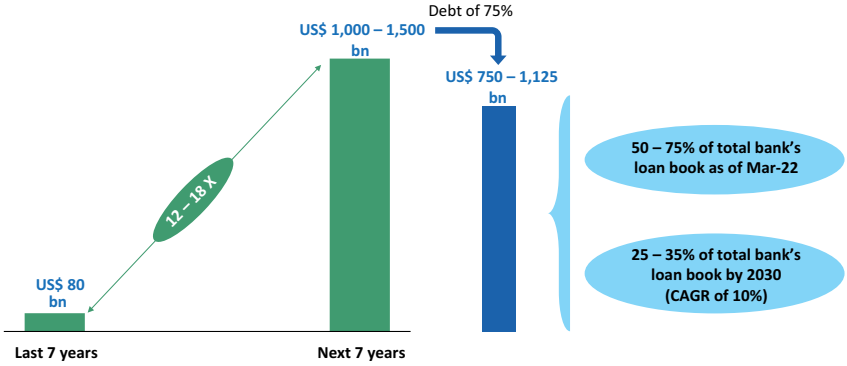


Figure 6 *Investment required in cleantech by 2030 (USD billion)*
Sources RBI and TCL's Cleantech Finance Research

imperative to finance energy transition in India. Given the scale of the requirements of climate finance, the collaboration of the developed world is essential.

India will also need to strengthen the domestic bond market to facilitate more green bond issuances, a product largely dependent on global pools of green capital as of now. Further, capital flow from Indian insurance and pension funds needs to be promoted. India would also need to create right processes to enable the channelization of funds from developed countries. Though investment required is significantly large, business models and payment security mechanisms are yet evolving in the right direction. In addition, industry will need to be vigilant of continually evolving policy environment and incongruous liability profile.

The cleantech industry and financial markets have achieved long-term sustained reforms. From feed-in tariff regimes to auctions led to increase in scale in renewable energy. Public–private partnership (PPP) models have fostered the transmission, water treatment and electric mobility projects. New class of platforms such as IDF, AIF, and Infrastructure Investment Trust (InvIT) are attracting capital from domestic and offshore players. But for substantial scaling up, strengthening of public institutions such as electricity distribution companies, municipalities, and urban local bodies is required. Weak financials and rising liabilities of these institutions create threat of non-payment. Cleantech projects have higher upfront costs and require longer contracts for viability. However, nature of technology is such that, future prices could be much more attractive than that of today. In the absence of contract enforcement framework, viability of cleantech projects could be jeopardized.

A missing framework to attract green investment is the harmonization of taxonomies, requiring precise and consistent definitions for a clear 'green' rating to an investment. Despite challenges, this scenario presents unprecedented opportunities in scale and longevity. TCL has played a pivotal role in mainstreaming the renewable energy sector and is working to make the emerging cleantech segments more attractive. The company is focused on its chosen sectors and markets, working with partners to channelize necessary expertise, capital and realize India's climate goals. ■

Manish Chourasia, Chief Operating Officer (COO), Corporate and Cleantech Finance, Tata Capital Limited

Addressing Urban Floods in Indian Cities

Bridging Inequities for Enhanced Resilience

Reducing flood vulnerability can play a significant role in reducing inequity among the urban poor even if exposed to recurrent floods. Article by **Dr Debolina Kundu** and **Vaishnavi T. G. Shankar** stresses on the investment in well-designed storm water drains, upgraded housing infrastructure, and improved access to basic services. It is not merely an infrastructure upgrade; it is a vital step towards ensuring safety, well-being, and future sustainability of marginalized communities. As cities evolve, prioritizing the resilience of those who are most vulnerable becomes not only a moral imperative but also a strategic necessity for building a more inclusive and resilient urban landscape.

Flooding has increasingly become one of the significant climate risks experienced by Indian cities in the last few years. The mortality due to flooding doubled from 1282 in 2021 to 2035 in 2022. The economic losses also increased from USD3.1 billion to USD4.2 billion in this period (CRED 2021; 2022). Cities in particular have high risk to flood-related losses and damages due to the high density of population, intensity of socio-economic activities, and coverage of built infrastructure. The 2005 flooding in Mumbai resulted in 500 fatalities and an economic loss of USD2 billion (Ranger, Hallegatte, Bhattacharya, *et al*. 2010). In 2015, a severe flooding in Chennai resulted in the loss of over 280 lives, and caused USD2 billion of damages and losses. India's urban population is projected to increase 40% by 2030 with 75% contribution to the national gross domestic product or GDP (MoHUA 2015). At the same time, the Intergovernmental Panel on Climate Change (IPCC)'s *Special Report on Global Warming of 1.5°C* highlights that India is projected to experience more cyclones with high-intensity storms and has higher risk to extreme rainfall. Both these situations can increase the frequency and intensity of flooding. In this context and considering the socio-economic significance of cities, building urban flood resilience is of utmost priority. However, an understanding of flood vulnerability stemming from urban growth is essential to build resilience.

Ill practices of waste management
Photo credit: Neville Mars (Flickr)

Development such as construction in low-lying areas, interference with natural drainage and floodplains, and inefficient storm water network, are major contributors to flooding in cities. Additionally, the expansion of impervious surfaces hindering groundwater absorption and, the loss of water bodies and green cover, limiting the capacity of

the natural ecosystem to absorb, store, and divert excess water during a flood are also a major concern. This pattern of urban growth has manifested in severe flooding incidents and the consequences can disproportionately affect certain populations, particularly the urban poor due to their socio-economic and physical circumstances. Considering that 17.3% of urban population live in slum-like conditions (Census 2011), this article examines the housing conditions and access to basic services and infrastructure to understand the correlation between existing inequities and flood vulnerability. Further, the article underscores the imperative of strengthening physical infrastructure as a pivotal prerequisite to reduce vulnerability and bolster flood resilience in cities. Vulnerability to flooding is influenced by a combination of physical, socio-economic, geographical, and environmental factors. While vulnerability

is context specific and can vary across cities, certain groups, especially the urban poor that are more susceptible to the adverse impacts of flooding. Existing inequities such as economic disparity, in terms of lack of financial means to implement protective measures or recover from a flood; unequal distribution of infrastructure and services in terms of absence of proper drainage systems, sanitation facilities, and durable housing; limited access to health care; proximity to water bodies or low-lying areas; and lack of social safety nets to bounce back after a flood are some of the reasons that make the urban poor more vulnerable to flooding. In addition, the level of preparedness and resources available for individuals and communities to effectively manage and mitigate the impact of floods are also crucial. These inequities are often interconnected and exacerbate the impacts of a flood on the urban poor. Understanding and addressing the specific inequities is crucial for developing targeted interventions and building flood resilience.

Physical infrastructure forms the backbone of resilience, serving as the first line of defence against the destructive forces of floods. Well-designed storm water drainage systems, flood-resistant buildings, and strategic land-use planning are instrumental in reducing vulnerability and minimizing the repercussions of inundation. Properly planned physical infrastructure also supports the effective deployment of emergency services and facilitates timely medical assistance. To further illustrate, housing and basic services and infrastructure, discussed next, are the two major areas where the gaps heighten the vulnerability of urban poor to flooding, along with potential entry points to integrate flood resilience into mainstream urban development initiatives.

Housing

Inadequate and substandard housing is one of the reasons for flood vulnerability. This includes inappropriate options for housing and poor construction, that is, inadequate foundation and use of improper construction materials (Davis 1978). The 2019 floods in Patna highlighted that informal settlements were impacted in various ways. This included complete collapse of houses and partial or minor damages to the houses. Further, the most significant expenditure incurred by individuals was directed towards repairing their

homes in the 2005 Mumbai flooding (Patnakar 2019). This situation can lead to a compounded impact, exacerbating economic inequity among the marginalized communities.

Considering there is a significant share of post-disaster recovery funds allocated to housing (Lyons 2009), resilient buildings can greatly reduce flood-related losses and damages. Three immediate steps that can be undertaken to address this are:

(i) Conducting a flood-vulnerability risk assessment which includes the identification of hotspots and vulnerable buildings in need for retrofit, reconstruction, or resettlement.

(ii) Increasing the availability of sustainable and affordable housing options. Five states have explored light house projects under Pradhan Mantri Awas Yojana–Urban (PMAY-U) to build housing considering the geo-climatic and hazard conditions of the region. There is potential in scaling up this approach to ensure the ongoing development is flood resilient.

(iii) Implementing the provisions of the Model Building Byelaws for risk classification of buildings and climate-resilient construction across the flood-risk cities to enable a transformation in the building construction ecosystem.

Basic Services and Infrastructure

Access to basic services such as water supply, sanitation, waste management, electric supply, availability of storm water drains (SWDs), connectivity through roads, and access to health care and education are crucial for reducing vulnerability and building adaptive capacity to floods. The extent of inequity resulting in flood vulnerability can be illustrated by merely focusing on waste management and availability of SWDs.

Waste management plays a crucial role in enhancing flood resilience, offering several key benefits that contribute to the overall preparedness and recovery efforts in the face of flooding. With inadequate waste management, floodwaters can become contaminated with various pollutants when mixed with improperly disposed waste and increase the risk of waterborne diseases and the spread of pathogens. A study conducted in Bengaluru indicated that the areas without door-to-door collection of waste are mostly unincorporated settlements and slums with small and inaccessible streets (Ramachandra and Mujumdar 2009). With inadequate options for waste disposal, solid waste piles up on streets, open spaces or dumped in water bodies or storm water drains. Adequate waste management is critical for not only reducing post-flooding risks but also the risk of flooding, especially if the accumulation of debris and solid waste is prevented from clogging the storm water drains.

A flood vehicle
Photo credit: Saikiran Kesari (Unsplash)

Swachh Bharat Mission – Urban has enabled cities to undergo a transformational change in managing solid waste. Many cities have explored options ranging from decentralized solid waste management (Alleppey) to setting up of bio CNG waste plant (Indore). However, there is scope to strengthen waste collection system, enhance information systems, and widen publicity and awareness campaigns to change behaviours (iECD 2022). With the next phase of the Mission focusing on establishing sustainable infrastructure for efficient and scientific processing of waste, flood vulnerability emerging from waste-related challenges can be largely mitigated.

Availability of adequate storm water drainage is another key aspect to reduce flood vulnerability. Many parts of a city, particularly informal settlements are either not connected with the storm water drainage network or have open drains which can overflow during a flood. On the other hand, due to the lack of affordable housing options, urban poor

often resides in precarious locations, making them vulnerable to flooding. This includes residing near natural drains or encroaching water bodies and SWDs. While the issue of housing needs to be dealt through resettlement and availability of more affordable housing options, increasing the SWDs coverage in vulnerable informal settlements is essential.

Conventional approaches to developing SWDs in informal settlements are challenging due to the nature of the settlements, mostly characterized by narrow streets and a lack of defined spaces between public and private (Imparato and Ruster 2003). Hence, a combination of non-structural and structural measures can be adopted. Sensitization for behavioural changes in waste disposal, removal of waste and debris that block the flow of rainwater and implementation of nature-based drainage solutions can be considered. In areas where it is feasible to build SWDs, engaging local communities in the planning, implementation, and maintenance can be considered to ensure that solutions align with their needs and to foster a sense of ownership and resilience within the community.

Conclusion

Reducing flood vulnerability can play a significant role in reducing inequity among the urban poor even if exposed to recurrent floods. Additionally, this will enable sustainable economic growth (Moulds, Buytaert, Templeton, *et al*. 2021). Hence, the investment in well-designed SWD, upgraded housing infrastructure, and improved access to basic services is not merely an infrastructure upgrade; it is an investment in the safety, well-being, and future sustainability of marginalized communities. As cities evolve, prioritizing the resilience of those who are most vulnerable becomes not only a moral imperative but also a strategic necessity for building a more inclusive and resilient urban landscape.

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Sustainable Delivery of Green Power

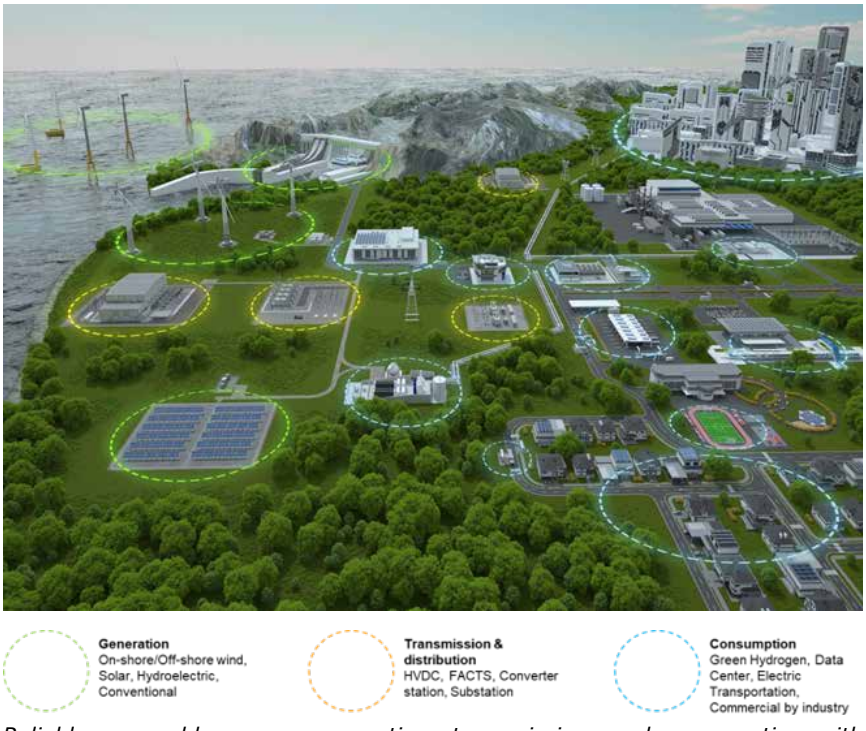
Enabled by Core, Power Electronics, and Digital Technologies

This article by **Akilur Rahman** reinforces our comprehension of some of the relevant issues and solutions pertaining to green energy generation. In this regard, power electronics and digital technologies have responsible roles to play for realization of seamless and emission-less generation, distribution, and consumption of energy.

Renewable energy, be it solar, wind or hydroelectric, is becoming the key contributor to sustainability and green energy transition for a net-zero future. In India more and more renewable energy-generation plants are being set-up in remote areas, for example, deserts of Rajasthan, salt marsh lands of Kutch, Himalayan mountains of Leh-Ladakh, possibly in the sea (off-shore) in future. In addition to setting up plants, what is challenging is to evacuate the power from these terrains, transmit, and deliver to the grid and load centres which may be hundreds or thousand kilometres away.

Evacuating Renewable Power from the Sources Efficiently and Sustainably

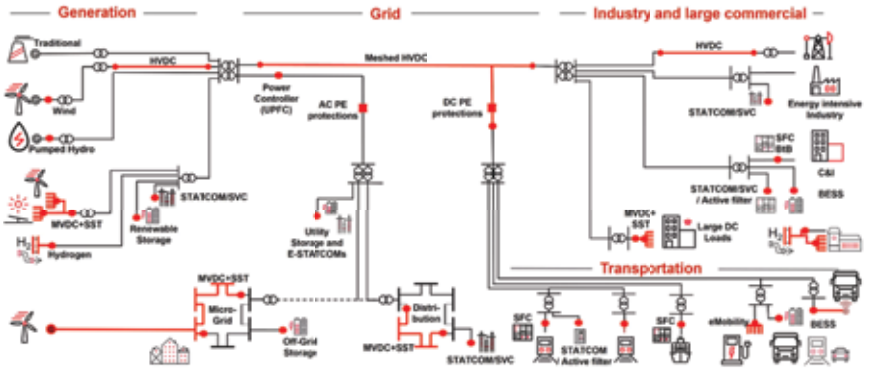
Collecting the renewable power in the substations for transmission is an important step. Highest level of reliability and efficiency of equipment, system, and automation ensures renewable energy generated is not wasted or lost. The equipment and their operation can contribute largely to reduce CO_2 footprint and emission. For example, green transformers filled with bio-degradable ester can support 23% reduction of CO_2 eq. emission over the product's life cycle. Additionally, 35% reduction of CO_2 emissions can be achieved from materials and process improvement. Gas-insulated switchgear with new eco-efficient sulphur hexafluoride (SF6)-free gas eliminates the addition of 2000 kilograms of SF6 into the transmission network, equivalent to the CO_2 emissions of almost 5000 cars for one year.



Reliable renewable power—generation, transmission, and consumption with no waste

Transmitting Power Reliably with Reduced Environmental Footprint

The energy system now-a-days is undergoing a tremendous transformation. Owing to its speed and outcome it has gained, it wouldn't be an exaggeration to call it a 'revolution'. Increasing sustainability and environmental attention, supporting regulatory frameworks and new technology developments in the power sector are making electricity the backbone of the future energy system. In this new and evolving situation, the role of power electronics has drastically changed.



Utilization of FACTS in energy transmission

Power electronics connects renewable direct current (DC) sources (for example, solar photovoltaic or PV) to the alternating current (AC) grid and is used to increase the controllability and efficiency of AC generation such as wind turbines and hydropower plants. High-voltage direct current (HVDC) technology realizes very efficient, long distance, and fully controllable power transmission, allowing connection of offshore wind generation and interconnection of countries, enabling more energy trading. Flexible AC transmission systems (FACTS) have become instrumental in solving the new power quality issues, helping the existing infrastructure to cope with the new dynamic power flow even when the grid strength is reduced. From generation to consumption, power electronics is enabling solutions such as battery energy storage systems, pumped hydro storage, hydrogen production, and conversion back to electricity.

Power electronics-based HVDC technologies have been used for long distance bulk power transmission. Reduced power losses, reduced environmental footprint, and better control of power flow and voltage are the key benefits. Some of the important HVDC lines in India are to transfer hydro-electric power from north-east to north-central region (Agra) and lately bidirectional power flow between fossil fuel power centre (Raigarh) and wind power-rich south (Pugalur). With giga-scale renewable generations being set-up and planned in Leh-Ladakh, Rajasthan desert, and Gujarat; Kutch regions, HVDC technology will play a key role in reducing CO_2 footprint.

Reducing impact to vegetation along the transmission corridor

Vegetation management in transmission lines uses images from a variety of visual sources, including photos, videos, and satellites. The incorporation of satellite technology allows utilities to survey their entire territory to automatically confirm line clearances and maintain compliance with regulations. Satellite technology also provides organizations with more comprehensive insights at scale, allowing them to reduce cost and emissions by minimizing truck and helicopter trips. By combining the images with climate, environmental and cut plan data, vegetation manager enables instant grid-wide visibility and machine-learning-powered insights so that organizations can optimize decision making.

Reducing transmission line fault downtime to avoid green power loss

In transmission line which runs through difficult terrain of forests, mountains, rivers, and others, it is very important to quickly locate any fault and restore power supply, thereby reducing downtime and waste of renewable power which it carries. Algorithms based on complex mathematics and travelling wave principle together with automation and digital solutions are used to accurately locate the fault on a power line and significantly reducing the number of towers to be inspected, thereby enhances workers' safety, and helps integration of renewable energy sources to the grid.

Reducing environmental impact during asset operation lifecycle

Extending life of power system asset and using less material in maintenance and operation of assets directly and indirectly reduces carbon footprint. Digitalized asset performance management with sensors, predictive and prescriptive artificial intelligence–machine learning (AI–ML)-based algorithms help in achieving the goal. Digital twin, right from design phase of asset till its retirement adds to the benefits of sustainable assets.

Digitalization for sustainability across the value chain of renewable power delivery

Power system including transmission and delivery are complex, hence, technologies for sustainability need key performance indicators (KPIs) to be defined clearly for measuring the improvements in net-zero targets. A smarter integration of core power automation and digital technologies can enable a dynamically improving sustainable power delivery system with green energy, in real-time. What it needs is strong collaboration among original equipment manufacturers (OEM), technology providers, integrators and system owners–operators to create an interoperable platform for co-innovation, co-creation, and co-operation. ■

Akilur Rahman, Chief Technology Officer (CTO), Hitachi Energy India

Role of Local Leadership in Attaining Sustainable Development Goals

A Case Study on the Salaulim Reservoir, Goa

The present article makes the readers aware on the pertinence of local leadership in realizing the mandates of SDGs. **Anuradha Saigal** and **Divya Bawa** have relevantly explained the motivating factors that could drive local leaders to contribute to the SDGs, followed by the reasons attributable for their failure, and concluded by the solutions for strengthening local leadership, for fostering effective and sustainable solutions. Authors are of the opinion that empowering local leaders with diverse support is crucial for achieving local outcomes that not only align with community priorities but contribute to global sustainability goals.

"The SDGs represent a global agenda; they require local action to achieve them."

Vikki Spruill, President and CEO, Council on Foundations

Achievement of any of the Sustainable Development Goals (SDGs) will require concerted global efforts (SDSN 2015). While international collaborations and national policies have crucial significance in this collective pursuit of the global sustainability, the roles of local governance and leadership cannot be overlooked. Local leaders are the backbone of effective governance and can have a substantial function in sustainability leadership by engaging citizens, enhancing technical expertise, mobilizing financial resources, and developing managerial execution capacity (Wang, Wart, and Lebredo 2014). Owing to their proximity to the grassroots, local institutions and governance systems can identify contextual challenges and implement tailor-made solutions based on the geographical, political, cultural, and socio-economic conditions. 'Think Global, Act Local', a widely popular UN Agenda 21 slogan also reflects on promoting local practices while maintaining a broader awareness of the global goals. However, local governments should not be seen as mere implementers of the solutions. They are the policymakers, catalysts of change, and on the level of government best placed to link the global goals with local communities (UNDP 2018).

It is important to recognize that local leadership encompasses more than local government bodies; it extends beyond governance and involves several other local actors such as civil society organizations (CSOs), philanthropies, research and academic institutions including schools, businesses, community-based organizations, youth groups, activists, and more.

Factors Driving Local Actions

While there are multiple evidences in the literature on the effects of local action in achieving SDGs, there should also be considerations for why local leaders should engage in implementing solutions that support global goals and sustainability. Based on this context, adapting from the chapter titled 'The Key Role of Local Governance in Achieving the SDGs' in the book *Co-creation for Sustainability: the UN SDGs and the power of local partnership* (Ansell, Sørensen, and Torfing 2022), seven motivating factors, detailed below, could be deduced, to drive local leaders to contribute to the SDGs

1. **Reputation building:** Demonstrating commitment to the SDGs boosts the reputation and status of local stakeholders, such as politicians, agencies, businesses, non-governmental organizations (NGOs), and others.
2. **Concrete problems:** The SDGs tackle issues directly experienced by local communities, organizations, businesses, and families, serving as a powerful motivator.
3. **Pragmatic problem solving:** Involvement in local SDG efforts allows for influence on societal development, avoiding national political conflicts.
4. **Resource interdependence:** Recognition of interdependencies fosters resource exchange among stakeholders.
5. **Avoiding red tape:** Local decision-making offers quicker action with less bureaucratic hurdles.
6. **Flexible participation:** Participation in local action is more flexible in terms of time and commitment compared to demanding national politics.
7. **Social and political capital:** Lastly, engaging in local problem-solving enhances the acquisition of social and political capital, fostering network relations and reducing loneliness.

Motivating factors for local actors to promote the SDGs

Despite these motivating factors, local leaders often fail to participate, plan effectively, or successfully implement activities that contribute to the sustainability of their areas and align with national and global sustainability goals. This failure may be attributed to factors such as lack of awareness, insufficient support from national or state governments, capacity and institutional gaps, weak local governance and accountability, lack of adequate funding, and limited access to local data (ACPA 2016). Strengthening local leadership, both public and private, holds the potential to overcome these barriers through collaborative efforts, ultimately fostering effective and sustainable solutions.

Local Sustainable Solutions in India

It is widely agreed that India will play a leading role in determining the success or failure of the SDGs, given its disproportionate share in the global development burden (ECB 2023). India has made significant progress in decentralizing the implementation of Sustainable Development Goals (SDGs) at the sub-national level, engaging states and district bodies, including urban local bodies (ULBs) and rural local bodies (RLBs), in the localization of SDGs planning, a process overseen by NITI Aayog. At the national level, the Ministry of Panchayati Raj, overseeing rural self-government, advocates integrating SDGs into local plans, known as the Gram Panchayat Development Plans (GPDPs). However, for such efforts to be fully successful, it is imperative to explore solutions that strengthen local leadership. These solutions encompass resource localization and mobilizing funds from the private sector, enhancing interdepartmental coordination, capacity development for both private and government stakeholders, implementing improved monitoring systems, and creating platforms for engagement and coordination among diverse stakeholders. Proposed key pillars for promoting local leadership include the following parameters:

i. **Mainstreaming local best practices into policy action:** It is crucial to acknowledge the role of integrating successful initiatives undertaken at the local level into broader policy frameworks at regional or national level. For instance, a pilot project in Raipur and Korba districts addressed indoor air pollution by providing capacity-building training to frontline health workers (*Mitanins*). This initiative successfully raised awareness about air pollution and health within communities. Due to its success, local policymakers embraced the project, leading to its integration into the Chhattisgarh State Health Resource Centre (SHRC). Local champions, therefore, play an essential role in highlighting

these best practices to ensure their effective conversion into policies.

ii. **Dissemination of learnings across states:** Local departments and think tanks operate in each state, tailoring their efforts to local circumstances while designing projects. This learning will be useful for other similar states, for example, Uttarakhand can learn from Himachal Pradesh's eco-village scheme on promoting climate-resilient villages. Another best case is on promoting healthy air zones wherein several CSOs in India are currently accelerating the transition to low/zero-emission and non-motorized transport within cities, by involving ULBs, state pollution control boards, and transport departments, together directed towards the common goal of improving local air quality. Facilitating cross-learning amongst states/districts/cities on best practices from localization interventions is a commendable approach which local actors can champion to foster collaboration, share knowledge, and accelerate sustainable development initiatives.

iii. **Empowering local institutions:** National-level think tanks and CSOs exemplified by organizations like The Energy Resource Institute (TERI) and the Council on Energy, Environment, and Water (CEEW), known for their excellence in promoting sustainable solutions, can act as vital bridges among diverse stakeholders at both national and subnational levels. These entities can engage in offering technical assistance and support to academic and research institutions on ground, such as schools and colleges, to generate awareness for sustainability, thus empowering them as leaders in sustainability. Further, capacity of local actors, especially grassroot CSOs can be strengthened for engaging with the private sector and local businesses to mobilize funds and resources for designing impactful and large-scale projects.

iv. **Data monitoring and knowledge management:** Creating dashboards for real-time data on SDG indicators can serve as evidence to influence policymaking at sub-national and national levels. For example, NITI Aayog has launched India Climate and Energy Dashboard (ICED) to provide publicly access to the data on climate, energy, economy, and environment to inform policy decisions. Importantly, these dashboards can also prove invaluable in shaping local sustainability initiatives if the data is collected from the grassroots level. Therefore, local actors having rich traditional knowledge and data can help in shaping robust top-down policies using a bottom-up approach.

Empowering local leaders with diverse support is crucial for achieving local outcomes that not only align with community priorities but contribute to global sustainability goals. By fostering collaboration, inclusivity, and innovation, local leadership and action can create a foundation for sustainable development that extends beyond immediate gains to ensure long-term well-being for all. As the SDGs continue to guide our global efforts towards a more equitable and sustainable future, it is imperative that we recognize and empower local leaders as catalysts for positive change. Through their dedication and commitment, local leaders play a crucial role in shaping a world where prosperity, social justice, and environmental stewardship converge for the benefit of present and future generations.

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Anuradha Saigal, Programme Manager, Climate Policy, Shakti Sustainable Energy Foundation ; Divya Bawa, Programme Manager, Climate Policy, Shakti Sustainable Energy Foundation

Unlocking a Greener Future with Conscious Living

Embarking on a journey towards sustainable living begins with the evaluation of our daily practices and their impact on the environment. As we navigate a world grappling with environmental challenges, recent events like COP28 have underscored the urgency of transitioning to clean energy and revaluating our lifestyles and consumption patterns. This article by **Priyanka Anand** delves into the concept of sustainability and its significance and offers practical ways of embracing eco-friendly practices in our daily lives.

With the advent of capitalism and globalization, conspicuous overconsumption has become the norm, exerting immense pressure on the planet's resources. According to the UN, our planet is running out of resources, but the population is continuing to grow. If the global population reaches 9.8 billion by 2050, the equivalent of almost three planets will be required to provide the natural resources needed to sustain current lifestyles. Sustainable consumption is often limited to the notion of recycling or mere waste management. Considering the present scenario, Sustainable Development Goal 12 (SDG 12) calls for responsible consumption and production, emphasizing the urgent need to rethink our approach. Sustainable consumption involves using products and services responsibly, minimizing resource exploitation, and reducing emissions throughout their life cycle.

Consumer choices play a pivotal role in shaping the market. While convenience and trends often dictate our purchases, industries are gradually evolving towards more sustainable options. Energy-efficient appliances and vehicles, many other such innovative technologies are emerging to cater to a conscientious consumer base and giving choice to people to go for such products.

Unsustainable consumer practices, including fast fashion, single-use plastics, the constant pursuit of the latest gadgets, and the commercialization of festivals, have far-reaching consequences. The fashion industry alone contributes significantly to global emissions.

According to the UN, overall, the fashion industry is responsible for 8–10% of the global emissions, more than aviation and shipping combined. Urgent measures are needed to shift from unsustainable practices to ones that align with the goals of sustainable consumption.

Significance of Sustainable Lifestyle

A sustainable lifestyle involves considering the triple bottom line—people, planet, and profit. Responsible consumption protects the planet and also ensures the well-being of individuals and economies. Initiatives supporting sustainable behaviour patterns provide hope and tangible pathways towards achieving SDG12.

The link between consumerism and climate change might not be immediately apparent, however, the carbon footprint generated through production and consumption is substantial. Unsustainable lifestyles contribute to mass production, depleting resources, consequently causing various forms of pollution—shifting to sustainable practices can mitigate these impacts.

Sustainable practices extend beyond individual behaviour, encompassing innovations in energy-saving technology and production. When these technologies are coupled with responsible production, they can contribute to reducing waste and shifting consumption towards sustainable technologies.

Practical Recommendations for Sustainable Living

In recent decades, lifestyle changes driven by technology and marketing gimmicks have influenced our consumption patterns. Adopting responsible shopping habits, embracing minimalism, and energy-saving behaviours at home and the workplace are tangible ways individuals can contribute to sustainable living.

Individual choices significantly impact the environment and the evolved market has given ample choices leading to overconsumption. Choosing necessary items, opting for eco-friendly products, using energy-efficient technologies, and being mindful of consumption can significantly reduce emissions.

Hoarding and inappropriate disposal of waste or discarded stuff adversely affect the environment. Mindful consumption helps to address this challenge, and it involves practices such as choosing quality over quantity and passing on unused or less used items to those who can use them. These practices

minimize waste and contribute to a more sustainable lifestyle.

Simple daily practices, such as turning off electrical appliances, conserving water, utilizing renewable energy sources, maximizing natural light use, and using energy-efficient gadgets/appliances can collectively make a substantial difference in reducing our environmental footprint.

Sustainable Food Habits

Our food choices also play a crucial role in sustainability. People are readily going for packed and ready-to-eat food. Fast meals and imported food items have dominated the market. Such changes are not healthy for both humans and the climate. These foods are not healthy in nutrient content; their processing, packaging, and transportation consume enormous resources. Increased meat production has further caused immense pressure with the emissions of greenhouse gases (GHGs) like carbon dioxide, methane, and nitrous oxide. Consumption of non-seasonal foods and exotic fruits/vegetables also adds to the carbon footprint. Shifting towards plant-based eating and local food items can have significant environmental benefits, reducing GHG emissions associated with livestock production. Animal Frontiers found that livestock is responsible for 14.5% of the world's GHGs. Nature Sustainability shows widespread shift to a plant-based diet by 2050 could remove over 16 years of CO_2 emissions. The environmental impact of livestock production is substantial, and a shift towards plant-based diets can contribute to reducing carbon emissions. While a complete transition might be challenging, incorporating sustainable options and locally sourced foods is a step in the right direction.

Responsible Digital Behaviour

Living in the digital era offers convenience. However, it comes with its own environmental cost. Conscious digital behaviour, both in personal and professional settings, can contribute to reducing our overall carbon footprint.

Being conscious of our digital activities, such as online shopping, social media usage, and file storage, using apps and digital modes of payment can significantly reduce our digital footprint. Simple changes, like setting limits on screen time, deleting redundant files/photographs, and unsubscribing from unnecessary accounts, can make a difference.

The workplace is a significant contributor to digital consumption. Implementing practices like minimizing the usage of multiple devices, reducing file sizes, closing the laptops when not in use, opening required tabs, and utilizing energy-efficient technologies can collectively contribute to a more sustainable work environment.

Raising Awareness and Advocacy

Fostering a collective shift towards responsible consumption raising awareness and advocating for change is essential.

Creating awareness involves a systemic approach; engaging all stakeholders in the supply chain, production, and consumption in initiatives towards change is crucial. Education on sustainable consumption, providing information through labels, and promoting sustainable public procurement can contribute to a more informed consumer base.

The transition to responsible consumption requires collaboration from businesses, policymakers, researchers, and consumers. Initiatives like behaviour change campaigns promoting the principles of reducing, reusing, repurposing, and recycling, supporting local goods and services, and advocating for sustainable practices can lead to effective change.

Conclusion

Embracing a sustainable lifestyle to bring transition is not just an individual but a collective responsibility. Efforts at both levels are needed to see the outcomes at the pace. By adopting mindful practices in our daily lives and spreading the impact of responsible consumption to ensure cooperative efforts, we can contribute to making the planet healthier and pave the way for a more sustainable future for coming generations. The journey towards sustainable living is a collective effort and every small change counts. ■

Priyanka Anand, Program Associate, The Nature Conservancy

Women Farmers' Leadership in Climate Change Adaptation

'Feminization' of Indian agriculture sector forms the subject matter of this engaging article contributed by **Dr Nitya Nanda** and **Dr Susmita Mitra**. Addressing the challenges faced by women farmers is crucial for achieving climate justice and sustainable development. Moreover, sustainable development emphasizes the need to enhance community resilience and strengthening the resilience of women farmers could contribute to the overall resilience of rural communities.

It is now well recognized that Indian agriculture is highly vulnerable to climate change. Over the last couple of decades, many male members of rural families have migrated to cities for better earning, leaving the women to look after their farming activities. Therefore, it is up to these women farmers to deal with the impacts of climate change and adopt appropriate adaptation measures. Addressing the challenges faced by women farmers is essential for achieving climate justice and sustainable development. Moreover, sustainable development emphasizes the need to enhance community resilience, and strengthening the resilience of women farmers could contribute to the overall resilience of rural communities. Climate change vulnerability arises from higher exposure, larger sensitivity to climate-related risks, and limited adaptive capacity. Several studies have highlighted that rural women face higher exposure as they are often responsible for food, water, and fuel for the entire family. Women are more affected by drought, errant rainfall, and water shortages as they have to spend significant time travelling to and forth to distant water resources. Compared to male farmers, female farmers' higher sensitivity to climate change arises from the social inequalities and ascribed roles, differences in property rights, access to information, less involvement in decision

making, and lack of employment opportunities. A 2012 International Food Policy Research Institute (IFPRI) study identified five critical factors that affect adaptive capacities of women farmers: natural, physical, human, financial, and social capital. Social barriers often prevent female farmers from accessing education and training, information, extension services, land, and other resources, and restrict them from adopting improved technologies.

Women Farmers' Leadership Role

Interestingly, despite numerous challenges and constraints, women have always been at the centre stage of climate change adaptation and mitigation programmes, because of their traditional eco-friendly practices and proactive nature in adaptation. To add more, environmental projects which are designed and run with the full participation of women have proven to be far more effective. Women are the effective agents of change as they often cope and adapt to climate change differently than men, by using their traditional knowledge, experience, and expertise. According to a study carried out by Food and Agriculture Organization (FAO) in 2011, with similar agricultural resources, women can get 20–30% higher yield compared to men. With growing 'feminization' of Indian agriculture sector, this provides an opportunity to address sustainable development and food security.

Based on a primary survey of 1200 women farmers across 10 districts of eastern Uttar Pradesh (UP), Council for Social Development (CSD) found that women farmers are showing leadership roles both individually and collectively. Given their involvement in tasks related to water collection and utilization, women farmers often take a lead role in water conservation and management. Every fifth woman surveyed by CSD reuses domestic wastewater for irrigation. It is often used for small farms attached to their house (mostly kitchen gardens). Wastewater after taking bath or washing utensils goes directly to these kitchen gardens.

Some of the young women farmers take charge of managing various aspects of farming, including crop planning, cultivation practices, and the overall maintenance of agricultural activities. In many cases, they are solely responsible for decision making related to the selection of crops, timing of planting, and harvesting. They also take lead roles in various community-based initiatives with the help of local non-governmental organizations (NGOs). CSD found that local NGOs form member groups of around 20–25 female farmers in each village. Group leaders are identified for every group who can take a major role in empowering the rest of the women. They lead various community-based initiatives like forming self-help groups or cooperatives where they collectively address common challenges, share resources, and engage in joint decision making. Women farmers with leadership qualities also become community mobilizers who try to build awareness on various issues like existing government schemes beneficial for them, harmful impacts of chemical fertilizers, vermicompost and other options for shifting towards organic farming, options for growing vegetables in small plots (kitchen garden), cultivation of mushroom beehives, amongst others for landless labourers.

A Women self-help group

The Challenges

Women farmers face a number of challenges and if government addresses those with comprehensive set of policy responses, the leadership roles of women farmers can be enhanced. Even though they have been pioneer in using traditional sustainable practices, they have been slow in adopting water-saving technologies due to limited knowledge about climate friendly agricultural techniques. Poverty and increasing cost of agricultural inputs are cited as the two major barriers to climate change adaptation. The major sources of poverty are lack of productivity due to degraded soil health, lack of knowledge about improved agriculture practices, lack of storage and marketing infrastructure, and inadequate agriculture input supply system. One out of every four women farmers also mentioned about inadequate knowledge of how to cope

up, and lack of institutional credit facilities. Moreover, single women find it difficult to get their land irrigated as it might require visiting the field in odd hours. The shift in the rainy season and longer summers has limited harvests. Farmer producer organizations (FPOs) dominated by women farmers face issues such as lower scale of operation, lack of information, and poor communication and linkages with wider markets. All these interlinked environmental-socio-economic issues have resulted into a vicious cycle of poverty, reducing the effectiveness of women leadership. The situation has also aggravated unemployment and outward migration in the region, putting large numbers of households led by single mothers/ women who are particularly vulnerable to climate change.

Women often have restricted access to crucial resources such as land, credit, and technology. Without ownership or control over these resources, it becomes challenging for them to implement and invest in climate-resilient agricultural practices. Most of the women farmers belong to backward social categories, poverty-stricken, and less educated. Nearly 80% women farmers are cultivating in their land, but on average, only 12% of them have land in their names. This is also reflected in the fact that less than 25% of female farmers have ever taken a loan in their names. Limited education and awareness often hinder women's ability to take leadership roles. Access to information, training, and educational programmes may be inadequate, preventing them from adopting adaptive strategies. Climate change can have direct and indirect effects on the health of women farmers. Increased exposure to heat, changes in disease patterns, and environmental degradation affect their well-being, making it difficult to actively participate in leadership roles.

Overcoming the challenges

Addressing these challenges requires a multifaceted approach that includes promoting gender equality, providing education and training, enhancing access to resources, ensuring representation in decision-making bodies, and developing policies that consider the unique needs and vulnerabilities of women farmers in the face of climate change.

The declining groundwater scenario highlights a major threat in near future. Therefore, demand-side management and conservation of water use should be promoted. Leadership of women farmers reusing domestic wastewater for irrigation should be acknowledged, promoted, and incentivized so that more women farmers adopt the practice. Rainwater harvesting and reuse of domestic wastewater of the entire village through multi-level ponds (as widely practised in some parts of Punjab and Haryana) can be replicated elsewhere. This type of village-level initiatives can be taken up through Mahatma Gandhi National Rural Employment Guarantee Scheme.

Promoting joint land titles for married couples can empower women in decision making related to land use and can help them access institutional credit which they find difficult to access now. Establishing women friendly financial schemes and incentives to support their entrepreneurial initiatives will also be useful. Support is needed for more formation of women's self-help groups and cooperatives to facilitate collective decision making and resource sharing. Community-based initiatives should be encouraged that empower women farmers through collaborative efforts. The young women are comparatively more aware, educated, and empowered. There is huge scope of community development through their leadership. Supporting these women leaders is an imperative for both government and the global community to ensure climate justice. ■

A woman farmer

Dr Nitya Nanda, Director, Council for Social Development; Dr Susmita Mitra, Assistant Professor, Council for Social Development

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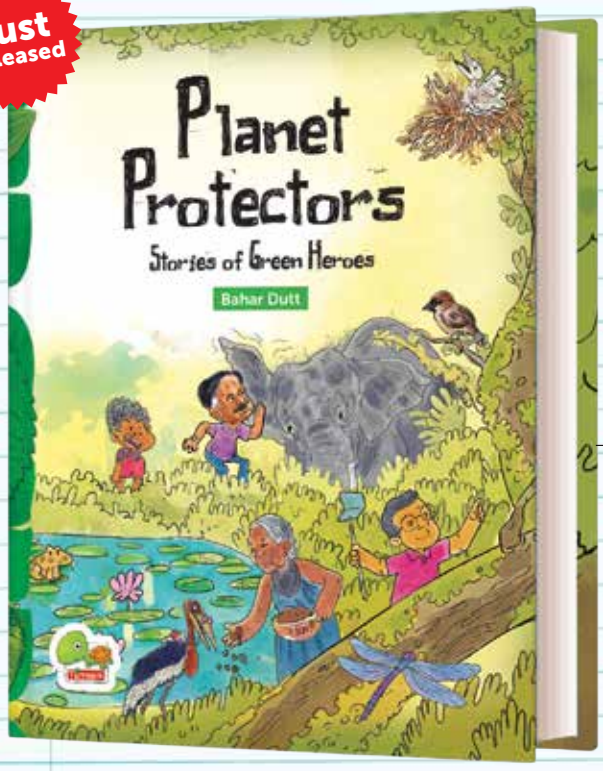

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India's Energy Transition

Unravelling Fiscal Challenges and Institutional Concerns

India's transition towards clean energy is certain to pose significant fiscal challenges. Fossil fuels have traditionally been a significant revenue source for the government, this article by **Dr Laveesh Bhandari** and **Dr Rajat Verma**, has been dedicated to the fiscal implications that are to be borne in mind to arrive at equilibrium in the taxes. Policymakers can navigate through these issues and establish a robust fiscal framework by considering a mix of conventional and non-conventional forms of taxes.

India has set an ambitious target of reaching net zero by 2070. This transition towards clean energy will pose a significant fiscal challenge for the Government of India, as fossil fuels have traditionally been a significant revenue source for both the Union and state governments. According to our estimates, fossil fuel revenues constituted 3.2% of India's GDP in 2019-20, corresponding to 15.0% and 6.2% of total Union and state governments' budgetary expenditures, respectively (CSEP 2022). Transitioning away from fossil fuels will be accompanied by the potential loss in revenue if viable alternative taxation options are not explored. Next, we mention some estimates of fossil revenues which depict the imperativeness of this issue and examine the tax structure in India.

Tax levied on fossil fuels accounts for a substantial share in the Government of India's revenue

Fossil Fuel Revenues and Tax Structure in India

One of our studies computes the contribution of fossil fuel revenues to the total tax revenues of India as it transitions towards green energy. We find that by 2040, the revenues generated by taxing fossil fuels would constitute just 0.9% of the GDP, while non-tax revenues associated with fossil fuels are anticipated to be approximately 0.1% of the GDP. India being a developing country with a large and persistent informal sector has limited avenues for greater tax revenues, and so the challenge of covering this significant fossil revenues gap is serious. By 2070, in alignment with India's net-zero commitments, fossil fuel revenues would be insignificant, highlighting the urgency of exploring alternative taxes to compensate for potential revenues that the government is expected to lose.

The challenge before the policymakers is not just generating a sufficient amount of government revenue, but also navigating the complexities of India's fiscal federal structure, which divides taxation powers between the Union and state governments. Many types of taxes are set and collected by the Union Government, while others are set and collected by state governments. Yet others are set cooperatively between the Union and state governments such as those by the GST Council. The key challenge has been that both Union and state governments impose and collect different kinds of taxes on fossil fuels. Therefore, any analysis of how a greener economy will function will also need to address how will revenues be accessed and how it would be divided between various arms of the government.

Taxation Alternatives and Related Institutional Challenges

To evaluate the taxation alternatives to compensate for potential revenue loss, it is crucial to analyse the institutional obstacles associated with these under the current taxation structure. For instance, as of today, the Union Government levies Carbon Tax (through Article 248, discussed next), it also allows state governments to impose some fossil fuel taxes. For a national carbon taxation to be effective, state-level fossil fuel taxes need to be removed, however, the Indian Constitution does not permit this. A constitutional amendment therefore may be necessary to ensure carbon taxes do give rise to inefficient taxation. But state governments will oppose it because as this removes their autonomy over their own tax revenues. This underscores the importance of considering multiple factors such as encompassing effectiveness in generating significant revenues, long-term sustainability/ continuity in terms of generating revenues, necessary institutional amendments, and the preservation of state autonomy. We identify these issues with the conventional and a few non-conventional fiscal options.

Direct taxes: There are certain yet limited avenues for generating tax revenues from direct taxes. This could be done either by increasing the existing tax rates or by including non-taxable income sources within the tax structure. Direct taxes have the potential to generate long-term revenues requiring less[1] or no institutional amendments but may not produce the desired results due to their limited potential for generating sufficient revenues, which is also evident from the current scenario, as the share of direct taxes in GDP is merely around 6% that accounts for only 37% of the overall tax revenue in India. We believe that given low incomes in India and limited size of the corporate sector, the possibility of increased direct tax revenues compensating for fossil fuel revenue loss is limited.

Existing indirect taxes: Indirect taxes which account for a major part of the government's tax revenues could also be enhanced to compensate for potential fossil fuel revenue loss. Within the existing indirect tax structure and India's federal nature, additional revenues from indirect taxes can be generated by the rationalization of the tax rates and/or the inclusion of additional items in the GST. However, either of the two does not appear likely, as they would require a common agreement within the GST Council, difficult to achieve.

User taxes: Travel tax (distance) and electricity duties have the potential to compensate for the potential revenue loss, however, these are accompanied by inherent implementation challenges. Distance-based taxes which are generally levied based on the total distance travelled by vehicles will require extensive monitoring and development of a mechanism to translate defined parameters into tax rates. Currently, only the Union Government is empowered to undertake such a taxation. Levying a higher electricity duty also involves similar challenges as distance-based taxes, along with an additional challenge of getting a state buy-in as taxes on electricity come under the mandate of the state (and not the Union) government. A combination of distance travelled and electricity duty could do the trick where the former is levied and collected by the Union and the latter remains with the states. Further, the possibility of linking the distance travelled tax with the established system of FASTag (which automatically tracks highway travel) could also be explored. But a mechanism that is able to track millions of vehicles on a regular basis and convert them into a fair tax needs to be created from the scratch.

Carbon tax: Another non-conventional fiscal option that could be examined is the carbon tax, which will not only help in compensating for the potential revenue loss but will also give a push to India's ambition to lower its emissions. Presently there is no legal mandate for the implementation of a carbon tax, however the Article 248 of the Indian Constitution allows the Union Government to levy taxes on goods and services which are not listed in the state or concurrent list.

[1] Inclusion of non-taxable incomes like agriculture income within the tax structure would require constitutional amendments.

Carbon taxes have the potential to generate significant revenue and compensate for the potential revenue loss, but they should be considered a medium-term measure, as the capacity of carbon taxes to generate adequate revenues would diminish as fossil fuel consumption falls. Many potential approaches for implementing carbon taxes can be considered, one of them will require the Union Government to utilize the powers conferred under the Article 248 of the Constitution. Another may be to attempt to incorporate within the GST framework by computing the rates based on the notional value that is proportional to the emissions of the carbon-intensive sectors. However, there are serious challenges, discussed in the ensuing section, that need to be suitably addressed.

Way Forward

As India transcends to the developed status, the overall tax-to-GDP ratio is likely to mature. However, fossil tax revenues will diminish in the wake of energy transition. Both the Union and the states need to earnestly consider finding feasible options for replacing these taxes. There will be significant implementation, institutional, and political–economic challenges given state autonomy considerations.

It is worth mentioning, if there are many challenges, there are also tremendous opportunities. Fossil fuel taxes can be replaced by both carbon taxes of various types, or by other forms of user charges whose rates can vary, depending upon the technology or input used, or even the level of emissions. New technologies such as real-time satellite navigation systems can help power newer forms of user charges/taxes such as distance travelled tax to help replace fossil taxes. These will be more sustainable and provide more equitable possibilities.

Policymakers can navigate through these issues and establish a robust fiscal framework by considering a mix of conventional and non-conventional forms of taxes. Nevertheless, the solution will need to ensure that all key players are buying into the suggested solution, for true sustainability the path to climate reform only goes through democracy and consensus.

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Dr Laveesh Bhandari, President and Senior Fellow, Centre for Social and Economic Progress ; Dr Rajat Verma, Associate Fellow, Centre for Social and Economic Progress

Revolutionizing the Polymer Industry

Shaping Sustainable Biopolymer-based Solutions

Article by **Dr Ruchi Agrawal, Professor Himadri B. Bohidar, and Prabhpreet Kaur** is autobiographical in nature. Authors share their insights on the escalating concerns of petrochemical plastics. They also highlight, it is high time, mankind shifts its focus of research and development objectives towards the synthesis of biodegradable polymers and their derivatives to make this industry environmentally benign.

With the current increasing rate in petrochemical-based plastic production, by the year 2050, there will be about 12 billion tonnes of plastic in landfills and in the environment (PSF *n.d.*). It must be realized that the solution to the plastic pollution problem may never become a reality if we keep focusing only on downstream processing (collection, separation, recycling of used plastics), while at the same time investing in the petrochemical industry. For a long time now, our efforts, including government initiatives have largely focused on the management and recycling of plastic waste. Time has come for our research and development objectives to shift focus towards the synthesis of biodegradable polymers and their derivatives.

In the current scenario, the synthetic polymers are being widely used as the preferred precursors of plastics because of their low cost and high strength. However, the inertness of these synthetic precursors makes them highly resistant to biological and chemical degradation, meaning that these tend to exist in nature for an indefinitely long time, ultimately partaking responsibility for water and soil pollution. These plastic/polymers do not decompose, instead break down into tiny fragments forming micro- and nano-plastics that can enter into the food chain. In this worrisome situation, scientists all over the world have reported the presence of microplastics in human blood, breast milk, and placenta which can interfere with the normal cellular activities in both pregnant and lactating mothers, and consequently the infants (Muniasamy, Shruti, Pérez-Guevara, and Roy 2023). Not to mention, the poor animals that choke to death after accidental consumption of plastics (Image 1). Even more dangerous is the leakage of toxic-additive compounds or plastic softeners such as phthalates that can cause developmental, endocrine, and reproductive health problems.

Owing to these increasing concerns of petrochemical plastics, the world is rigorously searching for alternatives. This momentum has given rise to the development of certain biodegradable polymers such as polycaprolactone (PCL), polyvinyl alcohol (PVA), and polybutylene succinate (PBS). But then again, these are derived from non-renewable petroleum sources. To build a sustainable society, we cannot rely on ad hoc approach to skirt the issues temporarily. A long-term vision is required to find appropriate solution to this plastic menace by investing heavily on biopolymer-based alternatives, where again low-carbon footprint and green chemistry ought to frame the guiding road map.

To tackle the problem on all levels, our team at the Sustainable Agriculture Division, TDNBC is working towards the production of carbon-neutral biopolymers from readily available renewable agricultural residues. With

the ultimate circular bio-economy goal where nothing is wasted and everything is transformed; we convert the recalcitrant robust structure of rice straw into ecofriendly polymers: cellulose (Kaur, Bohidar, Pfeffer, *et al*. 2023), its derivative carboxymethyl cellulose and lignin. Rice straw consists of 32–47% cellulose, 19–27% hemicellulose, and 10–12% lignin. The cellulose biopolymer extracted from rice straw has been explored for versatile applications in agriculture as carriers for agrochemicals and the fabrication of superabsorbent hydrogels, acting as moisture and nutrient pockets in proximity of seeds and roots. Unlike the conventional agricultural practices which lead to fertilizer loss by leaching, the advancement of precision agriculture by the use of such formulations for slow targeted release of agrochemicals can decrease the ecotoxicological effects of these chemicals in the environment (Kaur, Agrawal, Pfeffer, *et al*. 2023).

Our team has also synthesized biopolymer-based eco-friendly food packagings with antimicrobial coating that can increase the durability and shelf-life of the wrapped food. Our dedicated researchers also intend to replace the core of hygiene products with the non-toxic, biodegradable, biocompatible polymer to reduce the huge piles of solid waste that end up in landfills or being incinerated (Kaur and Agrawal 2023). Apart from the cellulose biopolymer, we have also explored depolymerized lignin (black liquor) to derive the bioethanol production from rice straw, for the synthesis of lignin and silica nanoparticles which can be applied for targeted delivery of drugs and nutrients (Kaur, Singh, Sharma, *et al*. 2023). Thus, these biopolymer-based solutions developed by our research team have the potential to revolutionize every field, from agriculture to food packaging to medicine.

> "Sustainability, ensuring the future of life on Earth, is an infinite game, the endless expression of generosity on behalf of all."
>
> **– Paul Hawken**
>
> *(Environmentalist, entrepreneur, author, economist, and activist)*

Image 1 Cows sniffing the trash heaps in search of food end up choking on plastic

Our mitigation initiatives for building safe and sustainable polymer industry go hand in hand with the long-term ecological and economic goals. Utilizing agro-residues as the low-cost source of renewable biopolymers does not interfere with the global food security, and also helps to manage the disposal issues related to the open-field burning of post-harvest agriculture stubble. By building a solid and resilient supply chain connecting the farmers with the biopolymer industry, we can provide an additional revenue stream to the farmers and contribute to the development of rural economies.

We have set protocols for the valorization of agricultural biomass at low-manufacturing costs and developed a spectrum of forms (Image 2) and applications of the derived bio-polymers. Our mindful sustainability goal is to contribute towards the climate-positive/carbon-negative agenda by making quality products that people choose in their everyday lives. Many people still use plastic carry bags due to their

convenience and affordability, despite the ban on single-use plastic bags. The real solution to this problem would be to take a leap from the use of synthetic non-biodegradable polymers to bio-based biodegradable polymers.

Through the use of biodegradable biopolymers, there is a huge scope to address the issues such as limited fossil fuel resources, disposal of agricultural residues, health hazards related to microplastics, solid waste management and other environmental hazards. Our emphasis in future is to focus on improving the properties of the engineered biopolymers for their better acceptance and performance in other fields as well.

As such, the agricultural residues-derived biopolymers are attractive in the quest for sustainable solutions and represent a progressive and environmentally responsible approach via reduced carbon footprint. This supports a more circular and responsible approach to material consumption, contributing to a healthier planet for current and future generations. We all have to recognize that choices we make today will have repercussions for our future well-being.

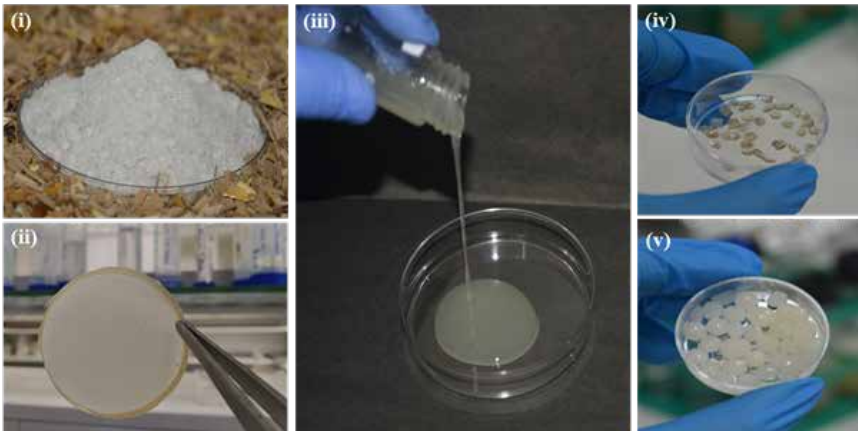

Image 2 Different forms of the biopolymer extracted from rice straw customized for various applications: (i) cellulose powder, (ii) composite film, (iii) viscous solution, (iv) composite hydrogel beads in dry, and (v) hydrated form

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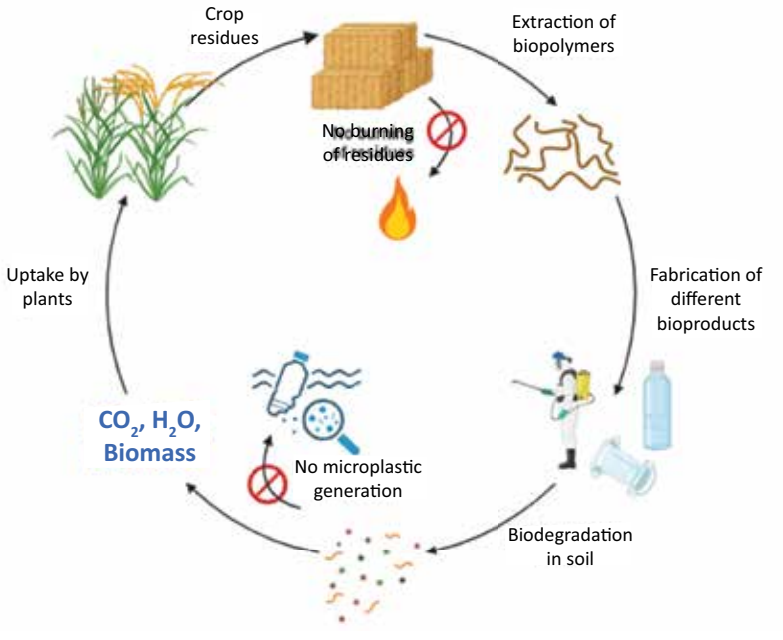

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Beyond Crop Yields

Building a Future Where Biofertilizers Aid Farmers, Feed Families, and Fight Climate Change

This article by **Dr Mandira Kochar** and **Dr Vatsala Koul** engages the readers with the concern of rising global food demand which is highly likely to escalate by 70% by 2050. To increase crop yield, farmers make extensive use of chemical fertilizers. This practice has a number of negative consequences on both environment and human health. This calls for sustainable practices of augmenting crop yield. By promoting these practices, we can mitigate climate change impacts, empower vulnerable communities, and build sustainable future for all.

The global demand for food is expected to increase by 70% to feed the increasing human population by 2050. To escalate crop productivity, it is a common practice for farmers to increase the use of chemical fertilizers, namely nitrogen, potash or phosphates. In fact, the development of the technology for the production of chemical fertilizers as well as other technical improvements in agriculture driven by governments and companies, led to the Green Revolution during the 1960s. Despite its multiple advantages in the beginning, in the long term, it brought negative consequences that are apparent today. The indiscriminate application of chemical fertilizers is causing harmful effects to the environment, such as soil acidification, water eutrophication, and air pollution, to name a few. Consequently, there is a need for the development of innovative natural products that complement conventional farming practices to achieve sustainability. Among the indigenous organizations, The Energy and Resources Institute (TERI) is leading the change, pushing sustainable solutions for agriculture, farmer benefits and climate responsiveness for a better future.

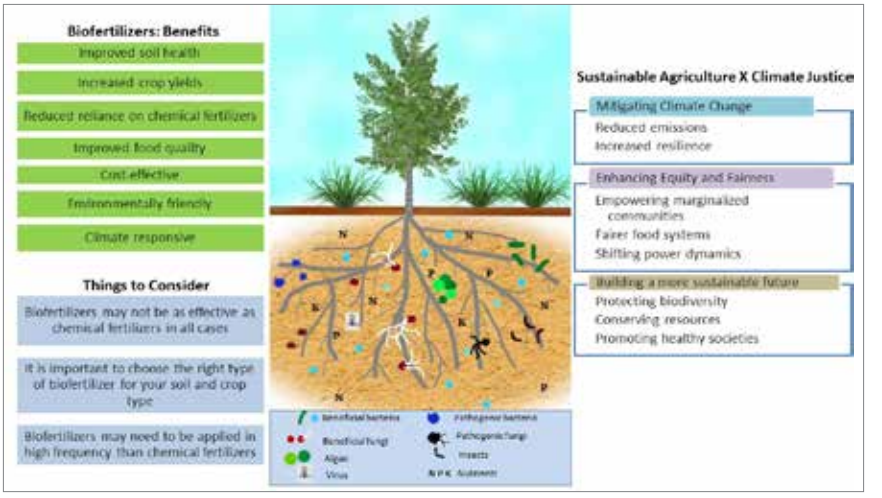
While challenges exist in transitioning to widespread sustainable agriculture, its potential to contribute to climate justice is undeniable. Some of the crucial agricultural activities for attaining climate justice are discussed here:

Reduced greenhouse gas (GHG) emission: Sustainable practices like no-till farming, cover cropping, and composting enhance soil carbon sequestration, drawing GHGs out of the atmosphere. Additionally, the reduced use of synthetic fertilizers and pesticides, lowers GHG emissions.

Increased resilience: By building healthy soil through organic matter and biodiversity, farms become more resistant to extreme climate events like droughts and floods, which are exacerbated by climate change. This reduces the need for emergency response, re-establishment, and regeneration, often disproportionately impacting vulnerable and marginal farmer communities.

Protecting biodiversity: Sustainable practices promote habitat restoration and biodiversity, vital for healthy ecosystems and the resilience of natural systems against climate impacts. This benefits both humans and the environment.

Conserving resources: Sustainable agriculture advocates for practices like water conservation and efficient resource management, crucial for building a resilient food system in the



An overview of benefits of biofertilizers

face of climate change and a growing population.

Fairer food systems: Transitioning to shorter supply chains and supporting local food production promotes equitable access to healthy and affordable food. This reduces reliance on industrial agriculture, which often exploits both resources and human labour.

Empowering marginalized communities: Sustainable agriculture often involves agroecological approaches that empower local communities and knowledge systems. This fosters food security and economic independence, especially for communities historically excluded from mainstream agricultural systems.

Promoting healthy societies: Improved air and water quality, reduced exposure to pesticides, and access to diverse, nutritious food contribute to overall well-being.

Shifting power dynamics: Sustainable agriculture fosters decentralized and diverse production systems, challenging the dominance of large-scale industrial agriculture.

By promoting these practices, we can mitigate climate change impacts, empower vulnerable communities, and build a more just and sustainable future for all. The use of biofertilizers represents a solution to most of the problems that result from the currently used unsuitable agricultural practices.

The heterogeneous group of beneficial microorganisms has many features with multiple positive effects on the plants as well as the rhizosphere, that is, the area around the plant roots. The soil harbours different forms of organisms—fungi, algae, nematodes, protozoa and essentially bacteria—though the existing isolation and cultivation methods have been able to reveal just 1% of the actual bacterial population. The distribution of bacteria in the soil is usually uneven but the rhizosphere is always rich due to the abundant presence of nutrients (sugars, amino-acids, organic acids, and so on) secreted by the plant roots as exudate. In exchange of this high nutrition resource and protective habitat, the beneficial soil microbiome influences the host plants, thereby augmenting their productivity, pathogen resistance, and stress tolerance.

A global assessment of the structure and function of the crop microbiome is urgently needed for the development of effective and rationally designed microbiome technologies for sustainable agriculture. Such an effort will provide new knowledge on the key ecological interactions between plant species and their microbiomes that can be harnessed for increasing agriculture productivity. The success of a probiotic consortium for agriculture depends on various factors that can be considered, analysed, and suitably modulated before its application as a biofertilizer in an agricultural system. The use of bioformulations, based on rhizosphere microorganisms presents a reliable and eco-friendly solution to reducing the chemical footprint in agriculture and thereby replenishing the soil macro and micronutrient levels for better future impact. The production and application of single and mixed inoculants based on selected plant probiotic bacteria is fast becoming an attractive choice at both economic and ecological levels, representing a real alternative for the sustainable reduction of the use of synthetic fertilizers in agricultural fields. The use of microbial consortia as inoculants has the potential to increase crop yield without the over application of chemical fertilizers, pesticides, and fungicides, and consequently reducing the environmental impact in agriculture and maximizing the production of healthier and safer foods, thereby providing enhanced economic benefits to the farmers.

While promising, utilizing microbial consortia for climate justice faces challenges. Research and development is needed to optimize efficiency, ensure safety, and scale up these technologies. Overall, microbial consortia hold immense potential to contribute to climate justice by mitigating emissions, supporting vulnerable communities, and building resilience. By actively researching, developing, and implementing these solutions, we can harness the power of microscopic allies to build a more equitable and sustainable future for all. ■

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Green Budgeting

A Pioneering Initiative in Puducherry

Governments worldwide are recognizing the imperative to balance economic development with ecological responsibility. Article by **Balaji** details the pertinence of green budget. The text has been authenticated by the case study of the Government of Puducherry whereby the UT has made noteworthy efforts in the upward allocation of green funds to strengthen climate resilience.

In an era where the pursuit of economic growth intertwines with the urgent need for environmental stewardship, the concepts of green financing and green policymaking have emerged critical in the endeavour for a sustainable future. Governments worldwide are recognizing the imperative to balance economic development with ecological responsibility, and the integration of green financing and policymaking serves as a compass in this transformative journey. Green financing, at its core, involves the allocation of financial resources towards projects and initiatives that demonstrate environmental sustainability, contribute to climate change mitigation, and foster overall ecological well-being. Green policy-making involves the formulation and implementation of policies that prioritize environmental sustainability, address climate change challenges, and promote eco-friendly practices across various sectors. It is here, the process of green budget helps a government to have a better assessment of their green financing and policymaking and strategize effectively towards sustainable policymaking and budgetary allocation that offers long-standing climate resilience.

Green budgeting is not merely a financial strategy; it is rather a paradigm shift in the way we approach economic planning. It integrates environmental

considerations into our budgetary processes, recognizing that economic prosperity and ecological sustainability are not mutually exclusive but intertwined facets of a responsible government. Green budgeting finds its space in the planning, policymaking, and implementation ideologies of national and sub-national governances as it helps in optimizing the financial allocations to developmental activities with environmental concerns. With the intent to foster a sustainable society, the global governance started transitioning from the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs) post 2015, the difference being that the SDGs mainstreaming environmental concerns into the development planning, while the focus until then was merely social development and well-being without much thought into the environmental aspect of development. However, it is post the SDGs, governments are largely trying to ponder upon the idea of 'development' with no compromise on 'environment'. Now, we have come to a space where we also address the financial aspect involved in development mainstreamed with environmental concern. It is precisely here we place green budgeting as our core idea of a government's financial planning.

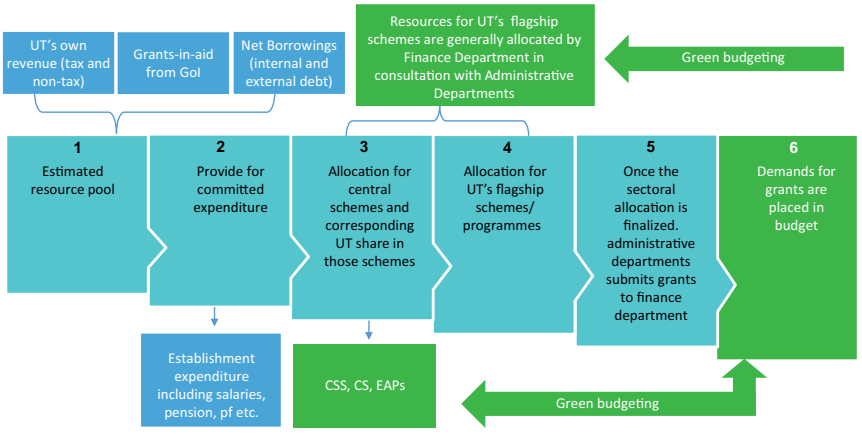
A context on Puducherry's Budget

This story is to showcase the fact that the Government of Puducherry has taken a significant stride in tabling the green budget in its annual budget session 2023/24 and the Department of Science, Technology, and Environment has carried out a methodical green budgeting exercise following a comprehensive assessment of the annual budget in consultation with the line departments of the Government of Puducherry. The Union Territory of Puducherry receives funding from the Central Government through three different channels: the

Central Assistance, Centrally Sponsored Schemes, other CRF and Loans. It is also worth noting that Puducherry is the only UT with legislature having a separate public account. Internally, the UT manages the funding and budget allocation either through its own resources via tax and non-tax receipts, grants from the centrally sponsored schemes or through borrowing from open market and central financial institutions. To be precise, the total budget estimate for Puducherry for the present financial year 2023/24 is INR11,600 crore and the idea was to identify the green allocation out of this expenditure. This way, it will be helpful in optimizing our activities and budget allocations to more greener initiatives, in meeting the environmental and climatic challenges of the present times and to sustain our resources and in developing clean energy resources.

Green Budgeting: The Process

The green budgeting exercise for the UT of Puducherry was conducted in collaboration with The Energy and Resources Institute (TERI), New Delhi and the analysis explores themes and activities for better integration of environmental components into existing budget items. The analysis was done by establishing a baseline indicator for FY 2022/23 and analyse the green budget for FY 2023/24. The process involved



Framework for green budgeting for the UT of Puducherry

data collection from several government departments of the UT on the following heads:
(i) green budget, (ii) percentage of green budget of identified scheme budget, (iii) percentage green budget of RE/ BE, (iv) the number of departments that identified schemes and green components, and (v) the number of budget line items with green components and the assessment was done with data inputs from 15 departments. A comprehensive data-collection proforma was prepared which included a list of environmental sustainability themes, based on which theme mapping of the proposed green budget activity could be done.

Categorically demarcating each of the budget item to a list of carefully defined thematic areas helps provide a better rationale in being decisive about an item being a green component, and moreover, mapping of the budget items to the Sustainable Development Goals helps track the UT's commitment towards achieving them by the year 2030, while also emphasizing the importance of SDG mapping for tracking environmental impact. Additionally, it highlights sustainability approaches adopted by each department, offering a comprehensive view of their efforts to promote environmentally positive practices.

Findings of Green Budgeting for the FY 2023/24

The green budget of the Government of Puducherry increased by 153% from INR191 crore in the baseline year to INR483 crore in FY 2023/24. The percentage of the green budget in the

Baseline indicators and analysis of green budget for the FY 2023/24

Indicators	FY 2022/23	FY 2023/24
RE/ BE (in '000 rupees)	115,000,000	116,000,000
Scheme budget (in '000 rupees)	24,520,483	29,437,884
Green budget (in '000 rupees)	1,908,127	4,834,121
Percentage of green budget of identified scheme budget	7.78	16.42
Percentage of green budget of RE/BE	1.66	4.17
Number of departments that identified schemes and green components	9	15
Number of budget line items with green components	120	134

Launch of Puducherry Green Budgeting Report: 2023-24 by the Chief Minister of Puducherry

identified schemes increased from 7.78% to 16.42%. As a share of total expenditure (revised estimates for FY 2022/23 and budget estimates for FY 2023/24), the green budget component increased from 1.66% to 4.17%. In the baseline year, nine departments identified schemes and green components, while in FY 2023/24, 15 departments identified both schemes and green components.

Out of 15 departments, 10 departments had thematic activities on climate change mitigation, followed by sustainable consumption and production, clean/green technology, pollution abatement, climate adaptation, water management, waste management, energy conservation, and water quality. Of 15 departments, 13 had activities under the programme/scheme implementation category, followed by green technology and infrastructure, regular operation and maintenance, policy action, IEC, skilling building, capacity-building, and subsidies.

In terms of SDG mapping, out of the 15 departments, 12 contributed to SDG 13, making climate action a major focus of green/environmental sustainability activities. SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), and SDG 12 (responsible consumption and production) were included in the activities of eight departments. SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities) were included in the activities of seven departments.

Way Forward

The *Green Budget Report* of the Union Territory of Puducherry for FY 2022/23 (baseline year) and FY 2023/2024 is a comprehensive document that outlines the green budget allocation, highlights sustainability initiatives, maps activities to promote environment-sensitive planning, accountability, aligns with the SDGs, and provides valuable recommendations for departmental budgeting. It is a road map for fostering sustainable development and promoting a greener future in Puducherry. It is a sincere hope that the Union Territory of Puducherry champions the cause of environmental protection by further integrating environmental components in more budget line items by various departments. Its ambition in the coming years is to continue this green budget exercise every financial year, roping in more departments into proposed green activities in their annual budget so that all the departments become an integral part of the green budgeting of Puducherry and also to increase the share of green budget, which is presently around 5% of the total budget, to 10% in the present year and beyond 10% in the future years. ■

Balaji, Senior Associate, Puducherry Climate Change Cell, Department of Science, Technology and Environment, Puducherry

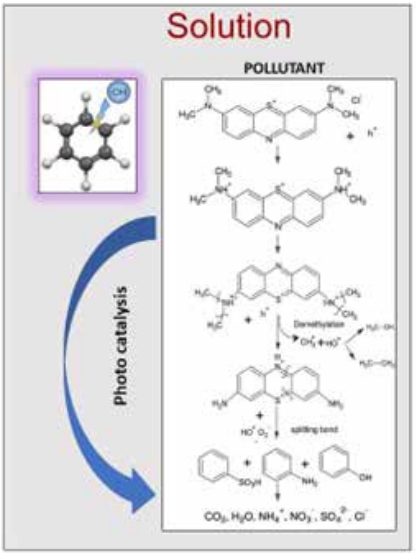
Bleeding Rivers

TADOX® Removing Colour at Point Source

As the demand for freshwater continues to surge and its availability diminishes, the need for effective wastewater treatment and reuse becomes increasingly urgent. Authored by **Dr Nupur Bahadur, Dr Metali Sarkar,** and **Dr Nimisha Singh**, the article talks about a cutting-edge technology—TADOX®—indigenously developed by TERI and its efficacy in wastewater treatment.

India's textile and dyeing sector stands as a vital pillar of the nation's economy, contributing 4% to the GDP, representing 12% of the nation's export earnings, and offering employment to around 45 million individuals. However, this industry is characterized by its extensive water usage, leading to substantial wastewater generation. This wastewater is laden with harmful chemicals, dyes, and pollutants and poses a severe threat to water bodies, soil quality, and aquatic ecosystems. The discharge of inadequately treated textile and dyeing units' wastewater has adversely impacted water bodies across the country, notably in revered rivers such as the Ganga and Yamuna. The consequences of this environmental challenge extend to many local rivers like the Hindon River, the Cooum River in Chennai, the coloured Bandi River in Rajasthan, and the severely polluted Sabarmati River in Gujarat, among others. This distressing and alarming situation underlines the urgent need to address the highly coloured and polluting wastewater, adversely affecting the freshwater resources. As the demand for freshwater continues to surge and its availability diminishes, the need for effective wastewater treatment and reuse becomes increasingly urgent. The current scenario of wastewater treatment in India faces multifaceted challenges, ranging from the excessive use of chemicals, toxic sludge generation, and improper treatment methods to the unsustainable discharge of inadequately treated water into natural water bodies. The prevalent reliance on biological treatment systems exacerbates the problem, involving large land footprint and vulnerability to shock loads, especially in the context of industrial effluent treatment. The inadequately treated coloured water, when fed into tertiary systems such as RO/MEE/MVR, leads to membrane fouling and biofouling, creating additional problems that escalate capital and operational expenditures. Furthermore, the treatment methods currently employed fall short of meeting the stringent quality requirements for water reuse imposed by national missions like Namami Gange, SBM 2.0, and AMRUT 2.0.

Addressing the intricate challenges of the quality of surface water necessitates collaborative efforts across all levels. TERI, a renowned and multi-dimensional organization, is actively engaged in addressing wastewater treatment and water reuse issues. TERI's researchers have developed a cutting-edge technology known as TERI Advanced



Benefits of TADOX®

- ✓ Removal of color & organics
- ✓ Improved shock load bearing capacity of biological treatment systems
- ✓ Improved biodegradability
- ✓ Less use of chemicals, hence less sludge generation; for e.g. from avg. 30 - 40 Kg/m³ to 0.2 – 0.5 Kg/m³
- ✓ Clean & green approach
- ✓ No start up time
- ✓ Stream specific treatment leading to reduced total treatment time from avg. 36- 48 h to 15-16 h
- ✓ High resource & energy efficiency
- ✓ Small footprint / land requirement
- ✓ Reduced capital expenditure by 15 -20% and operational expenditure by 30 - 40%

Oxidation Technology (TADOX®) (https://youtu.be/tCt5rxC7eik). TADOX® offers a solution for treating wastewater streams that contain high levels of colour, chemical oxygen demand (COD), biochemical oxygen demand (BOD), total organic carbon (TOC), dissolved organics, micropollutants, non-biodegradable substances, and persistent organic pollutants (POPs) found in effluents from highly polluting industries and municipal wastewater.

TADOX® is a patented technology that employs UV-Photocatalysis as an Advanced Oxidation Nanotechnology (AON), which results in the oxidative degradation and mineralization of targeted complex pollutants. These complex pollutants impart colour and high COD to the effluent. Moreover, TADOX® incorporates innovative approaches that minimize the use of chemicals in the overall treatment process, reducing the generation of sludge and thereby preventing secondary pollution. This approach also ensures a highly resource- and energy-efficient treatment process. The technology can be retrofitted in the existing effluent treatment plants to improve the overall treatment efficiency and treated water quality. In addition, highly polluting industries need to install tertiary treatment to comply with zero-liquid discharge (ZLD) norms by the government. The TADOX®-treated colourless and adequately treated water going to subsequent tertiary treatment, helps in the prevention of fouling and choking of membranes, enhances the lifespan and efficiency of three-stage reverse osmosis (RO) systems and reduces the load on subsequent evaporators such as multi-effect evaporator (MEE) enabling sustainable

20 KLD TADOX® Plant in Textile CETP in Kanpur; Funded by National Mission for Clean Ganga, MoJS, GoI

and affordable ZLD compliance with 90–95% enhanced water reuse efficiency. This approach fosters a win-win situation for both industry and the environment.

The technology has been successfully demonstrated at 20,000 litres per day (20 KLD) TADOX® plant at Textile CETP in Kanpur. It has been developed and commissioned with an objective to optimize the wastewater treatment efficiency, improve the quality of treated water and increase water reuse efficiency of this cluster. This project is funded from National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti (MoJS), Government of India. This is the first of its kind demonstration in the World of UV-Photocatalysis-based Advanced Oxidation Technology for treatment of Textile Effluent in a CETP at 20 KLD capacity.

The key results involve end-to-end TADOX® demonstration with complete removal of colour, organics, and improved biodegradability, which in turn, paves the way for TADOX® technology integration as part of Phase 2, at pre-biological treatment stage in the existing 1.55 MLD CETP, where this integration is expected to achieve adequate treatment, safe surface discharge norms as per NGT and reuse norms together with reduction in overall treatment time from current average 36–48 h to 14–16 h, less use of chemicals in treatment leading to reduced sludge from current average value of 20–35 kg/m^3 to 0.4–2.0 kg/m^3. Thus, such an integration of technology having smaller footprint and reduced treatment time, has a potential to augment capacities within the same infrastructure and meet future requirements.

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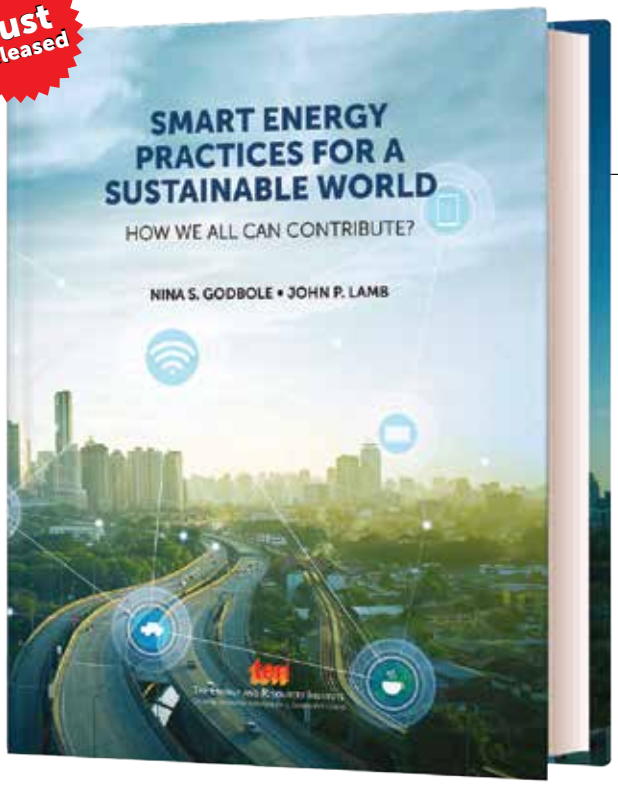
Dr Nupur Bahadur, Associate Director, TERI; Dr Metali Sarkar, Associate Fellow, TERI; Dr Nimisha Singh, Research Associate, TERI

Energy-efficient techniques for realizing sustainability

Just Released



Major topics covered

- Smart Energy Systems
- Impact of Electronic Equipment on Energy Use and Carbon Footprint
- Standard Energy Use and Carbon Footprint Metrics
- Smart Buildings
- Sustainable Practices for Green Health Care Services
- Knowledge and Behaviour for a Smart Planet
- Worldwide Case Studies for Green Practices

ISBN: 9789394657113 • Price: ₹1195.00

This book stresses the need for us to judiciously, sustainably, and smartly harness and use energy techniques in order to effectively combat climate change. The book also gives an in-depth discussion on utilization of artificial intelligence and information technology to realize energy efficiency in various sectors of economy including such as transportation, buildings, infrastructure, health care, and other services.

Text is supplemented by case studies that depict ground-level reality to facilitate comprehension of the subject matter. The appendices serve as an extended learning of the concepts discussed in the chapters. The publication would serve as a valuable reference for both scholars and researchers engaged in the domain, in addition to, being a guide to industry and the academic world.

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The Right Time to Accelerate Digitalization of Buildings

Spotlight: Award-winning Johnson Controls OpenBlue Technology

Decarbonizing cities is impossible without decarbonizing buildings. Article written by **Santhosh Muzumdar** lays emphasis on the deployment of integrated digital solutions in buildings with an aim to optimize energy consumption.

The Approach

Given that we spend 90% of our time indoors, it's important to invest in the structures where we live, work, learn, and play. Decarbonizing cities is impossible without decarbonizing buildings, as 60% of carbon emissions in cities comes from the buildings sector. Buildings are 'low-hanging fruit' in tackling climate since we can cut carbon and costs at the same time.

Here's how: An important step towards achieving net zero is to establish current state of energy consumption and carve out a decarbonization path.

The proven trifecta of energy efficiency interventions, renewable energy supplies, and digitalization are critical enablers in this process. A confidence-building initiative in this journey is the implementation of energy conservation measures that will deliver immediate savings. These measures can be enabled with digitalization tools that help monitor consumption and optimize the performance of building equipment.

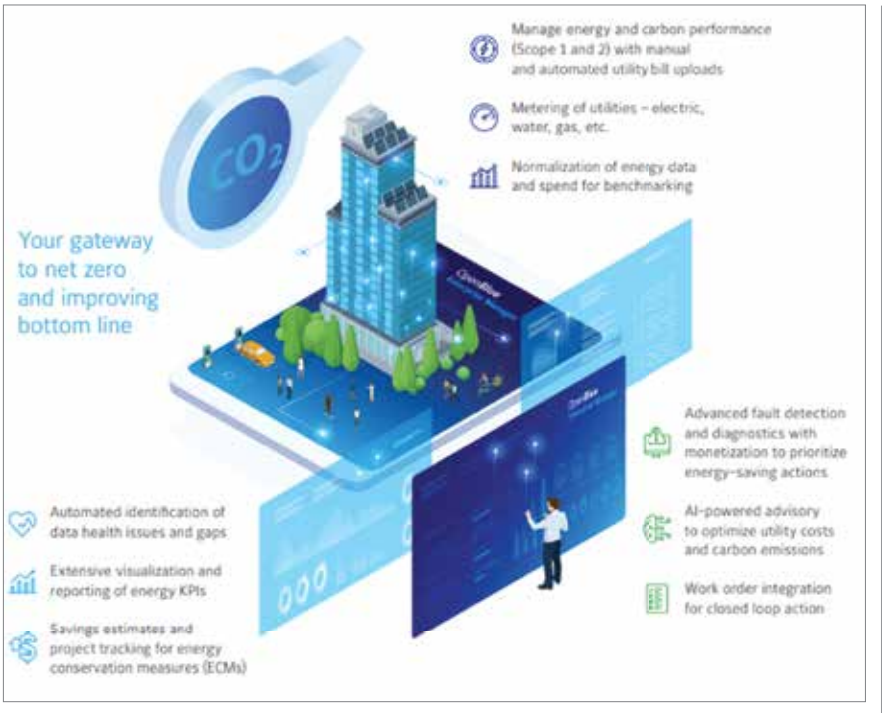
OpenBlue solutions by Johnson Controls is the blueprint for sustainable buildings, this award-winning suite of solutions integrating hardware and software components is transforming

buildings from static entities into smart strategic assets. Some proven benefits of OpenBlue include:

- Increased energy savings and reduced carbon emissions
- Efficient space utilization
- Optimized air quality
- Increase operational efficiency
- Increase well-being and productivity

Case Study: Unleashing the Potential of India's Buildings

A major hotel chain in South India had water-cooled chiller air-conditioning system in one of its buildings, the chillers were upgraded over a period of two decades, the air-conditioning system in the hotel consumed roughly 40% of



the total electricity. The hotel employed a contractor to review the energy consumption and suggest conservative measures. Through several levels of energy audit, from analyzing electricity bills over 12 months to installing devices to accurately measure consumption, a performance-based proposal was adopted, this meant the coordinator's payment is subject to reduction in energy consumption on an agreed baseline.

The contractor after a detailed study installed high-performance equipment for cooling with committed savings, digitally enabled centralized monitoring system and optimized logic controls. The result was a whopping 44% reduction in electricity spend, translating into INR1.5 crore savings during performance period and avoidance of 400 metric tonnes of CO_2 emissions.

This case study is an example of the potential that is relatable to an average building in India. A similar project in a manufacturing set-up resulted in 45% reduction in energy spend, INR8 crore saving and projected savings of 11,000+ metric tonnes of CO_2 emission reduction during the performance period. There are also use cases where 50+ buildings of a real estate company employing a central monitoring of energy consumption, digitally optimizing equipment performance and utilizing high-energy efficiency equipment has resulted in significantly higher savings and better living standards in buildings.

Discreet systems of a building which otherwise work in silos are brought together on a common platform to achieve higher operational efficiencies.

Digitalization is empowering organizations to get ahead of the game on sustainability. For example, advanced analytics is helping organizations to identify further energy savings and emissions reduction opportunities across buildings, while AI-enhanced technology[1] can help avoid unplanned repairs and maximize uptime of large heat, ventilation, and air-conditioning (HVAC) systems, which account for up to 70% of a building's energy consumption.

[1] The pace of artificial intelligence (AI) is rapidly changing to align with wider enterprise and naturally, as AI evolves the principles evolve too. Johnson Controls will apply strong testing, safety and security practices to optimize results and include appropriate human oversight capabilities.

Potential in India

A 30% savings on electricity consumed through energy efficiency and digitalization looks very likely. According to *India Energy Outlook 2021* under a balanced assessment of the direction in which India's energy system is heading, 30% savings from buildings would amount to 257 terawatt hours (TWh) of electricity by 2030, which is 19% avoidance of projected electricity generation using coal or 65% of solar PV (IEA 2021). Wider deployment of integrated digital solutions in buildings with an aim to optimize energy consumption is a clear indication of concrete steps in this direction.

An integrated network of digital buildings can result into the following benefits:

- Track progress of deployment of energy efficiency and renewable energy policies in cities and provide real-time data.
- Set benchmark for energy consumption in buildings (energy performance index) enabling data backed decision making and driving compliance to building codes.
- Provide critical information for evaluating feasibility of implementation of policies such as demand-side management, incentives for energy conservation among others.
- Enable awareness and educational initiatives to drive better sustainability behaviour among building users and owners.

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Santhosh Muzumdar, Director - Government Relations and Sustainability, Johnson Controls India

Creating Futuristic Mindsets Amongst Youth Through Climate Change Education

This piece of writing by **Dr Livleen K Kahlon, Taru Mehta,** and **Monmi Barua** underscores the relevance of youth in addressing climate change issues. The text also highlights significant contributions made by TERI as a research institute and the support the think tank receives from organizations such as GIZ and CEEW.

The recent outcomes of COP28 led to the appointment of a Presidency Youth Climate Champion, to help facilitate the engagement of children and youth in climate action, including the UNFCCC process (The UAE Consensus Negotiations Outcome 2023). Young climate advocates also have urged to raise their voices and help rescue the planet with their ideas. In the world, 1.8 billion people are between the ages, 10 and 24 years which is the largest youth generation in history (Youth and the SDGs). Therefore, it is imperative that we engage young people in every opportunity and invest in them as catalysts for a transformative impact.

TERI felt the need to bring out its research through a variety of mediums in its early years of existence. With the goal of fostering an environmentally conscious society, the Environment Education and Awareness (EEA) Division at TERI was formed in 2002 and since then voices of youth in climate change discourse have always been at the forefront. Hence avenues like Youth Climate Conclave (YCC), were developed to address concerns raised by youth, with knowledge-based and solution-oriented responses. The YCC is supported by major players, including the Delegation of the European Union to India, Ministry of Environment, Forest and Climate Change, Government of India, and United Nations Children's Fund. Activities under this national project were spearheaded by TERI and supported by several agencies including Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and Council on Energy, Environment, and Water (CEEW).

Innovation

The YCC plays a pivotal role in engaging Indian youth in science-based discussions on the most relevant climate change issues. The platform serves as an opportunity for youth and governments to drive joint action fulfilling the climate change agenda. The age group targeted is from 10–18 years to 19–25 years; so that the idea of 'catching them young' prevails while also nurturing the spirits for youth-led agenda in the process of capacity building (TERI 2022).

The activities under YCC begin with understanding the first expressions from students on topics which has far reaching impact on students' mindsets and behaviours. This is captured through a competition-based approach via photography, blogging, and short video. The topics in the past have revolved around, sustainable lifestyles, climate action, and role of youth. The objective has been to evaluate students' first-hand knowledge on the subject and interest to learn further, as the best six entries from each contest are invited to participate in YCC. This is followed by extending applications to the students to attend YCC. The application is a detailed questionnaire on understanding the

intent for attending the YCC and these are evaluated on basis of the reasons cited such as contribution to climate agenda, networking for climate, role of youth in policymaking, opportunities in this space, and so on. After a thorough study of each questionnaire, approximately 100 students are invited for a two-day meet in New Delhi.

The two-day event at New Delhi is an amalgamation of sessions, panel discussions, group work, debate, development of outcome document, photography exhibition, screening of short videos and messages, and networking opportunities. The pedagogy adopted is learner-centred and is targeted to a wider age group; it doesn't end in one-way communication, and leads to a state of enquiry, which helps in problem solving. The group work helps them in networking and enhances their critical thinking and socio-emotional skills. Towards the end of the teaching learning process, dedicated time is allotted to gather youth prioritization for development of outcome document which is articulated in a pledge and read out annually at World Sustainable Development Summit (TERI 2022).

Outcomes

So far, YCC has implemented four editions, where TERI has touched upon the critical mass in an effort to prepare their mindsets for climate justice, global negotiations, position of India in climate change discourse, and role of youth and other stakeholders in mitigating climate change. It is a platform, where youth are made to believe that they are at the centre stage and in the coming decade their role will be critical in adaptation and mitigation measures. YCC is a platform that helps students improve their critical thinking, creativity, scientific comprehension, and communication. YCC continues to prepare youth for future and build their abilities for demand-driven responses in future.

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Dr Livleen K Kahlon, Associate Fellow, TERI; Taru Mehta, Fellow and Area Convenor, TERI; Monmi Barua, Associate Fellow, TERI

Towards High-integrity Carbon Markets

The Paris Agreement Article 6 Implementation Partnership and its Center

Paris Agreement Article 6 Implementation Partnership and its Center (A6IP) came into being to expand the implementation of Article 6. The article by **Kazuhisa Koakustu** and **Hayato Nakamura** charts out how the Center can facilitate authorization, reporting, tracking, project initiation, and methodology development of the parameters associated with Article 6.

With Article 6 of the Paris Agreement rules agreed upon at the 26th Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC), countries are now moving forward with implementing carbon market mechanisms that allow for international cooperation on emissions reductions. To expand the implementation of Article 6, it is necessary to build high-integrity carbon markets with increased private investment through international collaboration. In response, the Paris Agreement Article 6 Implementation Partnership (A6IP) was launched at COP27 by the initiatives of the Government of Japan.

As of January 2024, 74 countries (including India) and over 100 UN and international organizations and the private sector joined the partnership, which demonstrates the growing commitment to the implementation of Article 6. IGES, the Institute of Global Environmental Strategies, houses the A6IP Center, as its secretariat. The A6IP Center is committed to facilitating the enhancement of institutional and human capacity across various multi-stakeholders in each country at regional, and global levels, all to expedite the development of such carbon markets.

To maximize the potential of Article 6 to implement and enhance nationally determined contributions (NDC) to realize net zero by 2050, it is imperative

to foster high-integrity carbon market that facilitates the development and implementation of decarbonization technologies and provides high-quality

carbon credits capable of stimulating private investment. Simultaneously, there is an urgent need to promote understanding of the Article 6 rules, establish an implementation system, invest in human resource development, and foster international collaboration, all of which are essential for the successful implementation of Article 6.

The A6IP Center forms the core of the A6IP, and it is committed to delivering robust support tailored to the diverse requirements of various participating countries and organizations including the private sector. Beyond the dissemination of the latest information via working groups for partner countries and institutions, as well as side events at COP28, the A6IP Center launched the Article 6 Implementation Support Package as a key component of its capacity-building assistance to help partner countries effectively implement Article 6. The A6IP Center will work in cooperation with international organizations, in particular with the UNFCCC Secretariat, and the World Bank as the strategic partners, and additionally, with other international organizations, for example, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations University (UNU), Global Green Growth Institute (GGGI), Asian Development Bank (ADB), and African Development Bank (AfDB).

The A6IP Center tailors every support package to align with the unique needs, priorities, and readiness status of each partner country. This approach is designed to streamline and bolster the accomplishment of the country's existing NDC while also preparing for their enhancement in the forthcoming NDC cycle to be submitted in 2025. The A6IP Center provides a comprehensive support package and the flexibility to choose individual support options, ensuring a customized and effective approach to support.

Support package options are as follows:

- Development of Article 6 Strategy: Paris Agreement and Article 6; Enhancing ambition through Article 6; and participation requirement for Article 6.
- Authorization: Establishment of legal and institutional frameworks for the authorization process, which outlines, for instance, scope of authorization, timing of authorization, conditions for authorizing mitigation activities, and a template for the letter of authorization.
- Reporting: Preparation for the initial report, annual report, and the report on regular information consistent with the timelines and requirements of Article 6 reporting; methods for corresponding adjustments of emission balance; and the interplay between Article 6 reporting and Article 13 transparency reporting.
- Tracking: Use of a national registry or an international registry to be used for registration, authorization, transfer, and cancellation of internationally transferred mitigation outcomes.
- Project Initiation: Preparation of Article 6 project pipeline; feasibility assessments of potential Article 6 projects; and development of Article 6 project concepts seeking Article 6 financing or blended carbon and climate finance.
- Methodology Development: Development of methodologies for estimating mitigation outcomes from eligible Article 6 projects; development and application of a baseline.

Additionally, based on the principles of high-integrity carbon market adopted at the G7 Ministers' Meeting on Climate, Energy, and Environment in Sapporo 2023, tri-dimensional integrity, namely supply side, demand side, and market side will be promoted across the above-mentioned process.

The support provided through the partnership is to enable 'real examples' on the ground through the project initiation and methodology development. Even having financing, the aim of Article 6 is to enhance international and global cooperation for making decarbonized society and practice real, and the A6IP Center is to produce various examples together with the partner countries and institutes to demonstrate the path to a net-zero world by 2050 within 1.5-degree temperature goal reach. Together, the Article 6 Implementation Partnership Center is ready to support implementation through global collaboration. ■

Kazuhisa Koakustu, A6IP Center, and Hayato Nakamura, Program Manager, A6IP Center

Impact of Nature-based Innovative Biofertilizers on Agriculture

Cultivating a Nutritious, Resilient, and Sustainable Food System from the Ground Up

To increase the crop yield, farmers make extensive use of chemical nitrogen fertilizers that are accompanied by a number of environmental repercussions. Their application in excess not only accelerates soil acidification but also contaminates groundwater and the atmosphere. Authors, **Dr Mandira Kochar** and **Dr Vatsala Koul**, in this article, elucidate environmentally benign alternatives.

Global climate changes have resulted in unexpected drought, extreme temperatures, excessive rainfall, and unanticipated storms, causing disasters that had never occurred in the past. Considering this, establishment of an environment friendly mechanism is of vital importance. In recent years, there has been an unrestricted and unchecked use of agrochemicals to obtain higher yield which on the flip side has given rise to several agricultural problems and damaged soils. Excessive use of chemical nitrogen fertilizers not only accelerates soil acidification but also risks contaminating groundwater and the atmosphere. Biofertilizers and those inputs containing soil's native microbiota offer a safer option for mitigating the negative impacts of adverse climatic changes.

Mycorrhiza, a soil fungus, establishes a mutualistic symbiotic association between itself and host plant roots. It contributes significantly to plant nutrition, particularly to phosphorus uptake and the selective absorption of immobile (such as Zn) and mobile (S, Ca, K, Fe, Mn, and N) elements to plants

along with water uptake while providing resistance against abiotic and biotic stresses. Mycorrhiza-associated bacteria and other soil beneficial bacteria are very closely associated with the rhizosphere microbiome and act as a third partner involved in the well-studied mycorrhizal–plant symbiosis. They are involved in influencing plant hosts directly and indirectly as well as interact at varying levels to enhance the plant's immune responses, mycorrhizal activity, root nutrient uptake, and provide resistance against various abiotic/biotic stresses.

TERI has successfully recreated the model mycorrhizal–bacterial interactions in symbiosis with plant roots. This not only helps to examine the effects on bacterization/mycorrhization of plant roots but also physiological impacts on

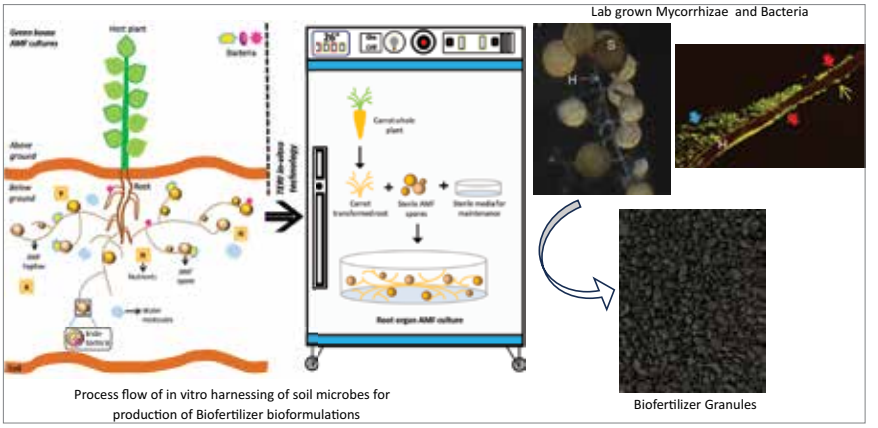


Figure 1 *Process flow of in-vitro harnessing of soil microbes for production of biofertilizer bioformulations*

plant growth and productivity during the host plant's life cycle. These are affected through their capability of producing growth regulators, forming biofilms, phosphate solubilization, micronutrient exchanges, sequestration of carbon, and nitrogen fixation.

A disruptive mycorrhiza product—Uttam Superrhiza—powered by the native biofilm-forming microbiome of the arbuscular mycorrhizal fungi has been developed by TERI's Sustainable Agriculture Programme. Being marketed in India by Chambal Fertilizers and Chemicals Limited in India, 1900 tonnes of Uttam Superrhiza granular mycorrhiza product were sold in the market, enough to fertilize 450,000 acres of agricultural land. It is produced in a contamination-free environment through TERI's patented *in vitro* technology and is enriched with natural mycorrhizal partner bacteria that form a biological film around the mycorrhiza (outlined in Figure 1). This provides Superrhiza a unique edge over other mycorrhiza products in the market as it not only provides additional functional benefits to the product, thereby making Superrhiza a truly *Uttam* (Hindi word literally meaning superior) mycorrhiza product. It delivers soil nutrients more effectively to a wide variety of plants, across different types of soils and responding to drastic changes in climates, thereby contributing towards sustainability in agriculture and combating changing climates and environments. It is a one-of-a-kind

mycorrhiza product which contains its native microbiome, leading to superior performance and re-establishment of its natural interactions once applied in soil.

Superrhiza benefits a variety of crop types including wheat, maize, pearl millet, sorghum, chickpea, potato, cotton, paddy, sugar cane, plantation crops, chilli, spices, pulses, oilseeds, and many other vegetables and ornamentals. It also delivers efficient access to and use of water and plant nutrients; positive impacts on soil microflora; improved soil health and structure; and benefits to environmentally stressed land. It is compatible with chemical fertilizers such as urea, diammonium phosphate (DAP), potash, compost and manure, and its formulation is stable at room temperature for at least two years.

Such soil microbiome components when formulated as advanced biofertilizers and tested for their impact on plants showed multiple beneficial results such as better productivity (15%–18% yield), increase in macronutrient (N, P ,K) and micronutrient (Fe, Zn, Mg, Ca, Cu, Mn) content of the plant tissues, implying synergistic behaviour to plants. Farmers across India have found an increase in overall plant productivity across different crops such as wheat, maize, onion, fenugreek, okra, chickpea, and cotton from 10%–15%. Individually, their observations have been: "increased grain filling, better response in fluctuating environments (such as unexpected heavy rain falls), increased plant height, plant canopy and root biomass (10%–22%), early harvesting from plants which allowed the farmers to take their produce earlier than others to the market" (Figure 2). Superrhiza also helped the farmers "reduce the chemical fertilizer input by upto 30% while providing the benefits in productivity, thereby saving money for the farmers". The inoculated soil was also directly impacted through increase in soil organic carbon.

Understanding this functional co-existence of the mycorrhizae and bacteria in the rhizosphere microbiome (associated with host plants) is aiding us in the development of superior performing biofertilizers for sustainable crop production. This aids in bringing the naturally existing microbial diversity into functional applications for ensuring climate responsiveness, long-term benefits to soil health and agriculture. It is attempting to change the dynamics of agri inputs usage towards improvement of soil quality and health.

This is a remarkable growth promoter technology that provides native biological inputs to supplement biofertilizer performance for synergistic effects and superior field performance. Further use of sustainable practices such as composting and no-till farming will enhance soil fertility and water retention, leading to higher yields and decreased dependence on irrigation. Together with minimizing addition of chemical inputs will promote a healthier environment for farm families and communities. Additionally, it will help build healthy soils and diverse ecosystems to increase farm resilience to extreme weather events, and climate change, contributing to food security and reducing reliance on external food sources. ■

Figure 2 *Impact of Superrhiza granular formulation on the growth of okra in field conditions*

Dr Mandira Kochar, Fellow and Area Convenor, TERI; Adjunct Faculty, TERI School of Advanced Studies; Adjunct Associate Professor, School of life and Environmental Sciences, Deakin University, Australia; Dr Vatsala Koul, Research Associate, TERI

Intersections of Climate Change and Gender

Specific Focus on Sexual Minority Groups

Via this article, **Dev Nagar**, makes the readers aware on how gender is an intersection that influences our experiences of dealing with climate change.

Climate change has been shown to disproportionately impact marginalized and vulnerable communities, intersecting with our socio–political–economic identities. Gender is one such intersection that influences our experiences of dealing with climate change. Although much work has been done on understanding the gendered impact of climate change, it is pertinent to note that most of such studies have been done considering gender in the binary.

In this context, the experiences of trans and intersex individuals have been largely overlooked in existing literature. Trans and intersex individuals belonging to socio–cultural gender and sexual minority groups and communities face unique challenges related to gender identity and expression, along with discrimination and marginalization in society. With the impacts of climate change becoming more evident, it may be pertinent to explore how the increase in abnormal weather events, rising temperature and shrinking coastlines, can have potential to exacerbate the already vulnerable position of such communities.

India is an especially relevant context for this research given its vulnerability to climate crises and the existence of a unique socio-cultural community called the *Hijras*. Such communities include transgender and intersex individuals, and are also known by various other names in different regions across South Asia, such as *Kinnars, Kothis, Aravani, Jogtis, and Khawaja–Siras*, among others. In India and Bangladesh, they are legally referred to as the 'third gender'. While the acceptance and understanding of gender beyond binary in South Asian societies is still inchoate, the *Hijras* for long have struggled to gain recognition and rights, while being subject to the discrimination and apathy from all ends. Despite the legal recognition of the *Hijras* as the third-gender category in India, prejudice against them remains pervasive.

The ongoing research initiative by our team at Climate Xero is an attempt to study the experiences of these communities in the context of climate change. Such research would help fill the gap and ensure formation of a more inclusive and equitable climate adaptation and mitigation strategies.

A recent pilot study was conducted in Delhi. Some interesting trends came out that support our initial hypothesis. Now efforts are ongoing to further expand our data collection operations across selected locations in India. For this research study, a qualitative research design has been utilized to gain an in-depth understanding of the experiences of the focus community in the face of climate change. The primary data collection method will involve semi-structured interviews with individuals from the *Hijra* communities. The sample will consist of around 45–55 individuals, belonging to the *Hijra* communities (and members from other such communities known by different names in different regions, across India). ■

Dev Nagar, Co-founder and Lead, Climate Xero, New Delhi

Impacts of Climate Change on the Agriculture Sector

This conversation with **Professor Ramesh Chand**, Member, NITI Aayog, establishes connectivity between climate change and agriculture. He talks about relevance of strengthening adaptation to climate change in agriculture and how institutional mechanism for funding can be channelized. He also addresses relevance of localization of issues related to slow-onset events and hence indicators may be designed considering the local factors. As per him, addressing climate concerns at grassroots level, within the communities, is pivotal.

What, in your view, are the implications of geopolitics in climate change and further its impact on the agriculture sector?

Different countries are on diverse developmental paths. North countries, to attain their high-living standards, inadvertently contributed to climate change through development, while developing countries, aiming to reach similar standards, requiring more energy and goods. This leads to the notion that controlling greenhouse gas emissions or opting for specific agricultural inputs varies based on national interests. For instance, oil-producing countries proceed cautiously on hydrocarbon reduction. Yet, amidst these differences, global institutions unify diverse perspectives. Despite geopolitical strains, these institutions help achieve consensus amongst the countries to combat climate change. In this amalgam of aspirations, pursuing solutions for sustainable development echoes our global solidarity.

How can adaptation to climate change in agriculture be strengthened and how institutional mechanism for funding for this can be channelized?

Adaptation comes in two forms—one tied to resources (in terms of finance) and the other requiring policy shifts—a more accessible option. The latter is akin to low-hanging fruit, easily within reach.

Our focus lies on achieving Nationally Determined Contributions (NDCs) and achieving net-zero goals. However, agriculture, the provider of food and fibre, poses multifaceted challenges. Amidst this, rising hunger is a concern, necessitating a delicate balance between production and sustainability. Ensuring food production becomes paramount, yet potential setbacks are a concern. Opting for energy-efficient and less fertilizers in farming may elevate costs, impacting affordability of the food. Thus, careful navigation of such trade-offs is imperative. Whether adaptation or mitigation, implications on food quantity, quality, and prices need consideration. Balancing these facets becomes the crux of our approach—ensuring sustainability without compromising access or affordability to food.

What key actions can be employed to assess and track agricultural losses due to slow-onset events? Additionally, how international compensation efforts for farmers can be informed for loss and damage in agriculture?

The impacts of slow-onset events are slow and not clearly visible unlike the extreme events. Their catastrophic nature underscores the importance of preventive measures. Identifying these measures becomes crucial, considering the elongated cause and effect trajectory. Addressing climate change and sustainability indirectly aids in managing these slow climatic events. While their adverse impacts escalate, collective actions such as mangrove conservation for sea erosion control serve as pivotal points. These approaches often refer to as public goods, where individual incentives might be lacking, emphasizing the significance of collective action. International compensation mechanisms have initiated, however there is a much need to acknowledge shared responsibility across nations, states, municipalities, and local communities. It is a simultaneous call for global action and grassroots involvement, highlighting the necessity for collaboration across all echelons to truly address these persistent challenges.

What should be the appropriate key indicators and metrics to track impacts of slow-onset events on agriculture and rural livelihoods?

The debate around climate change has been prevalent. Gradually, acknowledgment of climate change by the world shifted towards quantifiable aspects of it like the severity of sea-level rise and temperature change emphasizing the need to recognize the nature of change. However, to effect substantial change, localization of issues related to slow-onset events becomes imperative and hence indicators may be designed considering the local factors. Addressing these concerns at a grassroots level, within our own communities, is pivotal. The ethos of 'think globally, act locally' encapsulates the essence. Sensitizing people at a local level emerges as a crucial step—a means to instill awareness and action within our immediate environments. It is within the precincts of our localities that the seeds of change must be sown, fostering a collective understanding and response to these global challenges.

What are the key action strategies for promotion of synergies between various schemes for promoting ecosystem-based approaches in agriculture and natural resources management?

The government remains receptive to refining scheme and policies, inviting diverse perspectives, inputs, and suggestions for improved policy implementation. There has been recognition that increased collaboration across departments yields enhanced outcomes, and for this, mechanisms exist to unite various ministries on a single platform, fostering effective and continuous collaboration. This commitment to cohesive action facilitates a shared space where ideas converge, ensuring a concerted approach towards better governance and impactful outcomes.

Considering the global population growth, how scalable and adaptable is sustainable agriculture in meeting the increasing demand for food while maintaining environmental sustainability?

The pace of population growth is slowing down, globally as well as in India. India's total fertility rate has dropped below 2.2%. In contrast to the India's growth rate of over 2% in the 1990s, now hovering slightly above 1%, thus exhibiting a reassuring trend. As per the projections, an annual rise of 2.25% is estimated in food demand in India. The surge in food demand is mainly driven by three key factors—population increase, the need to address deficits, and increase in income of individuals altering their consumption patterns. Agricultural growth exceeds 3%, granting a position where trade-offs between growth and sustainability become plausible. The balance between meeting escalating demands and ensuring environmental sustainability becomes pivotal in navigating India's future food landscape.

Can you discuss the economic viability of sustainable practices in agriculture for farmers and how the current policies can be strengthened?

Viability, when viewed through a financial lens, appears as a constructed notion. Practices deemed desirable but not economically feasible can be rendered viable by adjusting prices. Implementing mechanisms to compensate policies offers a pathway to viability. For instance, crops like legumes, which enrich rather than deplete soil (by fixing nitrogen), could receive incentives for chickpea crops. This approach ensures that practices beneficial for sustainability but potentially challenging economically can find a foothold, encouraging their adoption and contributing to a more sustainable agricultural landscape.

What measures can be taken to address issues related to market forces promoting monoculture and associated socio-political challenges faced by farmers?

Cropping choices are largely determined by input/output prices and to some extent influenced by technology, shaping the agricultural patterns. The historical response to food shortages has led to the Green Revolution in India, emphasizing individual crop production. Over time, the focus shifted from 'cropping systems' to 'farming systems', now encompassing broader 'food systems'. Such levels of integration yield favourable outcomes; transitioning from single to mixed crops and further to diverse crops demonstrates its long-term benefits. Incentives embedded within these systems play a pivotal role. With the current surplus, trade-offs favouring diversified systems become feasible. While small-scale monocropping is not detrimental, when done on larger areas risk disease outbreaks and biodiversity loss. Scaling considerations underscore the importance of crop diversification. Ongoing endeavours aim to dilute crop concentrations, fostering diversity. This deliberate shift aims to mitigate risks associated with extensive mono-cropping, promoting resilient and sustainable agricultural landscapes.

What are your key takeaways from COP28?

My major key takeaways from COP28 are:

- COP28 marks a significant shift by including agriculture and food systems in discussions, a previously overlooked domain. This recognition is pivotal in addressing global challenges. India is yet to sign any agreement on it.
- Encouragingly, there has been some level of agreement and traction towards phasing out fossil fuels, signalling a progressive stance towards sustainable practices.
- Amidst on-going global conflicts, the achievement of consensus and agreements within COP28 is commendable and credits have to be given for that. This underscores the significance of international cooperation, fostering dialogue despite geopolitical tensions.

Such negotiations and discussions are a testament to the dedication to finding common ground, bridging differences in pursuit of shared goals.■

We Must Change to Mitigate Climate Change

In this colloquy, **Deepali Khanna**, Vice President–Asia, The Rockefeller Foundation gives her insights on the significance of the leadership while dealing with climate change and sustainable development. She is of the opinion that addressing these global issues demands a leader capable of thinking and acting beyond local or national interests. To realize this ambition, we need to identify and scale the most promising climate solutions, operating, and investing in innovative ways to augment transformations and catalyzing actions.

What, in your view, defines effective leadership in the context of sustainable development and climate justice?

Effective leadership in the context of sustainable development and climate justice is multifaceted, involving a complex interplay of attributes and actions. Central to this is a 'big bets' mind-set, a belief that seeking to solve problems boldly, rather than settle for incremental improvements, will attract partners with the capacity to achieve transformational change.

Equally crucial is the leader's capacity to bring together a diverse range of stakeholders, often from sectors that traditionally do not collaborate. This involves bridging gaps between government entities, private companies, non-profits, and communities. An effective leader in this field recognizes that complex problems like climate change require multi-sectoral solutions and can facilitate such cooperation.

Inclusivity is another key trait. Leaders must ensure that voices traditionally marginalized in environmental discourse, particularly those of women, young people and local communities, are not just heard but are integral to decision-making processes. This approach acknowledges the disproportionate impact of climate change on certain groups and ensures that solutions are equitable and effective at the grassroots level.

Transcending boundaries, both geographical and disciplinary, are also vital. Climate change and sustainable development are global issues that demand a leader capable of thinking and acting beyond local or national interests. This requires a deep understanding of international dynamics and the ability to negotiate and collaborate across cultures and political divides.

A sense of urgency is another defining characteristic. The rapidly escalating nature of environmental crises requires leaders who can act swiftly and decisively. However, this urgency must be balanced with thoughtfulness to avoid unintended consequences.

Translating words into action is where many leaders face challenges. Effective leadership means being able

to convert ambitious plans and policies into tangible, impactful actions. This involves not only strategic thinking but also operational acumen and the ability to drive and manage change.

Lastly, stronger accountability is fundamental. Leaders must be held accountable for their commitments to sustainability and climate justice. This involves establishing clear, measurable goals, transparently tracking progress, and being answerable to stakeholders, including the public. Accountability ensures that leadership is not just about setting agendas but also about achieving real, positive change in the world.

What are the implications of the conflict-ridden geopolitical situation in the world on climate change and sustainable development discourse?

In a conflict-ridden geopolitical environment, the focus often shifts from addressing climate change and sustainable development to immediate security concerns. This diversion of attention and resources undermines global efforts to tackle environmental issues. Climate change challenges, including its impacts on health, food, and energy systems, are exacerbated by conflicts. Disrupted supply chains and strained resources make it harder to cope with climate-induced pressures.

Economic strains from conflicts, like inflation and increased national debts, can also reduce the availability of climate finance. This particularly impacts developing countries that depend on external funding for climate resilience and adaptation projects. Their ability to implement effective climate strategies is compromised, leaving them more vulnerable to climate change's effects.

Moreover, geopolitical tensions hinder international cooperation, which is crucial for concerted climate action. Conflicts strain diplomatic relations, making consensus on environmental policies challenging. This lack of global collaboration slows down the progress in addressing climate change.

Lastly, conflicts can lead to increased exploitation of natural resources, further harming the environment and exacerbating climate change.

What role does the Global South play in propelling G20 leadership on climate commitments and sustainable development?

The Global South is already demonstrating leadership in this arena. The New Delhi G20 declaration, a historic consensus among parties, is a prime example. This declaration underlines both India's leadership and the commitment of these countries to spearhead initiatives and policies aimed at addressing climate change and sustainable development.

Further illustrating this leadership, the current Brazil G20 presidency is poised to effectively advance the agenda set forth by India. Brazil's role is particularly significant, as it represents a continuation and reinforcement of the momentum initiated by India, ensuring that the focus on climate and sustainable development remains at the forefront of the G20 discussions.

Looking ahead, the next G20 presidency will be held by South Africa, another Global South country. This succession of presidencies within the

Global South is not only symbolic but also strategic. It provides a continuous and focused drive to propel G20 leadership towards more robust climate commitments and actions towards sustainable development.

Key areas where this leadership is most needed include multilateral development bank (MDB) reforms and climate finance. These are domains where commitments have been made, but now require translation into concrete actions. The Global South, through its increasing influence and proactive approach in the G20, is well-positioned to advocate for and implement these necessary reforms and actions.

The Global South, with countries like India, Brazil, and South Africa at the helm of G20 leadership, is providing much-needed momentum and direction in the global effort to combat climate change and promote sustainable development. Their active participation and leadership are essential in ensuring that the G20 remains committed to and effective in addressing these critical global challenges.

How can leaders make sure that decisions they make take into account the long-term implications on the environment and help create a more equitable and sustainable future?

Leaders can ensure their decisions positively impact the environment and foster a sustainable future by adopting a forward-thinking approach centred on the well-being of future generations. This perspective involves envisioning a world that is not only prosperous but also sustainable and healthy. Utilizing sophisticated technology is crucial in this process, allowing leaders to make informed decisions based on data-driven projections and analyses.

Integrating sustainability into core decision-making processes is vital. This means considering environmental implications as integral to business strategies, policy development, and project planning. Collaborative approaches are also key, involving stakeholders from various sectors to foster innovative and inclusive solutions.

Continuous learning and adaptation are essential, with leaders staying informed and flexible to evolving environmental challenges. Setting clear, measurable goals and tracking progress ensures accountability and alignment with long-term sustainability objectives. Additionally, promoting public education and awareness about environmental issues encourages collective action towards a sustainable future.

Give an example of how or how your organization has integrated sustainable development and climate justice in your sphere of action/work/decision-making?

At The Rockefeller Foundation, we are deeply committed to leading the response on climate action. In September 2023, we announced an unprecedented commitment: an investment of over USD1 billion over the next five years to advance the global climate transition. We aim to bring the world together to address climate change in a more concerted manner and help seize the climate transition's opportunities and benefits for the billions of people who have historically been denied them. As part of this commitment, we are also prioritizing achieving a science-based net-zero standard for our operations globally and divesting our endowment from existing fossil fuel interests while refraining from future fossil fuel investments.

Our approach to climate justice isn't just about big investments; it's about integrating climate considerations across all aspects of our work to transform power, health, food, and finance systems. We aim to catalyze global action for solutions that will speed-up transformations within these systems. We believe that addressing climate change effectively requires a holistic approach that considers the intersection of people and the planet.

To realize our ambition, we are helping to identify and scale the most promising climate solutions, operating and investing in innovative ways to augment transformations, catalyzing actions through our convenings and our voice, and supporting big bettors.■

Contribution of Skilled Leadership Towards Addressing Sustainable Development and Climate justice

Dr Dhruba Purkayastha in this interaction with Neha Khanna, explains and emphasizes the significance of skilled leadership for suitably addressing sustainable development and climate justice. He also defines how roles, domains, and responsibilities in private sector are different from those of the public counterpart. Presently Dr Dhurba is engaged with Climate Policy Initiative (CPI), as India, Director. The CPI, a global non-profit research and advisory institution, dedicates itself towards streamlining sustainable finance and energy transition.

What, in your view, defines effective leadership in the context of sustainable development and climate justice?

We need clarity on context and understanding of sustainable development—is it SDGs or ESG? As it is often mistakenly understood.

Justice by ILO's definition has four pillars—recognition, distributive, restorative, and procedural. However, given the huge task in the Indian context justice also has component of social justice.

While green growth looks like a great pathway forward and yes, it is possible but not without adequate social protection in Indian context which is 14.5%, still below the poverty line. Further, those who have moved out but are still at the lower income levels are at a danger of falling below poverty line again if the approach to climate transition is done without climate justice. A holistic approach would be based on social protection. At high level and in the end, it is tradeoff between public goals—health, education, and environment—the balance is what I would call leadership in sustainable development.

What are the implications of the conflict-ridden geopolitical situation in the world on climate change and sustainable development discourse?

From the last GST COP it's clear that while many large developing countries are on track on NDC and beyond, the OECD countries are lagging. The lack of any mention of Article 6.2 or 6.4 was a big negative. While these may not be direct result of the conflict-ridden geopolitical situation, but the public resources of many countries are strained because of wars and likely to have an impact on the public finance contributions to

climate for addressing global commons (effectively get reduced) and would get directed to defence and security. Hence the fulfilment of the USD100 billion pledge is unlikely to happen. So, while the world needs finance flows towards climate to increase, the increase may not be witnessed.

What role does the Global South play in propelling G20 leadership on climate commitments and sustainable development?

While the problem of climate is a result of the stock of GHGs, and consequent carbon budget available, the solution is being addressed through flows/ emissions as there is hardly any viable technology around reducing stock of GHG (except forests as a carbon

sink). Global South has much smaller contribution to the problem, but they have become a part of the solution for this global public good and have been seen to take leadership through G20. Indonesia, India, and Brazil have led and are leading the change on trying to ensure climate commitments are met. Ideally Global North needs to commit a specific percentage of GDP to a global public finance pool dedicated to climate investments but even the USD100 billion commitment per annum (which is miniscule) is looking unlikely to happen. A recent landscape report highlighted that total flows towards climate are at 1% of GDP, which is insufficient.

How can leaders make sure that decisions they make take into account the long-term implications on the environment and help create a more equitable and sustainable future?
Leadership in public and private sectors have to approach these issues a little differently. Public leadership needs to understand and apply that, the issue of environmental sustainability has long-term irreversible impacts because of economic and policy actions taken in the past and present, hence, it is called the Tragedy of Horizons. Therefore, policymaking horizon needs to focus beyond five years and needs to focus on inter-generational equity. On the other hand, private sector leadership needs to institutionalize the internalization of negative externalities caused by private industries. That can be done through carbon price, costing, internal carbon, pricing, etc. Above all, finally environmental governance needs

to improve through standards and implementation of those standards.

How do you envision integrating sustainability across policies, industries, and sectors?
The change needs to begin from the top, with change in thought at the leadership level. This needs to be followed by setting stringent standards and their enforcement. Sustainability is not outside daily life, but rather a part of it and this needs to be imbibed across industries, sectors, and geographies. Overall, we need an enhanced environmental governance policy, institutions, and regulation. And complement same by citizen-led movement on environmentally sustainable lifestyles and embodies in Government of India's LiFE initiative.

Give an example of how your organization has integrated sustainable development and climate justice in your sphere of action/work/ decision making?
CPI's work in India focuses on developing innovative finance and policy solutions that support equitable green growth and transition plans. It works at the confluence of human and earth systems ensuring that the solutions or pathways propagated by it are as much people-centric as they are climate-positive. Two such programmes are: India PURE Finance Facility: the project preparatory facility is catalysing long-term equity and debt financing from domestic and international financiers for promoting productive use of renewable energy (PURE) in rural and semi-urban centres. The programme is also facilitating transition from fossil fuel-run processes and equipment to use of clean energy-based electricity, resulting in the abatement of emissions; these productive uses have the potential to generate and support livelihoods and foster inclusive economic growth.

Just Transitions: the project is about designing an institutional framework for addressing the adverse social and economic effects of energy transition—Just Transition Finance Facility—which would support low-carbon transition in a fair and equitable manner at sectoral and sub-national levels. It aims to support the Jharkhand state government in designing suitable policies and programmes by developing differentiated approaches; enabling discussions with relevant stakeholders; facilitating capacity-building, and skilling solutions while driving economic growth and development.■

Sustainable Energy in a Conflict-ridden World

Arne Walther, via this article, makes us aware how climate security is a national interest but cannot be delivered by national governments on a unilateral basis. It is a global responsibility. The impact of climate change does not recognize national borders. Multilateral action must heed to the differentiated responsibilities of countries taking into account their national circumstances. The Global North must step up its financial and technological support to the Global South at a scale that has so far not been available. We need more energy to fuel global economic and social development. But it must be cleaner energy, used in a more efficient way, accessible and affordable for all.

War continues between Russia and Ukraine in Europe and between Israel and Hamas in Gaza, both without any early end in sight and both with potential to spin into wider regional conflict. The fighting, the loss of lives, and devastation are local, but the disruptive economic, social, and political impact is global. These media headline wars must not let us lose sight of the many other conflicts that simmer, erupt and are allowed to continue as everyday occurrences elsewhere. Times are hot not only geopolitically, but also climate wise. Last year was the hottest year on record, this year probably hotter. We are mismanaging the environment to the peril of our planet.

A gloomy backdrop, indeed, as Indian and international stakeholders gathered to address all the more purposefully 'Leadership for Sustainable Development and Climate Justice' at TERI's 23rd World Sustainable Development Summit (WSDS) in New Delhi on 7–9 February 2024. Deliberations highlighted progress and achievements so far and reconfirmed the aspiration to do much more.

The future comes by itself. However, a fair and sustainable one does not. We are in transit to a new-normal entangled in a web of 'polycrises' mostly of our own human making with aggravated here-and-now uncertainties for countries, business, society, and individual citizens. A time of geopolitical change, economic change and climate change. A time of political polarization, technological disruption, pandemics and increasing disparities and inequality in and among nations. We are all in the same boat. But the boat is leaking and blown off course. It is not good enough just putting on lifejackets and sitting still.

We must navigate through what are set to be increasingly turbulent times. International cooperation, visionary leadership, and innovative policies are called for.

The challenges are global, geopolitical dynamics are pushing multilateral approaches to the backburner. We need more, not less, cooperation to reach our UN sustainability goals. The Global North must listen more closely to the Global South as it speaks up on the global stage. With its Presidency of the G20 last year and being the 'Voice of the Global South', India has raised awareness of the interests of the Global South in the evolving world order.

In these disruptive times, citizens expect their governments to deliver many types of security. Military security, economic security, energy security, social security, food security and not least in our-day climate security. Delivering on one form of security, governments must take care not to jeopardize others, interconnected as they are. Addressing the energy trilemma—energy security, environmental sustainability, and economic affordability—is as crucial as it is complex.

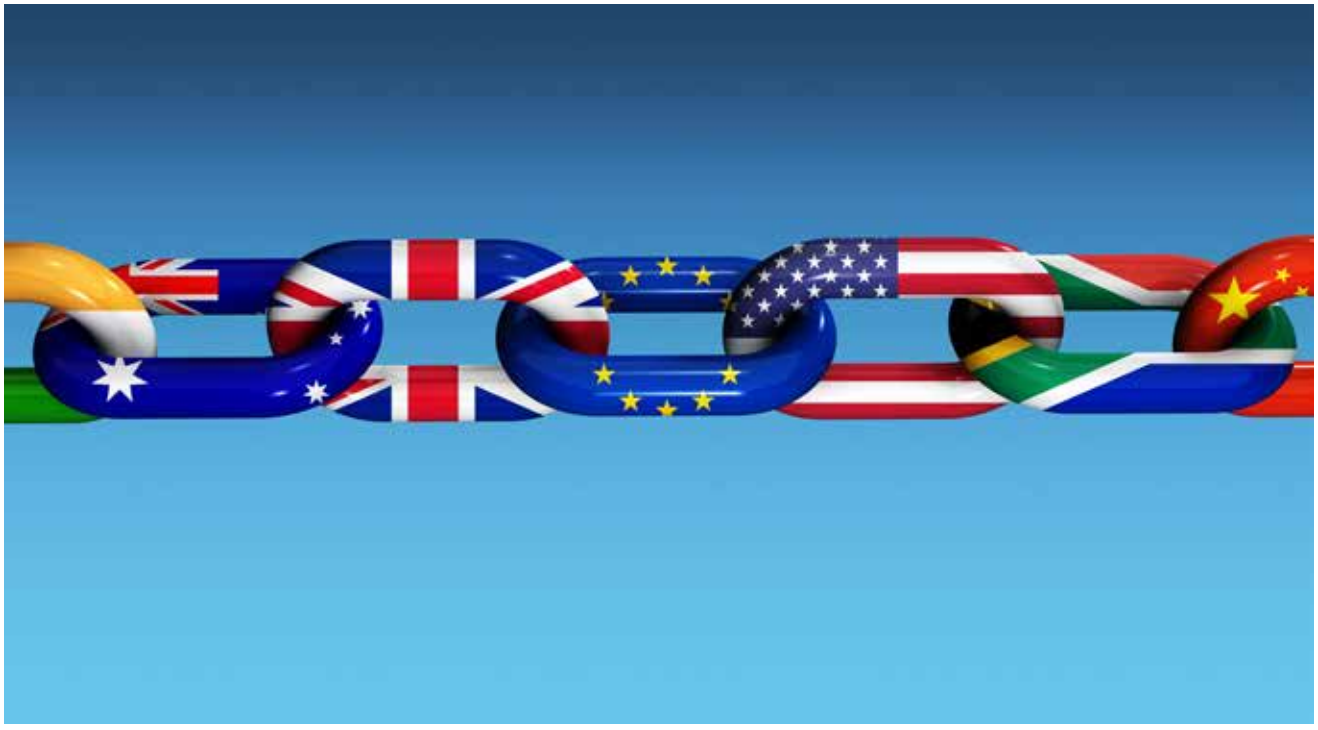
The Elephant Told to Leave the Room

Against a troubled geopolitical backdrop, flickers of light emerged from the climate negotiations at COP28 in Dubai in December 2023. Multilateral efforts for a sustainable future are still alive and even kicking. For the first time, countries agreed in a consensus statement on the need for 'transitions away from fossil fuels in energy systems in a just, orderly and equitable manner'. Fossil fuels, the elephant in the room, have now been given public notice to leave. And direction was given for phasing in green energy production, distribution, and use.

The ambition is clear. But pledges lack a global enforcement mechanism. There could still be some implementation devils hidden in the COP28 outcome call on "Parties to contribute in a nationally determined manner, taking into account the Paris Agreement and their different national circumstances, pathways, and approaches". This must not be a temptation to pursue 'business-as-usual' energy policies.

Climate security is a national interest but cannot be delivered by national governments on a unilateral basis. It is a global responsibility. The impact of climate change does not recognize national borders. Multilateral action must heed to the differentiated responsibilities of countries taking into account their national circumstances. The Global North must step up its financial and technological support to the Global South at a scale that has so far not been available. Here, COP28 signalled progress on its very first day by creating a milestone Loss and Damage Fund to support developing countries hit by climate change.

Despite all the pledges by countries and all achievements so far, the COP global stock-take acknowledges that much remains to be done. We are not on track to meeting the ambitious global



emissions' and climate targets that would bring the world to carbon neutrality by 2050 and limit global warming to 1.5 degrees Celsius above pre-industrial levels by the end of the century. Setting ambitious goals is good. Achieving them through workable solutions in multilateral effort is much better.

Call of the Day

We need more energy, not less, to fuel global economic and social development. But it must be cleaner energy, used in a more efficient way, accessible and affordable for all.

Despite all that is being done to develop and scale up renewable energy options, and contrary to climate ambition, global demand for fossil fuels is now increasing and that at higher price levels. We need both energy transitions and energy additions. Increasing global energy demand increases the urgency of energy transitions away from fossil fuels, today still accounting for some 80% of the global energy mix.

Global transitions to renewable and cleaner energy is the call of the day for reducing carbon emissions and mitigating global warming. There is no 'one-size-fits-all' for energy transitions as governments address the dual challenge of energy and climate security. New opportunities will be created along with both new energy partnerships and new energy dependencies, vulnerabilities, and challenges replacing or adding to old familiar concerns. A new range of essential minerals, metals, material, and technology will be needed and traded. This, too, will impact the new geopolitics of clean energy, while the old geopolitics of oil and gas will linger on side by side for quite some time.

In a conflict-ridden world, geostrategic polarization and weaponization of energy for political purpose may disrupt markets and patterns of trade causing sky-rocketing energy costs and slowing the pace of transitions to greener energy. Instead, we need more, not less, international dialogue and cooperation. Energy transitions cannot be left to market forces alone. Governments must play their part by providing incentives and framework conditions that 'nudge' industry in the sustainable direction. A new global, public–private energy partnership, the likes of which we have never seen before, is required to accelerate just transitions to a greener and sustainable energy future. ■

Ambassador Arne Walther, Member, International Steering Committee for TERIs World Sustainable Development Summit (WSDS); Walther International Consulting

Transparency for Just Transitions

In this stimulating article, **Dr Wuester**, communicates about the relevance of transparency in just transition in the sphere of climate and development policies. As per him—transparency and data are the determining factors in ensuring a transition towards a low-carbon, climate-resilient economy. Transparency is crucial for engaging stakeholders, and bringing them along through the transition.

The themes of just transition and climate justice are central to achieving global climate objectives. As such, it was a good sign that just transitions took centre stage at COP28 in Dubai, not only in sessions specifically on the Just Transition Work Programme, but as a red thread throughout most discussions held at the conference. The concept of just transition and the goals a just transition should pursue— leaving no one behind, reducing inequalities, equitably distributing benefits and burdens—have become increasingly well-defined and widely understood in recent years.

How can just transition goals, such as enhanced inclusion and reduction of inequalities, be embodied in the planning and implementation of climate and development policies themselves? Countries around the world are currently trying to answer these questions, many supported by the guidance and tools developed by the Initiative for Climate Action Transparency (ICAT).

The ICAT has drafted a still to be published methodological framework for assessing just transition impacts and is working with the governments of Nigeria and South Africa to implement it in their respective countries. At a

COP28 side event, representatives of the governments of the two countries, along with several other stakeholders, discussed what they have learned thus far from their efforts to develop monitoring, evaluation, and learning frameworks for the just transition. These three key learnings are briefed here:

Just transitions cannot succeed without transparency

Transparency and stakeholder inclusion in just transition processes are crucial to ensure accountability, legitimacy, and credibility of climate actions. These in turn build the broad public support and ownership that are necessary to sustain deep and sustainable transformations to low-carbon economies. Transparency and stakeholder engagement must be pursued continuously from the very first planning stages to monitoring and evaluation.

In South Africa, planning and measuring the implementation of the just transition is the responsibility of the Presidential Climate Commission (PCC). The PCC reports directly to the President and comprises government ministers, civil society groups, labour, academia, traditional leadership, and business.

"It is by default forming the social partnership to accelerate the just transition and bringing these groups together to forge consensus around the difficult trade-offs that the transition will bring," Katie Ross, Monitoring and Evaluation Lead at the PCC highlighted at the COP28 side event.

The PCC seeks to embody the principle of procedural justice also by pursuing transparency: all commission meetings are broadcasted live.

In Nigeria, the government identified and engaged relevant stakeholders during the first phase of the development of its just transition monitoring framework. In a country, as diverse as Nigeria, one of the key approaches to transparency is inclusivity because without transparency, stakeholders cannot be brought along in the process. It is expected that this scoping and engagement will have a big impact on implementation of the strategy; stakeholders now feel part of the development of this document, which increases its legitimacy.

During the COP28 session, Nigeria's Peter Tarfa, encouraged other countries undertaking similar journeys to "think very deeply when they are determining their own criteria and how they map their own stakeholders. This is very important, because once there is no transparency, you will not be able to carry the stakeholders along."

The Nigerian Government also encouraged extensive media coverage

of the process so that the general public was kept informed of what their government was doing to develop a framework for a just transition.

Using indicators to demonstrate impact helps build acceptance of policies from stakeholders that could be negatively impacted by the changes

The labour force is one of the groups that could be most impacted by the transformations needed to address climate change, and engaging them from the beginning will improve understanding and buy-in. In Nigeria, this was particularly evident, because

the Nigerian labour force—represented by Nigeria's Labour Congress—felt a large sense of involvement in the project, when they were included in stakeholder consultations.

The views of the Labour Congress of Nigeria during the COP28 session were positive. Eche Asuzu, Climate Change Coordinator of the Labour Congress explained the outcomes and implications of worker engagement: "Workers in Nigeria felt a huge sense of involvement in the project. Commitment to transparency has been very high and doors have been opened."

However, Eche Asuzu stressed the need for planning to be followed by action, with the continued involvement of workers. The doors must be kept open and legislation should be changed to address the health, economic, and livelihood effects of climate change that workers are experiencing.

"We want to see the laws begin to speak that language, [so that] workers can look at it and say: yes, we are fully represented," he stated.

Countries can use existing indicators and monitoring processes

Most of the indicators required to track just transition progress are already in use. What's important is to build a bridge between the indicators of an environmentally driven process and those related to labour and human rights. The issue in many countries is that this data is usually held in different places. But once it is found and the connections are made, gaps can be identified where new indicators are needed. This is an important insight from experience in Scotland, shared by Prof. Nick Robbins, Commissioner on the Just Transition Commission in Scotland.

To address climate change, we will need transformational change. For all countries, transformational change means economic changes are needed, and some of these will impact development positively, and some will do so negatively. To make transformational change feasible, we must address the negative aspects, and amplify the positive ones. Transparency is essential in this process: it is a building block to ensure transformational change while leaving nobody behind. It helps to build confidence by those that are most affected by the policies and actions put in place to bring about that transformational change. ■

Dr Henning Wuester, Director, Initiative for Climate Action Transparency

The Government Must Adopt 'Biodiversity Offsetting' in Compensatory Afforestation Programmes

In this absorbing piece of writing, **Debadityo Sinha**, reveals his experiences of compensatory afforestation programmes. He opines—species and habitat loss are irreversible consequences of converting forest land for developmental activities, any compensatory afforestation initiative's success must prioritize biodiversity restoration, using local ecological history as the reference ecosystem.

The loss of forests and biodiversity stands out as a significant consequence of various developmental activities, particularly in mining, power generation, and linear projects. India reportedly ranks second in recent years regarding forest loss. To regulate the forest lost during developmental activities, the Van (Sanrakshan Evam Samvardhan) Adhiniyam 2023 obligates the user agency to compensate for non-forest activities by planting trees elsewhere. Commonly known as 'compensatory afforestation' (CA), this involves allocating funds to the Compensatory Afforestation Fund, established under the Compensatory Afforestation Fund Act of 2016. Procedures for implementing CA and subsequent monitoring are outlined in the Van (Sanrakshan Evam Samvardhan) Rules 2023 and the Compensatory Afforestation Fund Rules 2018, respectively.

In practice, CA often focuses on planting fast-growing species resilient to fire and drought. Recently, there's also been a shift towards recognizing the carbon sequestration benefits of afforestation. However, this approach falls short of addressing the ecological restoration necessary to compensate for actual losses in biodiversity and ecosystem services due to habitat conversion for developmental activities. This oversight stems from the misconception that successful afforestation is solely measured by the number of trees planted, disregarding the essence of a forest—its diversity of flora, fauna, and ecosystem services. For instance, planting trees in water-scarce regions can worsen droughts and significantly alter soil characteristics. The predominant focus on top canopy trees neglects the diverse components of a natural forest including canopy, middle story, under story and ground vegetation, and hardly supports wildlife. Such plantations do not contain the structural complexity and diversity of natural forests. Afforestation programmes in India, both government and privately funded, often harm local ecology in the designated plantation sites, negatively impacting local biodiversity and depriving communities of essential ecosystem services.

Recognizing that species and habitat loss are irreversible consequences of converting forest land for developmental activities, any CA initiative's success must prioritize biodiversity restoration, using local ecological history as the reference ecosystem. Global organizations like the UNDP and IUCN recommend incorporating 'biodiversity offsetting' measures in the decision-making and planning stages to mitigate unavoidable negative repercussions of development projects on species and ecosystems. The goal is to ensure no net loss in biodiversity and, optimally, to foster a net gain resulting from these developmental activities.

Incorporating 'biodiversity offset' into current CA programmes and other government plantation schemes can significantly change how we plant trees on the ground. These changes surpass traditional measures like counting trees and trapping carbon, offering extra benefits for biodiversity and ecosystems, ultimately benefiting local communities. This also ensures that compensation efforts are sustainable in the long run, responsibly utilizing public funds.

Many countries have already adopted biodiversity offsetting as part of their laws and policies. For example, Australia has a detailed offset policy at national and local levels under the Environmental Protection and Biodiversity Conservation Act of 1999. The Federal Government of the United States also has a 'no-net loss' wetlands policy, aiming to balance the Clean Water Act's requirements.

According to the World Bank, biodiversity offsetting relies on three main principles: additionality, equivalence, and permanence.

Additionality: Biodiversity offsets should result in extra-conservation benefits compared to what would happen without the offset, going beyond gains achieved through ongoing or planned activities not part of the offset.

Equivalence: Biodiversity offsets must aim to preserve the same biodiversity values lost due to the original project, maintaining a balance in conservation versus impact.

Permanence: Biodiversity offsets are expected to last at least as long as the negative impacts on biodiversity from the original project, ensuring lasting benefits to the environment.

For instance, consider a port development project that poses a threat to the habitat of Leatherback Sea Turtles along a coastal region. Compensation efforts should involve the establishment and preservation of a new habitat in a similar ecosystem. If an equivalent habitat for the same species is unavailable, the compensatory measure should prioritize the creation and protection of a habitat for the most closely related turtle species within a similar ecosystem. It's crucial that this compensation doesn't involve substituting with different species, such as tigers in Central Indian forests. Moreover, it should not be carried out in a location where the species is already found or well-conserved.

In cases where the compensatory site already has a pre-existing population of the target species, the focus should be on enhancing the habitat, ensuring a net gain in the species population, and maintaining it at the user agency's expense throughout the port's lifespan. If, due to unavoidable circumstances, CA must occur in an ecosystem significantly different from the original, success should be measured by the revival of the population of a threatened species native to that specific ecosystem. For example, if the CA site is in a scrub forest in Madhya Pradesh where the historically native and now critically threatened Great Indian Bustard (GIB) used to live, the success of such CA should be evaluated in terms of restoring the local flora and fauna, with the net population gain of GIBs serving as one of the indicator species.

As per Vidhi Centre for Legal Policy's annual Briefing Book *The State Shall: 25 Reform Ideas for 2024,* the following road map may be followed to integrate biodiversity offsetting principles in CA programmes in India:

1. The National Biodiversity Authority (NBA) should collaborate with leading research institutions to develop a National Biodiversity Offsetting Framework. This framework should establish core principles and processes for CA programmes in India, considering factors like local ecological history, species representativeness and rarity, and the ecosystem service requirements of communities. Additionally, a separate guidance manual on biodiversity offsetting will be available for voluntary adoption by other plantation programmes, including those under government schemes and CSR initiatives.
2. The Ministry of Environment, Forest, and Climate Change should amend the Van (Sanrakshan Evam Samvardhan) Rules, 2023 and the Compensatory Afforestation Act to make 'biodiversity offset' a mandatory requirement for evaluating the success of all CA projects instead of forest diversion for development. Additionally, privately funded plantations must be incentivized for 'biodiversity offsetting' by amending the proposed Green Credit Programme Implementation Rules, 2023.
3. NITI Aayog, in consultation with the NBA, should establish biodiversity richness as a Key Performance Indicator (KPI) within the Aspirational District Programme. The Central Government can then use this KPI to allocate funds to local bodies in the annual budget. This approach will motivate and incentivize local bodies and states to prioritize biodiversity in their forest management plans and afforestation initiatives. ■

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The Quest for Holistic Climate Leadership Amidst a Global Polycrisis

Climate leadership has been widely discussed in climate policy research mainly from the perspective of large actors. What has been less analysed is governments' ability to lead in solving the daunting challenge of a climate transition that also attains nature conservation and social justice. In this article, **Solveig Aamodt,** stresses on the responsibilities of an ideal leadership in the mankind's quest for climate leadership.

For climate and environment researchers, 2024 marks one year closer to 2030. Under the Paris Agreement and the Kunming-Montreal Global Biodiversity Framework, the global community has set targets for 2030 to remind ourselves of the urgency for action. In six years all countries need to have implemented considerable changes and put us on the track for reaching the overarching climate and biodiversity goals. Six years is a short time in politics, and global leadership is urgently needed, but hard to find.

Climate leadership has been widely discussed in climate policy research. The climate leadership (or lack of such) of large actors like the United States (Eckersley, 2020), China (Hurri, 2020), the European Union (Oberthür and Dupont, 2021), and India (Mohan and Wehnert, 2018) has been evaluated with reference to their ambitions to reduce greenhouse gas emissions, willingness to lead by example, ability to persuade others, and commitment to strong agreements. What has been less analysed is governments' ability to lead in solving the daunting challenge of a climate transition that also attains nature conservation and social justice.

From a social science perspective, there are two main approaches to a climate transition—a technological shift away from fossil fuels and a considerable behavioural change. We need a combination of the two, but so far the majority of political efforts have been geared towards the techno fix. Electrification, solar and wind power, batteries, carbon capture and storage, and hydrogen are the preferred solutions for all the major actors in global climate governance. Although, we need technological development and a massive shift towards renewable energy sources, a transition focusing only on emission reductions comes with considerable trade-offs related to other Sustainable Development Goals (SDGs).

To ensure that the climate transition does not leave us worse off in terms of nature conservation and social justice, we need governments to make bold and concrete decisions on what to preserve and how resources should be distributed (and redistributed) in tandem with reducing emissions. In their geopolitical scenarios for global energy transition, Bazilian, Bradshaw, Gabrial, *et al.* (2019) argue that a consensus-oriented multilateral approach is our best chance of reaching a climate transition

in line with the SDGs. Unfortunately, the geopolitical situation at the outset of 2024 is not following that scenario.

Winkler and Jotzo (2023), among others, refer to the current geopolitical situation as a 'polycrisis'. Wars and mistrust aggravate global health, food, and climate challenges, and create increased rivalry over the resources needed to meet these challenges. First, the war in Ukraine and its geopolitical repercussions demonstrate that what was once understood as a liberal international order of trade, rules-based regimes, and power balance is probably gone. But the global interdependence is still there. Second, the traditionally strongest proponents of the liberal order have demonstrated a stunning lack of defence for international law in their reactions to the bombing of civilians in Gaza, displaying the shortcomings of the UN-led multilateral system. Third, the increase in green technology requires unprecedented need for minerals, shifting the power balance between the haves and have-nots of these minerals. Through its 'belt and road' strategy, China has secured trade relations with the world's

largest mineral producers, and the United States has launched its Minerals Security Partnership to counter China's control over global minerals.

It thus seems like the space for agreeing on a holistic, multilateral approach to attaining global climate, nature, and social justice targets is meagre. And the mentioned large actors that could have taken strong leadership, are seemingly more preoccupied with competing for resources and influence. At the start of a new year one must nevertheless also highlight the possibilities for new initiatives and breakthroughs, and allow ourselves to have three hopes for climate leadership in the year ahead.

First, three major actors have the possibility to lead the way in 2024. India has a long tradition for seeing climate in integration with other development goals, and is the only BRICS country in the Minerals Security Partnership. India thus has the opportunity to push for sustainable and democratic approaches on both sides of the rivalry. Another major BRICS member, Brazil, is now back after four years of climate neglect. Deforestation rates in the Brazilian Amazon are again decreasing, and Brazil is in a unique position for uniting tropical forest countries in a global effort to reduce deforestation while considering the contributions and interests of indigenous peoples and local communities. In implementing its European Green Deal, the European Union has a similarly unique opportunity to show how the buzzwords of 'circular economy' and 'just transition' can actually be realized. Although new minerals will have to be mined, a breakthrough in re-using resources is most urgently needed.

Second, the COP28 decision to 'transition away from fossil fuels' is a major signal to finance and business communities. At the same time, 'nature-neutral' and 'nature-positive' have become buzzwords in investment communities. The march of investments away from fossil fuels and towards green projects must therefore thoroughly assess nature footprints in addition to carbon footprints. Business usually moves faster than politics, and global investors have the opportunity to take the COP28 signals literally, and kick the ball in the right direction.

Finally, neither governments nor companies are likely to take on ambitious climate leadership without strong watchdogs to hold them accountable. The role of civil society is crucial. Communication technology enables stronger civil society cooperation across borders, strengthening of democratic organizations, and sharing of information. Together with journalists and researchers, environmental and indigenous activists can reveal cases of greenwashing and human rights violations in allegedly green projects, but also highlight public and private sustainable leadership. Geopolitical rivalry manifests in local land conflicts, and local opposition to environmentally and socially harmful mineral extraction and other infrastructure projects are not only legitimate, but probably also urgently necessary for the survival of nature and its life-essential services. Let's hope for 2024 that local and indigenous knowledge of nature and resource distribution 'trickle up' to the tables of global governance.

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Leadership for Sustainable Development and Climate Justice

Effectuating a paradigm shift of the proportions which climate change demands, requires a departure from conventional models of decision making, which places long-term gains above short-term windfalls, and calls for a holistic approach in the light of economic, social, and environmental dimensions. Via this opinion piece, **Arun Awasthy**, enlightens us about how effective leadership can guide us towards a sustainable future!

For several years now, the global issue of climate change has been looming large, threatening our very existence. With each passing year, as the urgency grows, so do the mitigative actions demonstrated across the globe. Today, the need for urgent and decisive climate action has become pronounced than ever, demanding a paradigm shift in leadership across sectors that seek to steer humanity towards a more sustainable and equitable future.

There is an overwhelming amount of evidence of global commitment towards achieving net-zero emissions, and moreover, a unanimous agreement on the framework within which to reach said goal, exemplified by the Conference of Parties (COP) instituted under the United Nations Framework Convention on Climate Change (UNFCCC). Being the world's only multilateral decision-making forum on climate change and an almost complete membership of every country in the world, the COP offers a platform for the world to congregate to strategize and agree on ways to address the climate crisis, help vulnerable communities adapt to the effects of climate change, and achieve net-zero emissions by 2050.

Back to Basics: Energy Efficiency

The pathways towards a sustainable and green future are aplenty. Whether it is increasing reliance on green and renewable energy sources, responsible water and waste management, green industrial practices, there is no one right answer. In this context, the discourse around expanding renewable energy capabilities in India has gained considerable momentum.

India's energy ambitions are formidable, catapulting it to the forefront of renewable energy adoption. The fourth largest player in renewable energy installed capacity, India has set bold targets for the future, including the installation of 500 gigawatts of renewable energy capacity, annual production of 5 million tonnes of green hydrogen and plans afoot to cut carbon emissions to the tune of a billion tonnes by 2030. While this is underway, there is a low-hanging fruit that requires equal attention—energy efficiency.

In the present-day context where the price of renewable energy is affordable, to inculcate an energy efficiency mind-set can appear to be an uphill task. The sense seems to be that if cleaner energy sources to replace fossil fuels are

available and economical, consciousness around conserving energy would inevitably take a backseat. However, there needs to be a kaleidoscopic shift in perspective here. Consider this: if we were to have a leaky bucket, wouldn't it be prudent to fix the problem at its source rather than continuing to (invest in) pour water in it? In order to manage the demand on renewable energy and factor in the environmental and financial benefits, expanding our renewable energy capacity must take place alongside efforts to become more energy efficient.

This view is further validated by the recently concluded COP28, where recommendations on energy efficiency and renewables were made. The resultant pledge as pertains to energy efficiency was to double the global average annual rate of energy efficiency improvements from around 2% to over 4% every year until 2030 in order to meet the collective goal of the Paris Agreement to keep warming well below 2°C.

Greenfield for Greater Energy Efficiency

There is no dearth of strategies to achieve greater energy efficiency, ranging from energy-efficient appliances, LED lights, and construction, to name a few. But the true greenfield in this regard is the energy-efficient buildings, achieved through technology. Buildings, the physical foundation of community living, are crucial to our everyday lives. It is where we live, work, study, and conduct every conceivable 'indoor activity', in short, spend about 90% of our time. Buildings today account for nearly 40% of global emissions owing to operational inefficiencies and inefficient heating and cooling systems. It is incumbent upon us to solve for this with immediate effect. Concentrated efforts to reduce building emissions can shift the needle significantly in India's path to achieving net-zero emissions, and the opportunity therein is ripe on two counts.

The first is that the technology exists, evolving to greater levels of sophistication at a rapid pace. The second is that according to some estimates, approximately 70% of India's buildings are yet to be built! So far, technological advancements have already made inroads into enhancing building efficiency in many ways. Advanced building management systems have been effective in enhancing security and improving maintenance. Owing to its AI/ML capabilities, these systems can analyse occupancy patterns to then make real-time adjustments to heating and cooling systems, yielding a potential energy savings of up to

15%. Furthermore, through sensor data, predictive analytics, and machine learning, these systems equip buildings with the ability to conduct proactive maintenance, thereby reducing costs significantly. As technology and artificial intelligence (AI) evolve, the impact will no doubt be magnified multifold.

At this juncture, it must be acknowledged that India does face some challenges with respect to adoption of green buildings. Broadly, these include (i) lack of awareness, (ii) limited availability of suitable data, (iii) limited talent pool and knowledge programmes, and (iii) lack of a single consolidated standardization framework. However, the potential for addressing these challenges as we go forward in our mission to achieve net-zero emissions is vast, and it effectively boils down to leadership.

Leadership at All Levels

Effectuating a paradigm shift of the proportions which climate change demands, requires a departure from conventional models of decision making, which places long-term gains above short-term windfalls, and calls for a holistic approach that considers the economic, social, and environmental dimensions of their actions. This requires effective leadership across all levels—from the top-most levels of government to the corporate ecosystem—which recognizes the fundamental truth that everybody has the right to a sustainable future!

In the corporate realm, sustainable leadership is reflected in a commitment to environmentally friendly practices, responsible resource management, and a shift towards circular economies, besides enabling communities. Indian companies today are moving beyond profit-led considerations and increasingly recognizing the importance of corporate social responsibility and ESG commitments, understanding that their success is intertwined with the well-being of the planet and society.

Leadership at the level of government requires foresight, political will, an unwavering commitment to crafting policies that balance economic growth with ecological responsibility and enforcement of these policies and practices. India's policy framework has demonstrated a clear intent towards achieving its climate goals, as exemplified by the 'green-growth' initiatives announced during the FY2023/24 Union Budget, and other initiatives as well. More recently, India's leadership in the G20 has come in at an opportune moment, empowering the nation to effect tangible change in this regard.

However, challenges at the level of implementation do exist owing to the decentralized nature of governance and gaps in proficiency. However, taking a leaf from global success stories, such as in the case of the European Union, which places adequate policy driving powers down the flagpole, India can seamlessly overcome these challenges. India's actions thus far have strengthened its position within the Global South significantly, further enhanced by its presidency in the G20. In this regard, India's leadership in mitigating the climate crisis may well serve as a blueprint for its neighbouring countries.■

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The Faces of Climate Leadership

A Constructive Approach Towards Changing Capitalism and Consumerism

Article by **Varun Grover** is a significant addition to our awareness on climate leadership. The author is of the opinion that younger generations are the torch-bearers for the future. Taking the leadership path brings with it the responsibility to represent and work for ones who are less privileged and vulnerable. A shift and reduction in consumption is the parameter that needs to be added to our decision making.

Climate change, sustainable development, and sustainability have become the buzzwords and these concepts are no longer alien to many. The increased intensity and frequency of extreme weather events and changing weather patterns have further enhanced the belief in climate change. Almost all countries recognize both importance and urgency of fighting against global warming, climate change, and achieving Sustainable Development Goals. However, there are and will remain significant differences on how these climate change goals, net-zero targets will be achieved, how the cost of these will be shared, technology transfer, and more.

But the reality is we live in a polarized world and conflicts between cultures, geographies, and generations have started to increase. Thus, everything transforms into geopolitical issue, often climate discussions and negotiations fall prey to these. This often leads to trust deficits and slows progress on fighting climate change and even spills over.

The biggest irony and spill over in today's time is the ease with which wars get funded and supported by countries. World military expenditure rose by 3.7% in real terms in 2022 and reached a record high of USD2.24 trillion. Global spending grew by 19% over the decade 2013–22 and has risen every year since 2015. On the contrary, accessing financing for climate change, also called climate finance is full of difficulty and complexity. However, the seriousness and awareness regarding climate change is at its peak now. Funds for climate change are available in so many different and scattered forms—adaptation fund, mitigation fund, results-based financing, official development assistance, grants, Green Climate Fund, financing through carbon offsetting, debt for nature, green bonds, payment for ecosystem services, and many more. Even the commitment of developed countries agreeing on mobilization of USD100 billion annually to developing countries for climate action has not been reached. To make things worse, there are equity and justice issues which are far more complex and layered. A reality check for the world comes from the latest report by United Nations Environment Programme (UNEP) and its partners on State of Finance for Nature. Globally, close to USD7 trillion (a conservative value) is invested each year in activities that have a direct negative impact on nature from both public and private sectors financing sources. This is equivalent to roughly 7% of global gross domestic product. Critically examining

the European Commission, one of the climate leaders and part of the global north, its proposed (almost final) Carbon Border Adjustment Mechanism (CBAM) would not distinguish between countries, either according to their emissions, past or present, their economic situation or current capabilities. It will in some form act as a counter measure to soften and neutralize the principles of Common but Differentiated Responsibilities (CBDR) and Special and Differential Treatment (SDT) for the Global South, that is, developing and least-developed countries.

The other reality of the world is that we are run by capitalism and consumerism and will continue to do so. The most prominent faces we recognize are corporate leaders, CEOs, business houses, Amazon, Microsoft, Meta, INKGA Group, Bank of America, Heineken NV, Mastercard, Unilever, Syngenta, PepsiCo Inc., and others. As the fight for climate change must be collective, one cannot deny the role of CEOs and the business community. They define their goals and commitments towards bold climate ambitions and take actions to accelerate their net-zero transition by setting science-based targets, disclosing emissions and catalyzing decarbonization, collaborations, and partnerships across global value chains. It is worth mentioning, top-five industries channelling most of the negative financial flows are construction, electric utilities, real estate, oil & gas, food, and tobacco. Businesses and corporate houses can be climate leaders, but they need to clean their act, reduce footprint of their activities at the earliest. The private nature-negative finance flows amount to USD5 trillion annually, 140 times larger than the USD35 billion of private investments in nature-based solutions. The nature-negative flows are associated with destruction of forests, wetlands, and other natural habitats. The businesses first damage, destroy, and overexploit the natural resources and then invest in the re-establishment, restoration, and reclamation of the same natural resources. Hence a shift and reduction in consumption is the leadership decision making that is missing from the businesses.

External leadership is important but equally required is individual contribution. As it is advocated, 'start small' and 'change begins within'. Thus, the biggest task to make things better is to accept 'change'. Human behaviour is the most significant solution which can lead us to become better or worse. To lead a less resource intensive, less consumptive, slow life, our habits need to change. From philosophy, kindness is the path for betterment. Every act of kindness can bring about a good change. Even Gandhiji said this, "there is enough for everybody's need and not for everybody's greed." Nature has enough resources that are sufficient for everyone but human greed, consumptive behaviour, and accumulation of material possessions beyond one's requirements and need create societal imbalances and socio-economic disparities. Indian government has launched the Mission LiFE with the

same intent of behavioural change and reducing consumption.

The youth, Gen Z, millennials and the younger generations are the torch-bearers for the future. Taking the leadership path brings with it the responsibility to represent and work for ones who are less privileged and vulnerable. These are those sections of society whose future sustenance is becoming riskier as a result of climate change, pandemics, wars, food inflation, changing globalization, technological advancements, and other uncertainties. We all need to prepare and plan for a better future and play a role in being the backbone for upcoming challenges and act. Efforts and solutions are required for developing models for regional solutions, blended financial instruments, addressing sustainable development concerns, climate-justice issues, leveraging finances, tackling more evolved forms of green washing, using tools like artificial intelligence (AI) responsibly, contribute, conduct relevant research and studies, and so on.

In the end, the world has become highly unpredictable and always in a flux, it's very difficult to concretize where we all will be in the next five years. The surety is we all would be battling climate

extremes, would have accepted that 1.5°C threshold cannot be salvaged, there would be a war somewhere and some nations would still be waiting for their share of climate finance or loss and damage fund.

Many leaders act in a reactive manner and address the symptoms and not the root cause. They sense urgency and act. Climate crisis has become an existential risk. It is a 'wicked' problem. Wicked problems are significantly more complex. No single mind, or small group of minds, can encompass the full array of information needed to solve a wicked problem. Many are still on the denial boat. Climate scientists and other experts are doing their best in emphasizing it as a true emergency. The planet may reach a tipping point and we may not have anything left to return to. Let's hope the global leadership starts taking serious decisions and working on actual solutions for climate action. ■

> "Regional and national initiatives have their value. But the UN Framework Convention is the forum in which a truly global response is being formulated. The Kyoto Protocol is now fully operational, and its Clean Development Mechanism has become a multibillion-dollar source of funding for sustainable development. This mechanism is an outstanding example of a UN-led partnership linking government action to the private sector in the developing world."
>
> UN Secretary-General, Late Kofi Annan

Varun Grover, Associate Fellow, TERI

Shifting Paradigms in a Changing World

Measures to Mitigate Climate Change Repercussions

In this article, **Karnika Palwa**, expresses and explains about where the modern world stands in its endeaours towards minimizing consequences of climate change phenomenon. The text has been authenticated with the context of the nexus of the three parameters—development, justice, and conflict—that are deeply interwoven beneath the surface.

Where We Are?

There is enough scientific consensus that by 2100, temperatures on the planet will be at least 1.5°C greater than pre-industrial era and probably even greater in the absence of immediate and drastic global emission reductions. Science has well established, the climate change can unleash various weather-related catastrophes. The current global average temperature is already 1.3°C higher than pre-industrial levels and we are by far witness to increasing storm intensity and frequency, untimely rainfall events in unpredictable quantities, increase in drought and flood events, globally as well as in India. The multi-dimensional impact of these extreme events hit the marginalized communities and the natural ecosystems first and the most. For the warming to be limited to 1.5°C, the global emissions must peak before 2025 at the latest, as per the Paris Agreement, which means that the emissions must only drastically decrease from here on.

Habitat destruction, growing pollution, and changing climate together are critically endangering an increasing number of species around the world, pushing natural ecosystems to the edge. Extraction and disposal, in the current ways, have been severely polluting air, land, water, and even the human bloodstream.

Development Inertia

In the face of mass species extinction and earth system collapse, the dream of uncompromised economic growth and this under the pretext of development is perhaps a stale idea with uncalculated costs. If developing countries like India were to match the per capita energy consumption of developed countries, it would need to use up a significant portion of global carbon budget that is currently available to all. Clearly then, developing and least-developed countries can no longer aim to equal the per capita energy consumption that of developed countries. It is an unsustainable and unequitable aim for the planet and for human society. Commitments made by world leaders in international conventions to cut emissions seem fetched far in time and symbolic in spirit, ambitious or almost incognizant in the face of the current crisis.

A recent analysis by Benjamin Neimark, Partick Bigger, *et al*. has found that the carbon footprint of the first two months of the ongoing Israel–Gaza conflict has been greater than the annual carbon footprint of 20 independent countries of the world that are vulnerable to climate crisis. Emissions from war and those from the resurrection of communities post the war remain unaccounted in the larger debate. Clearly, wars make communities furthermore vulnerable to climate crisis and regresses their current development trajectory.

Transitioning into Tomorrow

While tremendous efforts are consistently required to reduce emissions, there is

a simultaneous and fast-growing need to prepare the communities of today and those of tomorrow, the youth, with the required skills and knowledge of self-sustenance. Grassroots community projects that devise alternative methods to local food production and local energy usage without destroying the natural environment, have the potential to become successful replicable models. Whether in a rural, peri-urban or urban setting, such projects at a community level open up possibilities for creating livelihood options or green jobs. Such community-managed systems have a better chance at surviving resource crisis and economic instability. Ecological restoration in such a scenario can become either an outcome or an opportunity for more green jobs creation. There are several such examples that are mushrooming across India and in fact existed as culture in some communities even before the concept of transition towns became popular.

Cities consume maximum amount of energy with most of their services like food, water, electricity being borrowed from far off places. They are also role models for villages and so, in that sense, they must become trendsetters even for this transition. Several transition towns in the west offer learnings that can provide valuable insights for Indian cities as well. Local responses will be different for the rural and urban settings although the areas of work remain common as; managing water, waste, transportation of people and goods, food production,

health, education, alternate livelihood generation. In any setting, the youth population are an integral part of these systems to get initiated, to survive, and constantly adapt to changing needs. Exchange of learnings, information, and skills between projects becomes essential to brainstorming as well as reinforcing strength, commitment in the communities. Local leadership needs a holistic view of the crisis, its range of impacts and what diversity of skills must the community harness. A connection with climate science and future-projected impacts can help the projects prepare and innovate better in terms of adapting agricultural practices, diversifying livelihoods, adapting structures. An important threat is privatization of green activities but which are unequitable in nature and/or not reducing carbon footprint. Community-ownership must be the basic guiding principle. Unaligned political is highly likely the strongest barrier for the success of such projects. In the absence of state support, independent projects will probably function in niches and their rate of replicability across the region also goes down.

Deeper Reflections

In a world where we are reaching ecological tipping points and normalizing conflict, will it help to go back to the classical debate of what sustainable development must mean? Or, how different cultures and regions perceive development? In a sense, the need for discussing climate justice is a fall out of our collective inability to make development sustainable for all. In addition, rarely do we mention natural ecosystems as stakeholders of the practised injustice. Can natural ecosystems like forests and rivers be recognized as living beings with legal agency? Can people organize themselves to address access to natural resources in an equitable way? The nexus of the three—development, justice, and conflict—are deeply interwoven beneath the surface. In the history of movements for change, it has been communities that have got together to bring about any significant shift of governance priorities or action on ground. Conflict has continued to exist in human history but strengthening community spirit may still hold strong potential for aiming towards an equitable and nature-centric society. ■

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Tumse Na Ho Payega

The Naysayers' Attitude Towards Climate Change

In this opinion piece, **Jeeya Thukral** trifurcates Earth inhabitants into—planet protectors, planet destroyers, and planet ignorants. People's approach is the root cause of climate change. The author opines—people do not consider climate change as a problem until it becomes a crisis.

This is a world of greed, where people hoard as many cars as they have relatives. They crave to buy new clothes, stay in chilled rooms, fly by planes, and chop down millions of trees to create tourist traps for cash. They adore to build their mansions by ruining natural habitats. People envy their lavish life.

In this world, there is another type of people who are forgotten and neglected. They are the ones who deal with our garbage, who sort out our waste, who keep our surroundings clean. They are the ones who barely earn 100 rupees per day and struggle to survive in this world with their family, children, hope, and poverty. They are the people who work on the frontlines, who dedicate their whole day to managing waste, to creating paper bags, to sanitizing other people's doors. And in the end, they pay the highest price.

> When the crisis comes, believe me
> The ones who lend us a hand
> Who never harmed this land
> Will bear the greatest agony

In last there are people who live in this world and devote their weekends to clean-up, awareness, conducting sessions, and signing petitions,

mobilizing change-makers. They aspire to bring change someday, but they encounter some unkind questions such as:
Are you a waste collector?
Do you think that picking up this garbage matters at all?
Don't you need to join the system to make any difference?
Are you unhappy with your job?
Why do you waste your time on this activity?
People laugh at them.

The main problem is that people do not consider climate change as a problem until it becomes a crisis. They prioritize luxurious life over a healthy and long life. The statement is true that money cannot buy everything. What will happen to the lakhs of money you saved when you cannot help your children and grandparents to breathe, when your family is swept away by the sudden flood, or when you cannot travel to any place by flight due to climate change? This is a huge challenge. We are up against millions of people who do not care about this crisis. Once we succeed in influencing them and making them care for the environment, then we will begin our main fight against climate change.

That is why we need leaders who have the power to transform mind-sets, who can usher in a radical change not instantly but steadily, who are devoted to the cause, who comprehend why climate education is essential from the primary level, who can tackle those questions, and who know how to cultivate more leaders like themselves.

From the version of me who just snapped a picture of the global climate strike and pretended to care for the society, to the version of me who spearheaded the global climate movement and inspired others to act. Still figuring out impactful answer to those unkind yet important question. ■

Jeeya Thukral, Climate Activist

Shaping Climate-responsive Futures

Blueprint for Not Just a Low-carbon Future but Also a Climate-resilient Future

This opinion piece contributed by **Professor Anand Patwardhan** confirms beyond doubt that climate actions are sub-critical and not happening at the scale and pace demanded by science and sought by leaders. The author is of the opinion that principal factor for slow and halting climate action is the political will. He makes us understand that involvement of the primary stakeholders, the general public, is of paramount significance. The writer motivates us to ask relevant questions to ourselves how we can contribute towards developing a climate-responsive future.

The topic of this article on 'shaping climate-responsive futures' is particularly timely and urgent—given that this is the critical decade if we have to achieve the goals of the Paris Agreement. Unfortunately, all available evidence suggests that we are not on track to meet these goals.

And that is because climate actions are still sub-critical and not happening at the scale and pace demanded by science and sought by leaders. So the question is—why is that the case—and perhaps even more important— what do we do about it?

I think the answer to that lies in how we understand and frame a 'climate-responsive future'.

First and foremost, a climate-responsive future needs to respond to the needs of the present. Because the main factor for slow and halting climate action is the political will. It is not technology as solutions are available in plenty. It is not even money—responses to the past crises have shown that the spigots of public finance can be turned wide open in a matter of days (not even weeks, months or years)—if the need is perceived to be immediate in the light of the severe and widespread consequences.

In the financial crisis hundreds of billions of dollars were spent practically overnight in bailing out institutions deemed 'too big to fail'. COVID recovery packages amounted to trillions of dollars—sums of money vastly greater than all the multilateral climate finance to date.

I am not saying that these responses were not justified—those were true 'emergencies' and were perceived accordingly. However, for all handling climate emergency, it does not seem to have generated a similar response.

I would argue that for the climate problem to be perceived as a true emergency it has to be connected much

more clearly and directly to the here and now. To the myriad social, economic, and environmental challenges that are uppermost in the minds of people and therefore of politicians, whether in the developing world or the developed. To poverty, to hunger, to jobs, to security, to clean air and water.

In the singular focus on climate, we seem to have forgotten that this critical decade is also the decade for the SDGs which were set for 2030 and where we are also falling woefully behind.

Rather than seeking solutions for the climate, we have to prioritize solutions for these problems of the here and now that are also good for the climate. Distributed generation using renewables is good not because it generates mitigation benefits but because it may be the fastest way of providing electrification.

The focus needs to be on development policies that generate climate co-benefits. And it is more important to maximize the development benefits even if it means that sometimes climate co-benefits might be modest—better that there is action that leads to 'some' gains rather than no action at all due to the lack of political will.

Second, a climate-responsive future needs to be a just and equitable future. While the 'just transitions' phrase has become popular, just transition has to be across countries as well as within countries. This means that resource transfers from the Global North to the South are not a matter of charity but an obligation and a matter of climate justice and when countries place targets in their NDCs' conditional on those transfers they are simply honouring that idea of climate justice.

And 'just transitions' has to concern itself not only with sharing the burden fairly, but also with sharing the gains fairly! The transformation to a low-carbon world is a process of creative destruction. Will this process only entrench existing disparities across countries or lead to a more equitable world order?

Enormous wealth has been created by the economic rent from fossil fuels. Who will gain from the development and manufacture of low-carbon technology? The answer is—the primary energy is limitless and free; but the technology to convert it into use is not. For India, the growth of renewable energy technology is not just about producing low-carbon electricity, it has to be an integral driver of economic growth itself. Domestic content mandates are not protectionism,

they are about delivering on economic growth.

We recognize that mitigation of GHG emissions generates a global public good. So will we be willing to make the intellectual property that makes this possible also a global public good? Will we ensure that the trade in the new materials that make this low-carbon transition possible is not exploitative and not a new form of mercantilism?

And finally, a climate-responsive future means not just a low-carbon future but also a climate-resilient future. We often forget that the Paris Agreement not only determined to limit warming to well below 2°C; it also adopted a global goal on adaptation.

For large parts of the developing world, climate action is much more about coping with the real and growing impacts of climate change than being about mitigating already low emissions. Unfortunately, adaptation and resilience still remain stepchildren. We often talk about a closing window of opportunity for climate mitigation. The window of opportunity for anticipating and preparing for a more than 2°C world is also closing rapidly. If we have to truly work towards a climate-responsive future, both agendas need to be pursued with equal vigour. ■

Dr Anand Patwardhan, Professor, University of Maryland, College Park

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Postal Regn. No. DL(S)-17/3328/2020-22
RNI No. DELENG/2008/24157
ISSN No. 0974-5688

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TerraGreen (WSDS Special Issue)

The 23rd edition of the annual flagship multistakeholder event of The Energy and Resources Institute (TERI), the World Sustainable Development Summit (WSDS), was held on 7–9 February 2024 in New Delhi. The Summit deliberations focused on the umbrella theme: 'Leadership for Sustainable Development and Climate Justice'.

We are living in a time of polycrisis. Some of the key challenges confronting the world today include planetary crises, sliding back of sustainable development goals (SDGs), rising conflict, worsening climate situation, and more, which threaten world peace. It is more important than ever that environmental stewardship is promoted at all levels and across all spheres. The existing challenges for attaining sustainable development are complex and interconnected and will need everyone to work towards creating a more sustainable future.

This special edition of *TerraGreen* covers a wide range of contributions to nudge leadership on climate action, green growth, energy transitions, sustainable agriculture, sustainable infrastructure, youth stewardship, market instruments, gender, innovations, and sustainable consumption.

WSDS 2024 was supported by the Ministry of Environment, Forest and Climate Change [Nodal Ministry] and was co-branded with Mission LiFE (Lifestyle for Environment). WSDS 2024 partners include: Royal Norwegian Embassy [Country Partner], Bloomberg Philanthropies [Star Partner], The Rockefeller Foundation [Senior Partner], The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection & International Climate Initiative [Senior Partner], The World Bank [Senior Partner], Tata Capital [Associate Partner], Johnson Controls [Associate Partner], TERI School of Advanced Studies [Associate Partner], Asian Development Bank [Associate Partner], International Energy Agency [Co-Associate Partner], Natural Resources Defense Council [Co-Associate Partner], TATA Power [Contributor-Corporate Partner], and National Bank for Agriculture and Rural Development (NABARD) [Base-Corporate Partner].

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